3 Dimensional KPI Assessments for High Efficient NFV Multi-Vendor Integration

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1 Challenges of Multi-vendor NFV

The Network Function Virtualization (NFV) model established by the formal ETSI Industry Specification Group on (ISG) supports a vision of an open ecosystem that enables rapid service innovation for Communication Service Providers (CSP). The objective is to be able to "mix & match" eveything from bare metal to an architected Telco Cloud from different vendors without incurring significant integration costs and avoiding lock-in.

Integrating multiple NFV/SDN software stacks and hardware from different vendors need to be guided by a set of Benchmark Standards or Key Performance Indicator (KPI) to minimize CSP risks of deploying a multi-vendor environment. Specifically, KPIs are required to address these challenges in order to achieve operational capabilities:

- Interoperability and portability between different network appliance vendors, hardware vendors, and with different hypervisors
- Achieving the target performances
- Elastic scalability based on automation
- Ensuring the appropriate level of resilience to hardware and software failures
- Ensuring security against attack and misconfiguration
- Operation & Manageability of the end to end solution

Up to now there is an industry lack of a true multi-vendor NFV benchmark or KPIs that provides choice of hardware, operational simplicity and end-to-end network visibility is resulting in high costs of integration and holding back large scale multi-vendor NFV deployments.

2 Benchmarks for Multi-vendor NFV Integration

A system integrator provides the ability to implement end-to-end NFV service solution deployments, covering every facet from network planning, design and integration to final verification. All the best practices and integration capabilities are recorded in a multi-vendor benchmark library.

What's needed is a multi-dimensional NFV evaluation methodology, model and system that could leverage on the benchmark library to aid with the assessment, validation and exploration of different multi-vendor solution combinations in order to guide the NFV implementations.

The benchmark data includes all multi-vendor integration artifacts like test scenarios, test cases and test results directed towards facilitating analysis and evaluation process to meet specific multi-vendor criteria and integration goals.

2.1 NFV Assessment Framework

By drawing on its multi-vendor integration experiences, Huawei has constructed a three-dimensional evaluation system that provides a reference point to assess the implementation feasibility of a multi-vendor NFV solution as illustrated in the below figure.

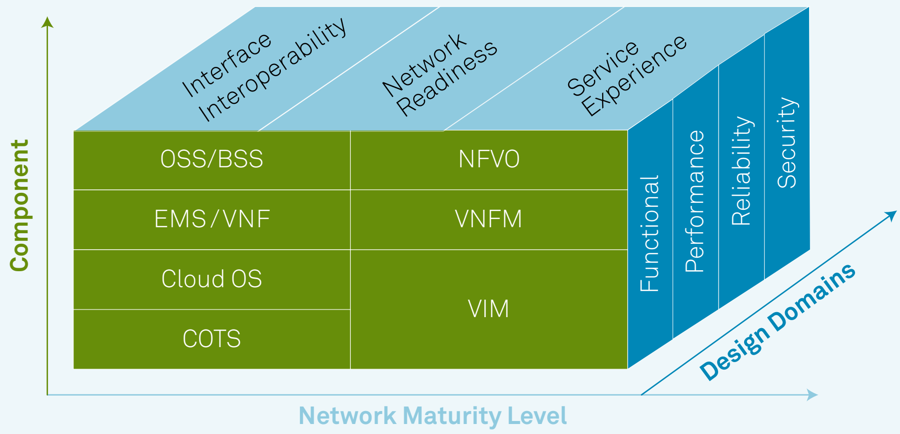

Figure 1: NFV Assessment Framework

The evaluation system is based on a comprehensive assessment framework that includes all major NFV components. It covers the validation & verification of functional and non-functional requirements optimized for enhanced service experiences. This validated and internationally acknowledged framework serves as basis for the evaluation and positioning of multi-vendor NFV solutions.

2.2 KPIs for Multi-vendor NFV Assessments

The multi-dimensional evaluation assess the feasibility of a multi-vendor NFV solution based on the following end to end aspects (examples):

Domains	Category	High-Level Key Performance Indicator (KPI)
Functional Testing	Basic Functional Test (Functional Acceptance)	Basic capability (CPU, NIC, COTS)
		Computing capability, network service capability, storage capability, and security management capability
		Manage virtual machine for VNF. vEPC & vIMS service ability
		VNFM basic capability , VNFM serviceability
		Interface interoperability capability for components
	Solution Test	Data services, Video services, VOLTE services, VoWifi services, vEPC services
		Management, operation and maintenance
		Network Readiness for service integration
Performance Testing	Network Performances	VoLTE service performance (call success rate, call setup delay, call quality, etc.) 4G data services (simultaneous online PDP context, user plane bandwidth, etc) for service experience
	NFV Stack Performances	VNF / CloudOS deployment management lifecycle duration. COTS layer : CPU, memory, network card performance indicators

Domains	Category	High-Level Key Performance Indicator (KPI)
Reliability Testing	Network Reliability	VN-NF interface reliability, Ve-vnfm interface reliability, Vi-vnfm interface reliability, Vl-Ha interface reliability and other components Interface reliability
	Component Reliability	VM reliability, cloudos reliability, and server reliability
	Virtualization Reliability	Virtual machine isolation, virtual machine anti-affinity function, virtual machine watchdog function
	Data reliability	Control node data reliability, compute node data reliability, VNFM data reliability, EMS data reliability

Table 1: Multi-dimensional KPI-based Assessment

The above Key Performance Indicators (KPI) provide a measurable value that demonstrates the strengths of a particular multi-vendor combination in achieving the target functional and/or non-functional objectives. The KPIs are used at multiple levels to evaluate the overall technical feasiblity of a multi-vendor NFV solution for network implementations.

3 Evaluation Methodology & Use Cases

3.1 Evaluation Methodology

For each category (i.e. "Basic Functional Test"), a detailed scoring is evaluated against a total of 100 points and additional secondary criteria is provided for the KPIs (i.e. "COTS Basic Capability") of each sub-category (i.e. COTS). Examples of secondary criteria for COTS Basic Capability KPIs include Stacked Exchange Class, Power Policy, Switchboard VLAN, LACP, Switchport VLAN, etc. These secondary criteria are weighted, based on the KPIs of the respective sub-category, resulting in an assessment of the overall technical feasibility for each category and the strength of the individual sub-category.

Through the below use cases, we examined how CSP multi-vendor NFV strategies can align with important sources of KPI metrics, such as network performance and reliability, as well as operational functionality, security and interoperability.

The scores are calculated by taking into account of the overall KPI compliancy against the number of features that are tested for each KPI sub-category.

3.2 Multi-Vendor NFV Use Cases

We present three evaluation use cases of a multi-vendor VNF / CloudOS / COTS configuration based on the asset library and the NFV Open Lab test results.

3.2.1 Functional Evaluation

The Multi-vendor NFV functional evaluations are based on a comprehensive assessment of 16 KPI metrics across the COTS, CloudOS, MANO, VNF and EMS layers. See Figure 2.

Sub-Category of Functional Evaluation

Sub-Category	Score	KPI
COTS	66.66	• CPU Basic Capability • NIC Basic Capability • COTS Basic Capability • COTS Service
CloudOS	61.86	• Compute Service Capability • Network Service Capability • Storage Service Capability • Security Management Capability • CloudOS Service
MANO	62.5	• MANO Basic Capability • VNF Lifecycle Management • VNF Elasticity • MANO Service
EMS/VNF	50	• EMS Basic Capability • EMS Service • VNF Service

Overall Score : 60.26/100

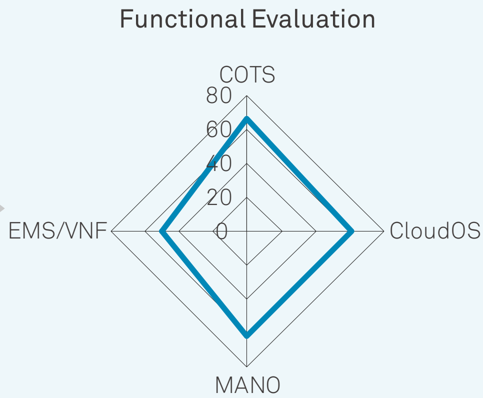

Figure 2: Functional Evaluation Results

This use case provided the following key findings:

- Average overall capability for COTS, CloudOS & MANO.
- Weak on EMS as it does not support VM mode installation, query of NFVI alarm, monitoring of CPU performance, monitoring of memory usage, etc
- Strong on VNF service including query of VM status, instantiation, termination & restart of VM, etc

3.2.2 Performance Evaluation

The Multi-vendor NFV performance evaluation KPIs are based on assessing the overall performance capacity of the resource layer, the service layer, the cloud platform layer, the operation and maintenance layer. See Figure 3.

Sub-Category of Performance Evaluation

Sub-Category	Score	KPI
Resource Layer	75	• COTS Operation and Maintenance • Hardware Specifications
Cloud Platform Layer	66.66	• CloudOS Operation and Maintenance • Thermal Transfer
Transport Management Layer	94.44	• Elasticity • Virtual Machine Lifecycle Management • VNF Lifecycle Management
Service Layer	50	• VNF Operation and Maintenance • VNF Service Performance Experience

Overall Score : 71.5/100

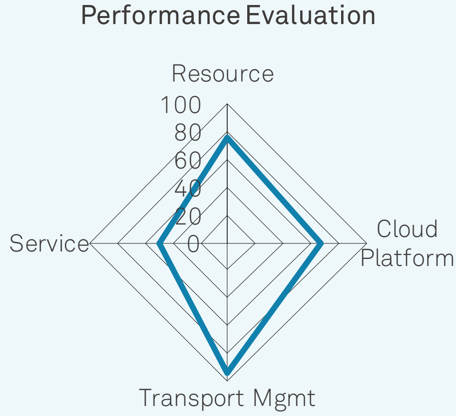

Figure 3: Performance Evaluation Results

This use case provided the following key findings:

- Robust overall capability but requires lengthy VNF upgrade time, causes service disruption in a disaster recovery scenario.

3.2.3 Reliability Evaluation

The Multi-vendor NFV reliability evaluation KPIs are based on assessing the overall network reliability of the network, node, data, component replacement, virtualization layers. See Figure 4.

Sub-Category of Reliability Evaluation

Sub-Category	Score	KPI
Networking Reliability	20	• Network Connectivity • Storage Networking
Node Reliability	25	• VM Reliability • CloudOS Reliability • Server Failure Recovery • Rack Failure Recovery
Data Reliability	33.33	• Control Node Data • Compute Node Data • EMS Data
Component Replacement Reliability	100	• Server Disk Replacement • Machine Replacement • Storage Component Replacement
Virtualization Reliability	100	• Virtual Machine Isolation • Virtual Machine Anti - Affinity • Virtual Machine Watchdog

Overall Score : 55.6/100

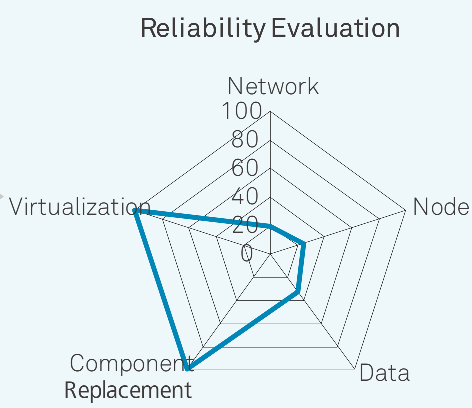

Figure 4: Reliability Evaluation Results

This use case provided the following key findings:

- Weak on network connectivity, node and data level reliability

3.3 Overall Benefits

The NFV Assessment System is intended to help CSP evaluate the potential impact of different multi-vendor NFV approaches by understanding the overall technical viability and risks associated with its strategies.

It provides key competitive advantages within today's market: cost reduction and fast time to market, and is therefore a must have for Continuous Integration Lifecycle activities / process:

- **Plan & Design:** The benchmark system assists CSP to verify the overall capability of its multi-vendor solution design and to identify & mitigate design risks. It simplifies and accelerates the design phase by avoiding the need to undergo the testing phase to uncover design issues
- **Build & Test:** The benchmark system provides CSP with extensive KPIs to guide the multi-vendor NFV implementations. NFV components from different vendors are designed & built independently of each other. Greater testing effort is required to manage multi-vendor integration complexity when these components are implemented on a common NFV network.
- **Deploy:** The benchmark system guides CSP in the deployment phase by taking into account of end to end functionality, interoperability, performance, reliability and security. The distributed nature of NFV and the relative immaturity of the technology make the benchmark system critical to success in deploying multi-vendor NFV solutions.

By taking into account of important functional and operational impacts from multi-vendor NFV network implementations , CSP can understand and mitigate these potential effects and improved on their delivery capabilities and efficency.

The NFV Assessment System enables CSP (and the vendors) to consider a more detailed view of the overall Multi-vendor solution capability on functional, financial and operational data in order to evluate the tradeoffs of gains and potential losses. CSP can then take an informed decision to make the necessary changes for the parameters on quality, features and costs to meet its business objectives.

4 Conclusion

Communication Service Providers (CSP) face increasingly complex choices in their multi-vendor NFV strategies. They must introduce new NFV/SDN technologies while managing integration costs and balancing operational risks.

The availability of multi-vendor benchmark or KPIs enables CSP to examine the deployment, operational, financial, and risk factors associated with the use of multi-vendor NFV approaches in their 2020/2021 network transformation strategies.

Based on a set of detailed KPI metrics, the NFV system Integrator can help CSP identify & mitigate design risks, manage integration complexity & costs, improve delivery efficiency and accelerate time to market for multi-vendor NFV solution implementations & operations.

Huawei is positioning to become a leading NFV System Integrator in the telecommunications carrier marketplace. The below chart highlights the value propositions offered by Huawei NFV System Integration Service. When it comes to getting the most value from your NFV System Integrator, Huawei is clearly your best partner of choice.

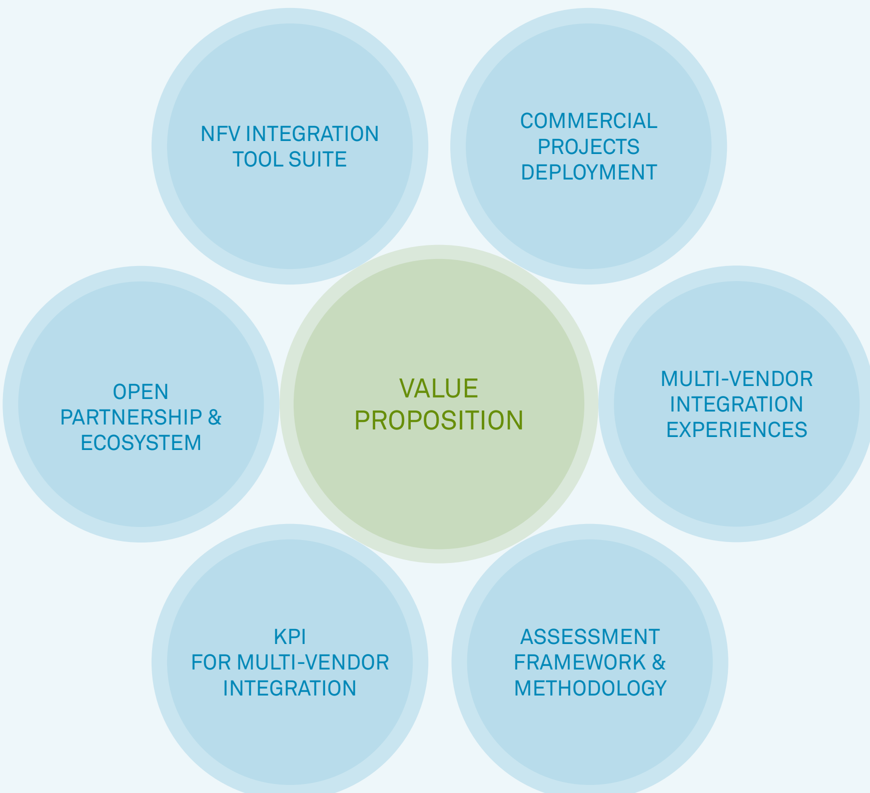

Figure 5: Value Propositions of Huawei NFV System Integration Service

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