ETSI NFV Plugtests™ and OPNFV Plugfest Joint Report

Results and Lessons from the third ETSI NFV Plugtests and fifth OPNFV Plugfest held from 29 May to 8 June 2018

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EXECUTIVE SUMMARY

The third ETSI NFV Plugtests and fifth OPNFV Plugfest were colocated at the ETSI campus in Sophia Antipolis, France. The ETSI Plugtests spanned over two weeks from May 29-June 8, 2018, while the OPNFV Plugfest coincided with the second week of the ETSI Plugtests.

The focus of this joint event was to bring commercial vendors and open source community members together to perform end-to-end network service testing, integration with OPNFV Fraser release, and foster collaboration between the OPNFV and ETSI NFV industry specification group (ISG) communities. The combined event was attended by 105 people, with additional remote attendees, from 55 organizations that included 9 end user companies and 14 research/not-for-profit organizations.

An important outcome of the joint event was collaboration across communities. Joint activities between ETSI NFV and OPNFV ranged from MANO API testing, Open Source MANO (OSM) project integration, service function chaining (SFC) testing, review of the upcoming TST009 (NFVI benchmarking) and TST010 (MANO API conformance testing) ETSI specifications, and running OPNFV Dovetail tests against four commercial NFVI/VIM offerings.

The ETSI Plugtests and OPNFV Plugfest had their separate activities as well. The ETSI Plugtests, supported by the European Commission, concentrated on building complex Network Services that combined virtual network functions from different providers, while testing interoperability with MANO solutions across platforms and sites. The attendees also exercised advanced NFV features such as scaling, migration, and automation. Moreover, the sessions demonstrated how multivendor combinations of NFV components can address 5G, Zero-touch network and service management use cases. The sessions also expanded the scope of NFV API testing to help advance the work on NFV conformance testing. In addition to OPNFV, the Plugtests saw participation from open source communities such as ETSI OSM, OpenStack, OpenAirInterface, Sonata NFV and Open Baton.

The OPNFV Plugfest focused on long duration soak, benchmark repeatability, performance testing tools comparison, and NFVBench testing in addition to the above

ETSI collaboration and testing activities. Additionally, the OPNFV Plugfest included a Hackfest which was an opportunity for community members to collaborate on their respective projects. Significant progress was made around edge computing, MANO integration, individual project planning, and community-oriented discussions. There were also several introductory sessions for those new to OPNFV around test projects, OPNFV Verified Program (OVP), Barometer, installers, XCI, and the new Lab-as-a-Service (LaaS) offering. Overall, the presence of project technical leads (PTLs) and key stakeholders made it easy to solve problems and get real-time feedback, helping accelerate progress from what typically would have taken weeks to hours or days. The Plugfest gave end users and vendors the ability to try new hardware, installers, scenarios, test cases, and tools while coming together as a community and solving problems collaboratively.

JOINT TESTING ACTIVITIES

Having both the ETSI NFV Plugtests and the OPNFV Plugfest colocated offered numerous possibilities for collaborative work at a fast pace and also to launch new collaboration initiatives. Below is a summary of the activities:

TST009 - Testing specification of networking benchmarks and measurement methods for NFVI

TST009 is an active ETSI NFV work item that modernizes current networking benchmarking specifications (like RFC2544) by taking into account the realities faced with virtualized platforms. The current methodologies are built specifically for physical network functions. Experience with NFV platforms has shown that the new systems behave quite differently, so new methodologies are warranted to help testers establish more realistic performance results.

TST009 prescribes an update to the binary search methodology (used to find the maximum traffic level, for example) to take into account some packet loss. The goal is to help the tester separate true resource exhaustion, indicating the maximum performance, from transient events that may occur in an NFVI. While transient packet loss events can occur in an NFVI, their occurrence can be dealt with separately, and thus their occurrence during performance testing should not necessarily stop the binary search for maximum performance prematurely. By characterizing both transient losses and resource exhaustion, the tester will be empowered to tune the platform to achieve maximum performance.

The VSPERF project has a main goal of benchmarking vSwitch performance in an NFVI platform. It was used to prototype the new above-mentioned binary search in order to validate the algorithm quickly before finalizing the specification. Performance tests were run using VSPERF with the new algorithm and the results were encouraging. They showed that in many cases, by using the prototype algorithm, more realistic maximum

throughput results were achieved. More experimentation will be done with VSPERF while the TST009 work item progresses towards completion.

TST010 - API conformance testing specification

TST010 is a new ETSI NFV work item that will define a complete conformance test plan for the MANO APIs that have been specified by the ETSI NFV SOL (Solutions) working group. The intent of the work item is to produce an automatable suite of tests that can be executed by the industry in order to validate compliance with the SOL specifications for the APIs.

Three specific areas of potential collaboration resulted from the discussions:

- **Automation of the test suite:** For individuals who want to use the OPNFV platform as a test environment, the tests could potentially be automated as part of the Functest project.
- **Call flow verification:** When a specific test case requires the verification of an API different than the one being tested, the OPNFV platform could be instrumented to verify that reaction programmatically. This would greatly improve test automation.
- **Triggering actions from the system under test:** For some notifications, certain actions need to occur in order for the notification to be triggered. Some actions are difficult to automate, especially in the cases of fault management. In order to enable this, the OPNFV platform, specifically the Barometer project, could be used to trigger those actions as part of the automated test suite.

Future discussions will continue to progress these potential areas of collaboration and to implement those features.

OPNFV SFC project

A representative from the OPNFV SFC project was present at the Plugfest in order to run tests with compatible VNFs present at the ETSI NFV Plugtests. What made this a unique opportunity is that OPNFV is one of the few NFVI/VIM platforms able to test service function chaining with the IETF Network Service Header (NSH). Due to the co-location, one compatible VNF vendor that provides a commercial virtual firewall able to decrement the NSH header, took advantage of this opportunity. Tests were initiated, and some positive results obtained. However, a full end-to-end test was not completed due to lack of time. Work will continue in order to complete the test. Some initial work to leverage ETSI OSM to orchestrate SFC on OPNFV was also initiated (see next topic).

ETSI OSM integration into XCI

ETSI OSM (Open Source MANO) is an open source community concentrating on the implementation of a MANO stack, including the NFVO and VNFM, among other components. During the Plugfest, members of the OSM community and from the OPNFV XCI project (Cross-community Continuous Integration) successfully worked together to include OSM as part of XCI, with OpenStack as the underlying VIM/NFVI. Thanks to the activities started at the event, OSM integration has been automated as part of the XCI scenarios.

The next steps are:

- Enable extensive testing of OSM in OPNFV XCI. The discussions between OSM, OPNFV XCI, SFC, and Functest projects have been initiated to reach this goal.
- Create a new scenario in XCI to integrate OSM with OPNFV SFC.

This activity allowed identification and fixing of two issues where OSM incorrectly handled the insecure http flag and the GUI and CLI behaved differently.

Dovetail

The OPNFV Dovetail project is the overall framework used to execute tests and collect results for the OPNFV Verified Program (OVP). Dovetail does not deliver test content directly. Rather, test content is developed in other OPNFV test frameworks such as Functest and Yardstick projects. Dovetail leverages this test content and provides a common set of test platform services for the OVP.

The combined event provided a good opportunity for OpenStack-based platform vendors to run their products against the Dovetail project. Dovetail was run on Nokia AirFrame Cloud Infrastructure for Real-time applications (NCIR), Red Hat OpenStack Platform (OSP), WhiteStack OpenStack, and WindRiver Titanium Cloud products. Testing was conducted against the 2018.01 Dovetail release as well as pre-testing against the subsequent Dovetail release.

OPNFV VERIFIED

The OPNFV Verified Program allows vendors and operators to obtain ‘OPNFV Verified’ status based on a set of compliance verification test cases that align to OPNFV releases.

ETSI PLUGTESTS™ TESTING ACTIVITIES

Over 45 organisations and 200 engineers were involved (either onsite or remotely) in the preparation of the 3rd NFV Plugtests activities, forming an engaged and diverse community of NFV implementers. This section provides an overview of the scope, main activities and outcome of this 2 weeks event. Further details are available in the 3rd NFV Plugtests Report.

Interoperability Test Sessions

One of the main goals of the NFV Plugtests is to run multi-vendor interoperability test sessions on Systems Under Test combining multiple Functions Under Test (FUTs) provided by different participants which this time included:

- 19 Virtual Network Functions (VNF), some of them providing also Element Manager (EM) and specific VNF Manager (VNFM) functionalities. These VNFs were combined in 27 different multi-vendor Network Services (NS).
- 10 Management and Orchestration (MANO) solutions, providing NFV Orchestrator (NFVO) and VNFM functionalities.
- 9 NFV Platforms, including hardware, providing NFV infrastructure (NFVI) and Virtual Infrastructure Manager (VIM) functionalities.

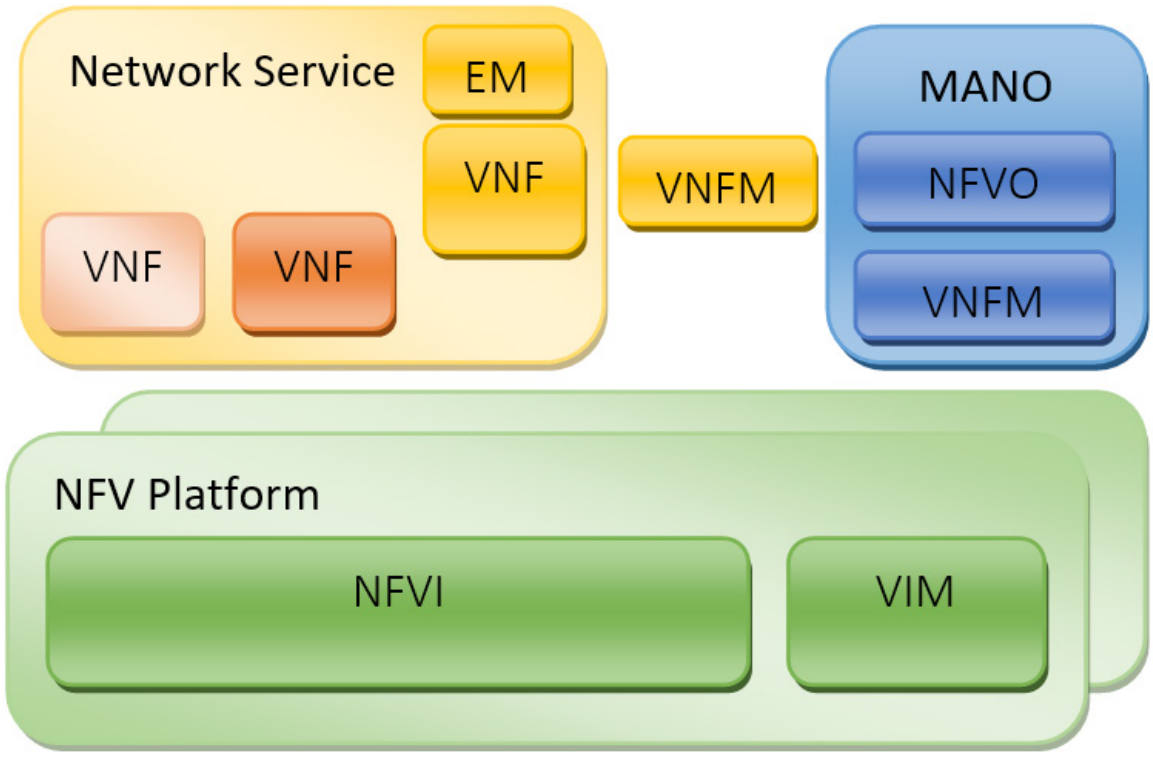

Figure 1: Functions and System Under Test

During the interop test sessions, the FUTs described above were combined in different System Under Test (SUT) configurations evolving from simple single-site NS deployments to complex multi-site deployments of multi-vendor Network Services featuring EPA (Enhanced Platform Awareness) or Service Function Chaining.

The full scope and the procedures followed during the interoperability test sessions are described in the 3rd NFV Plugtests Test Plan.

The different participating implementations were able to interact remotely since the moment they joined the Plugtests Programme through the NFV HIVE (Hub for Interoperability and Validation at ETSI) which provides a secure framework to interconnect participants' labs and implementations and prepare for the Plugtests. A total of 46 remote locations including several OSM Remote Labs and OPNFV Pharos Labs participating to the Plugtests leveraged the HIVE network to make their Functions Under Test available for the test sessions.

Figure 2: NFV Plugtests HIVE network

Functions Under Test

Lists of Virtual Network Functions, Network Services, MANO solutions and NFV Platforms participating to the Test Sessions are detailed here after. Note: The 19 participating VNFs were combined in 27 different Network Services and the full list available in the Plugtests Report.

Virtual Network Functions (VNFs)		
Organisation	**Solution**	**Short Description**
A10 Networks	vThunder	Secure Application Delivery Services: ADC, CGN, Firewall
Anritsu	Master Claw vProbe	Virtual Probe for Customer Service Assurance
Athonet	vEPC	Virtual EPC
Citrix	VPX + MAS	Virtual ADC + Management, configuration, analytics
EANTC	NFV Test Function	Traffic generator
Fortinet	FortiGate	FW, Security
Hillstone Networks	CloudEdge	NGFW, Security
IT Aveiro	Heimdall Web	SFC-MITM VNF to accelerate SSL/TLS processing (cloud-based)
IT Aveiro	Heimdall Hybrid Web	SFC-MITM VNF to accelerate SSL/TLS processing (hybrid: part cloud, part edge)
Italtel	iRPS	Centralized Routing Engine
Keysight	IxLoad	Application traffic simulator
Keysight	IxNetwork	Traffic generator
Keysight	BPS	Application traffic simulator
Mobileum	vNTR	Virtual NTR, Roaming
ng4T	NG40 vTester	Simulator, functional, capacity and load vTester
OpenAirInterface SA Eurecom	OAI-EPC	EPC Network Functionality
Spirent	Avalanche Virtual	L4-7 Traffic generation and analysis
Spirent	TestCenter Virtual	Traffic Generator, Traffic Analyzer, Capture, Control Plane emulator

Table 1: VNFs Under Test

Management and Orchestration Solutions (MANO)		
Organisation	**Name**	**Short Description**
Altice Labs Atos Demokritos iMEC	SONATA	Open Source SONATA NFVO + Generic VNFM
Cisco	Network Services Orchestrator (NSO) and Elastic Services Controller (ESC)	NFVO + Generic VNFM
EnterpriseWeb	EnterpriseWeb	Microservice-based NFVO + Generic VNFM
Ericsson	Cloud Manager	MANO Orchestrator, Generic VNFM
Huawei	CloudOpera Orchestrator NFV	NFVO + Generic VNFM
Luxoft	SDL	NFVO + Generic VNFM
Netcracker	Hybrid Orchestrator	NFVO + Generic VNFM
RIFT.io	RIFT.ware	Carrier Grade NFVO + Generic VNFM
Ubiqube	OpenMSA	Network and Security Automation Framework
Whitestack	WhiteNFV	OSM distribution (NFVO + Generic VNFM)

Table 2: MANO Solutions Under Test

NFV Platforms (VIM&NFVI)			
Organisation	**Name**	**HW**	**Short Description**
Huawei	OPNFV Compass	OPNFV POD @ Huawei	OPNFV: OpenStack Ocata + Pike, ODL Nitrogen
Nokia	NCIR18	AirFrame OR	OpenStack Pike
Red Hat	Red Hat OpenStack Platform	Lenovo POD - SR630/SR650 and OCP servers - G8272/NE2572 and G8052 switches	OpenStack Newton
Red Hat	Red Hat OpenStack Platform	QCT @ETSI	OpenStack Newton
SUSE	OPNFV XCI (Open SUSE)	POD @UNH IOL	OpenStack Queens + ODL Oxygen
Whitestack	WhiteCloud	Intel remote POD	OpenStack Pike + ODL Carbon
Wind River	Titanium Cloud R4 – Core Configuration	Wind River @ OSM Remote Lab	OpenStack Newton + OF 1.3
Wind River	Titanium Cloud R5 – Edge Configuration	Advantech remote POD	OpenStack Pike + OF 1.3
Wind River	Titanium Cloud R5 – Core Configuration	Lenovo POD - SR630/SR650 and OCP servers - G8272/NE2572 and G8052 switches	OpenStack Pike + OF 1.3

Table 3: NFV Infrastructure Platforms Under Test

IOP Test Automation

During this Plugtests, one of the key areas of improvement was the automation and repeated execution of a subset of the interoperability Test Plan, with over 1000 test runs and an overall duration of 157 hours. Overall, it was outlined that repeated automated testing helps to reveal behaviour inconsistencies or anomalies, which can go unnoticed in manual testing.

API Testing

The NFV API validation track run by ETSI in parallel with the interoperability test sessions allowed participants to evaluate the alignment of their implementations with NFV SOL OpenAPIs.

The scope of this API track, which was launched as experimental during the 2nd NFV Plugtests with a subset of NFV-SOL002 and NFV-SOL003 APIs, was extended to include NFV-SOL005, the Northbound Interface of NFV MANO. The API Test Plan included a total of 29 Test Cases for the following APIs:

- SOL002 - VNF Configuration API (Ve-Vnfm, Producer: VNF)
- SOL002 - VNF Indicator API (Ve-Vnfm, Producer: VNF/EM)
- SOL003 - VNF Lifecycle Management API (Or-Vnfm, Producer: VNFM)
- SOL003 - VNF Package Management API (Or-Vnfm, Producer: NFVO)
- SOL003 - VNF Lifecycle Operation Granting API (Or-Vnfm, Producer: NFVO)
- SOL005 - NSD Management API (Os-ma-nfvo, Producer: NFVO)

API Testing focused on validating the API producers (i.e REST server) implemented in participating FUTs, with a Test System operated by the ETSI Plugtests Team, which played the role of the API consumer.

Results

The interoperability results for multi-vendor network services test sessions were slightly higher than the ones reported in 2nd NFV Plugtests (held only a few months before in January 2018). While the number of this type of test sessions was lower, the overall number of test cases run saw an increase of 11%, quite possibly due to the fact that the number of test cases for these sessions was higher, and therefore, the sessions longer.

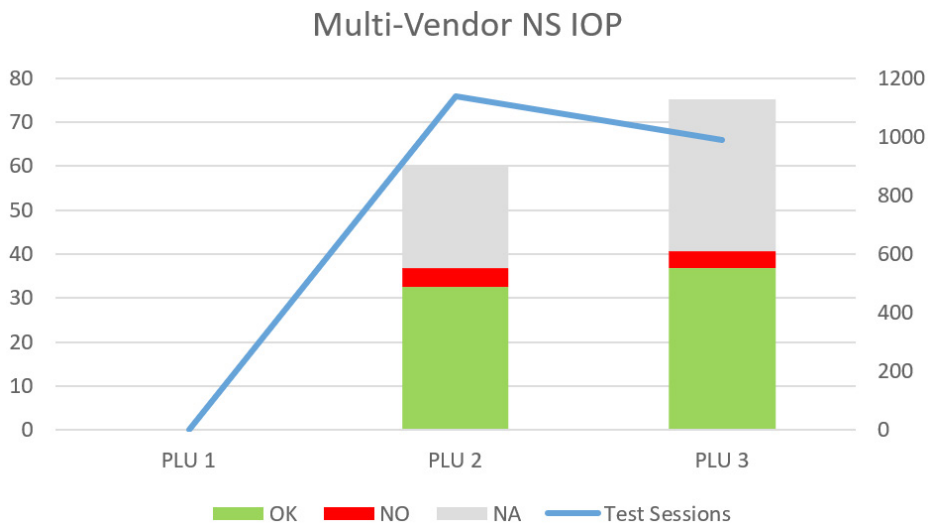

Figure 3: Multi-vendor Network Service Interop Testing

The small decrease in the number of this type of sessions was highly compensated for by the significant increase of sessions and results reported for parallel activities such as automated testing and API Validation sessions, as we see in the figures below.

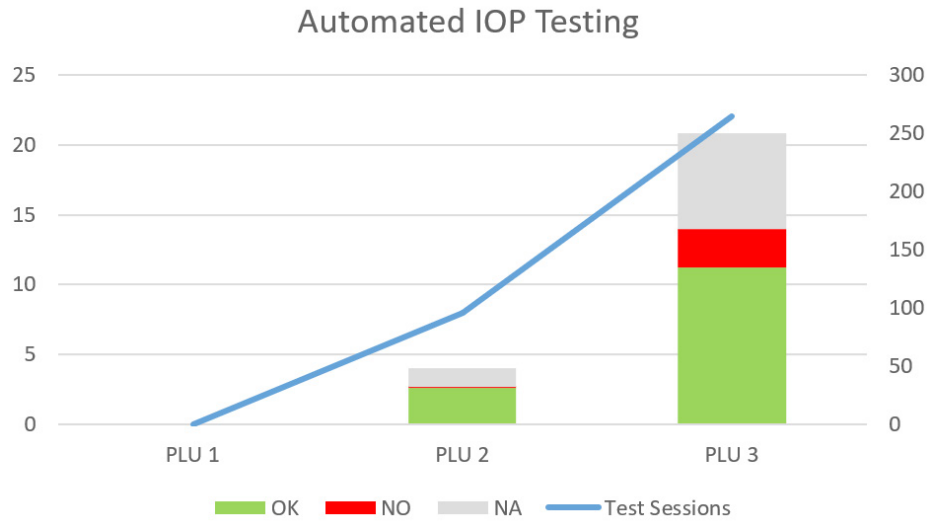

Figure 4: Automated Interop Testing

The figures show a significant increase in the number of automated test sessions (+175%) and the overall number of individual test cases that could be run automatically by a test system (+425%). This was due both to the increase in the number of test cases that were automated and by a growing interest in automation among Plugtests participants.

The API track saw also a growing interest among participants, with a significant increase in the number of test sessions (+125%) and overall number of test cases run (+100%).

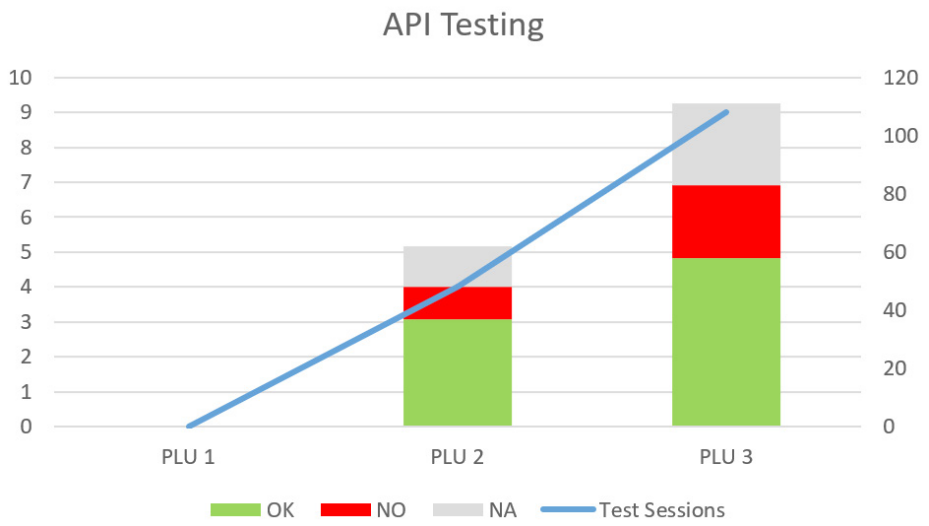

Figure 5: API Testing

Open Source Communities

The synergy with and across open source communities involved in the NFV Plugtests experienced also a visible growth with the arrival of SonataNFV and OpenAirInterface, who joined ETSI OSM, Open Baton, Open Stack, and OPNFV as supporting open source communities.

Multi-vendor Demos

During the 3rd NFV Plugtests, participants were offered the challenge to build and showcase real use case demonstrations combining different participants' implementations. A total of 6 multi-vendor demonstrations involving 14 vendors (A10 Networks, Fortinet, Spirent, Cisco, Wind River, Red Hat, Lenovo, Anritsu, ng4T, Mobileum, Whitestack, Huawei,

RIFT.io, Enterprise Web) and featuring all the participating open source projects (Open Air Interface, ETSI OSM, OPNFV, OpenStack and SonataNFV) were built and demonstrated during the event, covering a wide range of topics such as:

- Multi-VNF NS Orchestration
- Orchestrated Service Assurance in NFV
- 4G Mobile Network Orchestration
- Automated Life Cycle Validation
- NFV SOL Based VNFD Validation

Plugtests Outcome and Feedback to ETSI NFV

As in previous Plugtests, during the interoperability and API test sessions several items were identified as potential issues and discussed with the participating community.

The outcome of the discussion was compiled in the Plugtests Report and fed back to ETSI NFV. This includes:

- General feedback on ETSI NFV SOL Specifications: covering API and Specs versioning, JSON schema validation and API readability, and some specific items on SOL002, SOL003 and SOL005 from typos to potential inconsistencies and some clarification requests on VNF instance Ids, return types, NS states, etc.
- 16 bugs and recommendations on NFV OpenAPIs.
- Input to NFV TST Specifications including over 30 new/updated Interoperability Test Descriptions for TST007 and recommendations on conformance testing methodology for TST010.
- Learnings on interoperability test automation.

The 3rd NFV Plugtests Report describes in detail the preparation of the event, the participating implementations, the test plans and testing procedures, the overall results, as well as the lessons learnt and the feedback collected during the testing.

OPNFV PLUGFEST TESTING ACTIVITIES

The main focus of the Plugfest was to test various hardware and third-party software products, open source and proprietary, against the latest OPNFV Fraser release. The immediate availability of subject matter experts allowed for successful integration and productive (functional and performance) testing. The testing also uncovered several issues that have been or are being addressed. Since the focus of this Plugfest was to collaborate with the ETSI community, most of the Plugfest activity has already been covered in the "Joint Testing Activities" section. The table below provides a high-level testing summary of activity that were solely restricted to the OPNFV Plugfest:

Hardware	OPNFV Installer or Commercial Software	Testing
Google Cloud Engine	Fuel	Selected Functest Healthcheck/Yardstick tests
Huawei	Compass	Two long duration soak test
Intel	N/A	Benchmark repeatability aided by new search; NFVBench
Intel	Wind River Titanium Cloud 5	NFVBench with Titanium Cloud's AVP; DPDK driver

Table 5: Summary of Plugfest Testing Activities

Some specific focus areas were long duration soak testing, benchmark repeatability, and NFVBench testing.

Long-duration Soak Testing

Long-duration testing involves multiple OPNFV testing projects such as Bottlenecks, Functest, NFVBench, Storperf, VSperf, and Yardstick. This testing is designed to find issues that are likely to be problematic in a large production environment. Two long-duration tests lasting two days were ran by the Bottlenecks team during the Plugfest

with different levels of stress. Both of the tests found new hypervisor, rabbitmq, and other issues. These tests combined two OPNFV projects, Bottlenecks and Yardstick, and included a monitoring framework consisting of Prometheus, Grafana, and Barometer. The main beneficiaries of this testing are test developers and operations staff monitoring/ optimizing the system behavior over long time durations.

NFVBench Testing

The Fraser release includes the second version of the NFVBench project — an end-to-end dataplane benchmarking framework project based on the TRex open source traffic generator. The project, currently evaluates 8 metrics and was tested against an OPNFV scenario and Wind River's Titanium Cloud. The main purpose of this test is twofold: a) demonstrate that NFVBench can measure the dataplane performance of any commercial NFVi platform and b) measure the performance impact when using the standard Virtio driver and the Accelerated Virtual Port (AVP) driver in Wind River Titanium Cloud.

Comparison of Performance Testing Tools

Five OPNFV projects use the traffic generators. However, differences in traffic generator drivers can cause performance result variations between these projects even when measuring the same system under test (SUT). An experiment to test the same L2 forwarding OVS-DPDK vSwitch across VSPERF, NFVBench, and an additional benchmarking tool was conducted. The conclusion of this experiment is that the packet format (such as the number of flows created) and packet path can have a significant impact on results. When the exact same conditions were applied, all three projects produced the same results. This and ongoing future experiments could lead to efforts around developing a common driver or set of libraries, harmonizing requirements around traffic generators — while taking in real-life considerations.

Several issues arose from specific combinations of technologies in the Plugfest environment. The issues that were found and were (or are being) addressed were in the areas of Apex installer, OpenStack, Dovetail, Functest, and NFVBench.

OPNFV Plugfest Lab and Hardware Resources

Given the availability of high-speed networks, this was the first OPNFV Plugfest where the community performed all their testing activities with remotely provided hardware from ENEA, Huawei, Intel, Lenovo, Nokia, and OPNFV LaaS. As stated earlier, some of this hardware was also connected to the ETSI Plugtest HIVE network for joint activities.

ENEA made an ARMv8 based POD available from Stockholm:

- Jump node: Cavium Networks CN8890 ThunderX ARMv8-64 48 cores @ 2.0GHz, 128GB memory, 500GB HDD, 1x 40GbE NIC, 2x 10GbE NICs, 1x1GbE NIC
- Compute/controller nodes: AMD Opteron A1100, 8x 64-bit ARM Cortex A57, 32GB memory, 2TB HDD, 128GB SSD, 2x 10GbE
- Extreme Networks x670 10GbE switch, HP2530-48G 1GbE switch

The Huawei POD was made available from China:

- Servers: Intel(R) Xeon(R) CPU E7-8890 v3 @ 2.50GHz (144 cores), 512GB memory, 4.4TB HDD

Additionally, Huawei also made available virtual PODs from Munich.

Intel PODS 12 & 19 were made available from Hillsboro, Oregon:

- POD 12 includes
  - Servers: 2x Xeon E5-2699v4 @2.20GHz, 64GB memory, 3TB HDD, 180GB SSD, 2x 10GbE, 2-4x 1GbE
  - IZ1 10GE SDN switch on IA platform, Extreme 480 1GE switch
  - Ixia traffic generator connected to 3 nodes
- POD 19 includes:
  - Servers: 2x Intel® Xeon® Gold 6138 Processor , 64GB memory, 3TB HDD, 190-200GB SSD, 2x 10GbE, 2x 1GbE
  - IZ1 10GE SDN switch on IA platform, Extreme 480 1GE switch

Lenovo made three dedicated PODs available remotely from Morrisville, North Carolina. They were also connected to HIVE:

- GP POD:
  - Servers: ThinkSystem SR630 rack servers M.2, 2x 2TB HDD, 2x 480GB SSD, 2x 25Gbe NICs, 4x 1GbE LOM
  - Lenovo NE2572 25G ToR switch, Lenovo G8052 1G ToR switch
- GH Modular Scalable HW POD:
  - Servers: 6 GH servers, M.2, HDD, 2x 10GbE
  - Lenovo G8272 10G ToR switch, Lenovo G8052 1G ToR switch
- OCP POD:
  - Jump node: Lenovo rack server, HDD, 2x 10GbE, 2x 1GbE ports
  - Compute/controller nodes: OP@L OCP servers, SSD, HDD, 4x 25GbE NICs
  - Lenovo G8272 10G ToR switch, Lenovo G8052 1G ToR switch

NOKIA made two PODs available from Espoo, Finland:

- RM POD:
  - 3x Nokia AirFrame Rackmount servers 1U, E5-2630 v3 @ 2.40GHz, 64GB memory, 800GB SSD, 1TB HDD, 6x 10GbE
  - 3x Nokia AirFrame Rackmount servers 1U, E5-2680 v3 @ 2.50GHz, 128GB memory, 2x 1TB HDD, 6x 10GbE
  - Nokia AirFrame Rackmount switch 48x 10GbE
- OR POD (connected to HIVE):
  - 6x Nokia AirFrame OR servers, E5-2680 v4 @ 2.40GHz, 256GB memory, 256GD SSD, 1TB HDD, 4x 10GbE
  - Nokia AirFrame OR switch Z9100ON 32x 100GbE, Nokia AirFrame OR switch S3048ON, 48x 1GbE

OPNFV Lab as a Service (LaaS). It was also connected to HIVE:

- The OPNFV LaaS infrastructure provides on-demand resources, in the form of bare metal servers based on either Intel or ARM architectures. Resources may be booked on-demand through the https://labs.opnfv.org portal.
- In support of the Plugfest, the UNH-IOL (LaaS host) enabled a connection through the ETSI HIVE VPN for Plugfest participants to directly reach their booked LaaS resources.
- The LaaS infrastructure provide the following hardware resources:
  - 38x Intel Based Servers: 2x Xeon E5-2699v4 22-core 2.20 GHz, 512GB RAM, 1TB SSD, 6x 10GbE
  - 14x ARM Based Servers: 2x Cavium ThunderX ARM 48-core 2.0 GHz, 256GB RAM, 1TB SSD, 4x 10GbE

OPNFV Hackfest

The Hackfest portion of the event had multiple parallel tracks. The sessions consisted of design summit like presentations and discussions. The key topics covered were edge computing, MANO integration, individual project planning, and community focussed discussions.

Edge Computing

With 5G and IoT, edge computing promises to be a new computational model similar to the cloud revolution that started a decade ago. China Mobile kicked off the discussion with a presentation on their edge requirements with a focus on cloud federation (Keystone, Glance) and datapath acceleration. The presentation explored the role of OPNFV in edge computing. A second presentation, also by China Mobile, delved deeper into hardware acceleration requirements, VNFs that need acceleration, types of acceleration, synergy with the OpenStack Cyborg project, future developments, and the possible gap OPNFV could fill in terms of APIs. The edge computing track concluded with a discussion on the Edge Pharos specification. Pharos is the OPNFV test bed project that has enabled the creation of a federated NFV testing infrastructure of community labs around the world for hosting continuous integration (CI) and testing of the OPNFV platform. There was agreement that though the definition of the Pharos specification needed to be revisited for edge computing requirements, there is no urgency and a learn-and-iterate approach could be pursued.

MANO Integration

OPNFV has historically played an active role in this area by integrating open source MANO projects such as Open Baton, Open-O, and Tacker. At this event, the Plugfest focused on Open Source MANO (OSM) integration and the Hackfest discussed ONAP integration through the OPNFV AUTO project. In addition to an overview of AUTO, the discussion covered project goals, installation (scenario and installer independent), use cases and CI processes. The dialog also covered collaboration between ONAP Multi-VIM and AUTO projects in order to run Multi-VIM on top of an OPNFV installation.

Project Planning

A large portion of the Hackfest was dedicated to project planning. Specifically around test projects, a diverse set of topics were covered including Yardstick, Dovetail, long duration testing, and traffic generators.

- Yardstick: Community members discussed Gambia release enhancements, NSB (network service benchmarking), and the use of Barometer metrics for NSB. Topics such as expanded Kubernetes scenario support, code quality improvements, new usability and installation features, CI enhancements, and document changes were discussed as potential Gambia release work-items.
- Dovetail: The Dovetail team concluded a successful roadmap session where both mandatory and optional future tests were discussed.
- Long-duration testing: The session talked about using Bottlenecks and Yardstick for long duration testing purposes. It started with an overview of long duration testing and progressed to additional topics such as normal vs. stress testing, the visualization dashboard, and evaluation of tests, results, and log analytics. There was also discussion on how to look for problems and whether long-duration testing should be part of the release criteria.

Several other projects (installer, CI and feature projects) also had productive planning sessions. The continuous delivery (CD) based release process witnessed a robust debate around the current six-month OPNFV release cycle that delays access to upstream code. A new release process, an extension of XCI, is being discussed where versions of upstream code are integrated as part of a dual-track release to provide faster access to upstream innovation. There were discussions around which upstream projects might initially participate and what test gates would be required.

Community-focused Discussions

- Several process and community-focused items were discussed and resolved:
- The OPNFV documentation team worked on removal of submodules with a plan for another Docs Hacking Day.
- The Fraser release retrospective discussed the practices and issues around each of the 11 milestones and release-wide issues including security scanning.
- The OPNFV hands-on session discussed how to expose more communications service provider (CSP) professionals to the OPNFV stack via informal, all-day, hands-on meetups and formal training sessions.
- The discussion involved classifying projects into new, returning, and inactive projects; the experimental CD based release; a list of new features; and the possibility of packaging test projects separately.

Hands-on Experience Sharing Sessions

The Hands-on experience sharing sessions, that proved immensely popular at the last OPNFV Plugfest, were continued at this Plugfest and provided valuable information to those that might be new to OPNFV. This was especially important since many ETSI Plugtest attendees were infact quite new to OPNFV. The key sessions were:

- **Installers demos:**
  - Fuel installer overview that covered basics, architecture, functionality, and troubleshooting.
  - Compass installer overview that covered basics, architecture, and how-to-use guidelines.
- **Introductory sessions:**
  - Comprehensive overview of all test projects.
  - Overview of Barometer, Yardstick GUI with a demo, and Yardstick NSB accompanied by a demo.
  - Overview of Dovetail/OVP with an explanation of optional vs. mandatory tests and a glimpse into the roadmap.

- Motivation, history, architecture, and future plans for XCI with an introduction to OpenCI.
- Introduction to Lab-as-a-Service (LaaS) and update on its roadmap that will bring features such as dynamic allocation, multi-user booking, and auto deployment of OPNFV.

PARTICIPANTS

The following companies participated in the combined event. Many thanks to all the participants and the host, ETSI, who helped make the event a huge success.

Company	Description	URL
A10 Networks	Provider of intelligent and automated cybersecurity solutions	a10networks.com
Aarna Networks	Services and products around ONAP	aarnanetworks.com
Advantech	Embedded and automation products and solutions	advantech.com
Altice Labs	Products and services for the telecommunications and IT markets	alticelabs.com
Anritsu	Provider of communications test and measurement solutions	anritsu.com
Athonet	Software-based mobile packet core solution	athonet.com
ATOS	IT services company with a focus on digital transformation	atos.net
AT&T	Telecommunications service provider	att.com
BUPT	Beijing University of Posts and Telecommunications	www.bupt.edu.cn
CableLabs	Nonprofit R&D consortium for cable providers	cablelabs.com
CAICT	China Academy of Information and Communications Technology is a scientific research institute in China	caict.ac.cn
China Mobile	Telecommunications service provider	chinamobileltd.com
China Unicom	Telecommunications service provider	mychinaunicom.com
Cisco	Communications and information technology product vendor	cisco.com
Citrix	Secure delivery of apps and data to any device on any network	citrix.com

Demokritos	A national center of scientific research in Greece	demokritos.gr
DOCOMO	Telecommunications service provider	www.nttdocomo.co.jp
EANTC AG	The European Advanced Networking Test Center	eantc.com
ENEA	Information technology company	enea.com
EnterpriseWeb	Digital business automation software vendor	enterpriseweb.com
Ericsson	Network equipment vendor providing communication technology and services	ericsson.com
ETSI	A European standards organization developing standards in Europe for global use.	etsi.org
Eurecom	A teaching and research institution in the fields of information and communication technologies	www.eurecom.fr
Fortinet	Network security vendor	fortinet.com
Fraunhofer FOKUS	Research institution in Germany focused on the networked world	www.fokus.fraunhofer.de
Hillstone Networks	Network security vendor	hillstonenet.com
Huawei	Networking and telecom equipment vendor	huawei.com
IMEC	R&D organization focused on nanoelectronics and digital technologies	imec-int.com
Instituto de Telecomunicações	Private non-profit organization that conducts telecommunications related research and development	it.pt
Intel	Semiconductor and computing vendor	intel.com
Italtel	Telecommunications service provider	italtel.com
JP Morgan	Provider of financial services	jpmorgan.com
Juniper	Provider of high-performance network solutions.	juniper.net
Keysight Technologies	Helps companies accelerate innovation to connect and secure the world	keysight.com
Lenovo	Provider of technology products and services	lenovo.com

The Linux Foundation	Non-profit organization that accelerates open technology development and commercial adoption	linuxfoundation.org
Luxoft	IT service provider	luxoft.com
Mobileum	Develops analytics solutions that generate revenues, reduce costs, and accelerate digital transformation	mobileum.com
NEC	Provides integration of IT and network technologies	nec.com
Netcracker	Services and software products for communication and cable service providers	netcracker.com
Nextworks	Research and Development on ICT, telecommunications, control and automation.	nextworks.it
ng4T	Telecommunications technology testing tools	ng4t.com
Nokia	Communications and information technology company	nokia.com
OpenAirInterface Software Alliance	5G software alliance	openairinterface.org
OpenStack Foundation	Open source software foundation	openstack.org/foundation
Orange	Telecommunications service provider	orange.com
QCT	Global data center solution provider	qct.io
Red Hat	Provider of open source software solutions	redhat.com
RIFT.io	Network automation software provider	riftio.com
Spirent	Communications products and services	spirent.com
SUSE	Provider of open source software solutions	suse.com
UBiqube	Network and security automation vendor	ubiqube.com
UNH-IOL	Independent Interoperability and conformance lab	iol.unh.edu
Whitestack	Telecommunications industry technology vendor	whitestack.com
Wind River	Embedded and open source software	windriver.com

Table 6: Participating Organizations

CONCLUSION

The joint third ETSI NFV Plugtest and fifth OPNFV Plugfest was a significant event for the industry as a networking standards-driven body and an open source integration and testing project were able to collaborate at an unprecedented level and achieve outputs greater than a sum of the parts. In addition to the interoperability test sessions, IOP test automation, and API testing sessions conducted by ETSI — and the Plugfest and Hackfest sessions conducted by OPNFV — a substantial amount of testing and collaborative work was performed by the two communities together.

Announcements for future ETSI PlugTests will be made on www.etsi.org/news-events/events/ while announcements on future OPNFV Plugfests will be made on wiki.opnfv.org/display/EVNT/Plugfest and the opnfv-tech-discuss mailing list (lists.opnfv.org/mailman/listinfo/opnfv-tech-discuss).