NETWORK FUNCTIONS AS-A-SERVICE
OVER VIRTUALISED INFRASTRUCTURES

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Standards Tracking and Contribution

Interim Report on Standardisation Activities

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Executive Summary

This deliverable presents the standardization activities and results undertaken during the first and second year of the project as part of Task 8.2.

The document is an interim report providing information on the standardisation bodies, working groups and fora which were monitored, describes the progress within these groups and contributions which were submitted on behalf of T-NOVA up to the current date.

Due to the innovative nature of the T-NOVA project, standardization activity is considered an important objective and most of the partners are active in standardization through various bodies, working groups and committees.

In particular, the document outlines the initial standardization plan for proactive contributions to a number of very important standardization organizations.

The document provides also a list of the key standardization targets of T-NOVA, such as ETSI NFV ISG (Industry Specification Group) and many others.

The current version of the document includes a report on the standardization activities performed during the year 2015 and provides a list of the submitted contributions.

A description of the future standardization plans is also included.

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1. INTRODUCTION

T-NOVA introduces specific innovations at several fields of contemporary research such as federated network and cloud management, Network Functions Virtualization, Software Defined Networking, programmable networks, future network architectures and network service brokerage. All the aforementioned fields are being addressed by several focused activities within local and global standardisation organisations.

A primary aim of T-NOVA will be to reinforce the presence and role of Europe in these activities.

Following the recommendation by EC, T-NOVA plans to follow a proactive plan for contributions to a number of very important standardization bodies and committees.

More specifically, T-NOVA considers the importance of Network Function Virtualization (NFV) and Software Defined Networking (SDN) as key emerging areas for the implementation of future networks. The application of NFV and SDN requires research and experimentation in order to implement new network services on virtualized infrastructures.

Standardization and the experimentation with Open Source Software solutions and tools can play an important role in the acceleration of use of the NFV and SDN technologies for the availability of new services.

Standardization is important for service providers in order to have interoperable solutions provided by different vendors that can operate in an open ecosystem, in order to avoid the so called "vendor lock-in".
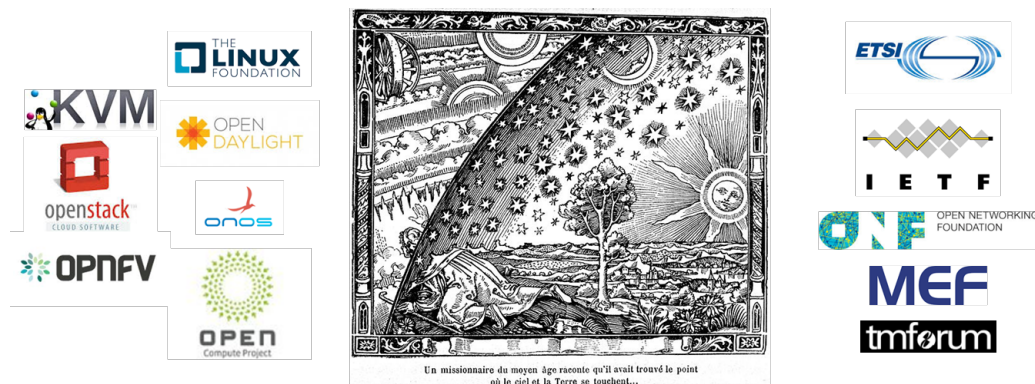
Figure 1 – Standardization and Open Source Software

In this context the open source solutions (Figure 1) can provide two things:

1) They can be used for implementing solutions that can be adopted in real networks. It should be noted that the adoption of open source solutions is now taken into account by the Communication Service Providers;
2) They can provide the experimentation that is fundamental for the definition of the standards. It is not possible to have good standards without a preceded phase of experimentation.

Important initiatives are undergoing under the Linux Foundation like the Open Platform for NFV (OPNFV) project and for the SDN controllers: ONOS and Open Daylight.

Future networks will provide extraordinary performances. For instance, 5G networks in mobility will provide latency below 10 msec and bandwidth above 100 Mbps.

This provides the opportunity for implementing new services, services that are not feasible with the current networks such as connected cars, virtual reality, tactile internet, etc. It will be also possible to improve existing communications services, for instance providing a higher video definition. The role of NFV and SDN and the implementation of marketplaces will be fundamental for fostering innovation and providing these new services.

2. INITIAL STANDARDISATION TARGET

The principal standardisation target of T-NOVA distinguished during the initial phases of the project is the ETSI NFV ISG (Industry Study Group), in which four of the T-NOVA consortium participants were already participating (HP, Intel, Italtel, Portugal Telecom).

The NFV ISG is the leading standardisation organization in the NFV field worldwide, and all the major network operators from around the world are represented. The scope of the ISG working groups in ETSI Phase 1 (i.e.: Management and Orchestration, Infrastructure, Software Architecture, Reliability and Availability, Performance) clearly corresponded to key activities within the T-NOVA workplan.

Specific contributions from T-NOVA were planned including:

- NFV MAN WG (Management and Orchestration) from WP3. WP3 leader (PTIN) is participating in the MANO WG and will align WP3 activities with WG progress;

- NFV INF WG (Infrastructure) from WP4;

- NFV SWA WG (Software Architecture) from WP5;

- NFV REL WG (Reliability and Availability) from WP3 and WP4;

- NFV PER WG (Performance) from WP5.

In addition to NFV ISG, contributions to other standardization activities were planned per partner as follows:

- VIO contributions to HGI (Home Gateway Initiative) aspects on Home Gateway virtualization.

- PTL contributions to IETF SDN Initiative from the results of the SDN Control Plane definition and development.

- CLDST contributions regarding the network brokerage aspects to the Metro Ethernet Forum (MEF) and the Tele Management Forum (TMF).

- INTEL planned to communicate project results on cloud management for NFV to the international standards initiatives in which the Cloud Services Lab personnel participates, such as the national ISO sub-committee mirror groups, the European cloud standards working groups, and the global ISO sub-committees (e.g. ISO SC38 – Cloud Computing). The lab also occupies a leadership role (co-chair) in OGF's Open Cloud Computing Interface working group, and has engaged in the ETSI Cloud Standards Coordination initiative.

3. STANDARDIZATION PLAN

The standardization plan was presented in the meeting held in Carini (Italy) in October 2014, and it is based on the following actions and rules.

The leader of the standardisation task (task 8.2) is in charge of the overall coordination of standardisation activities in the project.

The task leader will maintain and update the list of:

- Relevant SDOs/WGs covered
- Reference persons: Based on the knowledge of status of work he/she can help to be more effective.
- Opportunities for contributions identified by the Leaders of technical WPs

The Task 8.2 leader (ITALTEL) in collaboration with the reference person(s) for the various SDOs/groups shall maintain and update the T-NOVA wiki with the:

- List of topics that are concrete opportunities for contributions
- List of contributions under preparation
- Status of current work
- List of submitted contributions and main achievements

The Work Package Leaders or the other participants in the project will:

- Notify the identified opportunities at an early stage to the Task8.2 leader and to the SDO/WG reference person(s).

The SDO/WG reference person will:

- Assist author(s) of standard contribution during the preparation of the submission.
- Coordinate work of different project partners.

Author(s) of standard contribution will:

- Share draft contributions over the WP8 mailing list before submission, to gather comments and possibility for co-signing.
- Announce over the WP8 mailing list results of the submission of contribution (acceptance, revision and/or reject).
- Provide information gathered during the discussion of the contribution(s), as guidance for future project work.

4. LIST OF THE RELEVANT SDOS/WGS

Table 1 provides the list of the relevant SDOs/WGs covered in the T-NOVA project.

Table 1 – List of relevant SDOs and Open Source communities

SDO/OSS	
ETSI NFV ISG	ETSI Network Function Virtualization Industry Specification Groups
IETF	Internet Engineering Task Force
IRTF	Internet Research Task Force
ISO/IEC	International Organization for Standardization
ONF	Open Networking Foundation
MEF	Metro Ethernet Forum
TM Forum	TM Forum
OpenStack	
OpenDaylight	
OPNFV	Open Platform for NFV
HGI	Home Gateway Initiative

The following section provides specific information for each group.

4.1. ETSI NFV ISG

ETSI NFV ISG (Network Function Virtualization Industry Specification Groups), the ETSI group for network functions virtualization, was created by world's leading Telcos, joined by other network operators, TEMs, IT vendors and technology providers. The group aims at providing requirements and architecture specifications for the HW and SW infrastructure required to support the virtualization of network functions and the guidelines for developing virtualised network functions.

NFV addresses the consolidation of many network equipment types onto industry standard high volume servers, switches and storage, in Data Centres, Network Nodes, end user premises leveraging standard IT virtualisation. NFV is applicable to any data plane packet processing and control plane function in fixed and mobile network infrastructures. NFV is highly complementary to SDN but not dependent on SDN.

The group was initiated at the end of 2012 after the submission of a White Paper written by seven of the world's leading telecoms network operators. The ISG is based on a large community of experts working intensely to develop the required standards for "Network Functions Virtualisation". The membership of ISG NFV has grown to over 230 individual

companies including 37 of the world's major service providers as well as representatives from both telecoms and IT vendors.

The output of ETSI NFV Phase 1 is constituted by the following public available published documents on ETSI portal (see [DOC]):

- Architecture: Architectural Framework;
- Use cases;
- Terminology;
- Infrastructure: Overview; Compute Domain, Hypervisor Domain, Network Domain, Service Quality Metrics;
- Management: Management and Orchestration;
- Performance: Performance and Portability Best Practices;
- Reliability: Resiliency Requirements;
- Security: Security problem statement; Security and Trust Guidance.

The guidelines for Phase 1 were mainly based on Informative requirements in order to provide guidance and generate consensus on general architecture and general requirements. Many PoCs were also fostered in order to encourage the growth of the eco-system.

With Phase 2 the focus was "interoperability", i.e. the capability to implement a solution assembling components in an open ecosystem. The target for specification was also to provide normative requirements and not only informative ones. Specifically, the normative requirements were intended according the need to define different levels of detail spanning from the High level service definitions to the definitions of the Information Elements in the protocol interfaces.

The structure remained based on WGs and Task Forces extending functionalities of previous WGs: MANO, SWA, INF.

Additional information can be found at the following link: [NFV].

4.2. Internet Engineering Task Force

Internet Engineering Task Force (IETF) (see: https://www.ietf.org/) is the organization developing and promoting Internet standards. The IETF is organized into a large number of working groups and informal discussion groups dealing with specific topics.

4.3. Internet Research Task Force

The Internet Research Task Force (IRTF) (see: https://irtf.org/) focuses on longer term research issues related to the Internet while the parallel organization, the Internet Engineering Task Force (IETF), focuses on the shorter term issues of engineering and standards making.

The following are those relevant for T-NOVA:

- NFVRG (Network Function Virtualization Research Group)

- SDNRG Software Defined Networking Research Group

The Network Function Virtualization Research Group (NFVRG) has the objective to bring together researchers and grow the community around the world in both academia and industry to explore the technologies enabling the virtualization of network functions.

The NFVRG focuses on research problems associated with NFV, in correlation with other IRTF groups (e.g. SDNRG) and standardization activities of IETF WGs (e.g. SFC). A brief summary of the areas of interest include: new network architectures based on VNFs; Network and Service Function Chaining; Autonomous orchestration and optimization; Reliability; Security; Performance modelling; New operational models; Infrastructure and NF description and programming; Virtualized network economics and business modeling, etc.

Near-term work items are the following: Policy-Based Resource Management (focusing on optimized resource management and workload distribution based on policy); Analytics for Visibility and Orchestration (focusing on techniques for the applicability of real-time analytics); Virtual Network Function (VNF) Performance Modeling to Facilitate Transition to NFV; Service Verification with Regards to Security and Resiliency.

Relevant information and research developed by the research group will be submitted for publication as Experimental or Informational RFCs.

Additional information can be found at the following link: [NFVRG].

The Software-Defined Networking Research Group (SDNRG) addresses many open issues in the research in the SDN area, investigating SDN from various perspectives aiming at identifying the approaches that can be defined and implemented in the near term as well identifying future research challenges.

In particular, the research area includes solution scalability, abstractions, and programming languages and paradigms in the context of SDN. SDNRG aims also at providing objective definitions, metrics and background research with the goal of providing this information as input to protocol, network, and service design to other standardization organizations.

The areas of interest are the following: Classification of SDN models; SDN model scalability and applicability; Multi-layer programmability and feedback control systems; System Complexity; Network description languages, abstractions, interfaces and compilers; Security.

Additional information can be found at the following link: [SDNRG]

4.4. ISO/IEC

The scope of ISO/IEC JTC 1/SC 38 is the "Standardization for interoperable Distributed Application Platforms and Services." [2] This includes: Web services; Service Oriented Architecture (SOA); Cloud computing.

Additional information can be found at the following link: [ISO]

4.5. Open Networking Foundation

Open Networking Foundation (ONF) is a user-driven organization dedicated to the promotion and adoption of Software-Defined Networking (SDN) through open standards development.

Additional information can be found at the following link: [ONF].

4.6. Metro Ethernet Forum

MEF is a global industry alliance comprising more than 220 organizations including telecommunications service providers, cable MSOs, network equipment/software manufacturers, semiconductors vendors and testing organizations. The MEF's mission is to accelerate the worldwide adoption of Carrier-class Ethernet networks and services.

Additional information can be found at the following link: [MEF].

4.7. TM Forum

TM Forum has created ZOOM (Zero-touch Orchestration, Operations and Management project) to create a living blueprint for a new generation of service provider support systems to deliver true business agility, and expert guidance on how to to get there.

Additional information can be found at the following link: [TMFORUM].

4.8. OpenStack

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface.

Additional information can be found at the following link: [OS].

4.9. OpenDaylight

OpenDaylight is an open platform for network programmability to enable SDN and create a solid foundation for NFV for networks at any size and scale.

Additional information can be found at the following link: [ODL].

4.10. Open Platform for NFV

OPNFV is an open source project focused on accelerating the evolution of NFV.

OPNFV will "establish a carrier-grade, integrated, open source reference platform that industry peers will build together to advance the evolution of NFV and to ensure consistency, performance and interoperability among multiple open source components". The initial scope of OPNFV will be on building NFV Infrastructure (NFVI), Virtualized Infrastructure Management (VIM), and including application programmable interfaces (APIs) to other NFV elements, which together form the basic infrastructure required for Virtualized Network Functions (VNF) and Management and Network Orchestration (MANO) components.

The project was announced on September 2014 by the Linux Foundation.

The goal of OPNFV is to accelerate the introduction of new NFV products and services. As an open source project it is positioned to bring together the work of standards bodies, open source communities and commercial suppliers to deliver a "de facto" standard open source NFV platform for the industry. By integrating components from upstream projects, the community is carrying out performance and use case-based testing to ensure the platform's suitability for NFV use cases. OPNFV aims also to bring the learnings from its work directly to those communities in the form of blueprints, patches, and code contributions.

The scope of OPNFV's ARNO release (June 2015) was focused on building an NFV Infrastructure (NFVI) and Virtualised Infrastructure Management (VIM) by integrating components from upstream projects such as OpenDaylight, OpenStack, Ceph Storage, KVM, Open vSwitch, and Linux. These components, along with application programmable interfaces (APIs) to other NFV elements form the basic infrastructure required for VNFs and Management and Network Orchestration (MANO) components. OPNFV's goal is to increase performance and power efficiency; improve reliability, availability, and serviceability; and deliver comprehensive platform instrumentation.

One of the projects in OPNFV is Yardstick. T-NOVA provided contributions to the Yardstick project which are planned to be included in the OPNFV Brahmaputra release scheduled for early 2016.

The goal of the Yardstick Project is to verify the infrastructure compliance when running VNF applications. NFV use cases described in ETSI GS NFV 001 show a large variety of applications, each defining specific requirements and complex configuration on the underlying infrastructure and test tools. The Yardstick concept decomposes typical VNF work-load performance metrics into a number of characteristics/performance vectors, which each of them can be represented by distinct test-cases. The project scope is to develop a test framework, test cases and test stimuli.

Additional information can be found at the following link: [OPNFV].

4.11. Home Gateway Initiative

HGI is shaping the way that services are delivered in the digital home. HGI was founded in 2004 by major Broadband Service Providers (BSPs), and has since been joined by leading manufacturers of digital home devices, chips, and software.

Additional information can be found at the following link: [HGI].

5. LIST OF TOPICS

The list of reference persons for the participation to standardization groups is provided in the Table 2. .

Table 2 – Partners and reference persons

Partner	reference person	
Atos	Ramos Lopez, Aurora aurora.ramos@atos.net	Though according to the DoW ATOS may not contribute specifically to the standardization task, in relation to the standardization bodies identified as relevant to T-NOVA, ATOS is currently active in TMForum.
HP	Marco Di Girolamo marco.digirolamo@hp.com	HP is represented in the ETSI NVF ISG, Open Platform for NFV (OPNFV), OpenDaylight. The HP liaisons into these bodies are appointed and managed at corporate level, so our group cannot commit to any specific action, since we do not have the right empowerment. However, HP will seek ways to get internal links, and transfer T-NOVA results to the best suited people.
Intel	Michael J Mcgrath michael.j.mcgrath@intel.com	Active in following relevant standards/industry bodies: NFV: Open Platform for NFV ETSI Network Function Virtualization SDN: OpenDaylight Consortium Open Networking Foundation Cloud: OpenStack Foundation Open Cloud Consortium ISO JTC1 (Joint Technical Committee 1) with specific focus on cloud standards such as OVF and OCCI. Intel engagements with standards bodies are appointed and managed at a corporate level also with constraints regarding specific commitments to standards actions.
Italtel	Giuseppe Monteleone giuseppe.monteleone@italtel.com	Italtel participates to ETSI NFV ISG.
Primetel	Michael Georgiades michaelg@prime-tel.com	Subscribed to the following IETF mailing lists: vnfpool (Virtualized Network Function Pool) NSaaS (Network Security as a Service). No WGs are

		established yet for these topics but they are active discussions of interest, which we will follow. Also, subscribed to Nfvrg, Sdnrg mailing lists. Recent nsaas draft (http://tools.ietf.org/html/draft-dunbar-nsaas-problem-statement-00) discussed at http://www.ietf.org/mail-archive/web/ietf-announce/current/msg13119.html.
PTInS	Jorge Carapinha JorgeC@telecom.pt	PTInS is currently active in two standardization fora that can be considered relevant to T-NOVA: ETSI NFV ISG – member of the ISG and member of the NOC (Network Operators Council); TM Forum ZOOM (Zero-touch, Orchestration, Operations and Management).
CLDST	Thomas Pliakas, tpliakas@thecldst.com, Mika Skarp, mskarp@thecldst.com	CLDST is actively participating in Metro Ethernet Forum (MEF) and especially in Service Operation Committee (SOC).

6. STATUS (LIST OF CONTRIBUTIONS)

The list of contributions to standardization activities is provided in the following.

6.1. ETSI NFV ISG

WG	EVE
Partner	PT PORTUGAL SGPS SA
Title	Discussion of VIM interconnection scenarios
Description	This document discusses scenarios for SDN across multiple VIM and is especially targeted at section 5.2 of the "Report on SDN Usage in NFV Architectural Framework". Main references are ETSI GS NFV-MAN 001, ETSI GS NFV INF 005 and ONF "SDN Architecture".
Date	2015-01-07
Link	ETSI member only https://docbox.etsi.org/ISG/NFV/EVE/05-CONTRIBUTIONS/2015//NFVEVE(15)000004r3_Discussion_of_VIM_interconnection_scenarios.doc
Status	Approved. Contribution included in ETSI NFV EVE005 report, publication pending.

WG	Other
Partner	PT PORTUGAL SGPS SA
Title	Feature Proposal: Integration of VNF with WAN connectivity services
Description	The present contribution proposes the feature "Integration of VNF with WAN connectivity services"
Date	2015-09-14
Link	ETSI member only https://docbox.etsi.org/ISG/NFV/05-CONTRIBUTIONS/2015/NFV(15)FTR024_Feature_Proposal__Integration_of_VNF_with_WAN_connectivity_s.docx File:Feature_Proposal_VNF&WAN.docx
Status	Merged with three other feature proposals around NFV/WAN. The final proposal has been ranked #1, from a list of 21 eligible proposals, by ETSI NFV Network Operators Council (NOC) and later endorsed by the Technical Steering Committee (TSC). Although the 2016 work items will not be formally approved until the NFV#13 meeting in mid-February 2016, it is practically certain that this proposal will be part of the ETSI NFV work plan for next year.

WG	IFA
Partner	Italtel
Title	NFVIFA(15)000450r5 IFA005 Virtual Links
Description	Contribution to ETSI GS IFA 005
Date	2015-05-22
Link	ETSI member only https://docbox.etsi.org//ISG/NFV/IFA/05-CONTRIBUTIONS/2015/001-to-999//NFVIFA(15)000405r5.docx
Status	For discussion

WG	IFA
Partner	Italtel
Title	NFVIFA(14)000502 VNFD restructuring – Monitoring aspects
Description	Contribution to ETSI GS IFA 011
Date	2015-05-22
Link	ETSI member only https://docbox.etsi.org//ISG/NFV/IFA/05-CONTRIBUTIONS/2015/001-to-999//NFVIFA(15)000502_VNFD_restructuring___Monitoring_aspects__.pptx
Status	For discussion

WG	IFA
Partner	Italtel
Title	IFA010 section 6.3 VNF lifecycle management reqs – healing
Description	Contribution to ETSI GS IFA 010
Date	2015-03
Link	ETSI member only https://docbox.etsi.org//ISG/NFV/IFA/05-CONTRIBUTIONS/2015/001-to-999//NFVIFA(15)000350r3_IFA010_VNF_lifecycle_management_reqs_-_healing.docx
Status	For discussion

WG	IFA
Partner	Italtel
Title	IFA010 section 6.3 VNF lifecycle management reqs – migration
Description	Contribution to ETSI GS IFA 010
Date	2015-03
Link	ETSI member only https://docbox.etsi.org//ISG/NFV/IFA/05-CONTRIBUTIONS/2015/001-to-999//NFVIFA(15)000376r3_IFA010_VNF_lifecycle_management_reqs_-_migration.docx
Status	For discussion

WG	IFA
Partner	Italtel
Title	IFA001 Transcoding Use Case
Description	Contribution to ETSI GS IFA 001
Date	2015-05-22
Link	https://docbox.etsi.org/ISG/NFV/Open/Drafts/IFA001_Acceleration_-_UCs_report/
Status	Approved
	Contribution included in ETSI GS NFV IFA001.

WG	IFA
Partner	Italtel
Title	IFA010 Multi-Tenancy Introduction and Requirements

Description	Contribution to ETSI GS IFA 010
Date	2015-07-01
Link	https://docbox.etsi.org/ISG/NFV/Open/Drafts/IFA010_MANO_Functional_Rqmts_Spec/
Status	Approved
	Contribution included in ETSI GS NFV IFA010.

WG	IFA
Partner	Italtel
Title	IFA005 and IFA006 Multi-tenancy
Description	Contribution to ETSI GS IFA 005 and IFA006
Date	2015-09-10
Link	Link (1): https://docbox.etsi.org/ISG/NFV/Open/Drafts/IFA005_Or-Vi_ref_point_Spec/
	Link (2): https://docbox.etsi.org/ISG/NFV/Open/Drafts/IFA006_Vi-Vnfm_ref_point_Spec/
Status	Approved
	Contribution included in ETSI GS NFV IFA005.
	Contribution included in ETSI GS NFV IFA006.

WG	IFA, EVE
Partner	Atos, Italtel, NCSR Demokritos, PT PORTUGAL SGPS SA, TEIC l
Title	Feature Proposal: A Marketplace for NFV
Description	The present contribution proposes the feature "A Marketplace for NFV"
Date	2015-09-29
Link	Available on ETSI site: http://wiki.t-nova.eu/tnovawiki/index.php/File:NFV(15)FTR029_Feature_proposal_A_Marketplace_for_NFV.docx
Status	The contribution was considered partially out of scope for the NFV ISG and it was suggested to reconsider it for TMForum.

6.2. IETF

WG	IETF (Network Working Group)
Partner	Primetel
Title	draft-pastor-i2nsf-merged-use-cases-00
Description	"Use Cases and Requirements for an Interface to Network Security Functions"
Date	June 26, 2015
Link	https://tools.ietf.org/html/draft-pastor-i2nsf-merged-use-cases-00
Status	Experimental

6.3. IRTF Network Function Virtualization Research Group (nfvrg)

WG	IRTF Network Function Virtualization Research Group (nfvrg)
Partner	NCSR Demokritos
Title	T-NOVA: Developing a platform for NfaaS
Description	Presentation at the IETF Meeting 91
Date	13/11/2014
Link	http://www.ietf.org/proceedings/91/slides/slides-91-nfvrg-7.pdf
Status	N/A

WG	IETF (Network Working Group)
Partner	NCSR Demokritos
Title	T-NOVA: Developing a platform for NfaaS
Description	Presentation at the Interim NFV RG Meeting - Austin,TX
Date	10/12/2014
Link	presentation (http://wiki.t-nova.eu/tnovawiki/index.php/File:Slides-Austin-Interim-nfvrg.pptx) and minutes (http://www.ietf.org/proceedings/interim/2014/12/10/nfvrg/minutes/minutes-interim-2014-nfvrg-2)
Status	N/A

6.4. OpenStack

WG	Openstack – TelcoWorkingGroup
Partner	PT PORTUGAL SGPS SA
Title	"Traffic Steering Abstraction for Neutron", blueprint
Description	PTIN has submitted a blueprint to OpenStack which is part of the Development Effort under the TelcoWorkingGroup. This working group aims to define the use cases and identify and prioritise the requirements which are needed to deploy, manage, and run telecommunication services (NFV) on top of OpenStack. The blueprint "Traffic Steering Abstraction for Neutron" provides an abstraction which can be used to realize service chaining.
Date	
Link	More info at https://blueprints.launchpad.net/neutron/+spec/traffic-steering-abstraction
Status	Accepted, later merged with other blueprint proposals. Formally, the present state of the original proposal is "Abandoned": https://review.openstack.org/#/c/92477

6.5. OPNFV

WG	Yardstick
Partner	Intel and NCSRD
Title	Project entitled "VNF Characterization Framework and Resources"
Description	Contribution of a fully characterized open source VNF (vTC), VNF Workload Characterization Framework which orchestrates the automated deployment and testing of VNFs based on OpenStack Heat templates and four test cases (TC1 – RFC2544 throughput, TC2 – Multi-tenancy CPU throughput, TC3 – Instantiation Validation, TC4 – Multi-tenancy Instantiation Validation). All three have been added to the Yardstick work program.
Date	Feb 2016
Link	https://wiki.opnfv.org/yardstick
Status	In Progress. Contributions are expected to be included in the OPNFV Brahmaputra release in February 2016.

6.6. Other (running) activities

Participation to ETSI NFV ISG meetings:

- ETSI NFV EVE WG meetings (PTIN): on line
- ETSI NFV IFA WG meetings (Italtel): on line;
- ETSI NFV Plenary meetings (Italtel): Malaga February 2014;
- ETSI NFV IFA WG meetings (Italtel): IFA meeting in Helsinki from 22 to 24 April 2015;
- ETSI NFV IFA WG meetings (Italtel): IFA meeting in Sophia Antipolis from 15 to 18 September 2015;

Tutorial on NFV Phase 2: File:Brief tutorial on ETSI ISG NFV Phase 2.pptx

Issues around ISG NFV, Feb-Mar 2015: File:Report of ETSI ISG NFV9 and beyond 25032015.pptx

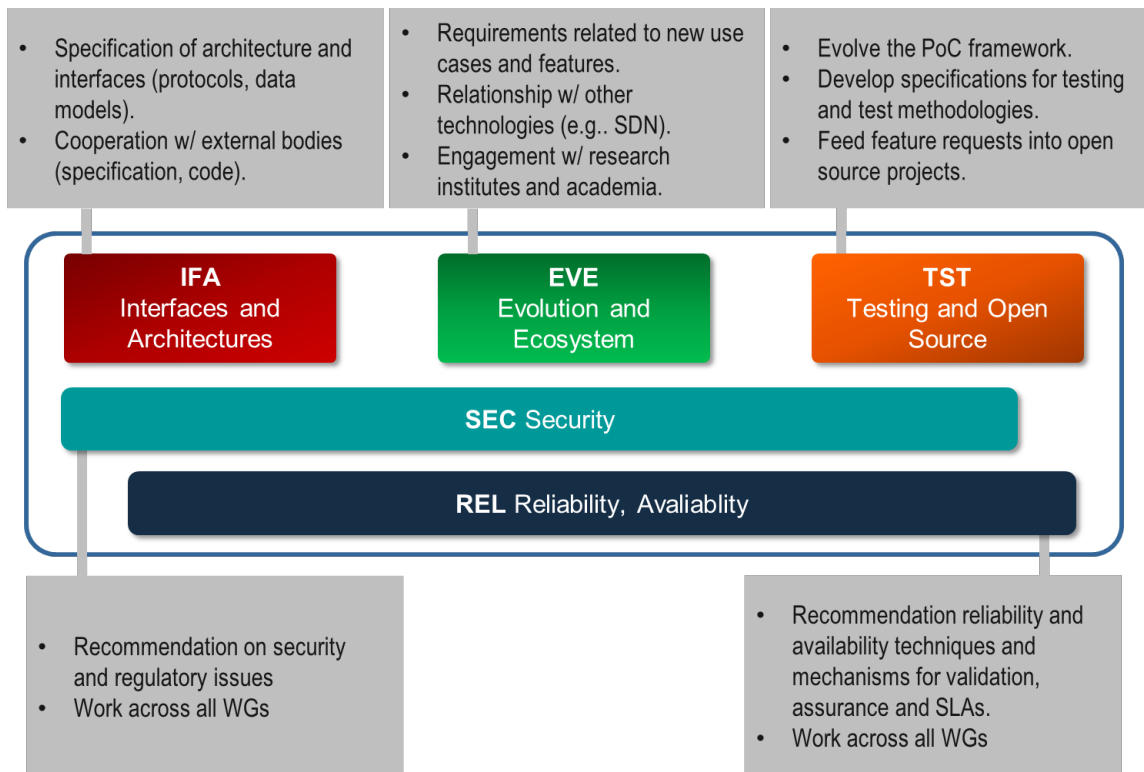The participation to the ETSI NFV meetings (PTIN, Italtel) is related to the following work groups:

- Specification of architecture and interfaces (protocols, data models).
- Cooperation w/ external bodies (specification, code).

- Requirements related to new use cases and features.
- Relationship w/ other technologies (e.g.. SDN).
- Engagement w/ research institutes and academia.

- Evolve the PoC framework.
- Develop specifications for testing and test methodologies.
- Feed feature requests into open source projects.

IFA
Interfaces and Architectures

EVE
Evolution and Ecosystem

TST
Testing and Open Source

SEC Security

REL Reliability, Avaliablity

- Recommendation on security and regulatory issues
- Work across all WGs

- Recommendation reliability and availability techniques and mechanisms for validation, assurance and SLAs.
- Work across all WGs

Figure 2 – Working groups in ETSI NFV ISG (Phase 2)

7. FUTURE WORK

The advantages of NFV over the use of dedicated infrastructures are multiple in terms of cost reduction, time-to-market reduction, flexibility, etc. However, NFV also brings a number of challenges that must be solved to enable its massive adoption in the market.

In particular, the first key point can be the promotion of innovation, by opening a part of the networking market and transforming it to a novel virtual appliance market, facilitating the involvement of software entrants, including SMEs and even academia and secondly the rapid introduction of novel network functions (including upgrading of existing ones) at much lower cost and lower risk, leading to significant decrease of Time-To-Market (TTM) for new solutions remain key issues in the NFV Market.

In order to facilitate the involvement of diverse actors in the NFV scene, an innovative "Virtual Network Function Marketplace" that can follow the paradigm of existing successful OS-specific "App Stores" is proposed by T-NOVA. The VNF Marketplace, which can be maintained by a Service provider, can contain VNFs created and provided by several third-party developers, published as independent entities and accompanied with the necessary metadata (including trading information as part of the VNFD). The Marketplace will allow customers to select the virtual appliances which best match their needs, "plug" them into their existing connectivity services and configure/adapt them according to their needs.

In order to facilitate competition and support different value chain configurations, a Brokerage Platform can also be established, allowing the Service Provider to transact with the multiple third-party Function Developers for selecting the best VNFs that suits their needs. Upon receiving the Service Provider request, the brokerage platform can examine i) the available Network and IT resources and ii) the available functions at the Function Store and come up with specific economic/technical offerings and associated billing models.

The marketplace allows network services and network functions by a variety of developers to be published and brokered/traded. Customers can browse the marketplace and select the services and virtual appliances that best match their needs, as well as negotiate the associated SLAs and billing models.

The main functionalities under investigation that can provide new possibility for contributions to the standards are described in the following sub sections.

7.1. Marketplace

The following items under investigation can provide the possibility to standardize the Marketplace:

- Publication of resources and advertisement. Through a customer front-end, third-party VNF developers advertise by describing their functions and customers can place their requests for services and virtual appliances.
- VNF discovery and trading. Through a brokerage module the SP can place their requests for VNFs and express requirements for their performance, receive offerings and make the appropriate selections, taking into account the offered SLAs and pricing. Several billing models are considered such as pay –as you go, subscription and sharing revenue between SP and VNF developers.
- E2E Service offering description, including SLA specification and possible applicable rewarding based on SLA evaluation.

▪ Customer-side monitoring and configuration of the offered services and functions. Via a service dashboard users can interact with the Orchestrator platform for monitoring the status of the established services and associated NFs, as well as for performing – according to their associated permissions – management operations on them.

7.2. MANO

The following items are under investigation for possible contributions to the standards:

▪ VNFD: VNF descriptor;
▪ NSD: NS descriptor;
▪ Assurance: Failure notification and diagnostics for a VNFaaS that shall be provided to the final customer; Failure notification and diagnostics for a NFVIaaS that shall be provided to the customer accessing to the NFVIaaS;
▪ SLA management: For VNFs and NS that shall be provided to the final customer; For the provision of NFVIaaS that shall be provided to the customer accessing to the NFVIaaS;
▪ Accounting: Accounting of resource usage for VNFs and NSs; Inclusion of commercial agreements in VNFs and NSs; Commercial agreement between a SP and NFVI provider.

7.3. NFV Architecture

As far as the evolution of the reference architecture is concerned the following items are under investigation for possible contributions to the standards:

▪ Implementation of a Distributed NFVI with centralized data center and edge network data center distributed at the edge of the network;
▪ Placement of resources and VNFs according to network topology and service requirement (e.g. latency for real time communication) and minimizing the utilization of network resources;
▪ NFVIaaS: Separation of Service Provider role and NFVI provider role implementing the access to NFVI resources managed by a different entity;
▪ Evolution of the "Use Cases" including the possibility to make use of the Marketplace concept as an extension of the VNFaaS and NFVIaaS use cases with the separation of Service Provider role and NFVI provider role implementing the access to NFVI resources managed by a different entity.

7.4. SDN

The following items are under investigation for possible contributions to the standards:

▪ Adoption of SDN in the NFV architectural framework;
▪ Interconnection of different NFVI PoPs.

7.5. Security

The following items are under investigation:

- ▪ Evolution of the Security framework: Definition of security features allowing the secure instantiation of third party provided VNFs; Testing of security features of third party provided VNFs; Securing the access of a SP to a NFVI in case of NFVIaaS provision.
- ▪ Service Verification: Since external Function Providers will contribute the VNFs, service verification is required prior to offering via the Marketplace. The verification process could be on-line or off-line depending on the protocol used for verification by the Service Provider.

7.6. Testing

The following items are under investigation for possible contributions to the standards:

- ▪ Evolution of the testing framework and Performance Evaluation: The performance of the VNFs made available through the Marketplace should be evaluated using actual deployment scenarios within the supported NFVI. In this context the SP should either allow a sandbox environment for Function Developers to evaluate the functionality and performance of their VNFs prior to allowing their uploading at the Marketplace.

7.7. NFV/WAN integration

Because T-NOVA (or any VNFaaS service, for that matter) is by definition composed of a network connectivity service and a set of associated network functions, integration of these two components is an essential requirement to guarantee successful deployment in a real scenario. The following items are under investigation:

- • Deployment models for integration of WAN connectivity services and NFV infrastructure – centralized, distributed, decentralized;
- • Connectivity between distributed NFVI resources for end-to-end service delivery; VNFaaS services with endpoints residing in multiple NFVI-POPs, interconnected by one or more WAN domains;
- • Integration of emergent enterprise WAN solution (e.g. SD-WAN) and VNFaaS.

The first topic is being tackled by MEF ("Carrier Ethernet and NFV" White Paper, currently under preparation) and will likely continue to be during 2016. The second topic (strongly related to the first but mainly NFV-centric) will be included in the ETSI NFV work programme for 2016. In both cases, T-NOVA will monitor the relevant activities and will contribute whenever considered relevant and appropriate. Strictly speaking, the third topic can be seen as outside of the scope of T-NOVA, as originally defined, but represents a major evolution trend that has gained prominence in the industry and is likely to boost the impact of NFV and VNFaaS in enterprise environments. Therefore, relevant activity by SDOs in this area (e.g. IETF, ONF, ETSI NFV, MEF) will be followed in the third year of T-NOVA.

8. CONCLUSION

This deliverable is an interim report providing information on the planning of standardization activities and the progress within standardization groups and contributions submitted on behalf of T-NOVA up to the current date. Activities towards the standardization of the project results will be explored in WP8 in order for T-NOVA to have the maximum possible impact both in the scientific and industrial/commercial communities.

Due to the innovative nature of the T-NOVA project, standardization activities will continue during the final year of the project and this document will be revised in the future to provide an updated report. The final activities will be published in the deliverable D8.22: Final report on standardisation.

9. LIST OF ACRONYMS

Acronym	Description
API	Application Programming Interface
COTS	Commercial-off-the-shelf
DC	Data Center
DMTF	Distributed Management Task Force
DPDK	Data Packet Development Kit
ETSI	European Telecommunications Standards Institute
EU	European Union
HGI	Home Gateway Initiative
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IPR	Intellectual Property Rights
ISG	Industry Specifications Group
ISO	Organization for Standardization
IT	Information Technology
ITU	International Telecommunication Union
KVM	Kernel-based Virtual Machine
MANO	Management and Orchestration
MEF	Metro Ethernet Forum
NCSR	National Centre for Scientific Research
NFaaS	Network Functions-as-a-Service
NF	Network Function
NFV	Network Functions Virtualization
OCCI	Open Cloud Computing Interface
ONF	Open Networking Foundation
OSS	Open Source Software
SDN	Software Defined Networking
SLA	Service Level Agreement
SDO	Standard Definition Organization
SW	Software
SWA	Software Architecture
UML	Unified Modelling Language
VNF	Virtualized Network Function
WAN	Wide-Area Network
WP	Workpackage
WPL	Workpackage Leader

10. REFERENCES

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