AN OPEN PLATFORM TO ACCELERATE NFV

A Linux Foundation Collaborative Project

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EXECUTIVE SUMMARY

The major goal of Network Functions Virtualization (NFV) is to increase service agility while enabling better asset utilization.

In order to help realize this goal, network operators have called for an open source reference platform to validate multivendor, interoperable NFV solutions. Open Platform for NFV (OPNFV)[1] is a new open source project that will provide such a platform.

OPNFV will enable industry collaboration to advance the evolution of NFV and ensure consistency, performance and interoperability among virtualized network infrastructures.

OPNFV will work closely with ETSI's NFV ISG, among other standards bodies, to drive the consistent implementation of an open and standard NFV reference platform.

The initial scope of OPNFV will be to provide NFV Infrastructure (NFVI), Virtualized Infrastructure Management (VIM), and APIs to other NFV elements, which together form the basic infrastructure required for Virtualized Network Functions (VNFs) and Management and Network Orchestration (MANO) components.

Increasingly, standards are being drafted in conjunction with major open source projects. OPNFV will work with many of these projects to coordinate continuous integration and testing of NFV solutions.

[1] OPNFV web portal: http://opnfv.org

This tight coordination of otherwise independent processes is crucial to the establishment of an NFV ecosystem: it can root out issues earlier, identify resolutions, and potentially establish de facto standards. The result is a faster and more economical approach to NFV deployment.

There is an implicit call for action in the formation of OPNFV and an invitation is extended to individuals, companies and organizations to participate in and contribute to the project. This may include creating code or providing input (potentially through an advisory board or a technical steering committee) to guide the project towards successful industry evolution to more agile and economical networks.

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INTRODUCING OPNFV

"...Network Functions Virtualization (NFV) replaces the need for physical appliances with virtualized network functions running on standard server platforms..."

Open Platform for NFV (OPNFV) is a new project that intends to provide an open source platform for deploying NFV solutions that leverages investments from a community of developers and solution providers.

The investments are designed to enable interoperability across a broad set of industry players and usage models. The goal is to create a framework that addresses the needs of the platform providers, application developers and end users who will be required to operate and maintain these complex systems.

The continuing growth of data traversing the network is well documented, driven by more devices, more users and new usage models such as video streaming and social media.

As a result, network operators are under pressure to build out their facilities to satisfy the demand for services from consumers, enterprises and the Internet of Things. Historically, this has been accomplished by adding purpose-built hardware-based appliances to the network, a capital and operationally intensive approach to growing and maintaining networks. As described in the joint-carrier white paper published in October 2012[2], Network Functions Virtualization (NFV) replaces the need for physical appliances with virtualized network functions running on standard server platforms, thereby leveraging server volume economics, standard IT virtualization and cloud technologies, and business models which will enable network operators to deploy and maintain networks in a more cost-effective and efficient manner.

This document describes the role of open source in this endeavor and the rationale for the OPNFV initiative.

[2] Original joint-carrier white paper introducing NFV: http://portal.etsi.org/NFV/NFV_White_Paper.pdf

THE OBJECTIVES OF OPNFV

The objectives of OPNFV are twofold: firstly, a collaborative development of an open source platform to promote interoperable NFV solutions; and secondly, to help stimulate existing open source communities to create the software code or hardware necessary to implement NFV solutions based on common industry requirements.

The overall design of the OPNFV platform should be modular and allow for extensions and innovation beyond the community components, providing choice to end users for additional value that may be gained from proprietary or specialized components. The goal is to have an open platform to support various implementation models while building on an open substrate for the infrastructure that provides interoperability between elements from various sources.

In the absence of collaboration, individual NFV vendors and users will independently implement numerous NFV platforms and solutions, making the goal of industry interoperability difficult to achieve. Such fragmentation will dilute resources and could lead to divergence and gaps, which will not benefit either users of the NFV platform or their customers. Further, key enabling upstream projects will likely grow weary of multiple attempts by NFV users to address the same defects, feature gaps or feature requests coming from a broad range of vendors and developers. The OPNFV project aims to provide an open reference platform for the deployment of Virtual Network Functions (VNF). OPNFV can benefit its members and community in multiple ways.

LEVERAGING THE ECONOMIES OF SCALE

"The goal is to have an open platform to support various implementation models while building on an open substrate for the infrastructure that provides interoperability between elements from various sources."

OPNFV acts as an avenue for the realization of NFV requirements via upstream open source projects, participating and helping to develop necessary improvements to accelerate adoption in network applications.

OPNFV will retain a focus on solving real problems, and will provide a forum for practical issues to be captured and accommodated in associated standards bodies and open source communities.

The OPNFV project, together with a comprehensive number of invested corporate members, intends to share the burden of integration, testing and validation of components. This collaboration with the broader community will result in increased industry-wide interoperability, reliability and efficiency that will shorten time to market.

INTEROPERABILITY

The promise of interoperability and the value of a unified approach are expected to increase the rate of innovation and accelerate the availability of commercial NFV solutions.

Member companies will be able to implement their own integrated solutions more focused on specific use cases and targeted market segments. Customers will leverage enhanced serviceability, reliability and performance optimization, allowing the larger OPNFV community to focus on modularity and interoperability. Additionally, insights achieved and shared by interoperable solutions will improve the effectiveness of the converged industry efforts, resulting in code improvements and facilitating the resolution of gaps and issues.

BUSINESS AGILITY

The implementation of an open reference platform for virtualized network functions allows the industry to focus on the creation of new business propositions and enables the rapid development of unique solutions to address user needs.

By building an open reference NFV platform, OPNFV will provide the first cornerstone to ensure the interoperability of NFV solutions from multiple vendors and encourage an ecosystem of developers to create new services, and drive new revenue streams, more quickly and at much lower risk.

APPROACHING THE CHALLENGE

As the community engages to address the overall scope of OPNFV, the project will work with other active forums using, validating, and evolving existing NFV reference documents and current best practices.

The formative community has identified the creation of a reference NFV platform distribution as an initial, key milestone to be followed by the development of additional functionality. OPNFV will validate existing standard specifications, contribute improvements to relevant upstream open source projects, and develop necessary new functionality both within OPNFV and upstream projects.

OPNFV does not intend to be considered as an alternative to existing standardization efforts. Rather, OPNFV will be run as a community, complementary to existing standards and open source bodies with a clear focus on the coordination of software development, integration and testing, documentation and API development for NFV. Of particular interest to the community are the requirements documented by the ETSI NFV Industry Specification Group (NFV ISG).[3] Additionally it is expected that insights developed within the OPNFV community will be fed back to the NFV ISG and other relevant bodies.

[3] ETSI NFV ISG portal: http://www.etsi.org/technologies-clusters/technologies/nfv

THE OPNFV ARCHITECTURAL FRAMEWORK

The architectural framework under development in OPNFV is reflected in the following diagram taken from the NFV ISG Architectural Framework.[4]

[4] ETSI NFV ISG Architectural Framework: www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.01.01_60/gs_NFV002v010101p.pdf

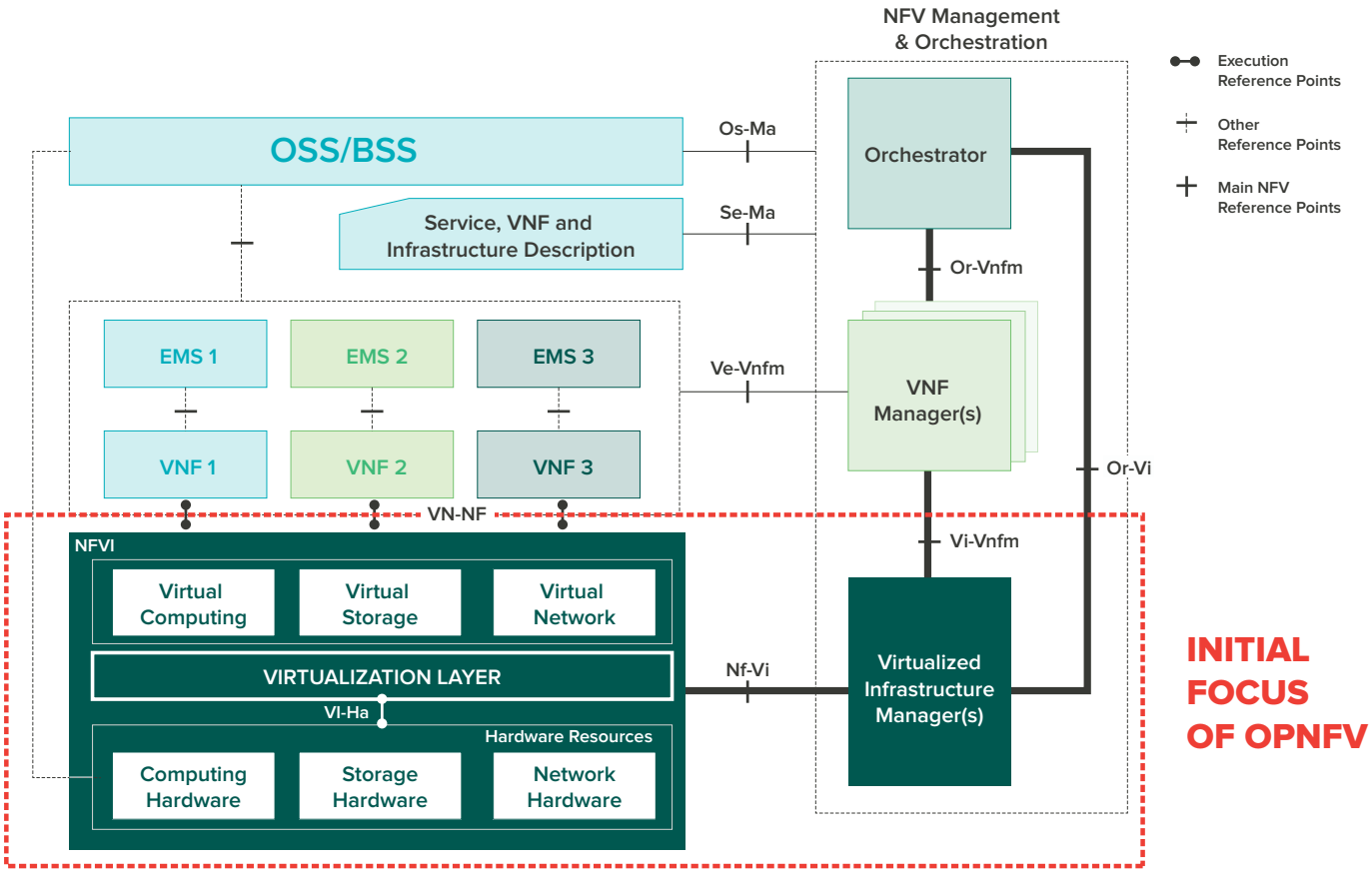

Figure 1: NFV Reference Architectural Framework

"While across the industry there are many initiatives to provide these capabilities in proprietary and public forums, the OPNFV project will work to bring these components together to realize a modular and pluggable framework for NFV deployment open to all industry participants."

The OPNFV project will initially focus on what is commonly referred to as the NFV infrastructure layer. The two functional blocks constituting the foundations for enabling the deployment of applications running in a virtual environment are the virtualization infrastructure (NFVI) and the virtualized infrastructure manager (VIM):

- The NFVI provides access to basic resources—compute, storage and networking—through hypervisors and SDN functions.
- The VIM manages the NFVI and provides the management capability required to deploy applications running in a virtual environment, commonly referred to as VNFs (virtual network functions).

The OPNFV reference platform work, rather than trying to reinvent these platform components, will be primarily focused on the alignment of the interfaces between these components and the delivery of a functional reference platform.

While across the industry there are many initiatives to provide these capabilities in proprietary and public forums, the OPNFV project will work to bring these components together to realize a modular and pluggable framework for NFV deployment open to all industry participants.

To achieve this, the OPNFV community will focus on the way these components interact and the interfaces between them. These interfaces can be distilled to four areas detailed in the following sections:

Virtual Network Function Interfaces to the Physical Hardware (VI-Ha)

The goal of creating common interfaces between the platform and underlying hardware is to allow the decoupling of software from hardware. It is expected that there would be multiple reference implementations that enable the capability for operators to:

- Share infrastructure resources for different purposes
- Reassign resources for different purposes
- Progress software and hardware in parallel
- Leverage software and hardware components from different vendors

Interfaces Used by the Applications to Execute on Virtual Infrastructure (Vn-Nf)

Application facing OPNFV interfaces are the point of integration for hosted functions and software to run on the platform. Application developers, whether migrating existing applications to a virtual infrastructure or developing directly toward a virtualized environment deployment, require guaranteed performance, reliability, and scalability from the underlying platform.

Along with these basic principles, the ability to work against a maintained and common set of APIs provides longevity and consistency to these applications.

Interfaces between the Virtual Infrastructure and the VIM (Nf-Vi)

While primarily internal to OPNFV, these interfaces for managing the NFVI virtualized resources present the ability to provide consistent and understood behaviors in the platform. They enable critical functions for system operations and maintenance including:

- Consistent management of NFVI virtual compute, storage and network systems
- Virtual infrastructure allocation and connectivity
- Monitoring of system utilization and performance and fault management

Interfaces from the VIM to the VNF Managers and Orchestration System (Or-Vi and Vi-Vnfm)

Providing the ability for application management systems and orchestration systems to interact with the virtual infrastructure manager, these interfaces provide visibility into the operation and state of the virtual system.

Application management systems are thus able to perform functions such as lifecycle management and system optimization for the virtual network functions running on the NFVI, and for orchestration systems to coordinate across elements of an end-to-end service offering.

OPNFV DISTRIBUTIONS

OPNFV will work with existing open source projects to deliver a complete and open platform for NFV.

Necessary adaptations to such projects will be developed either completely within the scope of such projects, or (once they are prototyped and tested) within the scope of OPNFV's development cycle.

They will then be proposed as contributions to the upstream communities. Some components of the overall OPNFV project might be out of scope of existing open source projects; these components will be maintained in the OPNFV project.

OPNFV does not mandate specific hardware resources for NFV deployment as long as the interface to the physical hardware (VI-Ha) reference point is supported. Nevertheless, the goal of a reference platform can only be achieved by building a complete stack, including hardware. Testing the software on a representative cross-section of major hardware platforms will help eliminate hardware-specific dependencies.

THE USER COMMUNITY

"The creation of OPNFV was motivated by the ETSI NFV Industry Specification Group"

OPNFV serves three broad communities of interest: End-users (network operators, including enterprises) who deploy the platform, standards organizations and industry forums that can use OPNFV as an implementation vehicle for their work, and open source projects that provide components of OPNFV.

In building OPNFV as an open reference platform, the community will work closely with other projects that provide components of the OPNFV platform, proposing and implementing changes, and explaining how they fit into the global requirements and use-cases for an NFV platform. While the emergence of NFV is rooted in carrier requirements, OPNFV is expected to not only serve the needs of service providers but to also be deployed by enterprises.

The creation of OPNFV was motivated by the ETSI NFV Industry Specification Group. OPNFV will work closely with the ETSI NFV ISG and other standards development organizations and industry forums to both facilitate interoperability among NFV platforms for virtual network functions, and encourage broad ecosystem adoption of standard interfaces within the platform.

The first results of the ETSI NFV ISG published in October 2013 are widely referenced as the starting point for the on-going industry effort to converge requirements for NFV and deliver carrier-grade network services. Additional releases of ETSI NFV ISG documents will also be important references for OPNFV.

MAJOR UPSTREAM PROJECTS

OPNFV, while an open source project in its own right, intends to collaborate and rely on other open source communities to achieve an industry wide NFV reference platform.

Some examples of well-known upstream projects are highlighted in the following section. While this provides an indication of some communities already identified, the OPNFV project will welcome participation by all relevant communities.

Major upstream projects where collaboration with OPNFV will be important, and their role in OPNFV, are:

- Virtual Infrastructure Management: OpenStack, Apache CloudStack, etc.
- Network Controller and Virtualization Infrastructure: OpenDaylight, etc.
- Virtualization and hypervisors: KVM, Xen, libvirt, LXC, etc.
- Virtual forwarder: Open vSwitch (OVS), Linux bridge, etc.
- Data-plane interfaces and acceleration: Dataplane Development Kit (DPDK), Open Dataplane (ODP), etc.
- Operating System: Linux, etc.

KEY ENABLERS

The goals of NFV are to increase service agility and enable better asset utilization. In recent years, several technology advancements make these goals achievable.

Cloud Computing

The advent of utility computing has had a profound effect on the way applications and services are built and delivered to market. The convergence of application development and deployment, and application scale-out based on user demand, has caused a massive increase in the rate of deployment and the speed and agility with which new applications can be brought to market. Cloud computing has also increased demand for openness and economies of scale.

Software-Defined Networking (SDN)

With the move to virtual compute and storage infrastructure driven by cloud computing, there has also been an increased demand on network infrastructure management. SDN provides the ability to define virtual network topologies independent of the underlying fabric and enables greater agility in the definition and management of network infrastructure; analogous to the way cloud computing has enabled greater agility of compute resources.

[3] ETSI NFV ISG portal: http://www.etsi.org/technologies-clusters/technologies/nfv

The Push towards Open Source

Without the rise of open source in enterprise, a project like OPNFV could not exist. Firstly, it builds on existing open source projects to build a reference platform. Secondly, it is the open, collaborative nature of OPNFV that allows network equipment providers, operators, VNF and platform vendors and hardware vendors to collaborate on a common, open platform on which all can innovate.

As an open source industry collaboration effort, OPNFV will deliver a common foundation for the orchestration and deployment of VNFs. In this effort, a majority of the customer risk in exploring, testing and deploying new technologies that interoperate with each other is mitigated. OPNFV will foster more innovation among vendors as they look to gain competitive differentiation in other areas that deliver greater benefits to the customer.

CALL FOR PARTICIPATION

"The OPNFV community is focused on encouraging an open ecosystem to accelerate innovation and adoption of NFV technologies."

The founding of OPNFV is an open invitation for all individuals, companies and organizations to participate and contribute to the project.

The OPNFV community is focused on encouraging an open ecosystem to accelerate innovation and adoption of NFV technologies. Thus, all participants have the opportunity to contribute code, provide input that steers the project and be elected to the Technical Steering Committee and/or Board.

As with other successful open source projects, meritocracy is placed at the core of all technical decisions (for example proposed projects) that impact the direction of OPNFV. Under this philosophy, participants at all levels of involvement can propose projects. The result is a dynamic project that fosters innovation from participants of varying levels of expertise and knowledge of end-user needs.

CONCLUSION

OPNFV is a key enabler for realizing the benefits of NFV technologies.

It will seek to provide a reference platform for validating interoperable NFV solutions that leverage investments from an open community of developers and solution providers, and thereby enable interoperability across a broad set of industry players and usage models. An open reference platform will accelerate the adoption of NFV as it will streamline the ability of vendors and users to be able to implement compatible NFV solutions, preventing wasteful duplication of effort in solving implementation and interoperability issues multiple times and in different, perhaps incompatible, ways.

As a complement to related open source projects and standards efforts, OPNFV is calling for the participation of all interested companies, organizations, and individuals to contribute to the project and to the successful realization of the key benefits, the service agilities and operational efficiencies, of NFV.

[1] OPNFV web portal: http://opnfv.org

CONTACT INFORMATION

For more information about OPNFV, please visit the project's website at **www.opnfv.org**. If you have questions, would like to discuss aspects of the project or inquire about becoming a member of the project, please use the email addresses or contact form on the website at **www.opnfv.org/contact.**

REFERENCES

[1] Network Functions Virtualisation: An Introduction, Benefits, Enablers, Challenges and Call for Action (2012-10); White Paper http://portal.etsi.org/NFV/NFV_White_Paper.pdf

[2] OPNFV web portal: http://opnfv.org

[3] http://www.etsi.org/technologies-clusters/technologies/nfv

[4] ETSI GS NFV 002 V1.1.1 (2013-10) Network Functions Virtualisation (NFV); Architectural Framework; http://docbox.etsi.org/ISG/NFV/Open/Published/gs_NFV002v010101p%20-%20Architectural%20Fwk.pdf

GLOSSARY

Hypervisor:

A piece of computer software, firmware or hardware that provides a mechanism to create, operate and manage a isolated virtual compute machine, which serves the purpose of physical compute.

IT, Information Technology:

The application of computers and networking equipment for data storage, retrieval, transformation and transmission in a business or enterprise.

Nf-Vi:

A NFV Architecture reference point specified in the ETSI, GS NFV 002 [3].

NFV, Network Functions:

Virtualization: the separation of a network functionality from the underlying proprietary hardware and/or operating system and operating them on general purpose compute machine through virtualization technologies.

NFVI, Network Functions Virtualization Infrastructure:

The infrastructure, a collection of hardware and software providing both real and virtual compute, storage, and network services, required for enabling NFV

OPNFV, Open Platform for NFV:

An open source project for developing an open reference platform for deploying multi-vendor virtual network functions for realizing network services.

SDN, Software Defined Networking:

A networking software technology that separates the control plane of network equipment from the forwarding plane and provides programmability to the control plane.

Virtualization:

The computing technology that enables creation virtual system resources like compute, storage, networking and other entities, that can be used in lieu of the real resource.

VIM, Virtualized Infrastructure Manager:

a functional block that is responsible for controlling and managing the NFVI virtual compute, storage and network resources, usually within one operator's Infrastructure domain specified in the ETSI, GS NFV 002 [3].

Vl-Ha:

A NFV Architecture reference point specified in the ETSI, GS NFV 002 [3].

Vn-Nf:

A NFV Architecture reference point specified in the ETSI, GS NFV 002 [3].

Virtualized Network Function:

An implementation of a network function that can be deployed on NFVI.