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Is Network Functions Virtualization (NFV) Moving Closer to Reality?

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Introduction

In the current computing environment, resource-intensive mobile apps achieve high efficiency because of virtualized servers and storage in the cloud. However, traditional networks are still manual, static, and complex. As a result, they're increasingly inadequate at handling the broad spectrum of demand, from big data to streaming media. For companies, data center virtualization has made on-demand compute power and instant scalability possible. Besides providing these organizations with CapEx and OpEx gains, virtualization helps diminish the IT burden, makes other data center innovations possible, and ensures steady resource access for end users.

Partly due to this trend, Network Virtualization (NV) and Network Functions Virtualization (NFV) are gaining momentum along with Software-Defined Networking (SDN). It's useful to note that the division of the data and control planes, characteristic of SDN, essentially requires a completely new networking structure. In contrast, NV and NFV offer the ability to add services and functions on top of a pre-existing network. This is an important distinction because it points to the possibility of fast adoption speeds for NV and NFV, which can be used by any organization familiar with virtualization.

In this white paper, we'll look at the history of NFV and its origins. We'll also explore the prospects for networking to gradually evolve from a hardware-centric approach to a software-driven model. Finally, we'll examine future market implications and how NFV can help organizations to achieve their goals when almost any network function can be virtualized.

History of NFV

With the mobile trend and wireless connectivity enabling diverse online interactions, text and email are gradually being replaced by other forms, such as streaming multimedia. The major telecomm carriers have taken notice. They're at the forefront of an initiative created to meet rising demand: NFV.

The culmination of informal telecomm carrier discussions and a white paper presented in 2012, NFV leverages cloud methodologies and technology to increase network service capabilities. At the SDN & OpenFlow World Congress later that same year, the group announced its goals: *to leverage standard IT virtualization technology to consolidate many network equipment types onto industry standard, high-volume servers, switches and storage.*

The NSF Industry Specifications Group (ISG) was formed under the auspices of the European Telecommunications Standards Institute (ETSI), an independent, not-for-profit, standardization organization. The group's goal has been to devise the requirements for an NFV platform that network operators can strategically adopt.

The NFV technical working groups are concentrating on three key areas:

- **NFV Use Cases:** These include service models and high-level use cases to be addressed by NFV
- **NFV Virtualization Requirements:** Key operational protocols for achieving NFV goals, broken down into specific domains, such as infrastructure and software architecture and security
- **End-to-end NFV Architecture:** The framework dividing the NFV work activities based on prototypes

The process of decoupling virtualized functions from the underlying hardware presents a range of management challenges. They require solutions that involve NFV mapping, instantiating virtualized network functions (VNFs), allocating/scaling resources to VNFs, as well as monitoring and support of physical/software resources. A key hurdle involves the integration of virtualized switches, appliances, and services with existing, legacy systems.

NFV development will ultimately involve a re-formulation of Operations Support System (OSS) functions, crucial to telecomm carriers. Some believe incorporating NFV with the current OSS will require creating unique links based on the specific characteristics of individual operators.

This has implications for standardization, an area that presents the biggest challenge for virtually deploying network technology. The purpose of the ETSI NFV ISGs is to specify NFV platform requirements that can eventually be adopted by diverse network operators. However, these networking companies have environments that span broad operational, regulatory and technology requirements.

NFV and Network Agility

The point of NFV is that almost any network function can be virtualized. Moreover, these functions can run on a commodity telecomm platform made up of dedicated proprietary hardware. In order to understand the mechanics behind NFV, it's important to understand NV, a related but wholly distinct concept.

Simply put, NV creates logical virtual segments in an existing network. It allows systems administrators to create a "tunnel" through the network to connect two discrete domains. NV enables IT to make routing and other network changes on top of existing hardware.

If NV provides the capability for creating virtual network tunnels, NFV offers the capability to apply services to that tunnel. When discussing network functionality, it's helpful to first understand the concept of layers. Seven Open Systems Interconnection (OSI) layers make up the network communication framework (L1-L7). These communication pathways enable hardware and applications to exchange information in order to function.

NFV is primarily concerned with layer 4-7 functions. These features consist of services, such as firewalls, IDPS, or application delivery controllers. Instead of manual provisioning, NFV enables administrators to build an abstraction on top of the network and then implement programmable functions in software on that specific logical environment.

Ultimately, NFV may offer the best approach for IT and administrators who want dynamic application network control, but don't want to change the way their sites are connected, how the networks are created or the service contracts that support them.

What NFV Offers Organizations

As mentioned previously, companies today are constrained by the limitations of traditional networking on proprietary hardware. Such a model, where one fixed-function appliance supports a specific application or service, is ineffective in the cloud era where dynamic applications and instant scalability are prevalent.

For these reasons, the combination of NV and NFV in the data center represents a powerful approach to deploying new network capabilities that can be easily built and disassembled as needed. Current levels of app portability and fast provisioning of VMs, for example, are reasons why such network agility is necessary.

The goal for NFV is to enable systems administrators to turn up specific functions, quickly build new networks and access dynamic network scaling to meet changing demand. Because NFV is based on cooperative element relationships and addresses, it reduces the complexity of creating new network services.

Reducing CapEx and OpEx

Adopting an NFV approach to dynamic network scaling will support organizational growth models by helping to eliminate overprovisioning. Proprietary network appliances that are customized and designed to meet only one network requirement risk redundancy as other services are added. NFV adoption would eliminate the need for purpose-built hardware, reducing CapEx in the process.

Moreover, adding instant scalability via NFV could help to alleviate costly implementations of new network services that have limited support functions. By removing the need to host networking equipment, companies can reduce or eliminate power expenditures as well as free up space within their physical infrastructure.

NFV implementation would simplify network provisioning and management, further reducing OpEx. It would allow hardware to be replaced less frequently, further increasing the return on investment (ROI). NFV could also eliminate costly overruns related to IT support thus enabling technical teams to manage other responsibilities.

While huge gains are possible, it's important not to understate the challenges. For example, decoupling NVFs from underlying hardware requires support for NFV service mapping, resource allocation/scaling, and monitoring VNFs, to name a few. As research continues through the ETSI NFV ISG, resources and attention are being developed to achieve solutions.

When it comes to telecom carriers and service providers, their burden is legacy infrastructures and expensive proprietary hardware. More nimble web companies, such as Google and Amazon, have networks that offer rapid response to changing demand from increasing numbers of mobile users.

It's interesting to note that as these newer companies created their cloud infrastructures, they were not burdened with having to replace preexisting, proprietary systems. Ultimately, a wide range of cloud service providers are pursuing some aspect of network virtualization to meet the growing need.

Accelerate Business Capabilities

The advantage of having NFV capabilities as they relate to business expansion is far reaching. For example, the ease with which NFV would enable network instantiations could significantly reduce the time required for new deployments. Such capabilities support changing business profiles and would make it easier for companies to react in volatile, changing markets.

Decreased network expense and faster response enables businesses to apply their resources elsewhere as they seek new market opportunities. Moreover, increased scalability potential and the ability to immediately turn up network functions offer improved capabilities across the business spectrum.

NFV is poised to transform networking infrastructures as they currently exist. According to research by Mind Commerce, global spending on NFV solutions will grow at a CAGR of 46% between 2014 and 2019. NFV revenues are projected to reach $1.3 billion by the end of 2019.

Similar to how the cloud has transformed the IT infrastructure, NFV along with Networking-as-a-Service (NaaS) and SDN, is set to change the traditional approach to networking. These new approaches can minimize the risk that comes with rolling out new services.

For example, the explosion in corporate mobile device use has brought with it new security concerns. Easier network deployments through NVF would enable IT to assign a V-Series™ appliance, such as a firewall or gateway, for more robust security functions, depending on the responsibilities of each new network.

Such increased network agility and flexibility within an organization would also enable dynamic scaling to meet changing demand, a key aspect of corporate mobility. As more data volumes (big data) and increasing amounts of traffic transition between external and internal infrastructures, NFV is set to enable companies to build, manage, and tear down networks as needed.

Significance of Industry Integration

General market projections for NFV adoption vary. But most analysts see significant gains in the next several years. While NFV is still a developing technology, like NaaS and SDN, many vendors and service provider deployments are already underway.

As the ETSI-backed ISG initiative suggests, major carriers have identified the importance of NFV to the future viability of new approaches to networking based in software. For service providers that support these efforts, NFV is anticipated to deliver significant gains in terms of revenue and reducing networking costs.

Some of the key major vendors who actively support NFV implementations include Alcatel-Lucent, Ericsson, Huawei, and Nokia. Related software developers and networking companies consist of F5 Networks, Juniper Networks, NEC, Opera Software, and Oracle, to name a few. What's significant is the fact that the networking industry recognizes that network operations need to evolve to sustain profitability.

In order to drive long-term network cost reductions and accelerate the speed of new services delivery, NSF along with NV, SDN, and NaaS represent the next stage of the evolution. These companies and network providers are motivated to adopt NFV due to the cost of purchasing and maintaining proprietary hardware that, in the end, achieve inefficient levels of network functionality.

Conclusion

As the NFV initiative continues, the gap between promises and realities remains significant. Many analysts believe the trend will require key support from C-level executives to succeed.

There's little doubt that NFV shows great potential. However, there are different perspectives on the viability of virtualizing networking and network functions. For example, while IT organizations see practical possibilities, engineering sees complexity and significant execution hurdles. In the meantime, research and development—backed by major telcos and equipment vendors—continues.

In terms of technological trends, once major players undertake adoption, the process gradually extends to more broad-based acceptance. Such might be the case for the NFV trend. As mentioned previously, NFV implementation would require a re-evaluation of the OSS layer as it pertains to all the major telcos and beyond.

Such changes could significantly impact networking redesign and architecture. As OSS modifications are adopted, they could be incorporated into the NFV management and orchestration layers. Ultimately, as trends such as big data, Bring Your Own Devices (BYOD), and multimedia streaming continue to grow and expand, they'll require ever more advanced, agile networks to transport increasing flows of information.

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Kerry Doyle (MA, MSr, CPL) writes for a diverse group of companies based in technology, business, and higher education. As an educator and former editor at PC/Computing, reporter for PCWeek magazine, and associate editor at www.ZDNet.com, he has written extensively on high-tech issues for over 15 years. He specializes in computing trends vital to SMBs and enterprises alike—from virtualization and cloud computing to disaster recovery and network storage.