Hewlett Packard Enterprise

Business white paper

Network innovation for CSPs

The four stages of network functions virtualization evolution

Table of contents

3 **Why CSPs must retool to become rapid innovators**

3 **NFV: Enabler for a virtualized, cloudified network**

4 **NFV: An evolution, not an endpoint**
5 Stage 1: Decoupling—more efficient operations
5 Stage 2: Virtualization—reduced infrastructure burdens
6 Stage 3: Cloudification—streamlined service delivery and faster scalability
6 Stage 4: Decomposition—more flexible building blocks

7 **Key considerations to help ensure successful NFV deployment**
7 Embrace open solutions
7 Pay attention to orchestration
7 Bridge new and existing resources

8 **NFV: A journey toward a more agile, efficient network**

8 **HPE: A portfolio of open, multi-vendor NFV solutions**

Network functions virtualization (NFV) holds the promise of helping communications service providers (CSPs) be more efficient—a tool to reduce capital expenditures and streamline operations. Although NFV is a great technology for increasing efficiency, its true purpose is enabling CSPs to innovate faster.

It's about driving innovation quickly and getting to a more open and flexible environment that lets the CSPs deliver new apps and services quickly.

Why CSPs must retool to become rapid innovators

We live in a "want it now" world where everyone wants and expects to be able to click and consume. This means anyone delivering a service to an end user needs to move from years to months, months to days, and then days to minutes in providing everything the customers demand.

Today it takes too long for CSPs to deliver new services to customers, or to adapt services already in motion to changing circumstances or demands. Think of online retail as the benchmark. If you want something from Amazon, you can order it in just minutes or seconds—in a point-and-click fashion.

Of course, it's not just about doing the same old things faster and more efficiently. We live in a society that has been conditioned to expect a steady stream of new and exciting innovations. People get bored quickly. Besides, while delivering core connectivity-oriented services to their customers more rapidly and efficiently, how do CSPs ensure they are not relegated to "plumbing provider" in the new market landscape?

For example, over-the-top (OTT) content providers are leveraging telco investments to deliver exciting audio, video, and media services to their customers at point-and-click speed. Therefore, failure to deliver new and innovative services quickly and efficiently is not an option.

NFV: Enabler for a virtualized, cloudified network

Leveraging the best technology available at the time, CSPs built great networks to deliver the capacity and reliability that made the Internet and mobile communications possible. But looking at those same networks today, rapid innovation requires moving away from closed, rigid, monolithic, purpose-built solutions to more open and flexible solutions built on a cloud paradigm.

Riding the wave of Moore's law, technology has advanced with unprecedented speed. With the maturation of enterprise information technologies such as virtualization and cloud, CSPs now have an opportunity to move to a more open, agile, and cloudified network model that will allow them to shift focus from network stability to service innovation.

This is what NFV is all about, and why CSPs themselves created the push for NFV. It's about driving innovation quickly and getting to a more open and flexible environment that lets the CSPs deliver new apps and services quickly.

NFV: An evolution, not an endpoint

Is NFV a single technological endpoint? The short answer is no. NFV is evolving in stages, with each stage driving more innovation and faster delivery of applications and services, while providing the technical foundation for subsequent stages.

It's also important to recognize that these stages are not a sequential adoption path. Customers beginning their NFV journey don't have to start at the first stage before proceeding to subsequent stages. Instead, these stages describe a progression of technology innovation. As new technology stages emerge and mature, CSPs have an expanded range of NFV capabilities to choose from—and they can jump ahead to the latest stage or choose to implement more mature capabilities associated with earlier stages.

Let's examine the four stages of NFV's evolution, where that evolution is today, how NFV will continue to evolve in the future, and the factors that ensure successful NFV deployment.

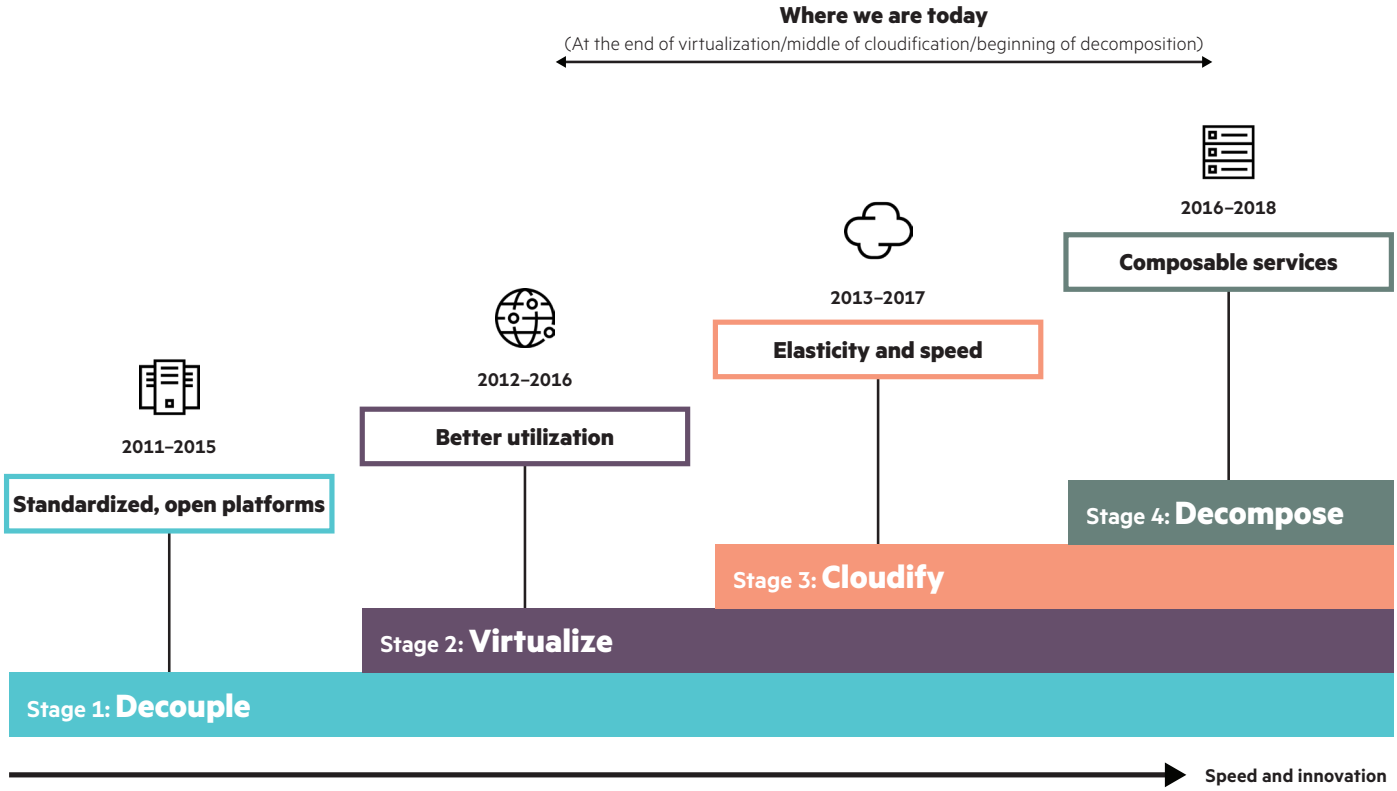

Figure 1: NFV: A journey toward a more agile, efficient network

Stage 1: Decoupling—more efficient operations

If we think back to how NFV emerged, the first stage was the decoupling of network functions from platforms. In this stage, network functions were separated from underlying hardware and deployed as software on standardized platforms. This freed CSPs from proprietary and closed solutions, making their networks more flexible. What's more, it reduced costs, complexity, and the CSPs could leverage market competition. As the initial stage of NFV matured, decoupling defined the advent of NFV back in 2011 and peaked as the primary deployment model in early 2015.

This fundamental step opened up many possibilities for flexibly deploying software-based functions. For instance, decoupling made it possible for CSPs to chain all sorts of specialized network functions in software—for example, implementing packet inspection to enable much more powerful parental controls services, which wouldn't have been cost-effective to implement by brute force using traditional appliances.

With decoupling, innovation comes from operations that are more efficient. Standardized platforms streamline maintenance and reduce management overhead. From an application perspective, development is no longer tied to the hardware. Rolling out a new app becomes a pure software development exercise, not a software-cum-platform development and deployment activity. This helps compress overall development cycles.

Virtualized functions change the economics of network service deployment.

Stage 2: Virtualization—reduced infrastructure burdens

Having decoupled network functions from underlying platforms, the second stage was the virtualization of infrastructure resources. Taking advantage of the fact that network functions have been decoupled from the underlying hardware, CSPs could use battle-tested virtualization technologies and deploy those functions on a hypervisor-driven, virtualized server infrastructure.

CSPs were able to achieve higher utilization and deployment densities as well as improved cost efficiencies and faster service delivery. This technology stage closely followed and was a natural extension of decoupling, which began in 2012–2013, started peaking in late 2015, and will continue to do so in the first half of 2016.

Virtualized functions change the economics of network service deployment. Going back to our parental controls service example—with virtualization as a tool, these types of computational-intensive services can be implemented cost-effectively. This is significantly cheaper than trying to do that in appliances because the CSP can get much higher utilization out of underlying (industry-standard) platforms.

With virtualization, innovation comes from reduced infrastructure burdens: lower overall costs, with higher utilizations translating to fewer overall systems in operation. From an application perspective, virtualization also allows developers to deploy new services faster because they don't need hardware dedicated to each app—deploy the hardware once, deploy the software (network functions) at will.

With cloudified network functions, innovation comes from radically streamlined service delivery and ability to scale environment very quickly.

Stage 3: Cloudification—streamlined service delivery and faster scalability

Building upon decoupling and virtualization, the third step is cloudification of the environment. In this stage, a wide area network is operated (controlled and orchestrated) as part of the CSP "cloud"—holistically aligned and consumed with compute and storage pools.

The result: Faster service delivery and a golden opportunity to develop new apps that are built for scale-out cloud deployment and to re-engineer existing apps to take advantage of cloud scalability. This ability to scale the environment easily as needs change translates to much better elasticity and the improved agility that comes with a cloud consumption model. Some CSPs began implementing cloud-enabled network functions in 2013–2014 and trends point to "cloudification" peaking late this year (2016) and into 2017.

What sets cloudified network functions apart is that they give CSPs a cost-effective way to support new, vertical-specific use cases such as the Internet of Things (IoT). Cloudified network applications will allow CSPs to support cost-effective services such as home automation.

With cloudified network functions, innovation comes from radically streamlined service delivery and ability to scale environment very quickly. From an application perspective, this allows new services to be developed and upgraded in a DevOps/Continuous Integration (CI) development model and is deployed in a more agile and elastic fashion.

NFV has allowed CSPs to think about deploying network function software and function platform hardware as separate purchase and deployment decisions.

Stage 4: Decomposition—more flexible building blocks

In the fourth and final stage in NFV's evolution, the network functions that were carried through previous stages mostly intact and unaltered are refactored. Specifically, CSPs decompose those network functions into more elemental building blocks. Think of them as sub-functions. CSPs then "recompose" these more granular sub-functions as network "services" and even integrate some of those sub-functions into the underlying resource pools where that makes sense.

What's the point of breaking down the functions, only to build them back up again? With this transformation, core services—commonly used sub-functions used across a range of network functions—don't have to be built into every network function software stack. Instead, the CSP can aggregate core sub-functions in pools and manage them selectively. More importantly, developers have much more options on how applications are built since the building block components are available in a finer-grain fashion.

In decomposition, innovation comes from building blocks that are more flexible. They provide great application and service innovation and radically improve scalability. Now, applications can be composed in a point-and-click fashion, enabling new applications that weren't possible with existing monolithic network function designs. Some CSPs are beginning to refactor network functions now, and these approaches will peak in late 2017 to early 2018.

To illustrate the value of decomposed network functions further, let's take a closer look at the opportunities this approach provides. As functions are decomposed, some of the sub-functions can be pushed closer to the edge of the network to do things that aren't possible in a more centralized model.

Consider collision-avoidance in self-driving cars. In that scenario, the intelligence to coordinate avoidance actions must reside as close to the cars as possible so that the avoidance software to instruct the self-driving cars to react fast enough to avoid a crash. Decomposition precisely enables the required functions to be embedded in the cars themselves so they can interact with each other more quickly and prevent the collision.

Generally, when network functions are decomposed, CSPs get dramatically enhanced capacity and flexibility to deliver new, innovative, and adaptive apps and services quickly. Foundational functions can be embedded into the underlying platforms, and new applications and services can be composed much more quickly.

Key considerations to help ensure successful NFV deployment

With NFV technology providing a great set of core tools to enhance network agility and innovation, here are a set of considerations that CSPs should have in mind as they go about implementing NFV solutions:

Embrace open solutions
NFV has allowed CSPs to think about deploying network function software and function platform hardware as separate purchase and deployment decisions. With this flexibility comes the need to ensure that the assorted functions, platforms, and related management tools work together. In that context, it's important for CSPs to deploy network functions and associated management tools that include standards-based interfaces so that they can be easily mixed and matched in a diverse implementation.

CSP support and involvement in the industry and customer bodies that drive these standards goes a long way toward helping the market move in this direction. Building on a robust set of open standards and a vibrant ecosystem of network function, independent software vendors can flourish, driving innovation and choice for CSPs.

Pay attention to orchestration
The NFV-specific orchestration is a new capability that must be in place to operationalize NFV and realize its benefits successfully. Without orchestration capabilities to drive the more dynamic operating model that NFV makes possible, the efficiency and agility benefits of network virtualization will go unrealized.

Bridge new and existing resources
Very few NFV projects will be green-field deployments. This means that most end-user services will ultimately rely on a combination of new NFV-based functions and traditional appliance-based network functions. Even if NFV implementations are well matched with NFV orchestration tools, only incremental benefits are gained if improvements aren't made to how existing, appliance-based network functions are managed.

To achieve the goal of improving overall service creation and delivery, CSPs should strive to harmonize and unify orchestration and implement new, end-to-end hybrid tools that bridge NFV and existing functions and resources. In this way, service delivery that relies on both virtual and existing resources can be accelerated to "virtual" speed.

Building on a robust set of open standards and a vibrant ecosystem of network function, independent software vendors can flourish, driving innovation and choice for CSPs.

NFV: A journey toward a more agile, efficient network

Like other technologies that have matured over time, NFV is not a single solution at a point in time. With each stage in NFV's evolution bringing more flexibility and speed to the network, CSPs will have better tools to help them quickly develop and deliver innovative applications and services.

HPE: A portfolio of open, multi-vendor NFV solutions

Hewlett Packard Enterprise approach to NFV is a multi-faceted program called OpenNFV. It consists of high performance, carrier grade NFV Infrastructure and end to end service orchestration products and solutions , a rich ecosystem of VNF vendors that include the traditional NEPs and innovative ISVs, a reference architecture to build multi-vendor solutions and a network of global labs to test and validate these solutions for a faster deployment. The HPE OpenNFV program helps CSPs confidently and quickly deploy NFV solutions and adapt those solutions as NFV technology matures. By embracing an open solutions approach, and bridging new virtualized and existing physical network deployments in a comprehensive orchestration and management framework, CSPs can enjoy the benefits of NFV now as they evolve their network environments over time.

Learn more at
hpe.com/dsp/infrastructure

Sign up for updates

Hewlett Packard Enterprise

4AA6-6179ENN, April 2017, Rev. 1