Enabling the Potential of Network Functions Virtualization

Addressing Architectural and Organizational Change

TECHNICAL WHITE PAPER

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Enabling the Potential of NFV

Introduction

The telecommunications industry as a whole has suffered many years of declining profitability and has already taken many incremental cost-cutting measures in an attempt to maintain margins against increasing price erosion of core services. Communications Service Providers (CSPs) are now looking towards Network Functions Virtualization (NFV) as a means to transform to a new and sustainable business model based on radically lowering costs and increasing the speed of innovation. The potential benefits of NFV are enormous, but to be successful the CSP will need to manage both a technical and organizational transformation.

Based on many years experience helping customers transfer monolithic IT service silos into virtualized, cloud-based models, VMware has built a depth of knowledge of both the technical and operational aspects of such transformation.

This paper discusses the role of the virtualization layer in achieving the benefits of NFV, the potential pitfalls of architecture transformation and the new operational model necessary for a successful NFV deployment.

The Role of the Virtualization Layer

NFV benefits are achieved through the transformation of the communications infrastructure from silos of monolithic and proprietary hardware service platforms to one in which services are run as applications, abstracted from their proprietary systems, running over an open and commodity compute, storage and network infrastructure.

While the abstraction of the proprietary service features and applications is a mandatory step, it is the manner in which the virtualized infrastructure platform is deployed, together with how the services are architected to take advantage of it that will determine the success or failure of any given NFV deployment.

The virtualization platform is fundamental to the NFV concept and its benefits. These benefits fall into two main categories of cost saving and open innovation:

- Cost savings will address the bottom line and give some short term margin relief but in themselves will not break the cycle of reducing margins.
- Open innovation is required to enable CSPs to differentiate and deliver end customer value. Thus increasing service revenue on the top line.

It is the combination of sustainable top line growth and bottom line savings that will transform the profitability of the CSP.

Cost Savings

Cost savings are delivered in the form of capital and operational savings. Each is discussed below.

Capital Savings

Capital costs are reduced in two ways. The first is the specification of commodity hardware for compute, storage and networking that replaces traditionally expensive and proprietary platforms from the network equipment providers (NEPs). The second and sometimes overlooked capital saving comes from the efficient use of that commodity infrastructure across a wide range of services (and hence service vendors) such as Voice over LTE (VoLTE), virtual private network (VPN) services, virtualized Customer Premise Equipment (vCPE) solutions and so on. This ability to 'under-provision' individual services on the basis of providing access to a common pool of spare resources (capacity) for peak load is possibly the greatest opportunity for capital cost savings and requires a virtualization platform that is common to all higher-level application and service vendors.

Operational Savings

Operational savings similarly derive from two sources. One is a new operational model that allows the telecoms provider to manage the creation, provisioning and tear down of services spanning multiple vendors quickly using an agile and flexible environment. The other is the reduced support costs that stem from a virtualized commodity infrastructure that is common to all services. For example, in a virtualized environment it should not be necessary for a 4-hour response-to-site hardware support contract. Hardware failures should be

managed by the automated migration of workloads to maintain service redundancy and rectified through routine hardware maintenance processes. The virtualization platform is the key component to achieving these operational benefits and delivers the flexibility required through a depth and breadth of integrated platform features available to all higher-level services.

Open Innovation

While cost savings provide some short-term relief to decreasing margins and considerable benefit longer term, it is the ability to differentiate independently of the equipment vendors and under direct CSP control that will drive end customer value and determine the sustainability of the telecommunications industry. A key motivation behind NFV therefore is to shift the balance of power into the hands of the CSP.

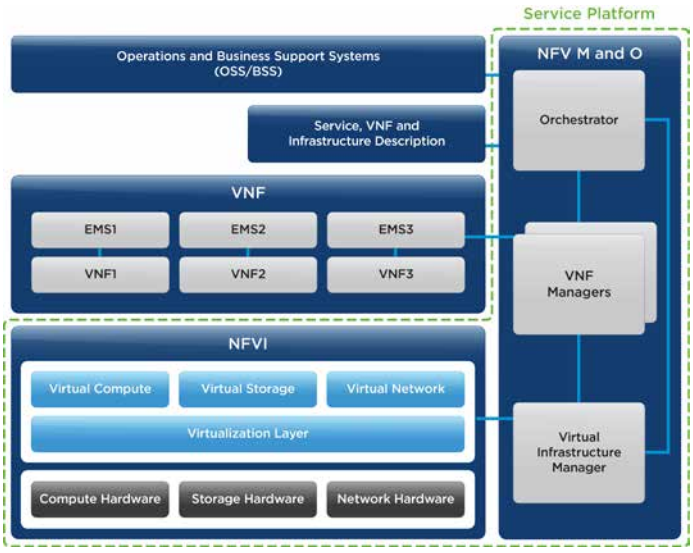
An open innovation environment contrasts with the situation today where much of the balance of power over service roadmaps, time to market and service innovation is in the hands of the NEPs and the application vendors. With open innovation, services will be capable of being conceived and brought to market very quickly. And removed equally quickly should they not be deemed successful. To achieve this shift the virtualization platform must be deployed across multiple services (multi-tenant) and under the control of the CSP. Vendors must compete to be deployed on the CSP platform.

Making Architectural Change

As stated previously, while the abstraction of network services from proprietary hardware is a pre-requisite for NFV, it is a well architected software architecture running on a well architected virtualization platform that will determine success or failure. Within this, how the virtualization layer is deployed, its capabilities and how it is exposed to and operated by the CSP is critical

The virtualization layer establishes the multi-tenant service environment. It provides the underlying capabilities of resource and workload management that combine with higher level applications to deliver carrier grade end user services and open innovation. It is therefore necessary to clearly understand the virtualization 'blueprint' of the new service infrastructure applied across multiple services before embarking on any one service migration.

It is typical to refer to the architectural framework under development within the European Telecommunications Standards Institute (ETSI) as the basis of NFV discussion. Figure 1 represents this framework with the elements that constitute the 'service platform' highlighted.



Key to Figure 1.

NFVI: NFV Infrastructure consisting of the physical shared hardware and virtualization software platform (shown in light blue).

VNF: Virtual Network Function. Service functions running as applications over the common infrastructure and associated Element Management System (EMS).

OSS/BSS: Traditional Operational and Business Support Systems.

NFV MANO: NFV Management and Operations functions governing service orchestration, automation and administration.

Avoiding Common Pitfalls

Transforming an infrastructure away from a monolithic approach to a cloud-based delivery requires careful planning and is a significant undertaking.

Figure 2 illustrates a commonly considered architectural approach referred to as Scenario 1.

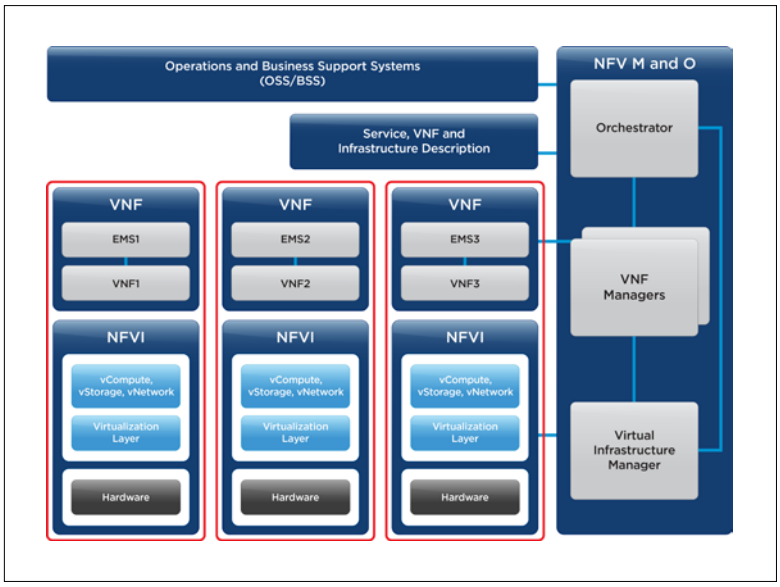


Figure 2: Scenario 1 - Fragmented Service Silos are not a step towards the benefits of NFV

In scenario 1 the service functions have been abstracted by the vendor to run over commodity software and hardware. Each service or set of vendor functions has been pre-packaged into a vertical software stack incorporating the virtualization layer as an embedded capability within the stack.

This approach does not deliver the intended benefits of NFV but it is easy to understand how such a solution can be mistaken as a 'good first step' based on the perceived benefits.

Perceived Benefits of Scenario 1

- By confining the discussion to discrete services it is often manageable within a single service or portfolio group of the CSP. This simplifies the process of technical and financial decision making.
- Such solutions are often proposed by existing suppliers looking to respond to the CSP's request for services abstraction but faced with the implementation and support challenges that would come from on-boarding onto a 3rd-party platform. By creating a vertical stack and delivering this as a 'product', the NEP can retain greater control of the solution and easily include a deployment, operations and support services wrapper.
- Such implementations can be managed through a single supplier/integrator relationship and delivered in a pre-tested configuration, thus simplifying project management and acceptance testing.
- The support implications of such a deployment are minimal as the service is still a silo and can be managed within the existing operational model.

However, this approach will deliver little if any short-term benefits and does not represent progress towards a full NFV multi-service deployment. Limitations of this approach are as follows:

Disadvantages of Scenario 1

- Capital savings are limited and magnified over time by an inability to over-provision services. Peak load capacity must be provisioned per-service silo.
- Operational support savings are limited or not realized due to a failure to leverage cloud service support models that leverage a common infrastructure team.
- Open innovation is restricted resulting in no appreciable reduction in time to market or differentiation of new services.
- Investments in service deployments that do not ultimately conform to the final integrated application/ platform blueprint will be wasted.

- Vendors remain in control of service roadmaps with feature sets remaining embedded within service silos.
- Market position may be lost due to delayed introduction of a true multi-vendor service platform.

As demonstrated above, scenario 1 may appear attractive at first but focusing on the abstraction of services as a first step replicates the complexities of silo-based services in a software form. If multiple service silos are created in this manner then investment could be wasted and significant additional complexity added when the final transformation to a true horizontal architecture takes place.

Furthermore, the power of the virtualization layer is hidden within the software stacks and not fully exposed to the CSP. As a result the CSP cannot begin to use the virtualization platform to achieve the cost and innovation benefits of a multi-vendor service platform and the control of service roadmaps remains largely with the vendor of the stack(s).

Getting it Right

To achieve the benefits of NFV CSPs must deploy a multi-vendor, horizontal virtualization platform from day one. Services can then be on-boarded to this single platform in a phased manner to allow a manageable transition. In this way a common pool of resources (compute, storage and networking) is made available to all services as shown in Scenario 2, Figure 3.

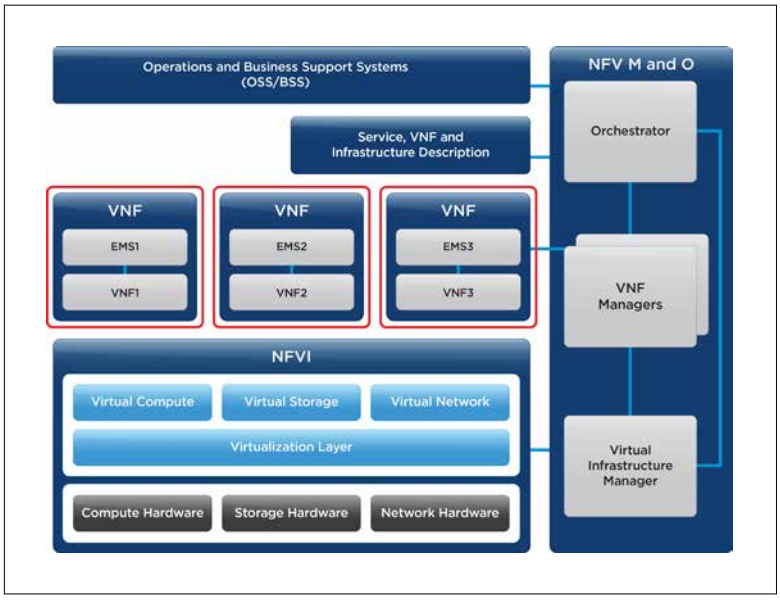


Figure 3: Scenario 2 - A Horizontal Virtualization Blueprint allows on-boarding of multi-vendor services

In scenario 2 the full potential of NFV can be realized.

- Capital savings are maximized through the deployment of commodity hardware with no over-provisioning required (all services access a common pool of spare capacity).
- Operational savings can be achieved using a cloud-based operational model and the flexible deployment of multi-vendor services—reducing time to market and increasing service agility.
- Further operational savings can be realized through the replacement of per-vendor hardware support contracts with routine maintenance schedules.
- Open innovation is possible through rapid onboarding and service chaining of new service functions through a common, multi-vendor virtualized platform.
- The CSP have total control of the platform with vendors integrating to the platform rather than CSPs implementing vendor-based service silos.

In scenario 2 the complexities, limitations and costs associated with service silos, whether they be physical or software based, are eliminated and the CSP can focus on the development of profitable, differentiated service.

However, the implications of scenario 2 do not come without significant challenges that must be overcome. These include:

- The need to implement a service blueprint across multiple services (and hence across organizational and budget boundaries).
- The need to transform and up-skill the operational support organization to operate a tenant/service platform in place of project-based segmented services.

VMware has developed expertise in guiding customers through these challenges. In addition to delivering technology, VMware have developed an organizational transformation practice that supports customers' transitioning their support model. Although a new method of providing operational support does require an acceptance of change, the exposure of the virtualization layer to the CSP operations team also represents significant and exciting opportunities for the business and for individuals. The next section discusses the operational changes required to support a cloud based service infrastructure.

Making Organizational Change

Some of the most significant challenges facing CSPs looking to deploy NFV service infrastructures are not within the area of the technology itself. They are in the areas of operational process and organization.

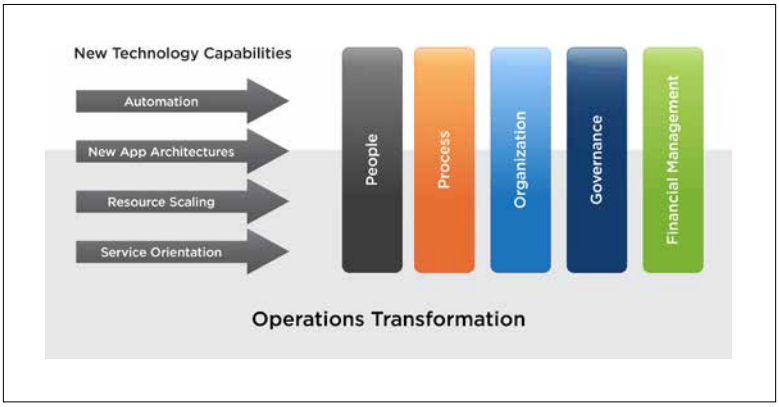


Figure 4: People and Process-Related change - Technology Drives Transformation

The characteristics of traditional enterprise IT compared with IT in the cloud is shown in Figure 5. We can see that there are striking similarities to that of the CSP deploying a virtualized communications infrastructure. Traditional CSP service deployments, like traditional IT, are project based and run on dedicated hardware. IT in the Cloud however is service driven using a shared infrastructure and automated processes

It follows therefore that in order to address the needs of NFV the principles of cloud-based IT operation can be used as a point of reference.

TRADITIONAL IT	IT IN THE CLOUD
Project-driven	Service-driven
Focus on servicing and maintaining technology in non-standard, non-shared environments	Focus on developing and delivering services while efficiently operating share environments
Operational functional domains overlaying siloed infrastructure domain with little interation	Ecosystem including Cloud Operation Center of Excellence (COE) and Clout Tenant Operation capabilities
Perdominately manual activites	High degree of automation
General purpose NOC	NOC with Cloud SMEs for tier 2 support
Administrator-level heavy	Administrator light; more focus on high value innovation

Figure 5: CSPs can leverage Operational Models and Transformation Services developed for Enterprise IT (Taken from VMware white paper 'Organizing for the Cloud')

Such process and organizational transformation is a considerable undertaking. But for forward thinking CTOs and operations staff it represents an opportunity to directly influence the short and long term success of NFV projects and the overall business strategy. Operations teams will evolve and grow to accommodate new skills, new ways of working and new areas of responsibility, as well as retaining traditional service and technology expertise.

A discussion of process change is beyond the scope of this paper. The remainder of this paper will consider aspects of organizational change.

What Drives Organizational Change?

Traditional communication services have been designed, implemented and operated as discrete projects. Vertical service silos have driven the creation of vertical support models with operations teams dedicated to specific services.

The move to a virtualized infrastructure is predicated on a service-orientated approach to infrastructure delivery. A common service platform is created where many applications (VNFs) can be deployed. This creates the need to change how operations teams are organized. An organizational structure is required that abstracts the creation, maintenance and ongoing management of the infrastructure platform from the higher level VNF services or 'tenants' that are deployed upon it. It is this separation of VNF applications from the underlying infrastructure that supports them that drives the need for organizational change.

The platform must deliver agreed service levels in the form of service level agreements (SLAs) to the VNFs. VNF owners become customers of the platform and require an organizational interface through which they can negotiate and contract to infrastructure services.

Figure 6 shows a standard model that has been developed to accommodate this change from monolithic application delivery to infrastructure-as-a-service operation in enterprise IT environments.

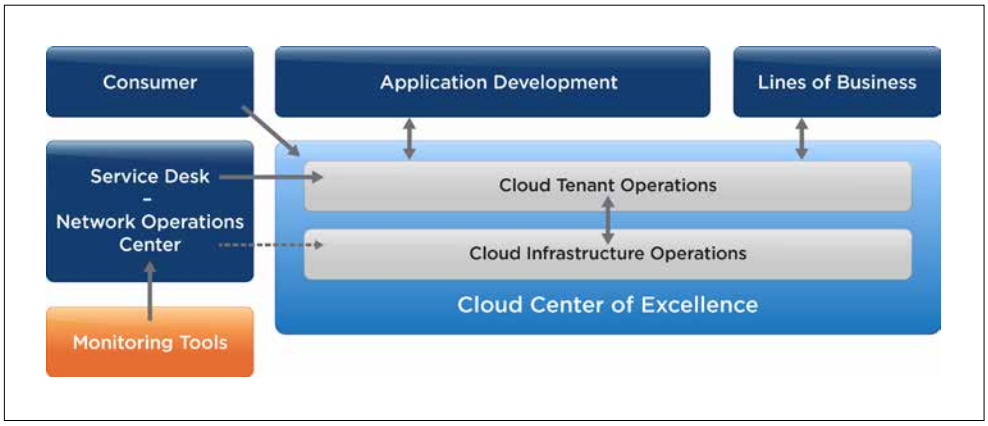


Figure 6: The Standards Cloud IT Operating Model

In the above model a Cloud Operating Center of Excellence (COE) has been created to bring together the core skills required to support the virtualization platform. The Cloud Operating COE is responsible for the operation, maintenance and ongoing evolution of the virtualized platform.

The Cloud Operating COE is sub-divided into Tenant and Infrastructure operations. The primary technical expertise (administrators, architects etc) reside within the Infrastructure team and act as the technical authority for all aspects of the infrastructure. The tenant operations team act as the business interface to other parts of the CSP and partner organizations and coordinate the on-boarding of VNFs. This includes the service level agreement contract for the VNF, reporting and the interface to the development team.

Other functions continue to exist including the Network Operations Center and Service Desk. These functions interface to the new Cloud Operation COE and as well as other traditional operational functions that are likely to exist in parallel for a significant time.

Applying the New Operating Model

Figure 7 shows how the standard operating model may be adopted to support an NFV deployment.

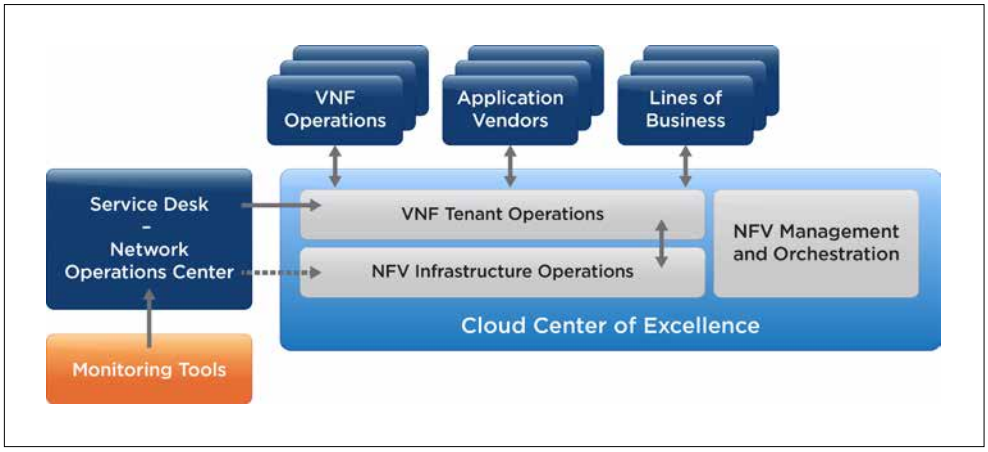


Figure 7: Cloud Operating Model Adjusted for NFV Platform Operations

In this model, the virtual network functions (VNFs) take the place of generic applications and these functions become the subject of the SLAs to be delivered by the platform. The VNF Tenant Operations function negotiates the SLA requirement with the higher-level service owners, shown in the figure as VNF Operations. VNF Operations may be internal to the CSP or a vendor acting on behalf of the CSP. In this process, the tenant operations team will call on the infrastructure operations team for technical support in identifying existing capabilities, designing new capabilities or adding capacity to support new services and service expansion.

The VNF Tenant Operations team will also interface to CSP lines of business and applications vendors to coordinate new service innovation or traditional service migration.

It is critical to establish such an operational model and define roles and responsibilities in order to facilitate the timely on-boarding of multiple VNFs to the platform. It is this Cloud Operations COE that delivers to the CSP the control of the platform and hence enables the cost efficiencies and service innovation inherent within virtualized deployments.

Getting Started

As stated earlier, the transformation of the operational model is a significant step for CSPs and critical to the success of NFV deployments. Below are some suggested strategies and key activities that can be used to assist in planning a roll out of a new operations model.

Executive Sponsorship

As with architectural change, organizational change will impact multiple services and operations teams and will require executive sponsorship to enable implementation. It is important that the leadership team(s) understand the strategic importance of the changes based on the concepts and benefits of virtualized infrastructures.

Mindset shift - view your infrastructure holistically.

No single service deployment will generate a successful business outcome on its own. A range of suitable services should be identified and embraced within a single NFV project and infrastructure development should be conducted that will satisfy all these services as well as allow for the inclusion of as-yet unidentified services. Focusing on a single service on the basis that 'any virtualization is good' is likely to lead to the deployment of inflexible service silos.

Make a distinction between the platform and the application.

A failure to make this distinction can lead to the development of fragmented clouds or service silos. The platform should be built and ready before VNF on-boarding begins. This is likely to require some new approaches to service integration and operation.

Set Expectations for On-boarding

Onboarding of VNFs will be a huge challenge at first. It is worth considering the creation of a specialist team within the Cloud Operations COE to focus solely on on-boarding. On-boarding will become faster over time—expectations should be managed for the first VNFs to be on-boarded as details are worked out and teams become familiar with the processes.

Consider an Operational Readiness Assessment as an initial step.

A formal operational readiness assessment is a good way to document current and desired organization and processes. A readiness assessment will allow the management team to identify actionable activities and define outcomes, and enable the organization to track progress towards a successful implementation.

Putting it all together

Through a combination of careful architectural and organizational planning, and with a focus on the virtualized infrastructure as a multi-vendor platform for the on-boarding of a range of VNFs, CSPs can leverage the benefits of Network Functions Virtualization and return to a profitable and sustainable business model.

To find out how VMware can help your organization succeed, please contact your VMware representative.

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