# Network Functions Virtualization (NFV): A Study for the Implementation of NFV in Almadar Aljadid

Author's name
Esra AbdulMajed Aljubrani

Abstract – Telecom operators have to consider various hampering factors when launching a new service. These range from finding the physical space and skilled personnel to impeding costs. A solution to some of these challenges lies in Network Functions Virtualization (NFV). Results of a study for Almadar Aljadid clearly shows the vast benefits that can be achieved in employing this new technology. By running different network functions and processes on top of standard high-volume servers and switches, NFV eliminates most of the obstacles clearing the way a step further in telecommunication.

## I. INTRODUCTION

Today's telecom networks are primarily built using specialized, often proprietary, equipment. (In the telecom industry, proprietary often means a technology or solution that is owned by a single company.) Some examples of typical telecom equipment are routers, switches, base stations, firewalls, voice gateways, and IMS and Mobile Packet Core. These types of equipment are typically monolithic in design; that is, they consist of hardware, software, and associated management systems. This type of architecture often leads to silos of operations, vendor lock-in, and the inability to respond to changing demands in an agile way.

NFV redefines the way typical network functions are delivered and operated in a CSP network. Using standard IT virtualization and cloud technologies, NFV defines an architecture where the network functions and applications are implemented as software-only entities and are designed to be independent of the hardware. These software entities use standard off-the-shelf compute and storage elements as the hardware platform.

This new architecture provides CSPs with an open platform on which innovative software functions and applications from a diverse vendor ecosystem can be implemented. NFV provides a way for CSPs to increase their service and business agility and provide innovative services to their customer base. NFV also helps CSPs optimize resource usage and thus reduce both capital and operating expenses. NFV Business Goals NFV is a radical shift in the design and use of telecom infrastructure and will no doubt have a significant impact on the way services are offered by CSPs and the way consumers experience these services.

## II. GREATER BUSINESS AGILITY

The ability to offer new services to cater to changing consumer demands, rapidly scale applications up or down, and move applications in the network as desired (for example, closer to the customer, centralized, or distributed).

### A. New opportunities and more innovation

Innovative new business opportunities are possible with virtualization technologies and a platform that can host applications developed in a collaborative ecosystem.

NFV encourages innovation by enabling CSPs to adopt a fast fail approach to introduction of new services. Since the cost and effort in introducing and rolling out new services is much lower, new services that were considered too risky to try out can now be experimented with in a controlled manner.

### B. Faster time-to-market

Rapidly introduce new services by reducing the time it takes to deploy and validate new software applications (from months to minutes).

### C. Improved business processes

Virtualization enables applications to be decoupled from their underlying infrastructure. This creates opportunities for automation and business process management re-engineering initiatives [3].

### D. Optimized OPEX:

Dedicated telco hardware requires specialized skills to support and maintain. Virtualization on industry-standard platforms that are more readily supported by IT personnel helps to reduce operating expenses. The higher level of automation

enabled by NFV also reduces the amount of manual effort required in configuration and service creation and consequently reduces the operating expenses.

E. Lower CAPEX:

Moving from dedicated telco appliances sized for peak demand to virtualization on industry-standard IT infrastructure enables better capacity utilization and on-demand scalability, which helps to eliminate or delay further investments in expensive, specialize infrastructure.

These benefits will provide CSPs with a unique opportunity to be more efficient by leveraging virtualization to improve their operational capabilities from end-to-end.

## III. NFV Challenges

Although NFV offers many benefits for service providers, it will impact future organizations and create challenges for operations and operations support systems (OSS). Unless addressed appropriately, these challenges can impact a successful transformation. They can be classified into three categories: Infrastructure, Operations and Services.

### A. Infrastructure challenges:

The infrastructure challenges with NFV transformation come from the introduction of new types of components in the network, originating from the IT world and based on industry- standard platforms. These components need to provide telco-grade availability and high performance, and meet the stringent SLAs that are typical in the CSP world [6].

Additionally, there is large installed base of legacy telco equipment. Although much of this current infrastructure will eventually be replaced by virtualized entities, either through an NFV transformation initiative or normal lifecycle management, a hybrid environment will always exist. Virtualization of certain telco equipment won't necessarily be feasible or desirable in every deployment situation.

### B. Operations challenges:

A significant operational challenge of the NFV transformation is how to maintain the customer and services views that are tied to the underlying infrastructure. This requires integration within existing OSS/business support systems (BSS) environments and end-to-end automation to enable agility and faster service velocity [7].

NFV, by decoupling functions from the infrastructure, warrants new procedures for testing/validation/acceptance and troubleshooting. Purchasing and planning processes and competencies also need to change to be more oriented to the way the IT domain works.

Another important operational challenge is to manage operations costs while deploying NFV. Factors contributing to this challenge include the following:

**1-** Complexity associated with managing a hybrid environment of virtualized and legacy equipment.

**2-** Complexity of managing functions implemented by a distributed set of software entities

NFV creates an elastic relationship between services and resources that makes SLAs and problem resolution more difficult.

Other operational challenges that exist include the need to restructure organizations and retool organizational competencies to be able to work in an IT environment.

### C. Service challenges:

The transformation to NFV (and SDN) will eventually create a CSP infrastructure that is programmable in real-time and highly automated. In order to take full advantage of the investments in the infrastructure, CSPs will have to revamp the way they offer services to their customers. The existing models of a fixed number of service offerings that are ordered from a catalog and need time to be deployed will have to be transformed into a model that allows customers to have self-care portals from which they will be able to personalize their service offers. This transformation to a personalized, on-demand service delivery will require changes in the way services are created and billed. The "catalog" of services that can be offered to a customer will need to be dynamic and policy based. The challenges in

the service domain will mainly be in the area of managing a dynamic service offering and its integration to the underlying infrastructure and real-time analytics [7].

## IV. Software Defined Networking (SDN)

Software defined networking is the latest revolution in networking innovations. All components of the networking industry, including network equipment vendors, Internet service providers, cloud service providers, and users, are working on or looking forward to various aspects of SDN. This section provides an overview of SDN.

### A. SDN Consists of Four Innovations

1. Separation of the control and data planes.
2. Centralization of the control plane.
3. Programmability of the control plane.
4. Standardization of application programming interfaces (APIs).

Relationship with Software Defined Networks

As shown in (Figure), Network Functions Virtualization is highly complementary to Software Defined Networking (SDN), but not dependent on it (or vice-versa). Network Functions Virtualization can be implemented without a SDN being required, although the two concepts and solutions can be combined and potentially greater value accrued.

Network Functions Virtualization is able to support SDN by providing the infrastructure upon which the SDN software can be run. Furthermore, Network Functions Virtualization aligns closely with the SDN objectives to organizations progressing work on SDN such as the Open Networking use commodity servers and switches [7] .

Network Function Virtualization Relationship with SDN.

## V. ETSI NFV Framework

The European Telecommunications Standards Institute (ETSI) is a recognized regional standards body made up of CSPs working together to define frameworks for solutions used in their networks. These standards and frameworks are used as a base by vendors when creating their offerings, ensuring that they are addressing the carriers' requirements.

The ETSI NFV Industry Specification Group (ISG) has defined a high-level functional architectural framework for NFV.

The ETSI NFV framework consists of three major components:

### A. Network Functions Virtualization Infrastructure (NFVI):

A subsystem that consists of all the hardware (servers, storage, and networking) and software components on which Virtual Network Functions (VNFs) are deployed. This includes the compute, storage, and networking resources, and the associated virtualization layer (hypervisor) [7] .

### B. Management and Orchestration (MANO):

A subsystem that includes the Network Functions Virtualization Orchestrator (NFVO), the virtualized infrastructure manager (VIM), and the Virtual Network Functions Manager (VNFM) .

### C. Virtual Network Functions (VNFs):

VNFs are the software implementation of network functions that are instantiated as one or more virtual machines (VMs) on the NFVI.

The NFV framework proposes virtualized, software-only entities referred to as VNFs running on virtual assets created by a virtualization layer from a pooled set of physical hardware resources that comprise the NFVI.

NFV Management and Orchestration (MANO) provides orchestration and lifecycle management of the virtualized software resources of the NFVI and the VNFs, as well as any virtualization-specific management tasks in the NFV framework.

## VI. Conclusion

Network Functions Virtualization (NFV) will bring cost efficiencies, time-to-market improvements, and innovation to the telecommunication industry infrastructure and applications. In addition, NFV could potentially offer many other benefits including, but not limited to: Availability of network, optimizing network configuration, improved operational efficiency, and reduced energy consumption by exploiting power management features in standard servers and storage, as well as workload consolidation and location optimization.

To reap these benefits, the technical challenges like security, performance, network stability, integration, and management and orchestration must be addressed by both the mobile operators and VNF vendors.

NFV as a platform consists of main components as defined by ETSI which include NFVI, MANO. The NFV interfaces and reference points tightly integrate those components together to enable seamless integrations of different VNFs from different vendors to run on different hardware on different hypervisors in different locations and datacenters.

The survey in this research proves that for a classical network mobile operator (NMO) like Almadar Aljadid, which the survey fielded at, to be transformed to a digital service provider, they must re-architect their network infrastructure in a way that enables the operator to enhance service agility and cost reduction. This clearly can be achieved by utilizing state of the art technologies such as NFV and SDN.

This research makes it very clear that the future "telecommunications cloud" will be based largely on industry standard IT cloud technologies, while these technologies will themselves evolve to support the requirements of telecommunications networks.

Future researches are also very important for overall and long-term success. In order to raise awareness around NFV, research a number of NFV related topics may include: Service chaining algorithms, NFV orchestration algorithms, Abstractions for carrier-grade networks and services, (optimization, scheduling, portability, reliability), Security of NFV Infrastructure, and Energy-efficient NFV architectures.

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