Service Provider Considerations for SDN & NFV – The SI Perspective

Ninad Jadhav | Raj Sahakari

Naveen Sharma

Network Technology Services and Solutions
Tech Mahindra Ltd.
1. Introduction

The Telecommunications industry is witnessing unprecedented growth and challenges today. There has been a proliferation of ‘smart’ devices [e.g. smart phones, tablets] and this has resulted in multi-fold increase in data traffic across the world. The content consumption trends have changed drastically, with video content consumption on the rise. Consumers are looking for services anytime and anywhere. Customer expectations (low latency, high data rates, etc.) are rising. Enterprises are going ‘Digital’ and seeking services on-demand. Machine to machine communications is giving rise to new services & applications such as smart metering, eHealth, industrial internet etc. Telcos themselves are seeking to harness the power of convergence of network and IT capabilities and drive services and operational efficiency via utilizing interfaces (APIs) to their network and IT systems. Telcos are trying to modernize their legacy networks. For e.g. there has been a push for migrating the legacy TDM networks to all-IP networks. Competition has intensified and operators need to enhance customer experience and provide innovative services to retain and grow their markets.

Software Defined Network (SDN) and Network Functions Virtualization (NFV) are two key transformational technology paradigms that will help service providers to evolve their static networks into dynamic and agile networks. This paper provides an overview of the SDN & NFV landscape, how
these technologies are likely to enable operators to meet their challenges and the opportunities they create. The paper further comments on the benefits of adopting these technologies and role of a system integrator in making this happen.

2. Transformation Drivers

Operators have been stuck in the legacy Telco stack for quite some time. The complexities of the network pose challenges in provisioning existing services as well as rolling out new services. Provisioning cycles are long and lack automation. There is a heavy dependency on the vendors for delivering advanced services and operators get locked-in to their chosen vendors. Operators need to transform their environment into more flexible, agile and open environments. SDN & NFV are slated to make this happen.

SDN and NFV are expected to drive a sea change in the way networks are designed and operated. Some of key aspects in which the SDN / NFV driven network environments would differ from the existing environments are mentioned below.

![Figure 1 - Key Drivers for SDN and NFV](image-url)

Legacy networks depend on variety of proprietary hardware appliances. These in turn require considerations such as space and power. Launching new services in such a scenario only leads to increase in costs on account of energy, capital investment, support for proprietary equipment, etc.
These aspects make the maintenance of the networks difficult. Besides, specialized skilled task force is required to maintain this equipment. Hardware-based appliances rapidly reach end of life, causing the need for replacement of these appliances without any revenue benefit. Operators perceive NFV as a means to move the network functions, implemented in ASIC-based hardware to software and utilize the benefits of virtualizing them.

Similarly, the core routing and switching functions are implemented in vendor specific appliances. There is a heavy dependency on vendors to provide enhancements to these functions. Vendors provide proprietary interfaces to configure and control their equipment. Configuring a network service requires configuring multiple network elements. Besides the need to configure the equipment through vendor specific proprietary interfaces, there exists very little automation of these tasks. As a result the service provisioning cycles are long. Reducing the service provisioning cycles is a key concern of operators. Operators have to adhere to agreed SLAs with their customer. This requires them to over provision the network at times. Flexible and adequate provisioning on need basis will not only help the operators in managing precious network resources appropriately, but also cause them to pass on the benefits to their customers. For e.g. the customer may want to use additional bandwidth on need basis rather than permanently subscribe for a high bandwidth package. To this effect, SDN provides flexibility in network provisioning, configuration and monitoring by primarily separating the control plane from the data plane. A network-wide view helps the operators in flexible provisioning of the network based on its state.

Rising consumer demands are putting pressure on the operators to transform themselves and address their issues. SDN and NFV show the promise to make this happen.

2.1 Network Functions Virtualisation

Network Functions Virtualization aims to leverage standard IT virtualization technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, by virtualizing the network functions. In essence, this means moving the network function requiring specialized hardware equipment to a software function executing on commoditized hardware. This is applicable to any data plane packet processing and control plane function in fixed and mobile network infrastructures. The benefits of NFV are multi-fold:

- Reduced equipment costs and reduced power consumption through consolidating equipment and exploiting the economies of scale of the IT industry.
- Single platform can support multi-version network appliances and provide multi-tenancy, thus allowing network operators to share resources across services and across different customer bases.
- Faster time to market by minimizing the typical innovation cycle.
- Rapid introduction of services – possible to do so based on geography or customer sets.
- Rapid scale up and down of services.

An Industry Specification Group (ISG) with open membership, led by network operators, has been setup under the auspices of European Telecommunications Standard Institute (ETSI) to work through the technical challenges for NFV. This ETSI NFV ISG [1] has been working on Group Specifications (GS) related to infrastructure, management & orchestration, software architecture, performance & portability, reliability & availability and security. The GS would then be taken up by various Standards Development Organizations (SDOs), for standardization.

### 2.2 Software Defined Networking

Software Defined Network (SDN) is a new approach to networking that makes the data network more flexible, easier to manage, operate, and respond better to application demand and network conditions. Following are the key characteristics of SDN.

<table>
<thead>
<tr>
<th>Decouple</th>
<th>Agile</th>
<th>Centrally managed</th>
<th>Programatically configured</th>
<th>Open standards based and vendor neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Decouple the network control and forwarding functions</td>
<td>• Dynamically adjust network traffic flows for changing needs</td>
<td>• Centralized controllers maintain a global view of network</td>
<td>• Configure and manage network resources quickly through SDN programs</td>
<td>• Standards provide well defined interfaces</td>
</tr>
<tr>
<td>• Benefit: Cost optimization of Network elements</td>
<td>• Benefit: Reduce time to service</td>
<td>• Benefit: Simplify the network design and OPEX</td>
<td>• Benefit: Enables new business solutions</td>
<td>• Benefit: Lower cost and multiple vendor choice</td>
</tr>
</tbody>
</table>

![Figure 2 – Key SDN Characteristics and Benefits](image)

Most networking vendors are now supporting SDN concepts but they have followed different approaches. Some align with open industry standards (e.g. OpenFlow), while others take a proprietary approach by providing APIs.

SDN offers enterprises, carriers and cloud service providers, automated & programmable control and provisioning that ensures network resources are optimally deployed; makes it much easier to support multi-tenancy; reduces both CapEx and OpEx; and increases service velocity and value.

The standardization bodies are aligning themselves to work closely. For e.g. the Open Networking Foundation (ONF) has signed an MoU with ETSI NFV ISG in March 2014 to work together on NFV, with focus on three elements – virtualized network function forwarding graphs, establishing persistent and secure communication between Virtual Network Functions (VNF), and SDN for configuration and control of NFV.
Similarly, OSS/BSS development needs to move to a model in-line with SDN and NFV. The TMForum has also set up an initiative to address the impact of SDN and NFV on the IT systems, under its Zero-touch Orchestration, Operations and Management (ZOOM) program.

### 2.3 SDN – NFV Synergies

The below figure [3] provides a perspective on the synergies between SDN and NFV.

**Figure 3 – Synergies between SDN and NFV [Source: Heavy Reading]**

SDN and NFV are complementary technologies. They are mutually beneficial but are not dependent on each other. Network Functions can be virtualized and deployed without an SDN being required and vice-versa [4]. However, there are alternate views as well. For e.g. the ONF feels that NFV is only a partial solution to the overall problem of virtualizing telecom networks to make them more agile and programmable. For greater service agility and new revenue streams, SDN is essential for NFV, while SDN implementation without NFV is also possible. The premise here is that most network functions would require cooperation from the forwarding plane and thus SDN is a necessity.

### 3. SDN and NFV Adoption

There is a great deal of apprehension in the service provider community about the SDN and NFV enabled architecture being able to meet the carrier grade network requirements. Early adopter service providers are conducting trials and proofs of concept implementations to assess the impact and use of SDN / NFV. The ETSI NFV ISG has approved several NFV PoCs [5] which are being led by Telcos such as AT&T, BT, CenturyLink, China Mobile, Deutsche Telekom, NTT, Telecom Italia, Telefónica, Telenor and Verizon. Similarly, TMForum is encouraging NFV catalysts to demonstrate the use of TMForum Frameworx standards for the management and orchestration of the NFV eco-system.

Some operators are moving from proofs of concept (PoC) towards actual implementations. For e.g. AT&T seeks to transform their networking businesses from their current state to a future state, through their Domain 2.0 program [6]. Telefonica has unveiled a network infrastructure initiative,
dubbed UNICA [7] that aims for a cloud oriented environment with all the functionality that it needs for deploying the network and service platforms. On similar lines, NTT Communications Group has announced cloud-based services based on NFV platform [8] that enterprises can activate themselves and pay for, on a per-use basis.

Early deployment of SDN is expected in the data centers (DC) of cloud service providers and large enterprises. Mobile clients, BYOD, the growing number of connected devices and cloud applications need a dynamic network which is enabled by SDN. Its adoption in DC, which is likely to begin with traffic flow management, optimization and visualization solutions, will gradually move into carrier networks.

On the NFV front, operators are likely to virtualize the enterprise customer premise equipments (vCPE) and the LTE core components (vEPC) in the initial phases and later take on more complex functions such as virtualizing the mobile base station (vRAN).

Open source technologies are serving as the foundation for SDN and NFV. There have been many open source community efforts such as OpenStack and OpenDaylight, which are being considered in the service provider NFV / SDN environments.

NFV & SDN show promise in the service provider as well as Enterprise market. IT virtualization (server and storage) has been adopted by Enterprise and Telecom service providers and network virtualization is the next logical step to take. As per a survey [9] of worldwide service providers that control over 51% of global telecom capex and 47% of revenue, they are moving toward SDN and NFV. Providers believe that SDNs and NFV are a fundamental change in telecom network architecture that will deliver benefits in new services and revenue, operational efficiency, and capex savings. According to a SDN market sizing report [10], the impact of SDN will exceed $25B per annum by 2018, and could grow as high as $35B annually. According to ABI Research [11] the virtualized telecom market would be of about $5 billion to $6 billion by 2018.

4. Challenges & Opportunities

Service providers are still assessing the potential impact and benefits of SDN and NFV. While the advantages of utilizing these technologies are evident, whether it will scale to support carrier grade services is still a question. With this in mind, operators are treading this path cautiously. Operators are typically planning SDN / NFV adoption over a 5-10 year horizon and are currently closely working with vendors in lab trials and proofs of concept. This is driven by the fact that operators have running contracts with vendors and have invested heavily in equipment already. They therefore need an optimized approach to protect these investments and at the same time migrate to the SDN / NFV world.
Some of the challenges that this transformation brings forth have been depicted in the figure below.

**Figure 4 – Key Challenges**

Apart from these, operators are in the process of consolidating their existing OSS systems, primarily to reduce the complexity that currently exists on account of multiple vendor solutions. The rationalization exercise will help simplify the OSS environment and processes and create grounds for a platform which would facilitate automation, and enable faster provisioning, fulfillment and assurance cycles. This would additionally call for a very efficient orchestration mechanism with modified workflows and capabilities to manage the life-cycle of services that are realized using virtualized as well as non-virtualised components. The intricacy of such a task is very high given the five 9s reliability that Telco systems demand. Besides, ecosystem readiness in fulfilling the carrier-grade requirements for the solution as a whole is quite some distance away.

The above challenges open up new opportunities, for the eco-system, such as:

- Certification of individual vendor components as well as end-to-end validation of services would be required to ensure service reliability and continuity.
- Organizations with a strong software background stand to gain as they can quickly adapt by re-training their staff.
- Service providers would require consulting services to migrate to SDN / NFV environment and evolve the operations appropriately.
• Operators are looking towards system integrators to take end-to-end ownership of the new infrastructure and to ensure that SLAs are met.

Tech Mahindra believes that System Integrators and value-added solution providers are in the best position to address the gaps and realize the end-to-end functionality of SDN / NFV systems & services.

5. Vendors’ Approach

SDN and NFV technologies are causing transformation in the vendor landscape too. Given the strong operator drive, vendors need to re-position themselves from a software product perspective. Operators believe that enabling their proprietary software to run on industry standard hardware in a standardized way may be a significant opportunity for existing vendors because their networking know-how is where the real value lies. Some major equipment vendors are already moving in this direction by offering virtualized versions of their products.

Vendors are adopting a multi-fold approach in adopting SDN / NFV. Operators want to protect their existing network investments and would like to take an approach which provides benefits of SDN and NFV without taking a disruptive approach. Some vendors are responding with solutions which help prepare overlay paths over existing networks and still provide the required control. Some others are adopting a proprietary approach to control their gear. Most of the vendors are following standardization efforts such as that of the ONF and are coming up with standards compliant (e.g. OpenFlow) solutions to better suit interoperability requirements.

Vendors are also establishing SDN / NFV platforms in collaboration with their partners and providing an environment for end-to-end service deployment. Examples of such eco-systems include HP’s OpenNFV initiative and Alcatel-Lucent’s CloudBand platform. Additionally, vendors are in the process of re-architecting their network functions so as to leverage the potential of cloud-based environments, viz. scalability, elasticity and on-demand execution.

With networks getting dynamic, they need to be provisioned and managed on the fly. ITSM vendors are therefore adopting changes to their products in ways such as introducing capabilities to interact with the SDN controllers and providing APIs for applications to consume information about SDN and non-SDN networks. They are also modifying their service fulfillment and catalog products to meet orchestration requirements.

Evidently, vendors are working closely with operators in conducting trials and PoCs. Several vendors such as Alcatel-Lucent, Brocade, Cisco, Dell, Ericsson, Fujitsu, HP, Huawei, Intel, Juniper, Radware and others are contributing to the PoCs being conducted under the aegis of ETSI NFV ISG.
6. The Role of System Integrators

As service providers adopt SDN and NFV technologies, a hybrid scenario would begin to emerge. Networks would become an interplay of traditional gear along with the new virtualized infrastructure. Parts of the network would be controlled via SDN controllers and would co-exist with the non-SDN part of the network. Similarly, on the IT front, existing OSS systems would have to be rationalized to adapt to the emerging SDN / NFV requirements of orchestration as well as quicker assurance and fulfillment cycles. Again, this would not happen overnight, and thus service providers would need to manage a hybrid network and IT environment while ensuring that their existing services are unaffected, coupled with new service launches going through seamlessly and in quick time.

Telco network and IT systems would be comprised of equipment, products and platforms from a number of vendors, each with different product maturities and flavors. Service providers may also adopt open solutions in certain pieces of the overall architecture. This would require integration between components from multiple vendors, associated validation & verification, E2E service realization and service level assurances (SLAs). This creates an opportunity for system integrators.

Since SDN & NFV warrant changes to network infrastructure, software architecture, network control, management processes and associated platforms and tools, it becomes imperative to understand how services that run on such a system would behave. The foreseen benefits on Capex and Opex need substantiation via concrete savings and operational efficiencies. Standards need to evolve quickly and individual vendor components need to be certified for compliance and inter-working. The network architecture and management systems need to be validated for performance, reliability, resiliency, security, and overall orchestration. SLA guarantees need to be respected amidst this migration and transformation. Service providers will bank on system integrators to play a major part in this transformation journey. For this, system integrators need to get involved early in service provider trials and PoCs. This would help them get a good understanding of vendor products and platforms, and also facilitate back-to-back relationships with vendors in events where system integrators have to front end the entire network and IT transformation. The figure below gives a snapshot of the wide variety of activities that the system integrator would be involved in for SDN / NFV.
With a significant increase in the software footprint in the Telco networks, new skill sets would be required from integrators for developing applications, integrating components, validating and testing services, as well as for managing Telco networks. System Integrators would add further value by providing software solutions and building software components that are (re)engineered to run in the virtualized environment. Thus the system integrator will play a vital role in fulfilling end-to-end requirements of SDN and NFV.

7. Tech Mahindra's Play

Tech Mahindra has a unique positioning as a vendor-neutral player in the SDN / NFV ecosystem. Based on its extensive experience in providing solutions and services to telecom service providers worldwide, Tech Mahindra is positioning itself to offer services much beyond a traditional systems integrator. Tech Mahindra intends to become the single point of contact for service providers and enterprises, right from providing consultancy, to solution development, applications development, planning, design, integration, deployment, validation, testing and managed services.

Tech Mahindra has been providing network and IT solutions and services to telecom service providers and enterprises. It has strong focus and extensive experience in areas related to SDN / NFV, such as infrastructure management (legacy and virtualized), network services & operations, BSS, OSS, cloud services, application development & management, etc. Incorporating SDN and NFV aspects is but a logical step in its services evolution.
Service providers and enterprises are dependent on the vendors to provide products enabling SDN and NFV capabilities. These separate products need to be integrated together to realize the desired solution based on the customer’s needs. In this regards, Tech Mahindra has been working closely with the vendor community to develop capabilities on their products so as to be able to integrate the COTS products in the customer’s eco-system. The product understanding of various products helps it to put up a solution best suited to the customer’s requirement. It also helps in situations where customer would like to integrate new components with their legacy systems. Tech Mahindra can thus help the operators in putting various pieces of the jigsaw together and take complete ownership of what it has built. Tech Mahindra also provides product engineering services and has helped to develop virtualized network functions such as vEPC and vIMS.

With its extensive experience in Greenfield and Brownfield implementations in network and IT systems, Tech Mahindra is uniquely posed to offer services ranging from consultancy to management & operations.

SDN and NFV provide the right platform for Tech Mahindra to extend its ICT capabilities to the new requirements of telecom networking. It also opens up opportunities to provide solutions and services in network & service migration, interoperability & certification, DevOps, NetOps and business process re-engineering. With its participation in ETSI NFV Industry Specification Group and other forums, Tech Mahindra understands operator requirements in the changing scenario and can provide aligned solutions and services.

Tech Mahindra has established an SDN / NFV Center of Excellence (CoE). As a part of this unit, it has established several labs for proof of concept (PoC) development as well as customer / vendor product
testing and assessment. These activities also help in building a skilled task force that can address solutions for customer requirements. Tech Mahindra is also building innovative engagement models, including co-innovation with customers & partners, in these domains.

8. Summary

SDN and NFV are causing a paradigm shift in the way in which modern networks & data centers will be operated. Virtualization of IT and Network resources is the key to this. However, embracing virtualization or deploying SDN and NFV by itself will not yield the desired benefits. The environment needs to be cloudified, automated & orchestrated, such that the benefits of a cloud service environment are achieved. Besides, lifecycle management of the functions, open standardized interfaces, a strong meta-model for services, and effective orchestration of the services, would be the key aspects to consider. SDN and NFV standards need to evolve quickly to alleviate the issues of integrating multiple virtual appliances from different vendors, interoperability and certification. Software based networking environments would require a different level of operations and skill base. Operators need to start preparing for this. It is unlikely that operators would take a big-bang approach to implementing SDN / NFV. Hence, a migratory path needs to be chalked out to provide assurance of realizing perceived benefits. Conducting PoCs and trials will go a long way in preparing the ground for adoption of SDN / NFV.

Overall, SDN and NFV show promise in enabling a flexible and agile environment for service providers resulting in benefits such as increased velocity of time to market, increased service velocity, Capex / Opex reductions and improved operational efficiency.
References

2. Open Networking Foundation (ONF), https://www.opennetworking.org
6. AT&T Vision Alignment Challenge Technology Survey, AT&T, November 2013,
7. Press Release:"Telefónica forges ahead on end to end virtualisation of its network", 24/02/2014,
8. Press Release : "NTT Com Launches Industry’s First Cloud Networking Services with Instant Self-Service
   Activation and Pay-Per-Use Model", May 29, 2014,
   http://www.ntt.com/aboutus_e/news/data/20140529.html,
10. SDN Market Sizing Report, Presented by Plexxi, Lightspeed Venture Partners and SDN Central, April 2013
    research/product/1014546-the-sdn-and-nfv-business-case/

Disclaimer

About Tech Mahindra

Tech Mahindra represents the connected world, offering Consulting, Digital Transformation, Integrated
Engineering, Business Services and Solutions, enabling Enterprises, Associates and the Society to
Rise®. We are a USD 3.8 billion company with 103,600+ professionals across 90 countries, helping
750+ global customers including several Fortune 500 companies. Our innovative services, platforms,
products, solutions and reusable assets connect across a number of technologies to deliver tangible
business value to our stakeholders. Tech Mahindra is winner of Forbes 2014 Asia Fab 50, Deloitte
Tech Fast 50, the CIO 100 among other awards.

We are part of the USD 16.9 billion Mahindra Group that employs more than 200,000 people across
100 countries. The Mahindra Group operates in key industries that drive economic growth, enjoying a
leadership position in tractors, utility vehicles, information technology, financial services and vacation
ownership.

Connect with us on www.techmahindra.com