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Operational, organizational and business challenges for network operators in the context of SDN and NFV

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ABSTRACT

Traditional operators deploy and operate telecom networks that rely on monolithic network elements that incorporate distinct network functions and implemented with a vertical integration of control and data planes. This mode of operation is transitioning towards a new situation where the control plane is separated from the data plane, and the network functions are no longer tightly bound to specific elements in the network. The two paradigms pushing in that direction are Software Defined Networking (SDN) and Network Functions Virtualization (NFV). This paper presents a number of challenges that traditional network operators must adapt to during this transition. We categorize these challenges using three important dimensions for telecom operators: operation, organization and business.

1. Introduction

Software Defined Networking (SDN) and Network Functions Virtualization (NFV) are two major trends in the telecom industry today. SDN proposes decoupling the control and data planes in network equipment (NE) and logically centralizing that control while leaving the NE to forward traffic, and enforcing policy according to instructions received from the controller. This makes the network programmable in a way that promises to be more flexible than the current managed paradigm. NFV, on the other hand, envisages the instantiation of network functions on commodity hardware, breaking the monolithic approach of functional software and hardware that exists in today's vendor offerings. Although they are separate initiatives it appears that SDN and NFV are complimentary; one prevalent view in the industry is that 'SDN enables NFV'. Undoubtedly these new trends will change the telecom industry in many dimensions. While the technological impacts have and are being extensively studied (refer to [1] and the references inside for SDN, and [2] for NFV), the implications of these changes on network operators have not received the same attention.

This paper provides an overview of the challenges facing operators in adopting SDN and NFV in production networks. In the following sections we cover three main dimensions of those challenges: operational, organizational, and business issues. The motivation of this overview is to spur further research and analysis and, we hope, the development of innovative responses to address them. We summarize these challenges in Table I and include our initial assessment of their relative significance.

2. Operational challenges

This section covers the challenges that relate to operator activities concerned with the building and operation of networks.

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Table 1
Summary of identified challenges.

Dimension	Area	Challenge
Operational	Network planning	• Comprehensive network resource planning • Multilayer planning tools
	Network deployment	• Increased testing and product homologation • Risk of overinvestment in data center infrastructures • Criticality of data centers and need for highly secure infrastructures
	Supportive systems	• Integration with existing OSS/BSS systems • Relies on Open Source developments
	Network operation	• Standardization of open interfaces that facilitate uniform control and management across technologies and vendors • Control plane resiliency • Network automation • Decoupling of service from transport
	Service provisioning	• Mapping between service requirements and network capabilities • Common APIs and information and data models
	Investment protection and migration	• Coexistence with legacy networks
Organizational	Departmental organization	• Cross-technical and cross-functional reorganization of departments
	Skills and know How	• Multidisciplinary teams
	Partnership ecosystem	• Larger number of partners requiring more coordination and management effort
Business	Analytics	• Correlation of decoupled service and transport indicators • Big Data analytics for predictive actions
	Customization	• Standard interfaces for network service and resource consumption • Isolation and security • Proper billing mechanisms
	Network and IT equipment Lifetime	• Re-programmability of equipment to extend the service lifetime
	Procurement	• Management of a larger number of vendors • Definition of new quotation models to compare prices and solutions respect to conventional products • Definition of new guarantees
	Capabilities for sharing network infrastructures	• New business models for infrastructure and capacity sharing • Impacts of regulation
	Innovation and experimentation	• Creation and maintenance of innovative teams

2.1. Network planning

The appearance of both NFV and SDN change the design rules and common practices used in today's networks.

The dynamic invocation of network functions enabled by NFV will change the traffic patterns, the traffic engineering (TE) requirements and the need for quality of service assurance across the network. The traffic patterns will certainly be different from those we have experience with, and they may become less predictable; in any case we believe the changes will complicate the network planning and operation tasks. In response to this, traditional planning approaches like overprovisioning of capacity are not an economical option. Overdimensioning network links to accommodate traffic where the peak load varies widely and changes frequently creates a significant Capital Expenditure (CapEx) inefficiency. An alternative is that new, on-demand, transport control and traffic management mechanisms will have to be put in place to create a network that adapts dynamically offered load.

Today's conventional networks or, more accurately, the traffic loads presented to them mean that overprovisioning, while not optimal, is tolerable. It is certainly common practice. We believe that SDN and NFV will enable new services that, in response to increasingly diverse customer and application needs, will generate greater and more variable traffic loads. It is in this context that we see SDN and NFV as being among the key catalysts for introduction of smart and dynamic traffic engineering into operator networks.

To face this challenge we think on network programmability as key feature of SDN that can permit new ways of resource optimization by implementing sophisticated traffic engineering algorithms to go beyond the capabilities of contemporary distributed shortest path routing. In addition, multilayer coordination can help to rationalize the usage of technological diverse resources for a common purpose. This new way of planning and operating networks requires a comprehensive view of the network resources and planning tools capable of handling these multilayer problems. An optimal planning process and tool chain then becomes multidimensional and multi-layered and has an important impact on operational cost and flexibility.

2.2. Network deployment

The traditional cycles for the deployment of new NEs in existing networks are long. A new NE or technology is first tested extensively to ensure compatibility with already deployed systems. Once validated new equipment can be introduced and integrated in the network. Conventional product homologation is done simultaneously and in an integrated way for both the control and forwarding plane; they are, after all, both present in the same NE in the current model.