Body of European Regulators
for Electronic Communications

BEREC

Regulatory Perspective on SDN and NFV

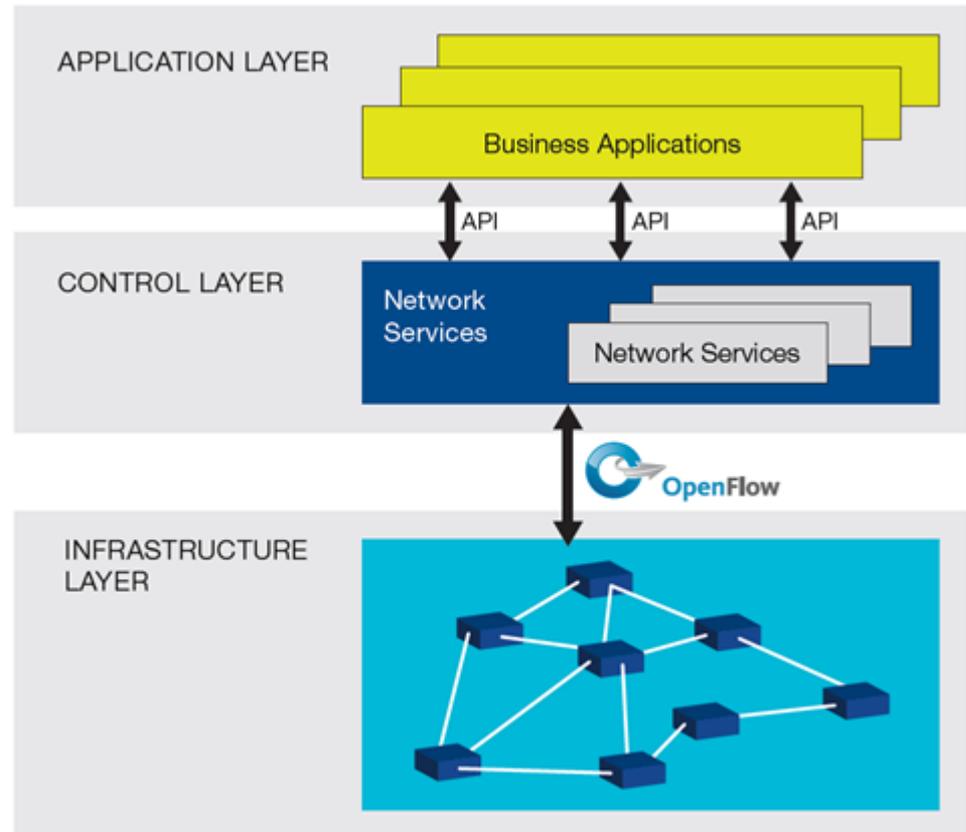Wilhelm Schramm, RTR-GmbH

Co-Chair NGN EWG

Agenda

- What is SDN and NFV?
- BEREC Workshop on 'Regulatory implications of SDN and NFV'
- Conclusions

# What is SDN and NFV?

What is SDN?

- ONF has defined a SDN architecture
- The ONF/SDN architecture consists of 3 distinct layers
- The ONF/SDN architecture has 3 key attributes
  - Logically centralized intelligence
  - Programmability
  - Abstraction

APPLICATION LAYER — Business Applications

API | API | API

CONTROL LAYER — Network Services / Network Services

OpenFlow

INFRASTRUCTURE LAYER

Source: ONF (2014), p. 3
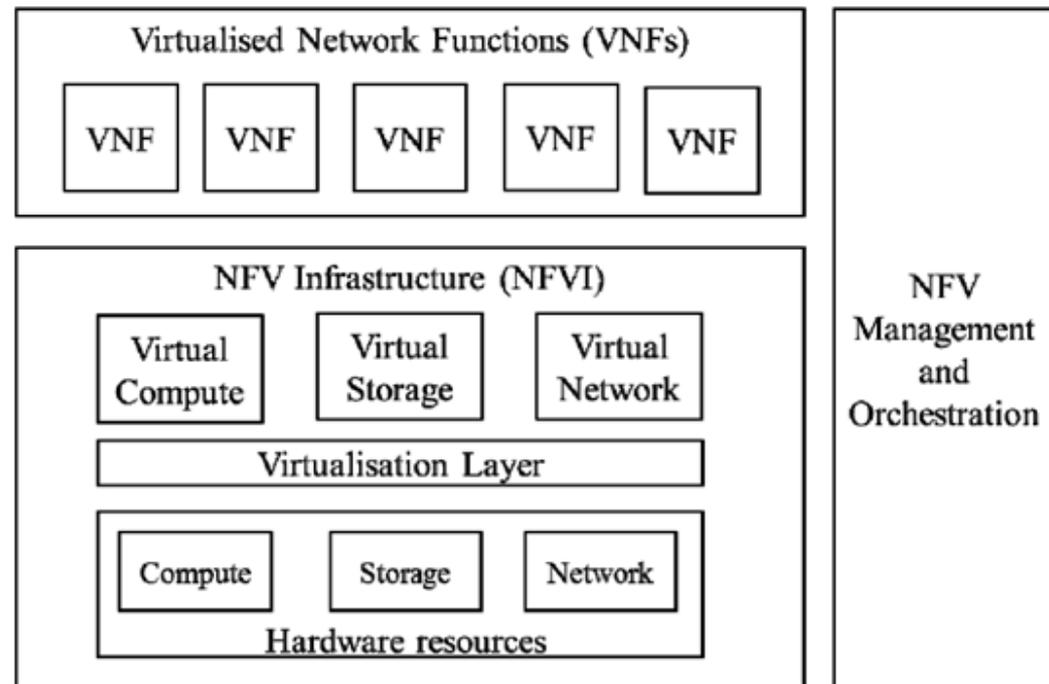
What is NFV? (1)

- NFV aims to transform the way that networks are built and operated
  - Evolving standard IT virtualisation technology
  - Consolidate many network equipment types onto "industry standard" high volume
    - servers,
    - switches and
    - storage
- Network functions are implemented in software
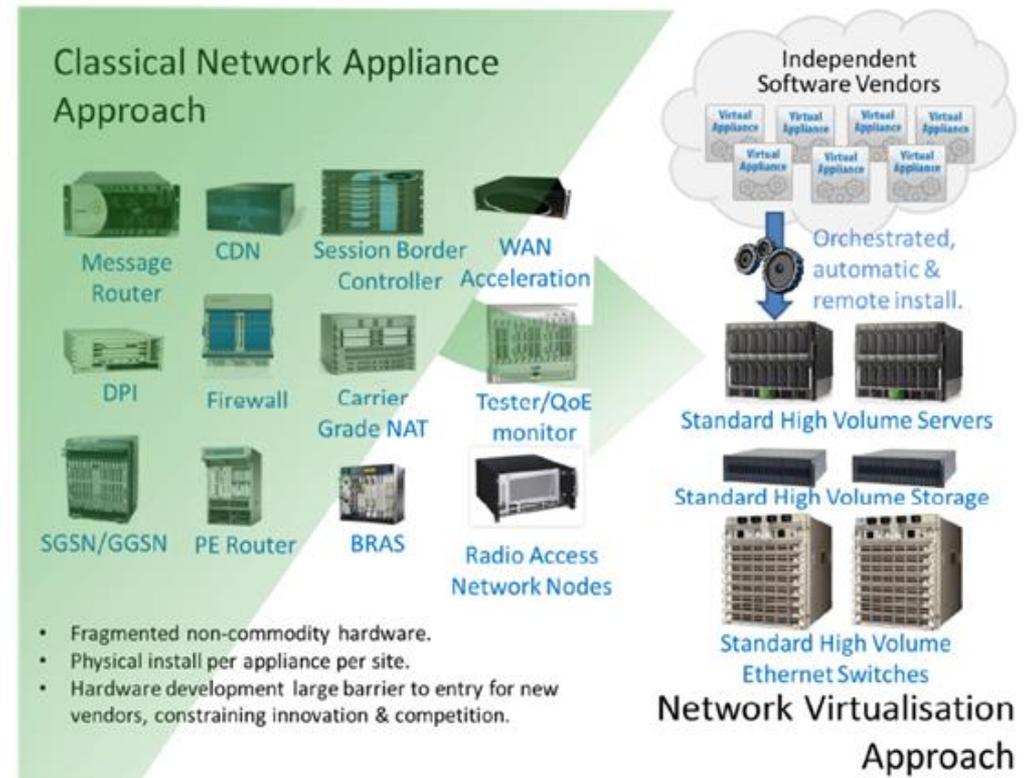
Source: NO ETSI NFV ISG (2012), p.5

What is NFV? (2)

- ETSI has defined a high-level NFV framework with 3 domains:
  - Virtualised Network Functions
  - NFV Infrastructure and
  - NFV Management and Orchestration
- A VNF is a virtualisation and software implementation of a network function
- The NFVI consists of the virtualisation layer and the hardware resources

Virtualised Network Functions (VNFs)

VNF VNF VNF VNF VNF

NFV Infrastructure (NFVI)

Virtual Compute   Virtual Storage   Virtual Network

Virtualisation Layer

Compute   Storage   Network

Hardware resources

NFV Management and Orchestration

Source: ETSI GS NFV 002 (2014), p. 10

What is the relation between SDN and NFV?

- NFV is highly complementary to SDN
- Ultimately, NFV and SDN will be subsumed into a unified software-based networking paradigm

- Network operators have the possibility to use both, SDN and NFV, and to combine SDN and NFV appropriately
- SDN and NFV are in a state of dynamic developments. This includes also how to combine SDN and NFV (see e.g. ETSI GS NFV-EVE 005)

Source: NO ETSI (2012), p. 5, NO ETSI (2014) p. 16.

Future network based on SDN and NFV
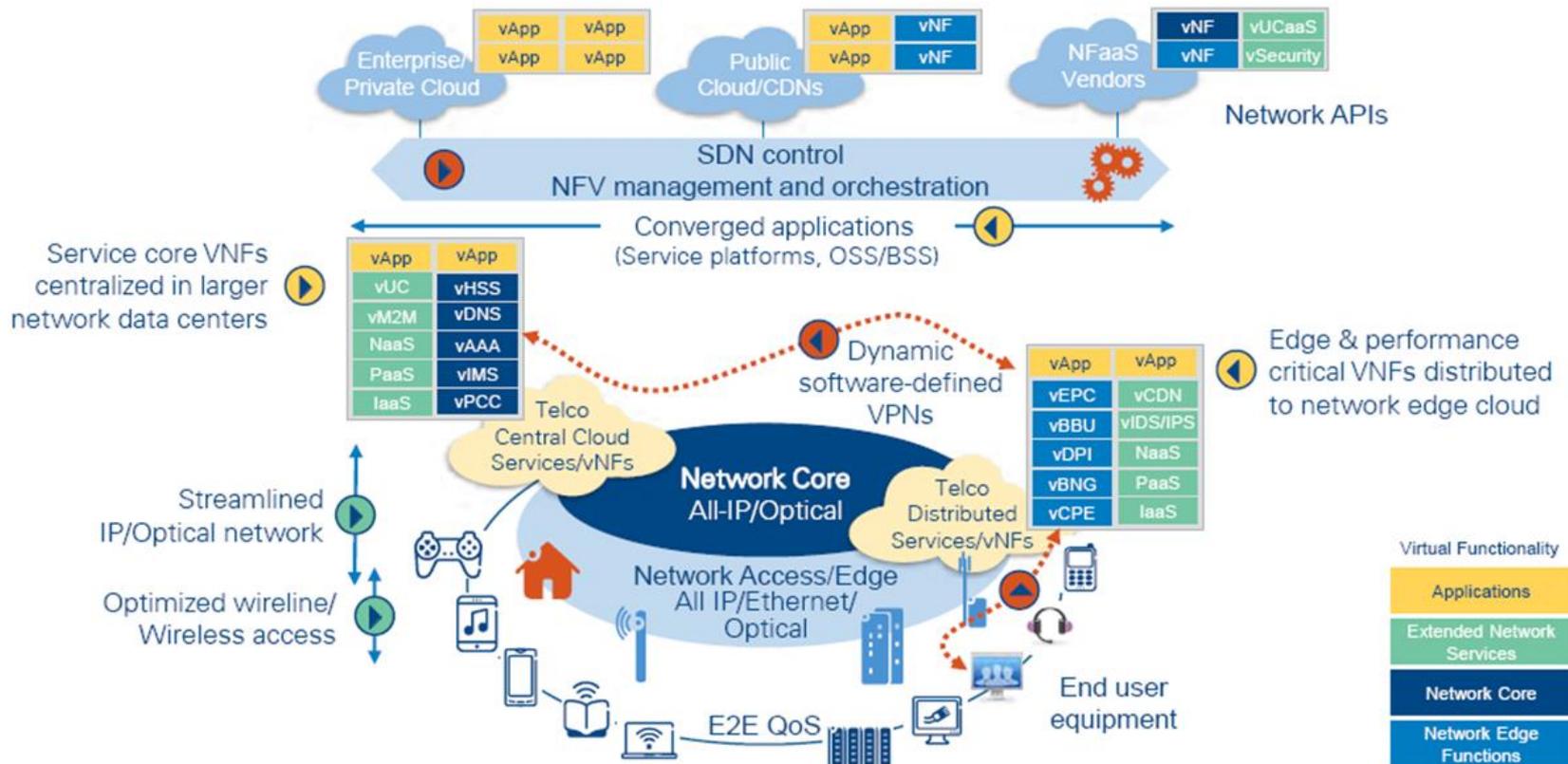
Source: Athur D. Little, Bell Labs (2015), p. 12

Benefits of SDN and NFV

SDN and NFV have the following benefits:*)

- A new dimension of programmability, automation, and network control
    - Enables to build highly scalable, flexible networks
- Reduced equipment costs (CAPEX) and reduced power consumption (OPEX)
- Rapid innovation
- Targeted service introduction depending on geography or customer sets
    - Services can be rapidly scaled up/down as required
- Optimizing network configuration and/or topology in near real time
- Much more efficient test and integration
- Further benefits

*) NO ETSI NFV ISG (2012), p. 8, ONF (2012), p. 2

BEREC Expert Workshop on 'Regulatory implications of SDN and NFV'

Introduction

- From a regulatory perspective it is important to anticipate the regulatory implications of SDN and NFV

- BEREC held an expert workshop on 'Regulatory implications of SDN and NFV' on 21 January 2016 in Brussels

- Experts in the area of SDN and NFV presented their view on the regulatory impact that SDN and NFV will have

- The speakers of the workshop were asked to answer in their presentations questions with regard to several specific topics which are <u>relevant from a regulatory perspective</u>

Agenda of the workshop

- Presentations of 3 standard development organisations
    - Open Networking Foundation (ONF)
    - ETSI NFV Industry Specification Group
    - MEF
- Presentations of 3 network operators
    - Colt, QSC and Telefonica
- Presentations of 3 vendors
    - Alcatel-Lucent (now Nokia), Fujitsu and Hewlett Packard
- Panel discussion
- The presentations and a video recording of the presentations and the panel discussion are available at the following BEREC website
  http://berec.europa.eu/eng/events/berec_events_2016/104-public-berec-expert-workshop-on-regulatory-implications-of-sdn-and-nfv

Current state of development of SDN and NFV

- SDN and NFV have a the potential to completely change how network operators design and operate their networks and services
- Today, SDN and NFV are
  - In an initial stage of development
  - In their early days of deployment
  - Far away from realising their full potential
- Therefore today, it seems that it is rather unclear whether and to what extent the potential of SDN and NFV will actually be realised
- The development of SDN and NFV
  - Is very dynamic
  - Open source projects play an important role
  - Therefore differs from the 'traditional' development process
  - Uncertainty on what role traditional standard development approaches will play in the future

Topic 1: New forms of fixed network access (1)

Question:
- Will SDN and NFV enable fixed network access which provides alternative network operators with more control over the network of the incumbent compared to current layer 2 wholesale access products?

Discussion:
- Yes, in principle
- Requires SDN/NFV with multi-tenancy capabilities which enable different parties to have <u>control</u> over the same network
- Currently
  - This is not yet developed
  - The ETSI NFV Architectural Framework does not explicitly identify an inter-provider interface or reference point

Topic 1: New forms of fixed network access (2)

- Currently (contd.)
    - Several potential difficult issues need to be resolved (e.g. security, trust models, SLA measurement and enforcement, fault detection)
- The development of such new forms of fixed network access may need:
    - Interested parties (i.e. ANOs) need to coordinate their interest and participate in the development and standardization process
    - This may be difficult due to the large number of open source projects and uncertainty on what role traditional standard development approaches will play in the future
    - Incumbent network operators are also involved in the development process and might be reluctant to develop or support such solutions
- It needs to be seen whether SDN and NFV will actually be developed in a way which will enable such new forms of fixed network access

Topic 2: New forms of data (Ethernet) Services (1)

<u>Question</u>:

- Will SDN and NFV enable or facilitate new forms of data (Ethernet) services which provide customers with the possibility to set up data (Ethernet) connections dynamically on-demand (similar to a phone call)?

<u>Discussion</u>:

- Colt is already offering such Ethernet services
  - Initially between more than 50 on-net pre-wired data centers
  - Initial inter-operator proofs of concepts and commercial offerings are already planned for 2016 - 2017
- MEF is developing the so-called 'Lifecycle Service Orchestration' (LSO) approach which will enable such Ethernet services

Topic 2: New forms of data (Ethernet) Services (2)

- If an open numbering space and the calling party pays principle is used, this may lead to a termination monopoly and the need to regulate termination fees of these data (Ethernet)Services
- Colt plans and expects that a common numbering plan will not be used
- It needs to be seen based on which numbering space and billing model the new forms of data (Ethernet) services will be offered in the future

Topic 3: New forms of mobile virtual networks and sharing of network elements

Question:
- Will SDN and NFV enable new forms of mobile virtual networks and sharing of network elements?

Discussion:
- Yes, this is expected
- E.g. virtual base stations and multi-radio access technology (RAT)
  - One network operator provides a common base band unit (BBU)
  - Several network operators implement their own RAT (3G, 4G, wifi) on top of this BBU
- The concrete forms that will be available in the future depend on
  - The further development of SDN and NFV and
  - The mobile network operators involved in this development process

Topic 4: Reliability

Question:
- Will networks based on SDN and NFV have the same (or even higher) reliability than networks of today?

Discussion:
- Yes, same level of reliability in the long term, but maybe not in the short term
- In the long term, the level of reliability may even be higher

Topic 5: Impact on current value chains

Question:
- Will SDN and NFV have an impact on current value chains? Which?

Discussion:
- Yes, this may be the case
- SDN and NFV enable new types of services, e.g.
  - NFV infrastructure as a service (NFVIaaS)
  - Virtualised network functions as a service (VNFaaS)
- Services may also be offered by new parties
  - E.g. vendors may offer VNFaaS
- May raise issues e.g. about the regulatory status of providers of new services in the value chain

Topic 6: Relation between OTT providers and telecommunication service providers

Question:
- Will SDN and NFV have an impact on the relation between OTT providers and telecommunications service providers? Which?

Discussion:
- Different views
- For OTT and new entrants, it is easier to deploy SDN and NFV
  - No large legacy infrastructure and more familiar with open source communities
- No big change for OTTs
  - OTT are already network agnostic
  - OTT want to concentrate on the service running on top of the underlying infrastructure
- Telecommunications service providers have the possibility to offer new services to OTT providers
  - E.g. virtual machines (VM) at the edge of the network (i.e. caching and low latency network functions, video transcoding etc.)

Conclusions

- SDN and NFV have the potential to completely change how network operators design and operate their networks
- To date, SDN and NFV are still in their early days of development and deployment and far away from realising their full potential
- Therefore today, it seems that it is rather unclear whether and to what extent the potential of SDN and NFV will actually be realised
- Regulatory authorities will need flexibility in order to be able to respond to this dynamic development of SDN and NFV appropriately

Thank you

Literature (1)

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