OPEN NETWORKING FOUNDATION

Regulatory Implications of SDN & NFV: An ONF Perspective

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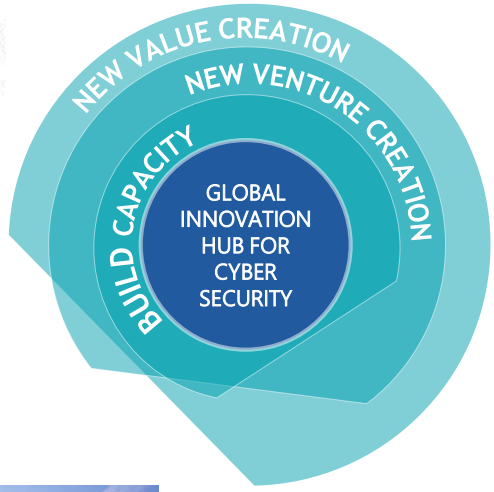
Centre for Secure Information Technologies



Est.2009, Based in The ECIT Institute

Initial funding over £30M (CSIT 2 - £38M)

90 People
- Researchers
- Engineers
- Business Development

Largest UK University lab for cyber security technology research

GCHQ Academic Centre of Excellence

Industry Informed
- Open Innovation Model

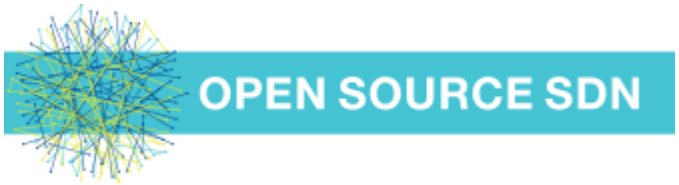
Strong international links
- ETRI, CyLab, GTRI, SRI International
- Cyber Security Technology Summit

Open Networking Foundation

The Open Networking Foundation (ONF) is a user-driven organization dedicated to the promotion and adoption of Software-Defined Networking (SDN).

Areas

Operator	Services	Specification	Market
Carrier Grade SDN	Architecture & Framework	Open Datapath	Liaisons
Data Center	Information Modeling	OF-Config	Proofs of Concept
Enterprise	L4-7 Services	Open Transport	Publications
Migration	Northbound Interfaces	Protocol Independent Forwarding	SDN Solutions Showcase
	Security	Testing & Interop	Skills Certification
		Wireless & Mobile	Workshops

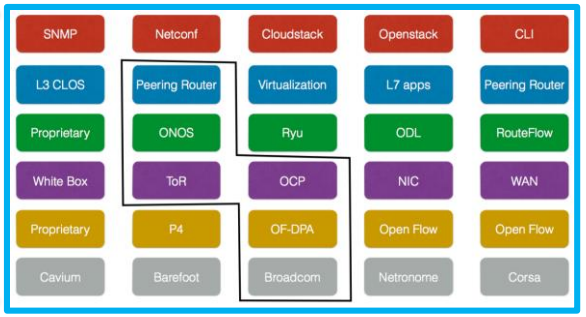


Recent ONF Tech Community Developments

- Northbound APIs
  - Intent-based framework (into ODL)
  - Flow Objectives (into ONOS)
  - Real-time media automating QoS/QoE (into IMTC)
- Information Modeling
  - Consistent way to specify APIs
  - Essential for end-to-end services
- Layer 4-7
  - Service Function Chaining Solution Architecture
  - OpenFlow support for SFC header extensions
- Carrier-grade SDN
  - Meeting of carrier-grade and service quality
  - Migration methods and techniques
- Instantiations
  - AppFest: medical researchers, NRENs, government agencies
  - SDN Solutions Showcase
- Skills certification
  - ONF-Certified SDN Associate (OCSA)
  - ONF-Certified SDN Engineer (OCSE)

Open Source SDN (opensourcesdn.org)

- ONF coordinates: repository, governance, communities
- Open to the public
- Destination for much of our committee work
- 16 Projects
  - Aspen (Real-Time Media NBI)
  - Atrium (L3 SDN distribution)
    - BGP, Flow objectives, OpenFlow 1.3, OCP, vendors
    - ONOS in release 2015/A, ODL in release 2016/A
  - Boulder (Intent NBI)
  - Centennial (Wireless Backhaul PoC)
  - Durango (OVS support in OF-Config)
  - Englewood (Transport API)
  - Florence (Security assessment tools)
  - Frontier (SDN “flight data recorder”)
  - PIF (Protocol-Independent Forwarding intermediate representation)
  - Steamboat (L2 SDN distribution)
  - Telluride (End-to-End WAN as a Service)
  - Vail (Cloud access for enterprises)
  - …



OpenFlow Developments

- Optical & wireless extensions
  - Packet-optical integration PoC
  - Wireless transport PoC
- Interoperability
  - TTPs
  - Flow Objectives
- 1.3 in hardware
  - Atrium (7 switches)
  - 1.3 conformance spec (basic, single-table)
- Evolution
  - PIF

Remember: OpenFlow is three things:

- An architecture (separation of forwarding/control)
- A model (match-action forwarding plane)
- A protocol (to load the Forwarding Information Base)

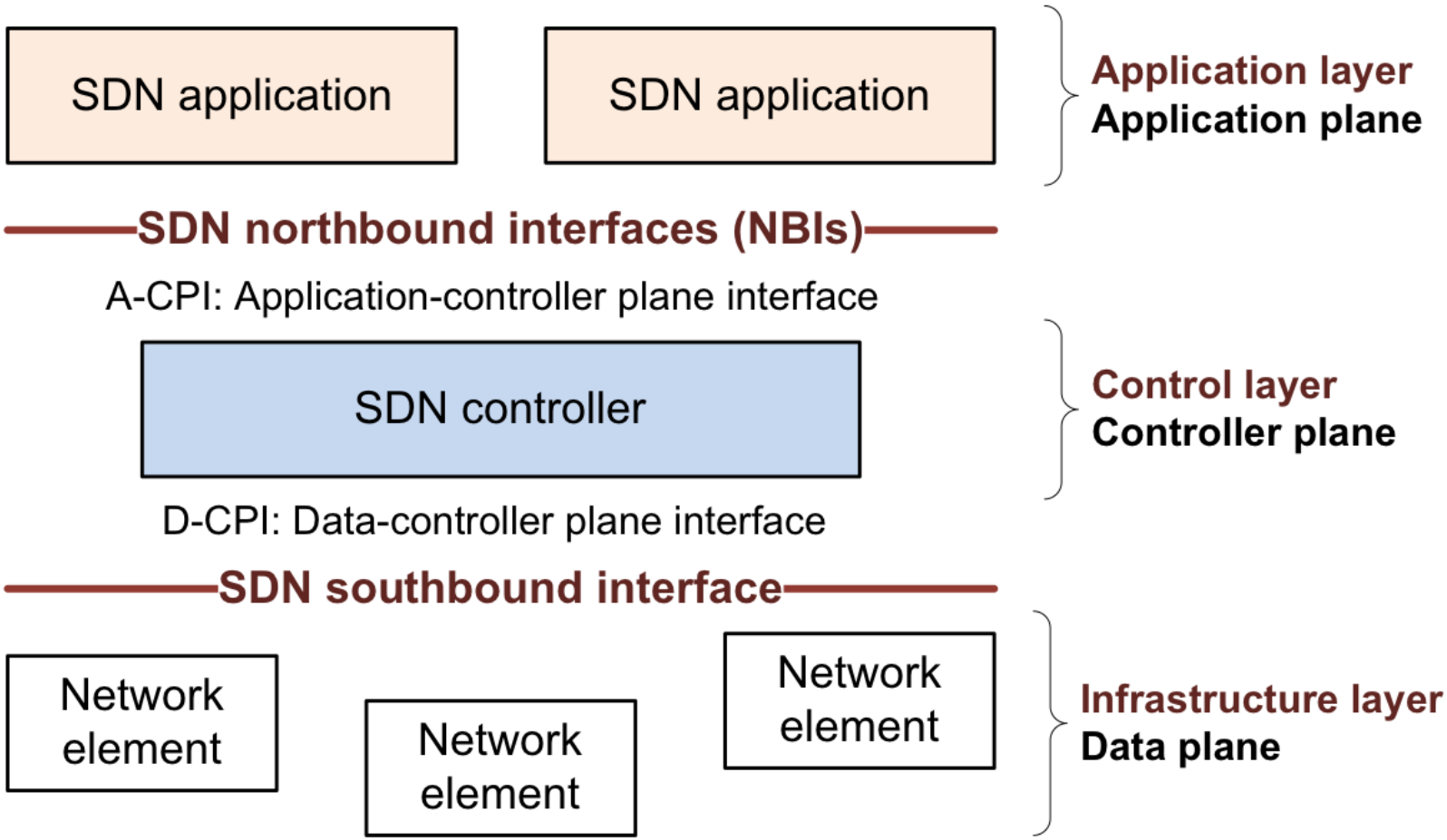
Questions regarding regulatory implications of SDN and NFV

Q1.

Do SDN and NFV enable fixed network access which gives alternative network operators more control over the network of the incumbent compared to current layer 2 wholesale access products (also known as Ethernet bitstream or virtual unbundled local access (VULA))?

- Is this possible in principle?
- Will SDN and NFV also be standardized in a way (including multi-tenant support) which will make such forms of network access possible based on SDN/NFV?
- Will SDN and NFV also be offered by vendors (and/or open source) which will make such forms of network access possible based on SDN/NFV?

A1.



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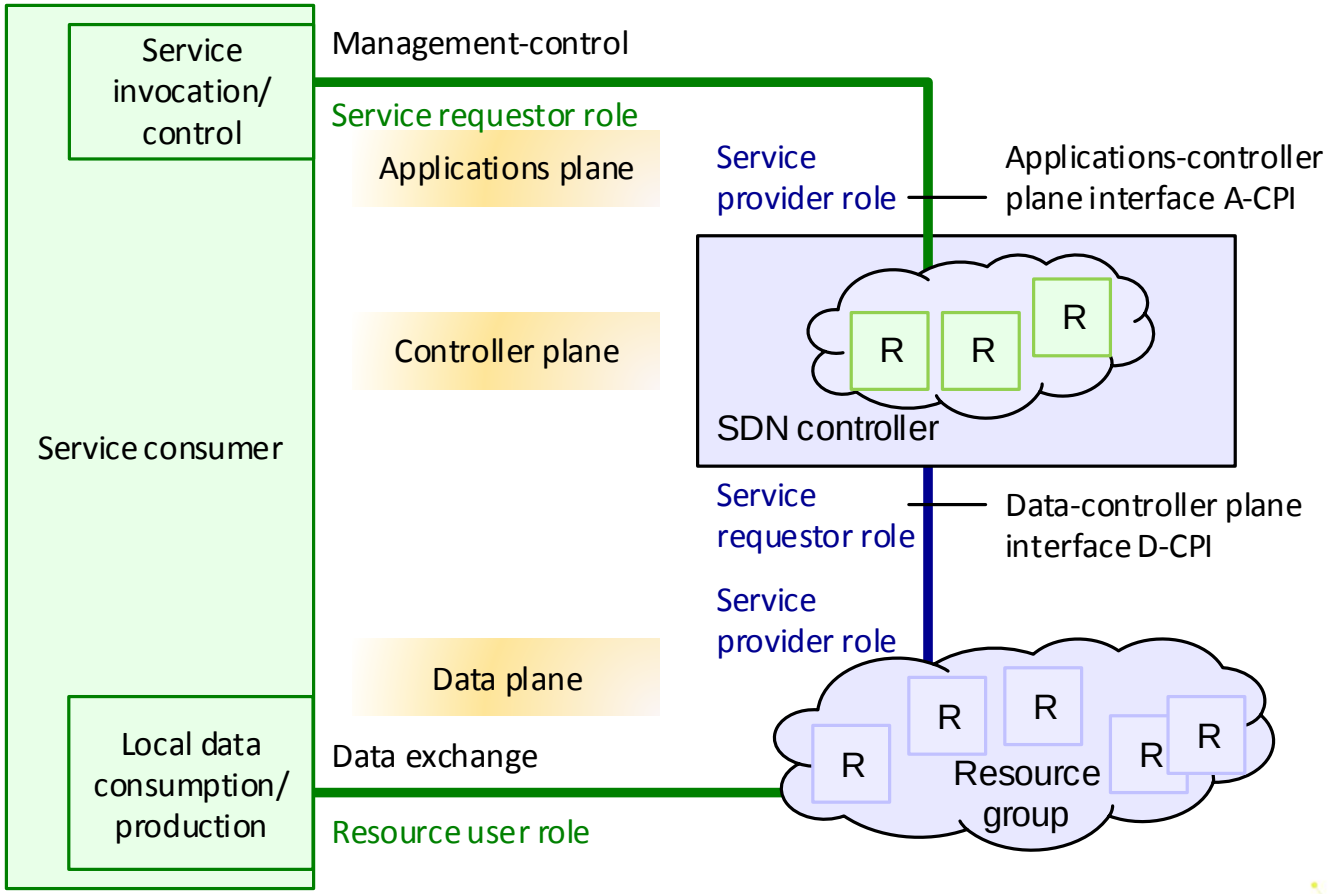

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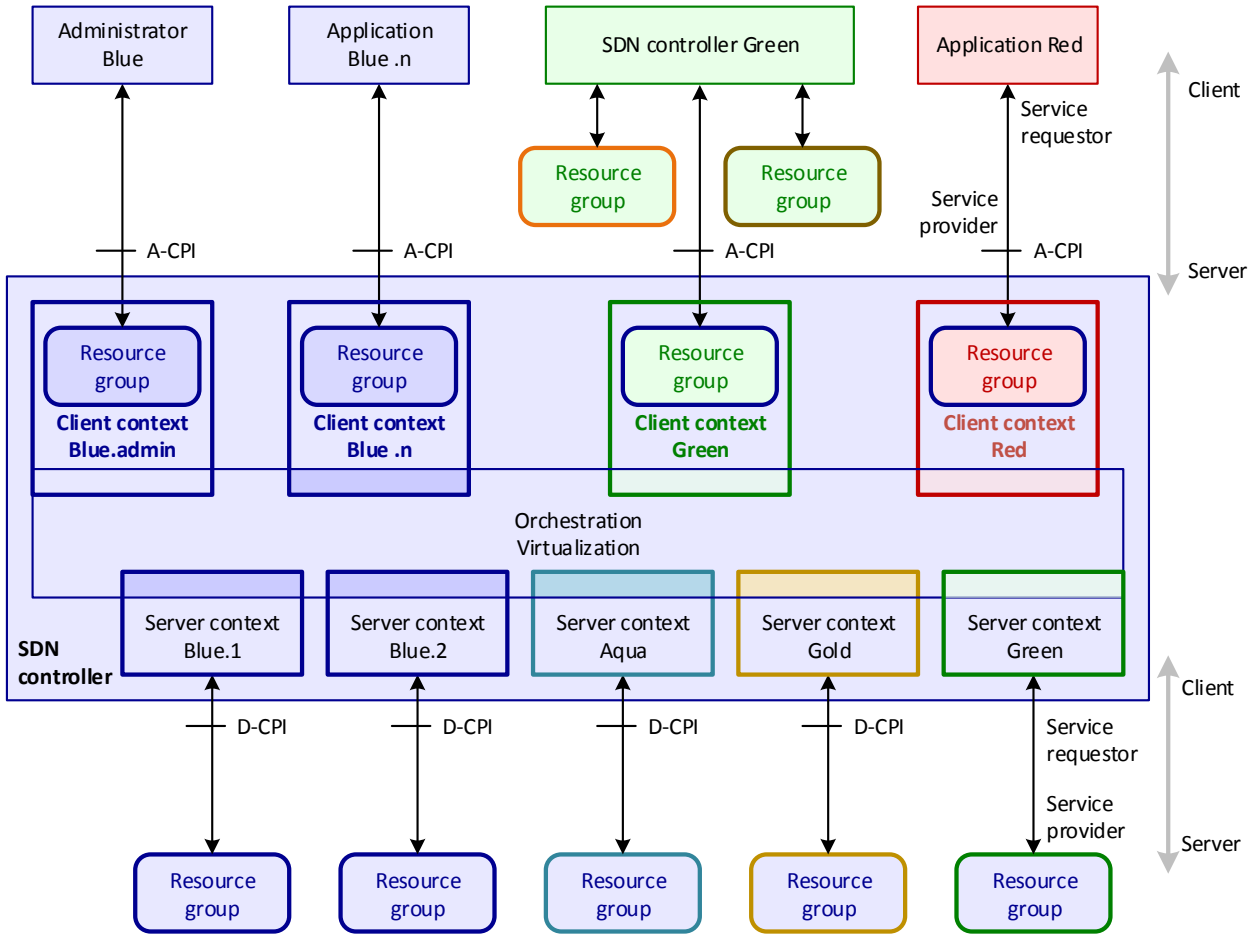

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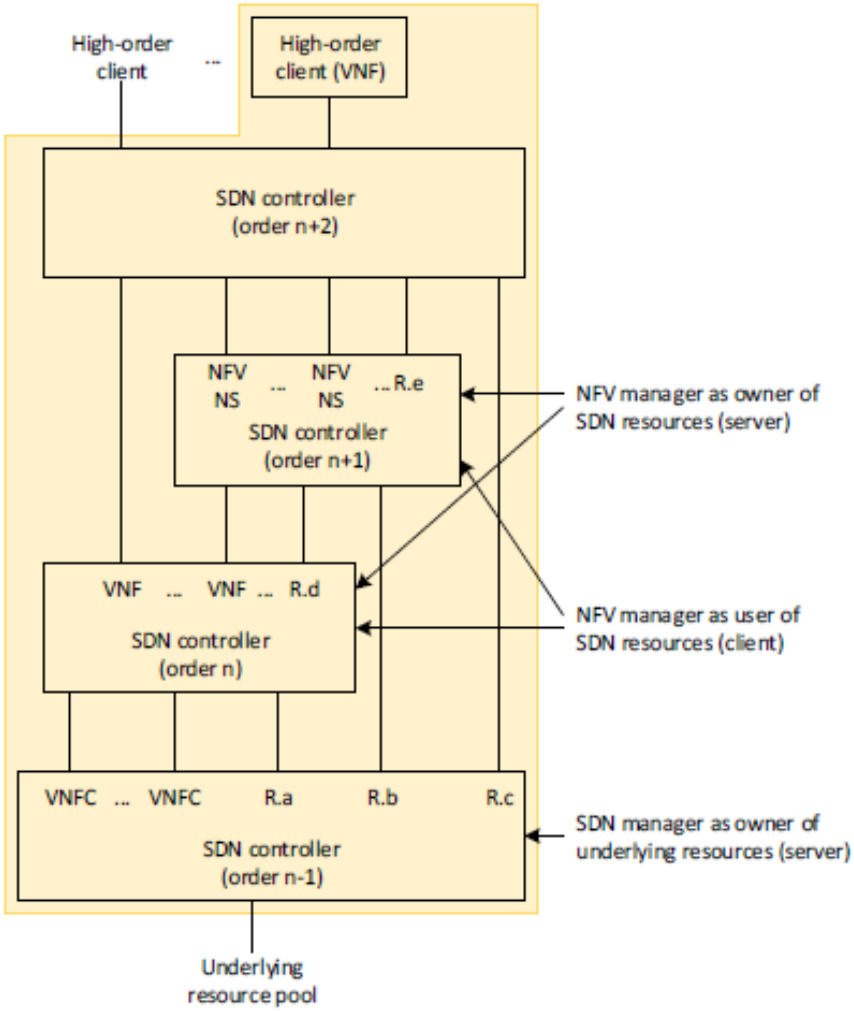


Impact:

- Security
- Multi-Tenant Segmentation
- Multi-Controller Interaction
- Multi-OSS Environment

These aspects discussed in ONF Technical Communities.

A1.

Do SDN and NFV enable fixed network access which gives alternative network operators more control over the network of the incumbent compared to current layer 2 wholesale access products (also known as Ethernet bitstream or virtual unbundled local access (VULA))?

- Yes, granularity of OpenFlow, recursive control/services
- Defined Interfaces, information models, etc. are under development to enable this. These elements will not necessarily be standardized but follow the software model (e.g. software APIs) supporting evolution to incorporate new capabilities.
- Indeed. Currently a range of provisions/options exist in an evolving vendor landscape (orchestration solutions, platforms for VNFs, overlay solutions) – “vendor SDN” versus “open SDN”

CAVEAT: Outstanding security questions to be resolved

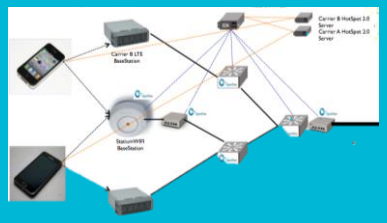
Q2.

Will SDN and NFV enable other new forms of network access or network sharing?

- If this is the case, please present them.
- Will SDN and NFV facilitate new services that enable end users to set up data (Ethernet) connections dynamically on-demand similar to phone calls?
- Will SDN and NFV enable network operators to offer Virtual Network Functions (VNF) as a service to other operators? Do you expect that this will happen? Which VNFs?

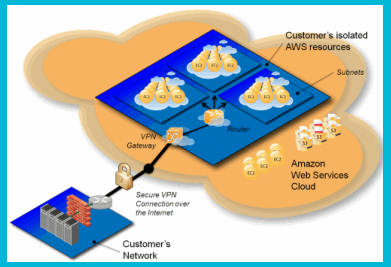
A2. Operator Open SDN Deployments

Every trial of ONOS, ODL, Ryu; Dynamic Provisioning; their own DCs; SD-WAN; Transport SDN



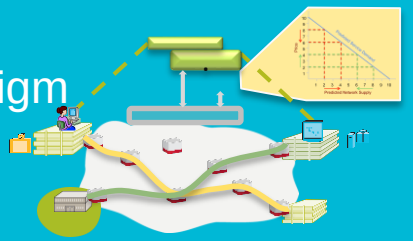
Telecom Operators

Virtualization & abstraction, layer separation, scaling



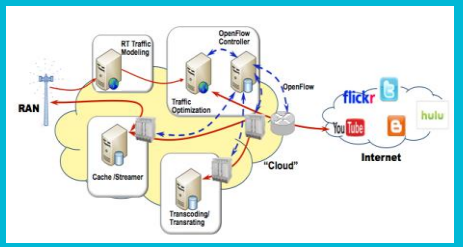
Cloud Providers

SFC in hypervisors, match-action paradigm



NFV Trials

Simplification, OpEx reduction



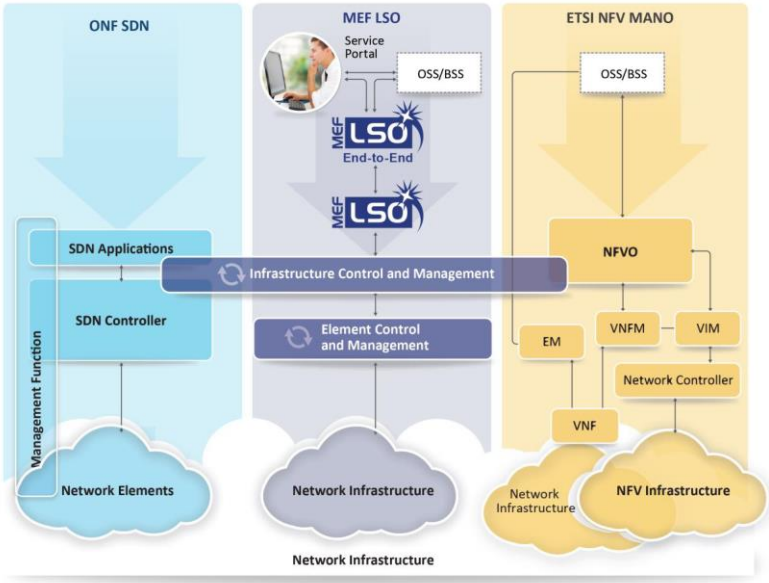
SMEs

"Open" = published but not controlled by a single party

A2.

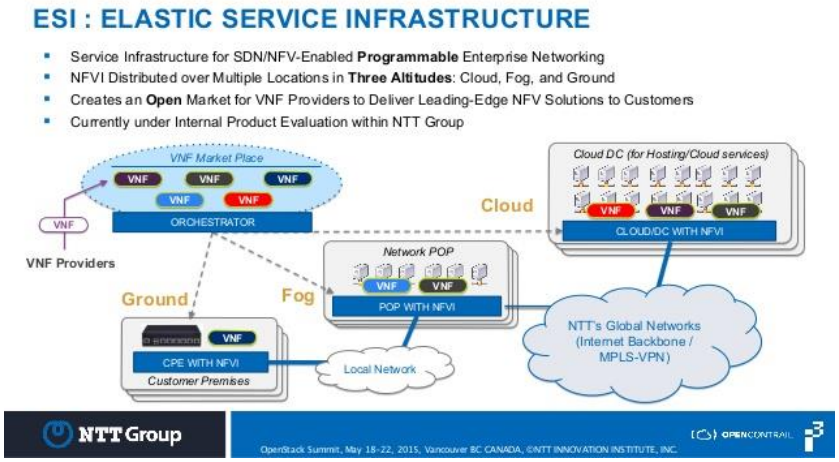
Will SDN and NFV enable other new forms of network access or network sharing?

- Yes, possible and currently offered
- Yes, Carrier Ethernet e.g. MEF Lifecycle Service Orchestration



Ref: *"The Third Network: Lifecycle Service Orchestration Vision", MEF 2015*

- Yes, a whole range – e.g. NTT

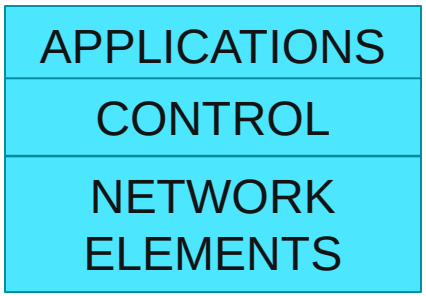


Ref: *"Delivering a Carrier-Class NFV Use-Case", NTT Group, OpenStack Summit, May 2015*

Q3.

Will SDN and NFV have an (further) impact on the current value chain? If this is the case, please present how SDN and NFV will alter the current value chain.

A3. Yes.



Current –
All-in-One, Dedicated

General-Purpose Products –
Specialists in Individual
Components & Technologies

Q4.

Will SDN and NFV have an impact on the relation between OTT and telecommunications service providers? If this is the case, please present how SDN and NFV will alter the role and possibilities of OTT and telecommunications service providers.

A4.

Yes, SDN and NFV enable TSPs to become more competitive with OTTs and more like the OTTs …

OTT:

- Swifter at creating new services;
- Software skills and commodity hardware expertise;
- Unimagined scale;
- Building private telco facilities;
- Deploy highly optimized, unique, dynamic services

TSP:

- Diversity reflecting local needs, cultures, and societies;
- Exploit SDN/NFV to streamline, serve more specific customer needs;
- Unimagined scale in China

Q5.

Do SDN and NFV have other regulatory implications?

A5.

Early days - gradual transition with great benefits

Recommendations:

Don’t stifle innovation by regulating SDN and NFV just yet!

Focus on standardized, open interfaces.


Thank You!
Questions?