



SDN and NFV as expressions of a systemic trend «integrating» Cloud, Networks and Terminals

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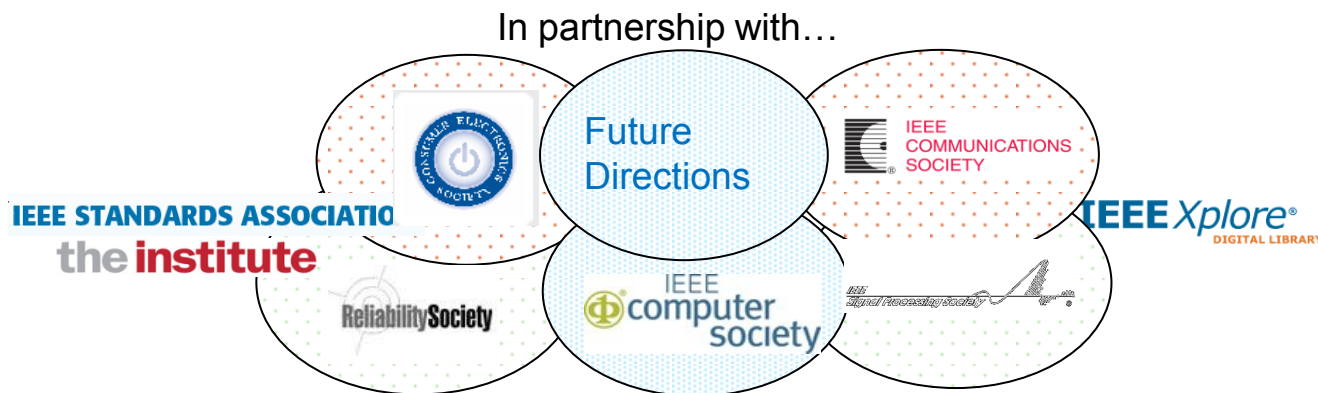
SDN-NFV Standardization Committee Meeting, 23rd June, 2015

Abstract

- ❑ SDN and NFV are not only concerning Networks. SDN and NFV are facets of a systemic trend, called Softwarization which is aiming at «integrating» Cloud, Networks and Terminals.
- ❑ In fact, Softwarization can be seen as a crossing point of key technological trajectories, such as: pervasive diffusion of ultra-broadband; IT HW performance increase (at lower and lower costs); growing availability of Open Source SW; more and more advanced terminals.
- ❑ In view of that, it is likely that Softwarization will be exploited by Industry with a bimodal approach, through two innovation cycles: a relatively slow one, looking at a seamless evolution of current network infrastructures towards SDN/NFV, and a much faster one, handling systemic and potentially disruptive adoptions (not delayed by legacies), where markets dynamics will select fast emerging “standards-de-facto”.
- ❑ It is argued that overall Standardization activities should be ready to face this bimodal strategy towards the Softwarization of Telecommunications by focusing, prioritizing and addressing the very key issues at the basis of these two co-existing approaches.

Initiative Goal

- ❑ IEEE SDN is a cross-societies initiative aiming at developing a worldwide cooperation on Software Defined Network (SDN) and Network Function Virtualization (NFV) - under the leadership of IEEE - also by creating the conditions for a pre-industrial adoption of SDN-NFV paradigm in Telecommunications and ICT.
 - ❑ A main challenge will be overcoming current fragmentation of the landscape by reaching a critical mass of leading technical experts (both from Industry and Academia), business managers of LE and SME, Entrepreneurs, Open Source communities, early adopters, Regulators, Policy makers, real Users, etc;
- ❑ IEEE SDN core team is composed of about 50 Experts actively involved in 7 Committees:
 - ❑ Conference, Education, Publicity, Publication, Standards, Pre-Industrial and Out Reach;
- ❑ Initiative is currently followed by the a Technical Community of about 2200 people.



What's today understanding on SDN and NFV ?

- The two basic principles of SDN – NFV are not new:
 - the former is about the separation between s/w and h/w has been around for a long time (e.g., active and programmable networks);
 - the later leverages on virtualization of network and IT resources which was demonstrated and exploited in IT systems after in the '60ties;
- At the beginning SDN – NFV have been mainly considered as technologies for the evolution of current core Telecommunications networks (e.g., routers, switches, transmission nodes, and middle-boxes);
- IEEE SDN is arguing that there is much more than that: said paradigms are part of a broader systemic trend called «softwarization» which will impact all Telecommunications and ICT areas (from terminals, to the edge network, to the core network to the Data Centers).

What's today understanding on SDN and NFV ?

- **«Softwarization» will bring Telecommunications and ICT towards the «software-centric platforms» capable of integrating «networks and services capabilities», to offer anyplace, anytime access to programmable services and applications (API);**
 - *IDC, for example, argues that this will be the primary growth driver of the Telecom and ICT industry over the next decade, responsible for 75% of the growth as worldwide industry spend moves from \$3.2 trillion in 2013 to \$5.3 trillion by 2020.*
- **SDN and NFV are not new but “more mature and sustainable” today due to:**
 - *1) the levels of penetration of ultra-broadband (fixed and mobile);*
 - *2) the dramatic increase of performance of IT systems;*
 - *3) the cost reductions in ICT;*
 - *4) the availability of Open Source S/W;*
 - *5) the availability of more and more powerful terminals...*

SDN and NFV is NOT only about Networks

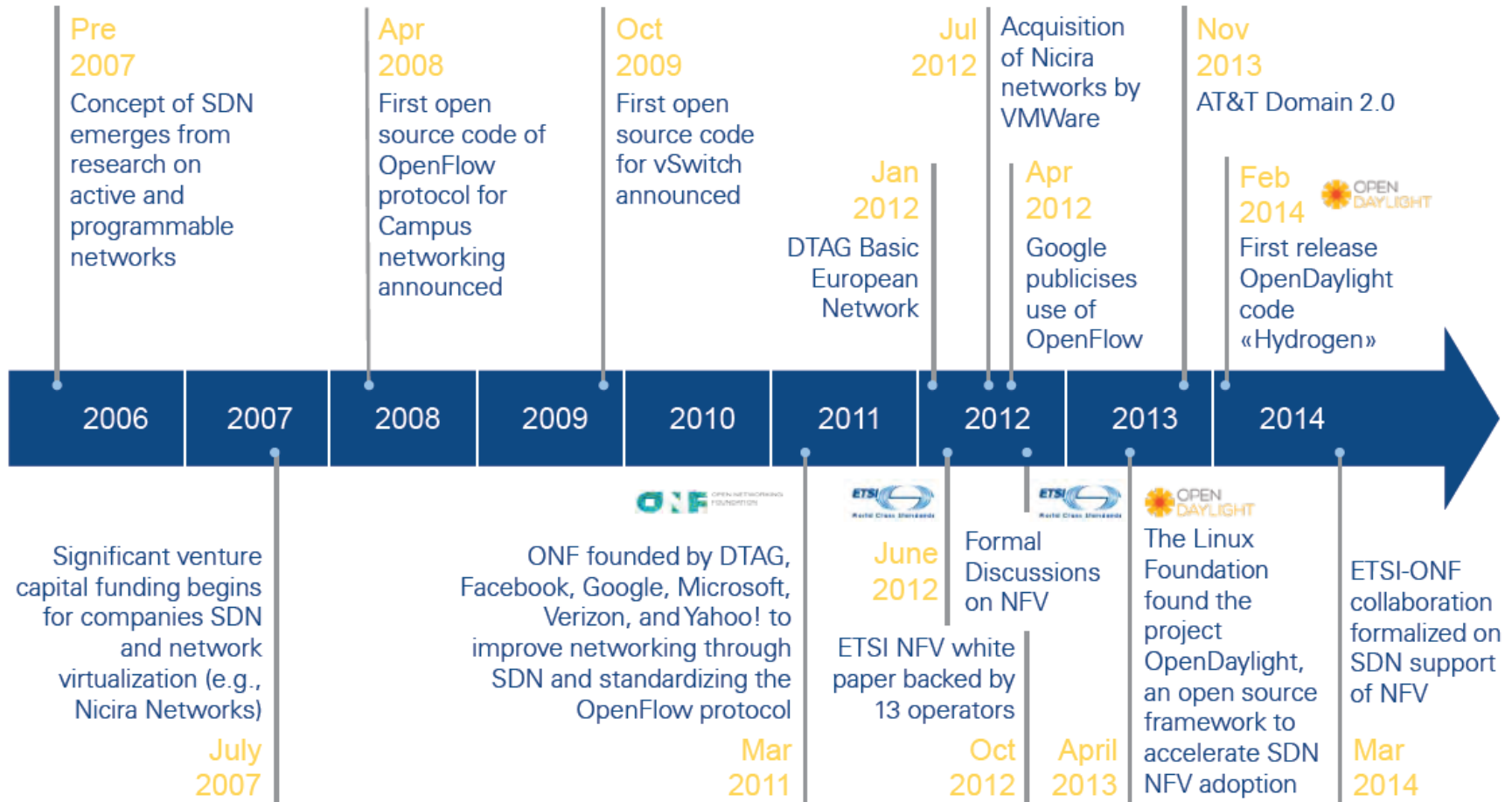
**Softwarization is a systemic trend impacting e-to-e
all Telecommunications domains (up to terminals)**

Softwarization = technology + business + regulations

IEEE SDN Challenges

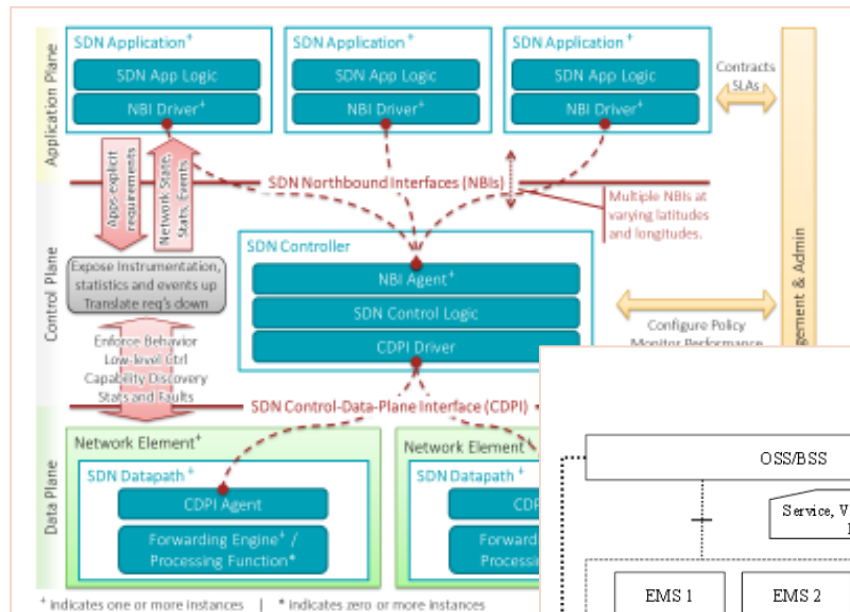
- **Standardization of a reference functional model/architecture (levels, abstractions, interfaces)**
- **Automation of Operations processes (current OSS/BSS cannot easily scale)**
- **Interoperability between “softwarized domains” and with the legacy infrastructures**
- **Best practice and Specs for testing the «open source» software (network and service functions, tools and platforms being adopted for «softwarization»);**
- **Reliability and performances**
- **Security “by design”**
- **The new value chain and the regulation rules**
- **Educating Industry managers, technical experts and, in general, students, common people about this change of paradigms in Telecommunications (Digital Society and Digital Economy)**
- **Contributing to creating the new required skill (subjected to Softwarization)**
- **Anticipating the needs and creating the conditions for a pre-industrial exploitation of “Softwarization of Telecommunications” through experiments, PoCs..., but also creating of ecosystems.**

The landscape

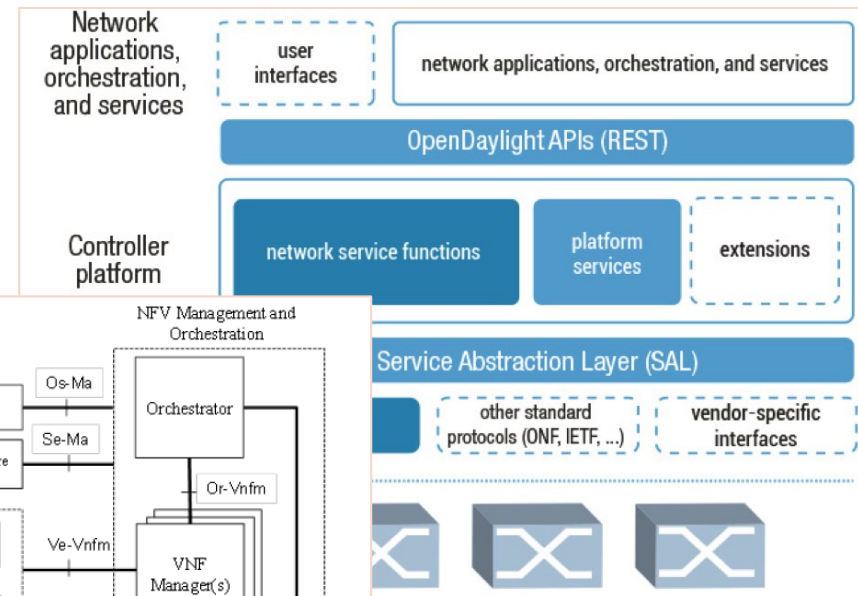


Source: ETSI, ONF, OpenDaylight and press articles

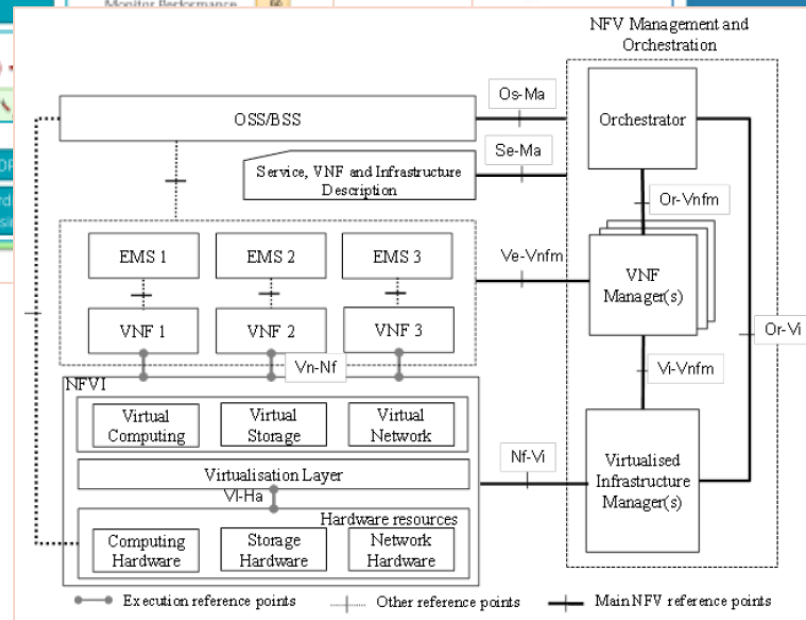
Several reference architectures...too many!



SDN reference architecture
(Open Networking Foundation)

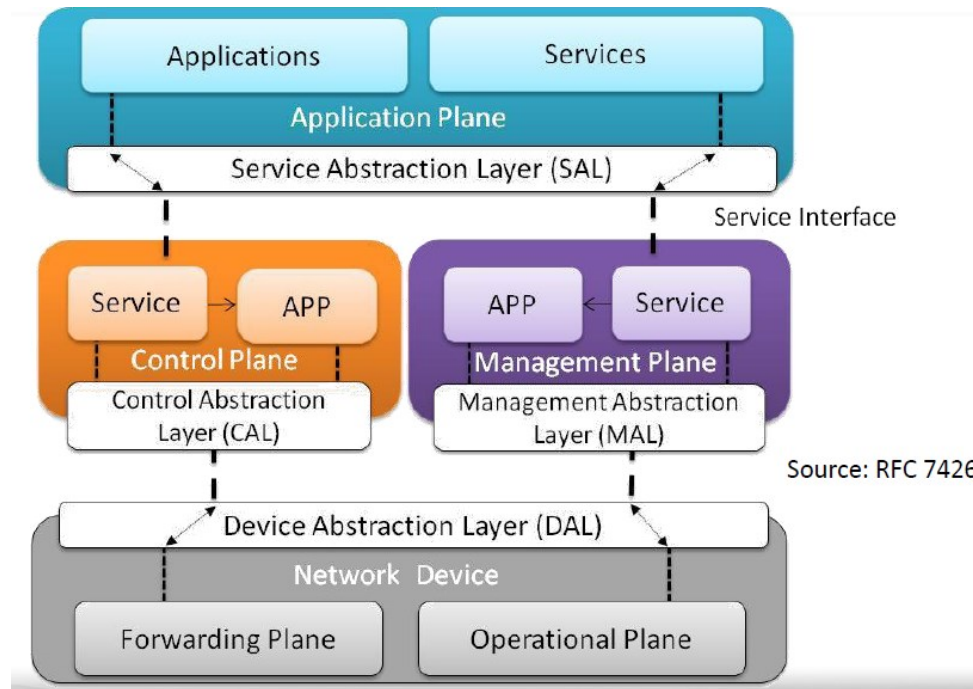


ODL reference architecture
(OpenDayLight – Linux)



NFV reference architecture
(ETSI)

Several reference architectures...too many!

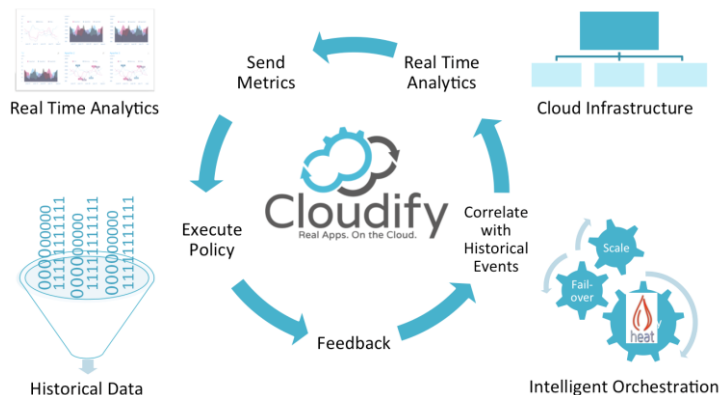


An interesting perspective:

Management and Control are becoming part of the dynamic design of the software architecture

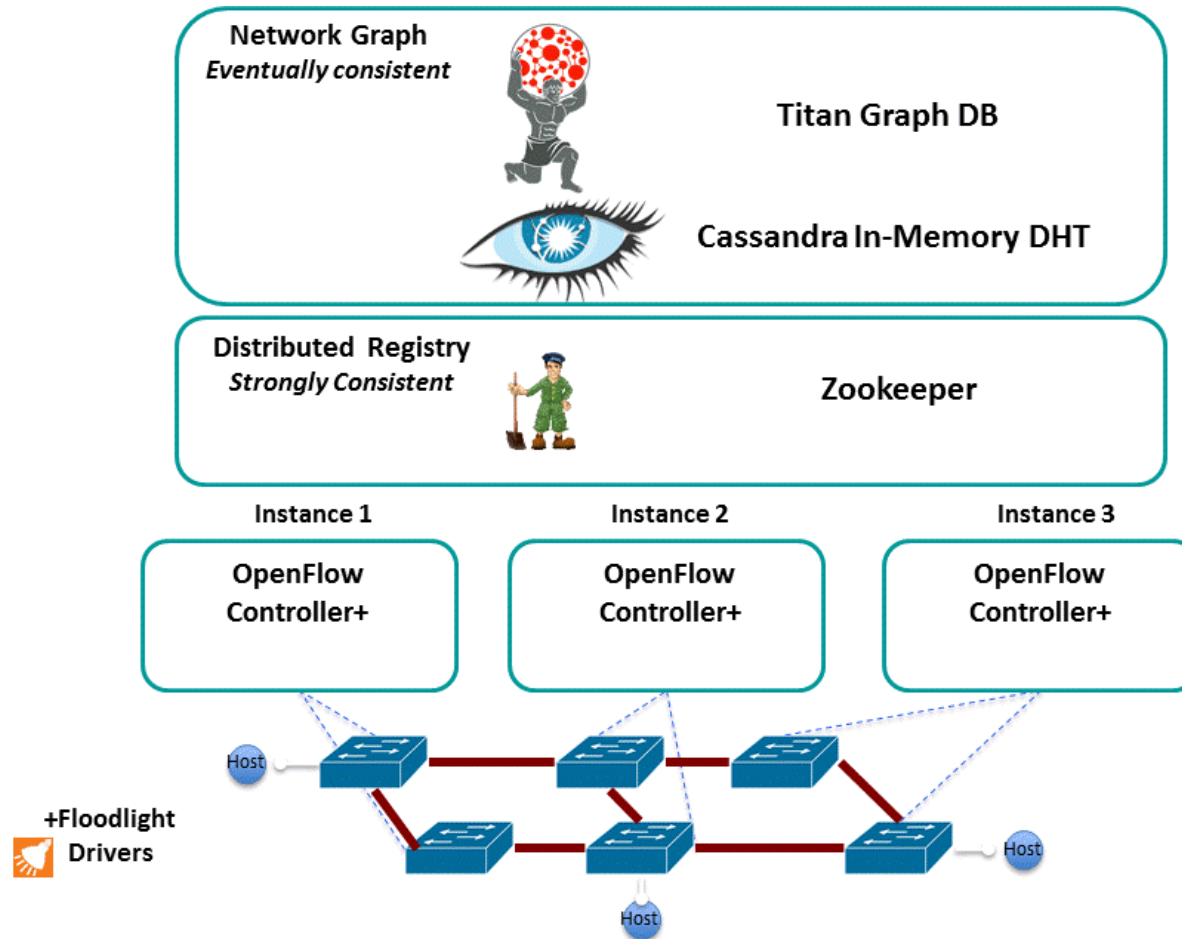
<https://tools.ietf.org/html/rfc7426>

Open Source Software tools and platforms



- **Cloudify** is an open-source tool adding monitoring, logging, alerts, analytics, workflow automation, software stack configuration, and dependency management;
- **OpenStack** is a free and open-source cloud computing software platform, which can be used as a based for an Orchestrator;
- **OpenDaylight** is an open source project developing a modular, pluggable, and flexible controller platform for SDN-NFV.

Open Source Software tools and platforms



Source: ON.OS

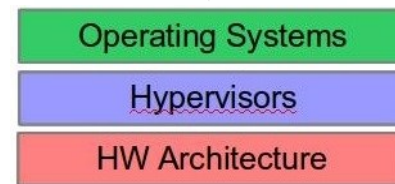
Towards the Future...

«Softwarization» of Telecommunications

1. Cost reductions (CAPEX, OPEX savings)
2. Automated Operations processes (more efficiency)
3. Flexibility, programmability, reduced TTM when provisioning services
4. New Service Paradigms (beyond commoditization of voice)
5. New Business models (OPEX-oriented)



Today
closed boxes



Tomorrow:
Virtual Network and Service Functions

Software-Centric Telecom Platforms...and «Culture»

Are we ready ?

Towards the Future...some evidences



We are becoming a software company.

We've begun a cultural shift within AT&T to embrace this new software-centric model.

We have a dedicated organization of more than 2,000 people focused solely on building this software-centric architecture.

And we're hiring new talent as well as retraining our current employees, with our workers enrolling in nearly half a million "Emerging Technology Training" courses covering Agile Project Management, Cybersecurity, Network Transformation and more.

We're also seeing a growing ecosystem of providers, startups and small companies as well as traditional telecom vendors.

And we're collaborating with open source groups such as OpenStack, ON.Lab, Open Daylight, OPNFV and others

<http://about.att.com/innovationblog/3215howdoyoukeeppace>

Towards the Future...

Apps

Apps

Apps

Apps

Distributed Software-centric Platforms

(network and IT functions services from Terminals, to the Network, to the Cloud)

APIs

«interoperability-embedded platforms»

«security by design»

Hardware Infrastructures

(data plane, processing-storage, fixed-radio connectivity)

What functional (software-centric) architectures ?

What's the impact of the underneath HW architectures ?

How trusting «Software-centric Platforms» ?

What Functional Architecture (we have too many today) ?

Which Specs, Validation Methods and Best Practices to test it.

Apps

Apps

Apps

Apps

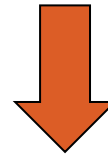
Distributed Software-centric Platform

(integration of network and IT services from Terminals, to the Network, to the Cloud)

APIs

Hardware Infrastructures

(data plane, processing-storage, fixed-radio connectivity)



Test-beds

(network and IT resources)

Labs

(network and IT resources)

Field-Trials

(network and IT resources)



Terminals



Terminals

A global and open innovation experimental environment for testing and validating open repositories of «virtual network and service functions»

Interoperability

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NSI 101



Network Services Agent (NSA)

Requesting Agent (RA)

Provider Agent (PA)

Network Services Interface

NRM

Network Resource Manager (NRM)

NSI Network Service Domain

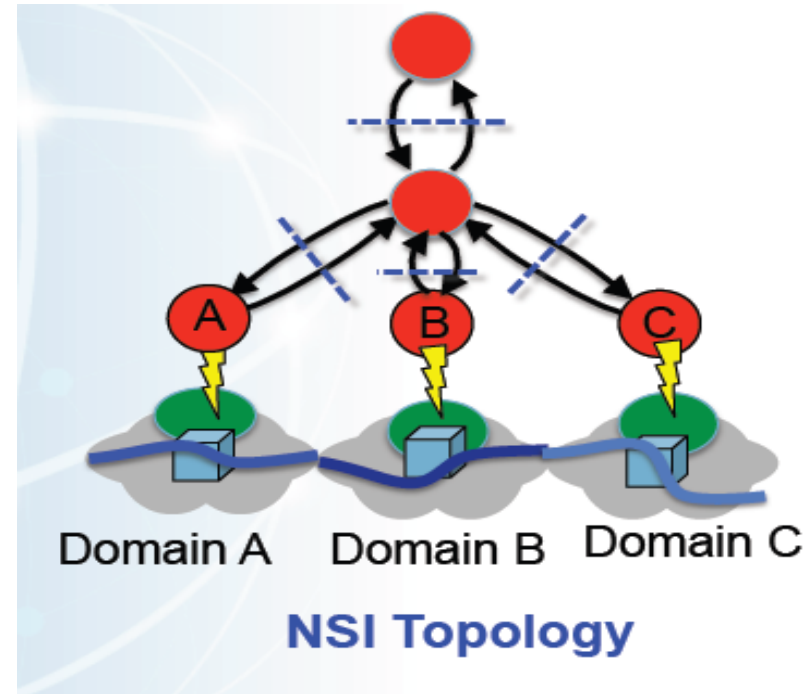
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Inder Monga, Tokyo 2013

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Lawrence Berkeley National Laboratory

U.S. Department of Energy | Office of Science



An interesting approach:

Network Services Interface (NSI): enabling multi-domain “softwarization”

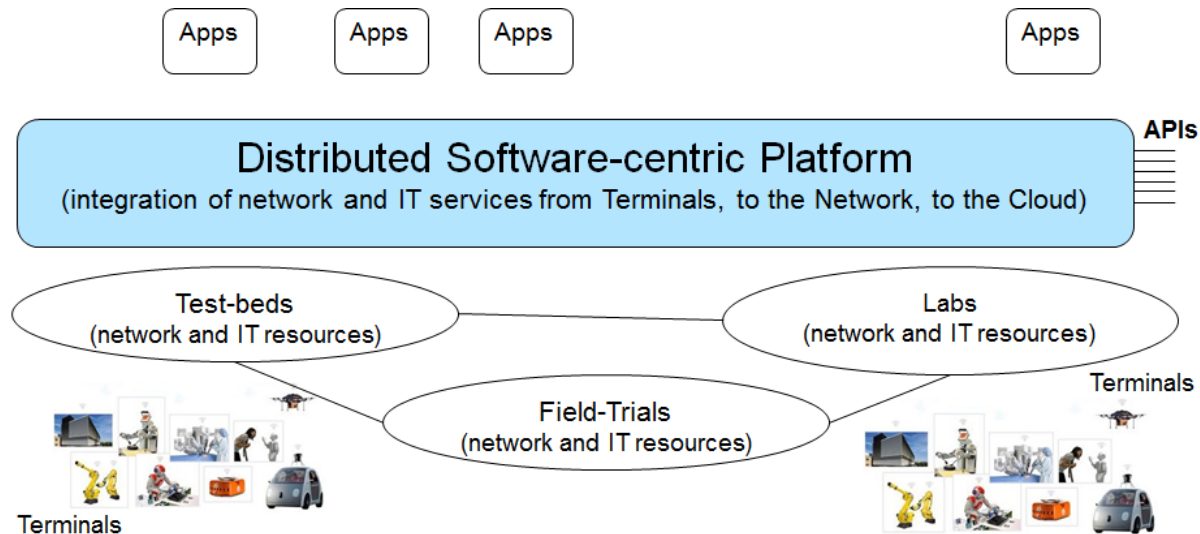
Summary

- ❑ SDN and NFV are not only concerning Networks. SDN and NFV are facets of a systemic trend, called Softwarization which is aiming at «integrating» Cloud, Networks and Terminals.
- ❑ Softwarization = technology + business + regulations
- ❑ Challenges includes:
 - Standardization of a reference functional model/architecture (levels, abstractions, interfaces)
 - Automation of Operations processes (current OSS/BSS cannot easily scale)
 - Interoperability between “softwarized domains” and with the legacy infrastructures
 - Best practice, Specs and Methods for testing S/W (network and service functions platforms);
 - Reliability and performances
 - Security “by design”
 - The new value chain and the regulation rules
 - Educating for the change of culture
 - Anticipating the needs and creating the conditions for a pre-industrial adoption of “Softwarization of Telecommunications” through experiments, PoCs...

Conclusions

❑ Living List of hot issue includes:

- ❑ What's the functional architecture for the Software-centric Platforms of the future ?
- ❑ What's the impact of HW architecture on the performance of the Software-centric platforms ?
- ❑ How trusting «Software-centric Platforms» ?
- ❑ Specs, Validation Methods and Best Practices for testing are required !
- ❑ A global and open environment for testing and validating «virtual network and service functions»



Federation of Open Field-Trials; Test-beds, Labs