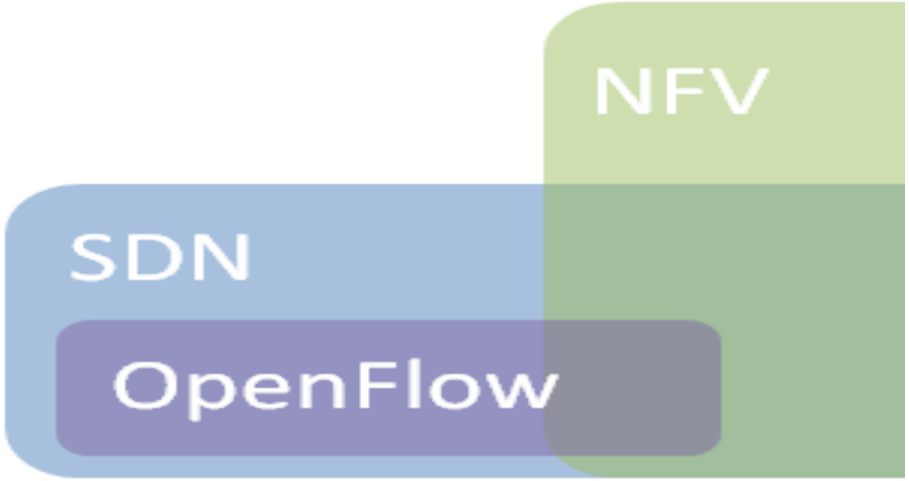

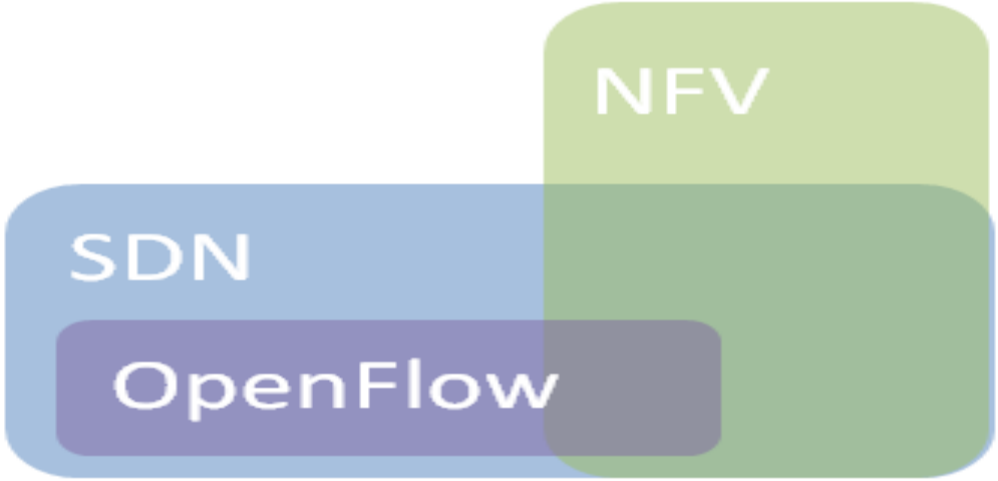

SDN/NFV—网络与分布式系统的统一

陈怀临，弯曲评论
www.valleytalk.org

ETSI World Class Standards

OPNFV

Top of mind for C-level executives

NFV tops the list of important trends

80% of executives (including 84% of CIOs and 76% of CTOs) surveyed said that the move to NFV is a top trend impacting their role.

36% chose the move to NFV as the most important trend.

NFV will be a major player in the single most important CSP market within three years according to 93% of respondents.

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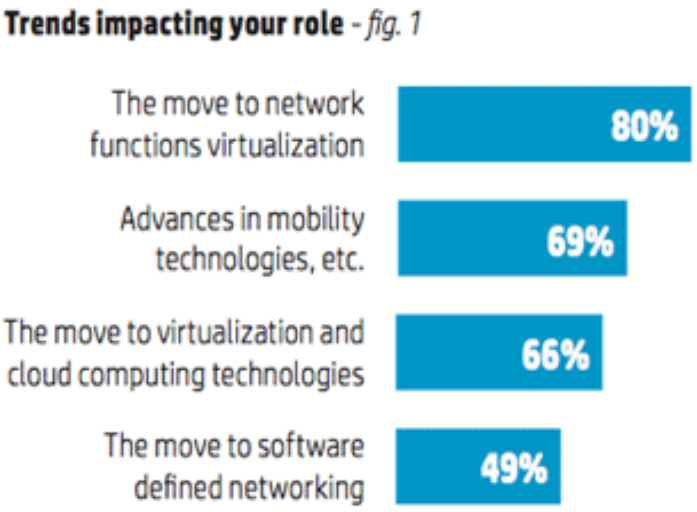
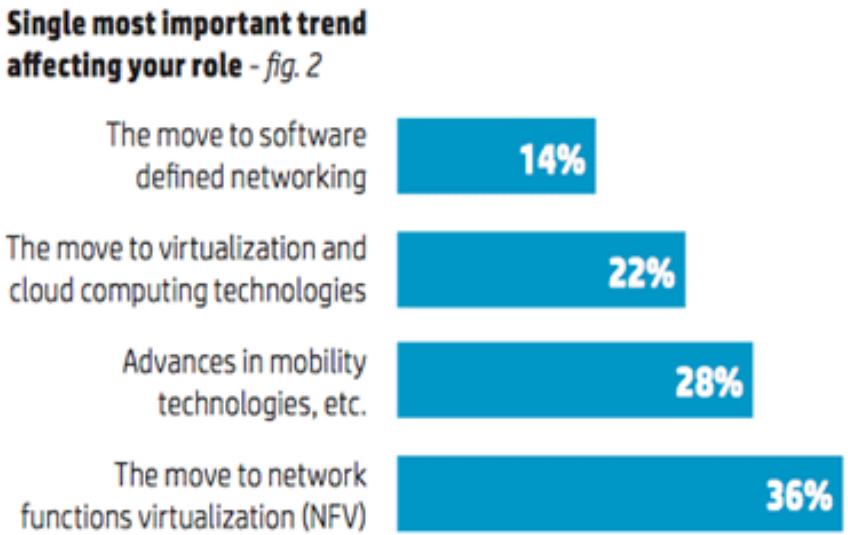
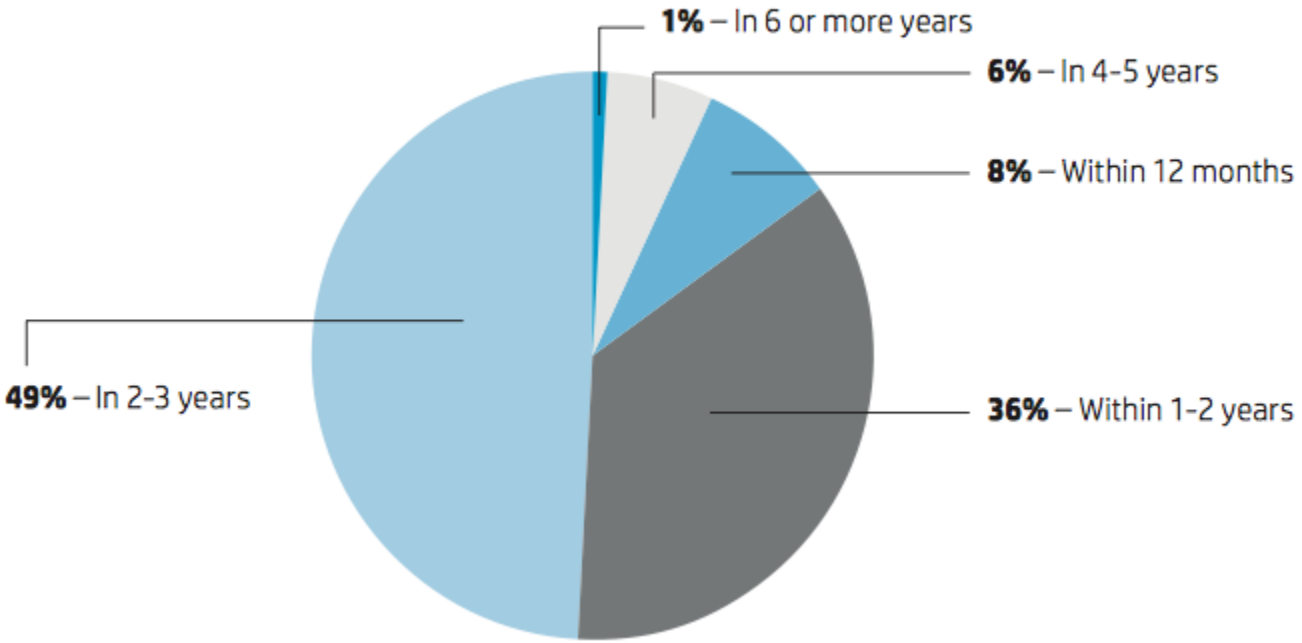
NFV out-trends SDN

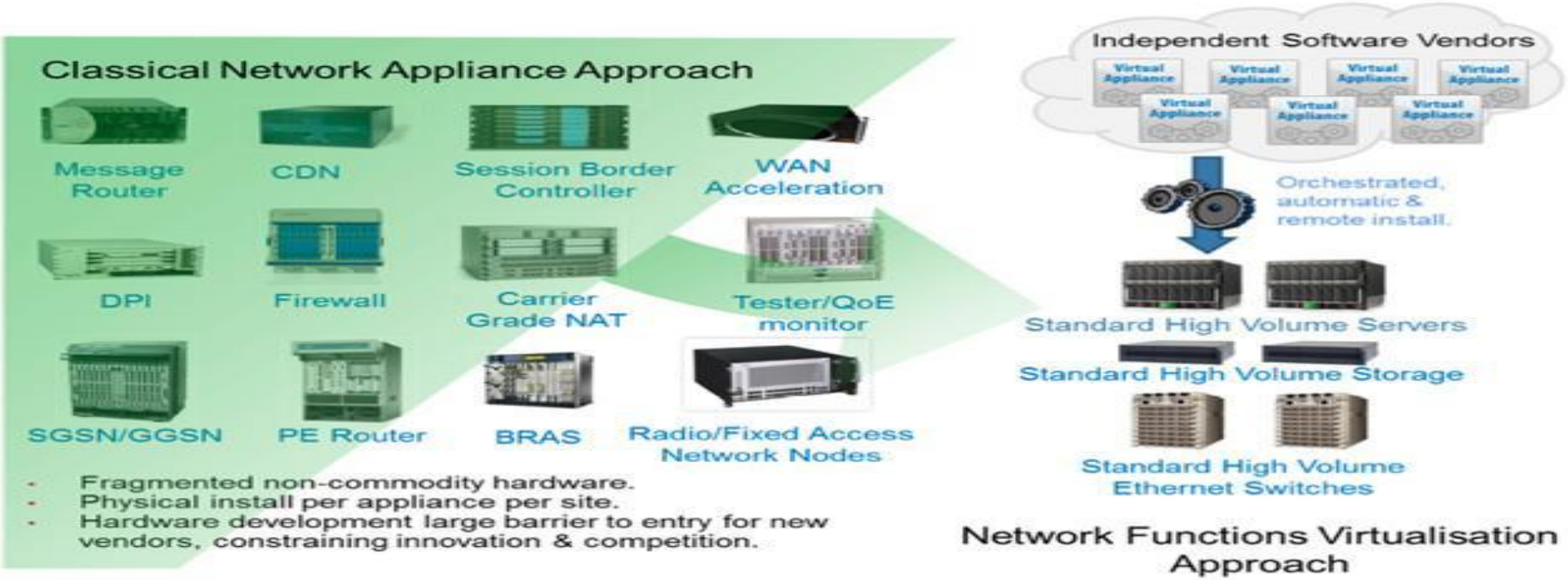




NFV to significantly impact CSPs

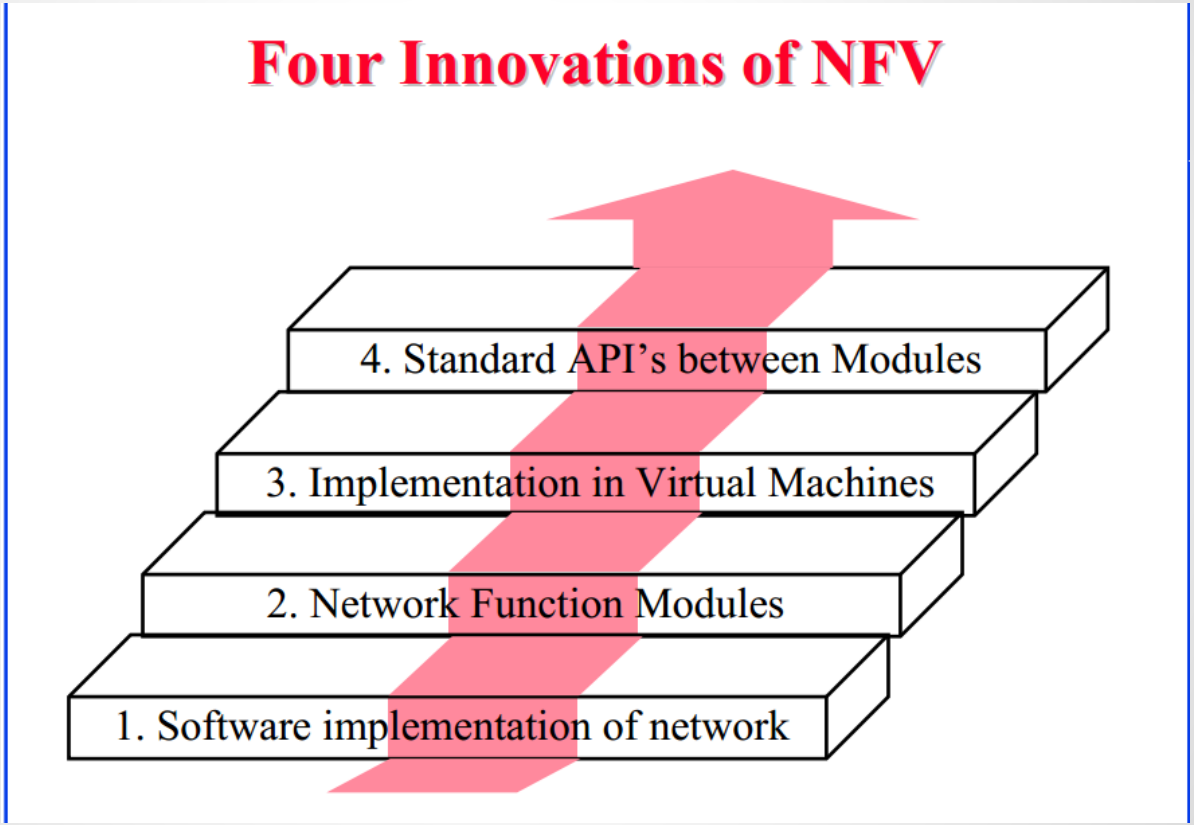
When will NFV be a major player in the CSP market? - *fig. 3*





What is SDN/NFV?

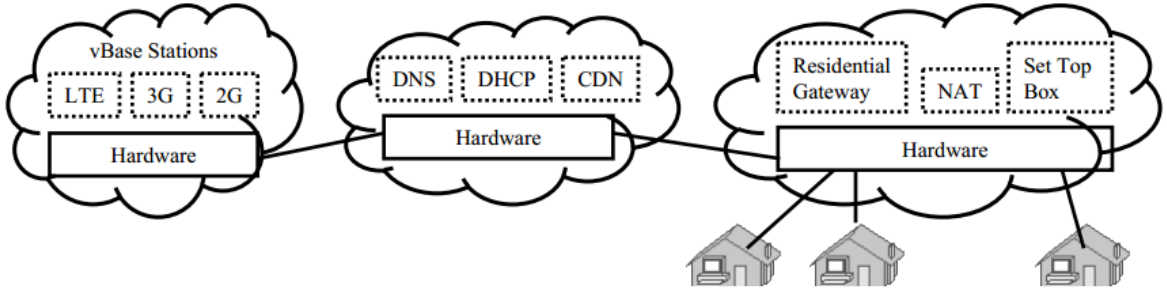
What's new with SDN/NFV?



What's new with SDN/NFV?

Network Function Virtualization (NFV)

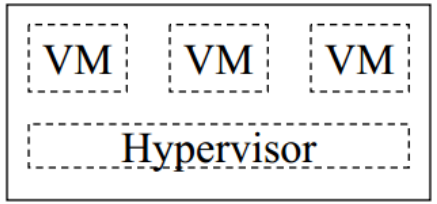
1. Fast standard hardware ⇒ **Software based Devices**
   Routers, Firewalls, Broadband Remote Access Server (BRAS)
   ⇒ A.k.a. *white box* implementation
2. **Function Modules** (Both data plane and control plane)
   ⇒ DHCP (Dynamic Host control Protocol), NAT (Network Address Translation), Rate Limiting,



What's new with SDN/NFV?

NFV (Cont)

3. **Virtual Machine implementation**
   ⇒ Virtual appliances
   ⇒ All advantages of virtualization (quick provisioning, scalability, mobility, Reduced CapEx, Reduced OpEx, …)



4. **Standard APIs**: New ISG (Industry Specification Group) in ETSI (European Telecom Standards Institute) set up in November 2012

Benefits of SDN/NFV

Why We need NFV?

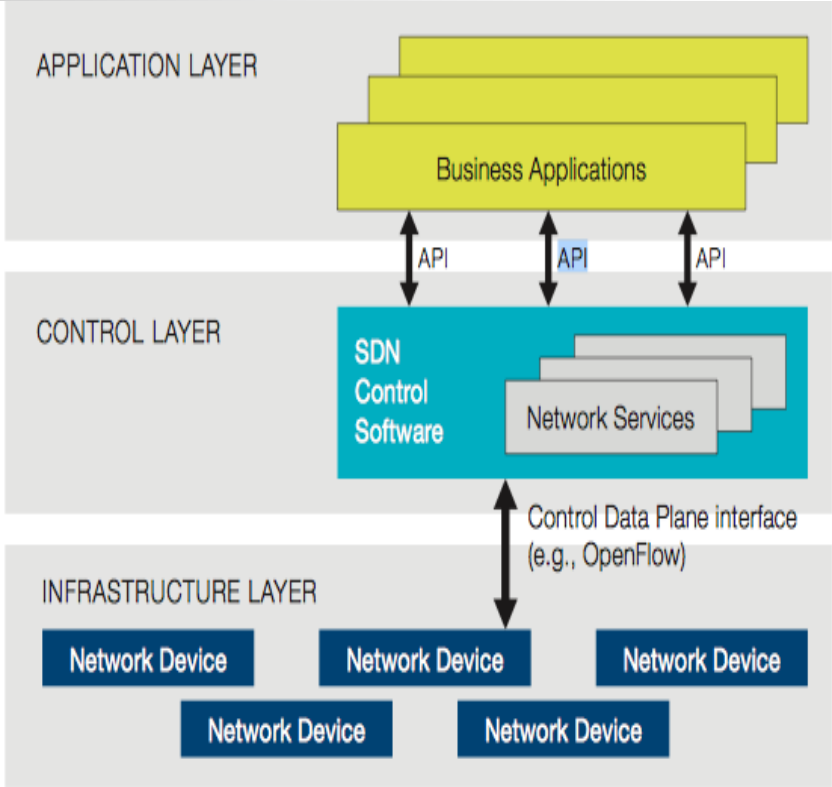
1. **Virtualization**: Use network resource without worrying about where it is physically located, how much it is, how it is organized, etc.
2. **Orchestration**: Manage thousands of devices
3. **Programmable**: Should be able to change behavior on the fly.
4. **Dynamic Scaling**: Should be able to change size, quantity
5. **Automation**
6. **Visibility**: Monitor resources, connectivity
7. **Performance**: Optimize network device utilization
8. **Multi-tenancy**
9. **Service Integration**
10. **Openness**: Full choice of Modular plug-ins

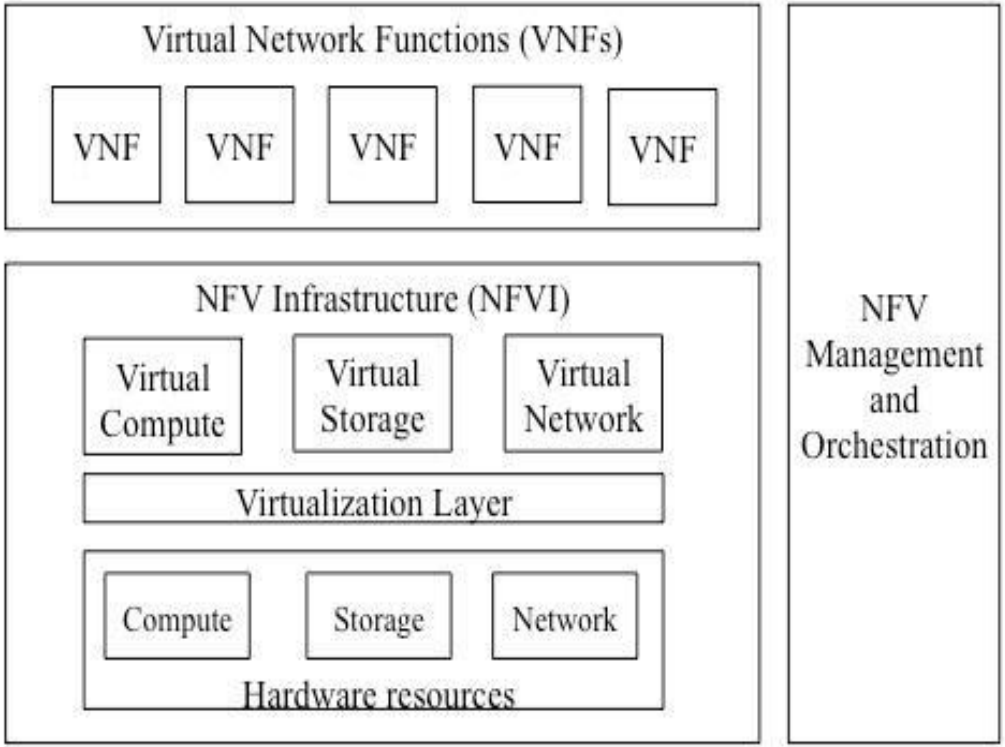
Essence of SDN/NFV

*** A new business process methodology for Carriers, rather than a new technology**

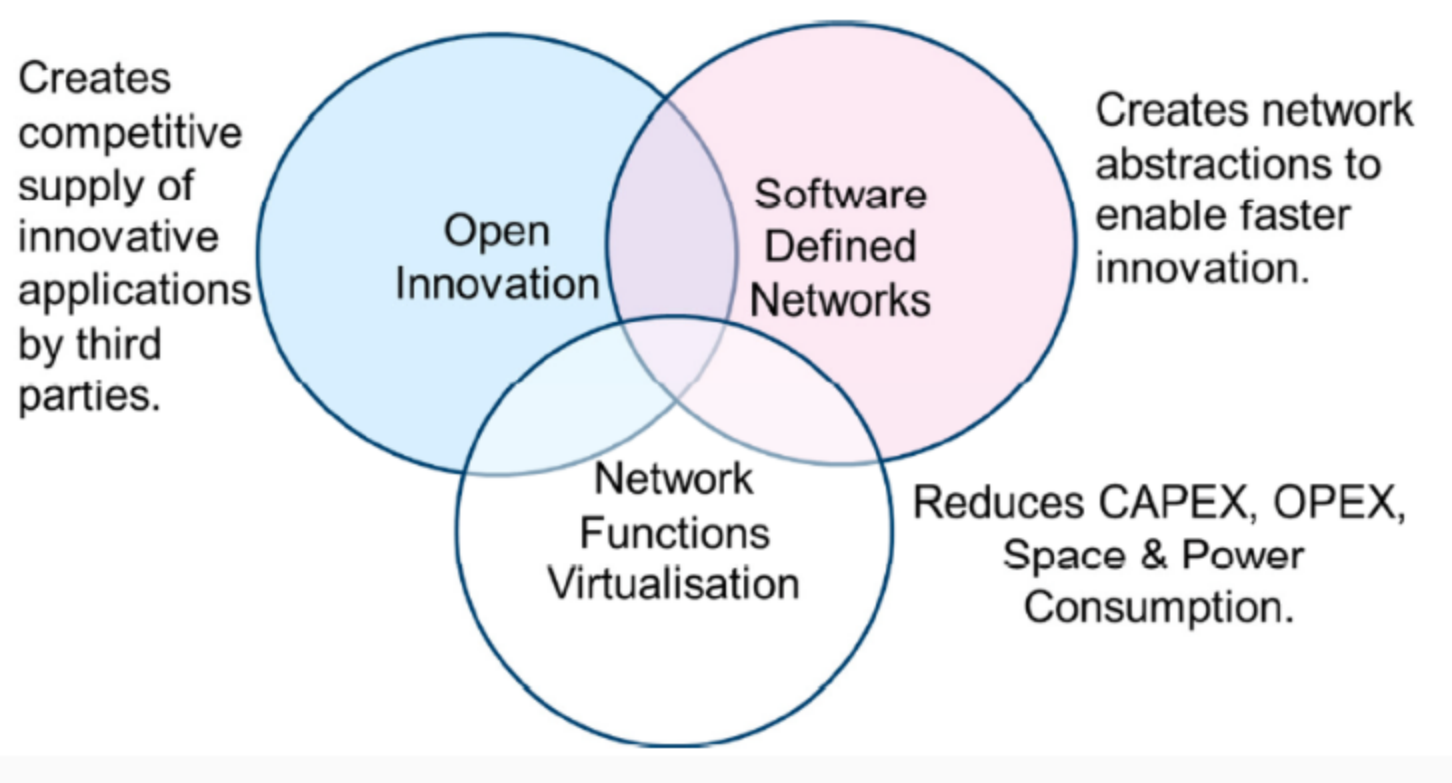
***Service *Providers* become enterprises. Huge new revenue streams for both SP and NFV software providers, e.g., VNO(Virtual Network Operator)**

SDN/NFV Architecture





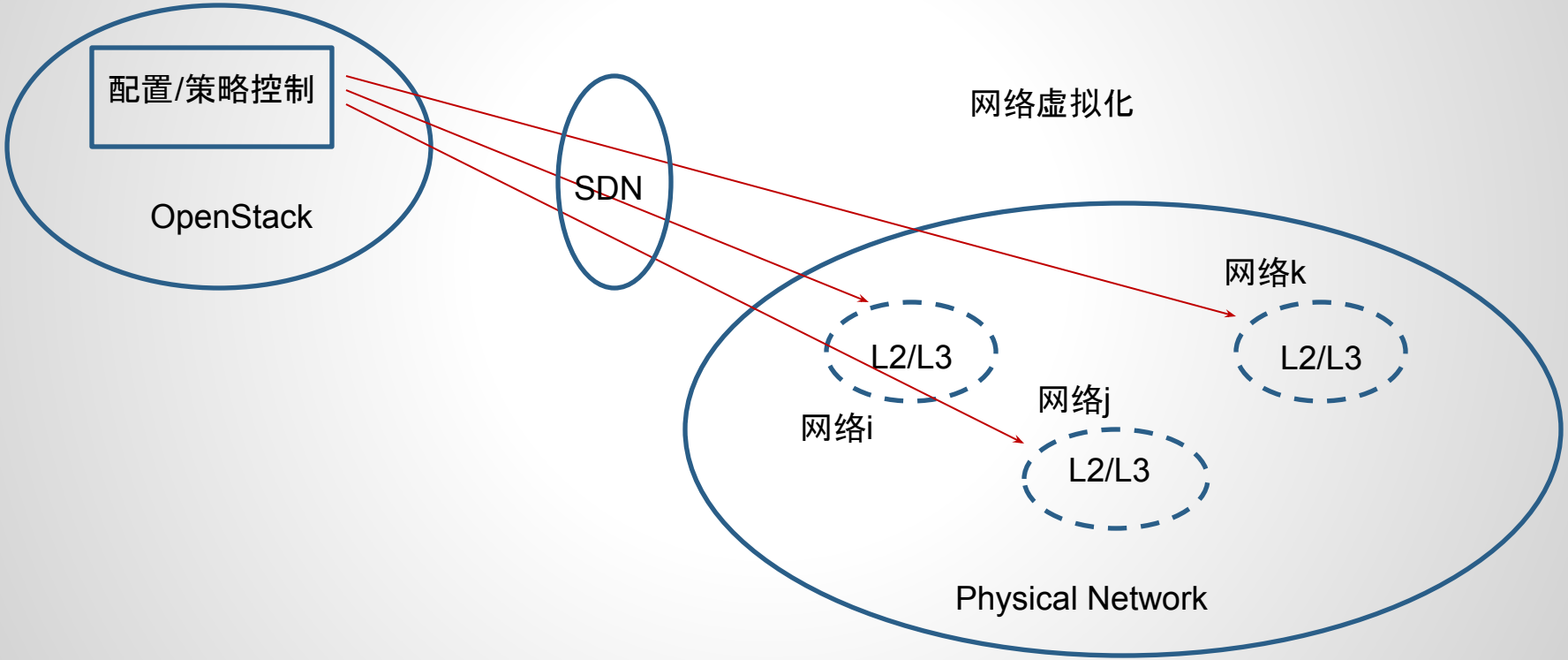
SDN & NFV will play together



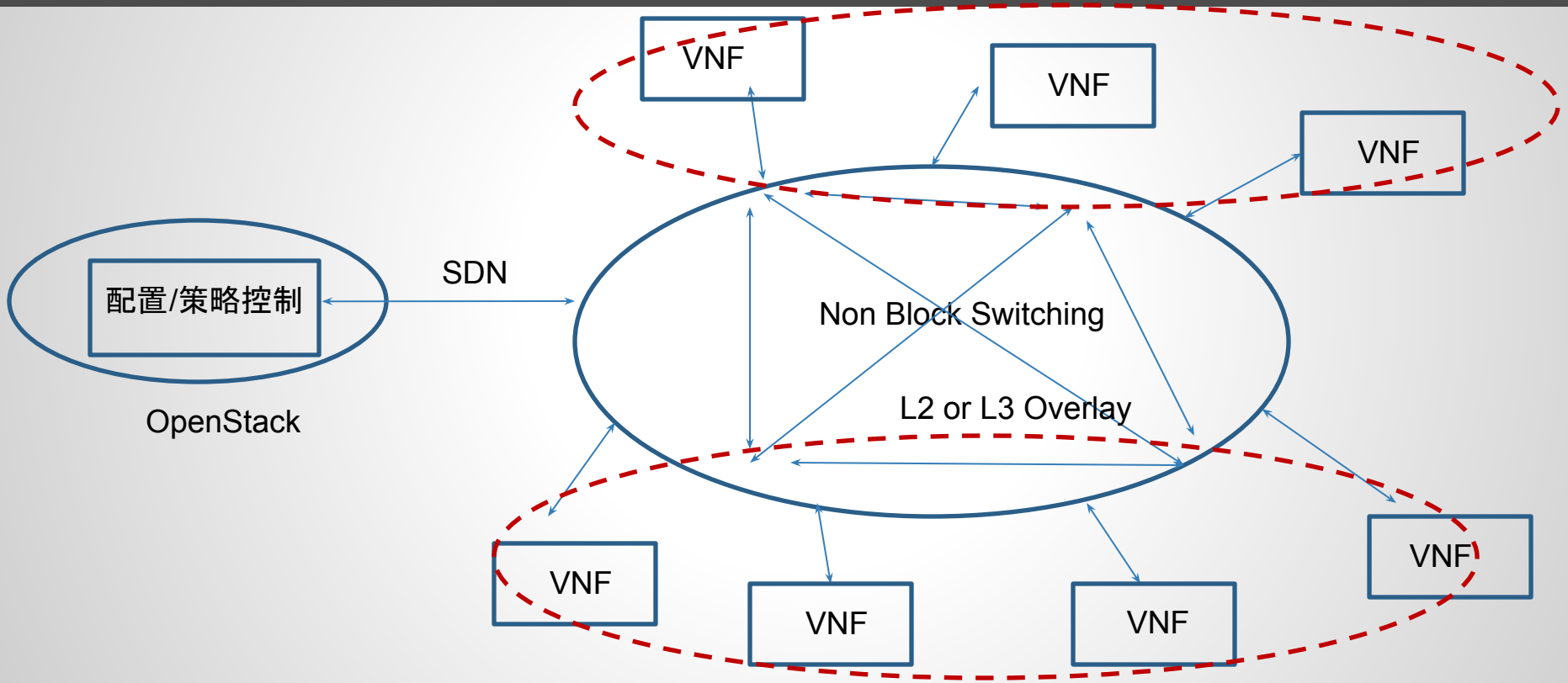
SDN & NFV side-by-side

Category	SDN	NFV
Raison d'etre	Programmability of network separation of data and control, centralization and control of	Transition to general-purpose server appliance from a dedicated network of function
Users of the target	Campus, data center / cloud	Service provider network
Device to the target	Switch and general-purpose server	Switch and general-purpose server
Initial application	Networking and cloud orchestration	Warranty router, firewall, gateway, CDN, WAN accelerators, the SLA
New protocol	OpenFlow	None yet
Standardization	Open Networking Forum (ONF)	ETSI NFV working group

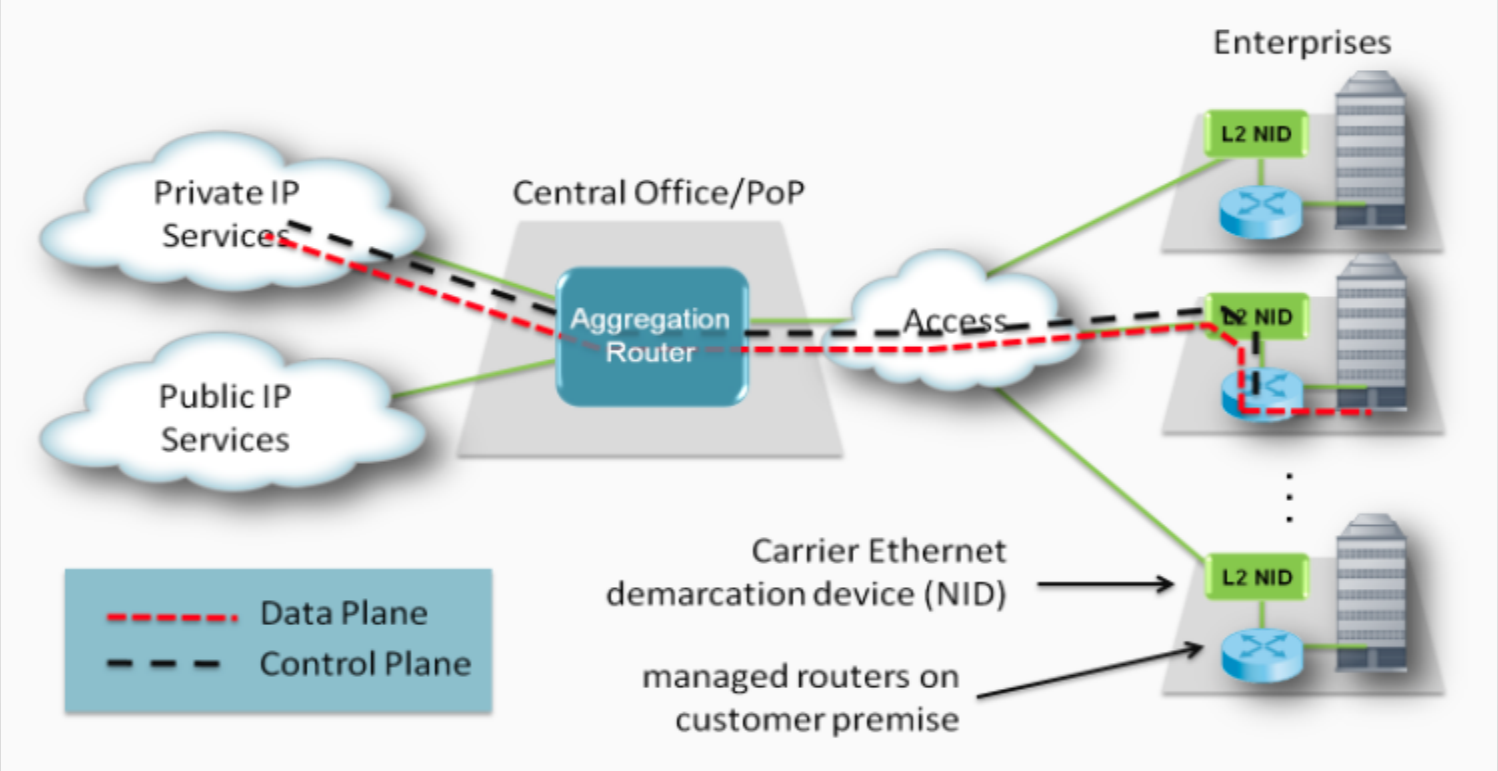
云平台, 网络虚拟化, SDN



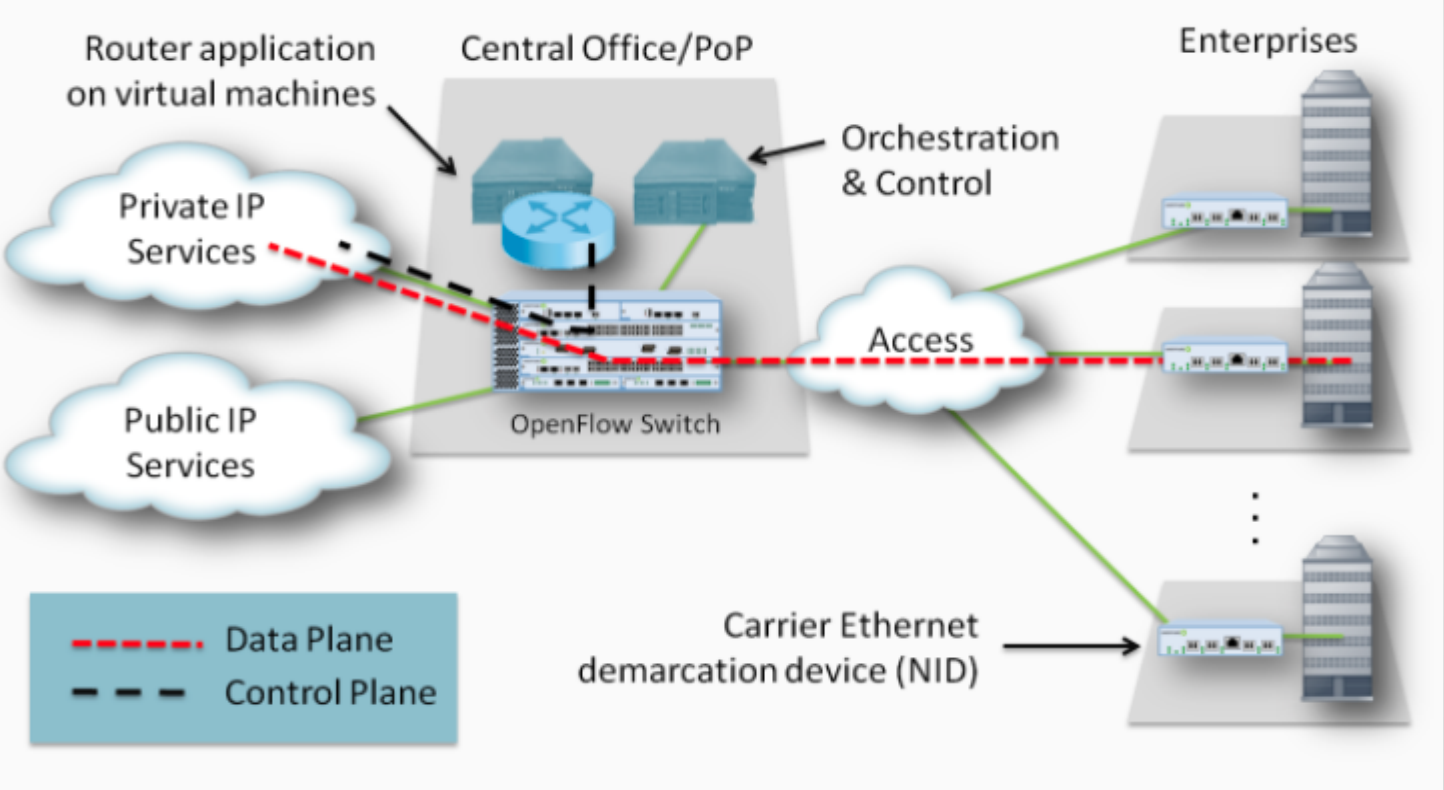
云平台，网络虚拟化，SDN, NFV



SDN & NFV working together



SDN & NFV working together (cont.)

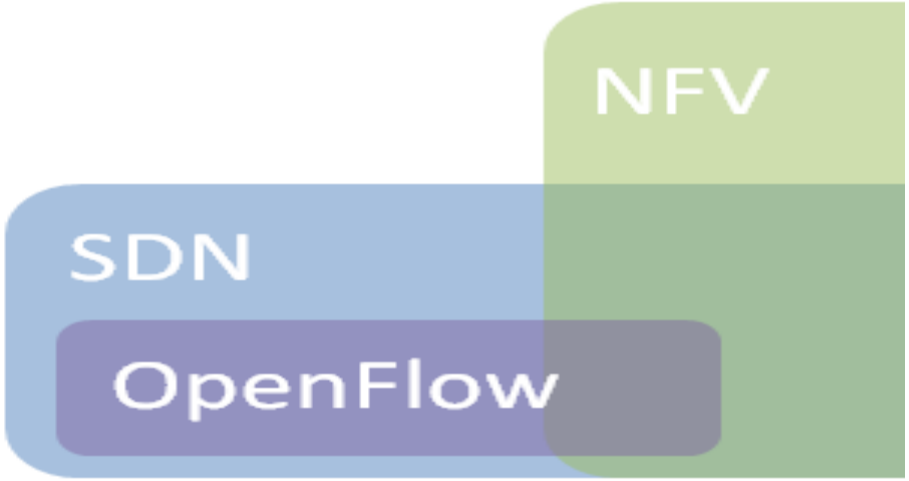


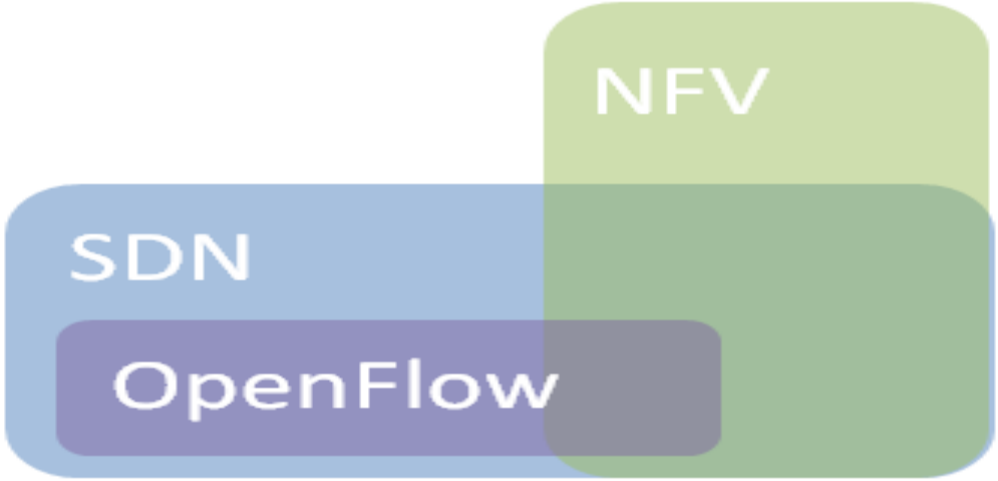
SDN & NFV Use Cases

NFV Use Cases

- **Cloud**:
  1. NFV infrastructure as a service (NFVIaaS) like IaaS
  2. Virtual Network Functions (VNFs) as a service (VNFaaS) like SaaS
  3. VNF forwarding graphs (Service Chains)
  4. Virtual Network Platform as a Service (VNPaaS) like PaaS
- **Mobile**:
  5. Virtualization of the Mobile Core Network and IMS
  6. Virtualization of Mobile Base Station
- **Data Center**:
  7. Virtualization of CDNs
- **Access/Residential**:
  8. Virtualization of the Home environment
  9. Fixed Access NFV

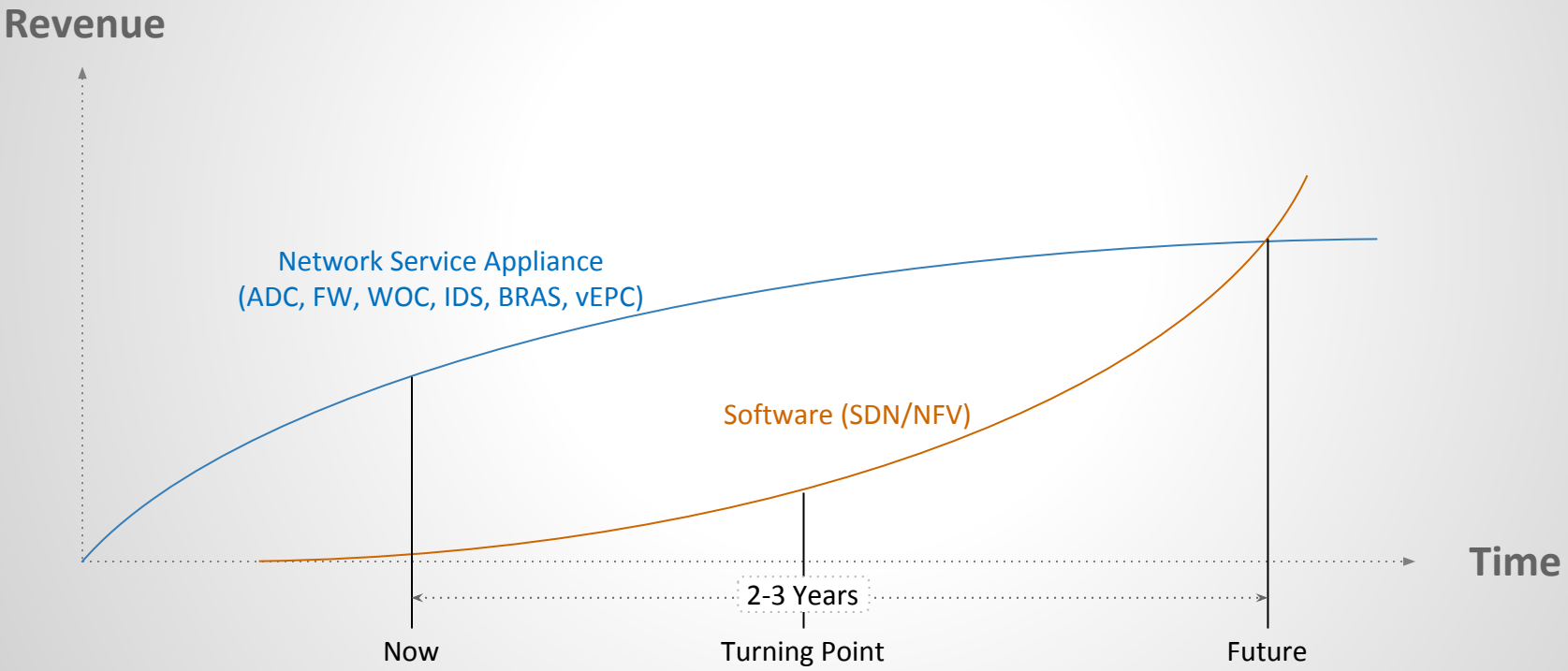
Ref: ETSI, "NFV Use Cases," http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf
Ref: M. Cohn, "NFV Insider's Perspective, Part 2: There's a Network in NFV – The Business Case for SDN," Sep 2013, http://www.sdncentral.com/education/nfv-insiders-perspective-part-2-theres-network-nfv-business-case-sdn/2013/09/





SDN/NFV—商业机会

Ready or not, the change is coming !



New Opportunities from SDN/NFV

- **Case 1:**
  - **Application Centric Network:**
    - ADC seamlessly guide SDN Controller providing L7 intelligence
- **Case 2:**
  - **Virtualized Network Functions for clouds service provider or/and service providers**
    - vADC is NFV's killer application

NFV Opportunity: vADC

•vADC and vFW are the killer apps for NFV --SDN Central . Matthew Palmer

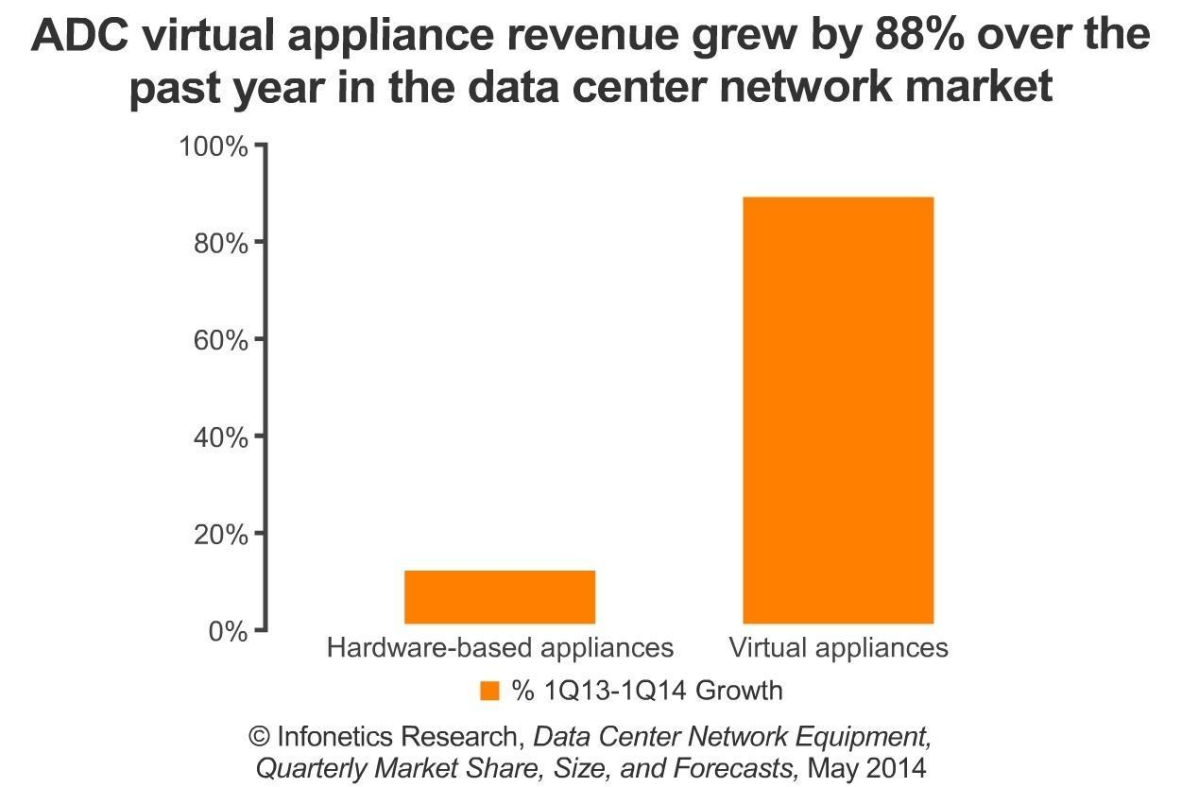
"**In the cloud data center, we mostly hear about NFV applications, such as, virtual application delivery controllers (vADCs) with end customers and virtual firewalls (vFWs).** In the CSP environment, NFV applications is mostly about virtual customer premises equipment (vCPE), and virtual evolved packet core (vEPC). For this article, we will focus on the most popular NFV use cases in cloud data centers and outline what you should do this year to lay the groundwork for NFV (I'll cover the CSP use cases in depth in a future article). **We see vFWs and vADCs as the two main technologies driving use cases for NFV applications in the cloud data center because both provide key functionality in the cloud environment. However, vADCs in many ways look like the most likely candidate to be one of the first apps broadly deployed to customers."**

NFV Opportunity: vADC

- vADC is the killer app for NFV --SDN Central . Matthew Palmer

"For apps developed and deployed in cloud environments, the ADC is a critical piece of the entire application environment that needs to be virtualized as a system and have the ability to move the entire application environment to any data center of choice. Many of these applications use ADCs in multiple layers within the cloud application such as the application front-end (i.e., a web server or API front-end) or back-end (i.e., balancing requests to back-end data stores and third-party applications), **which makes ADCs a key component of the overall application architecture."**

Cloud service providers



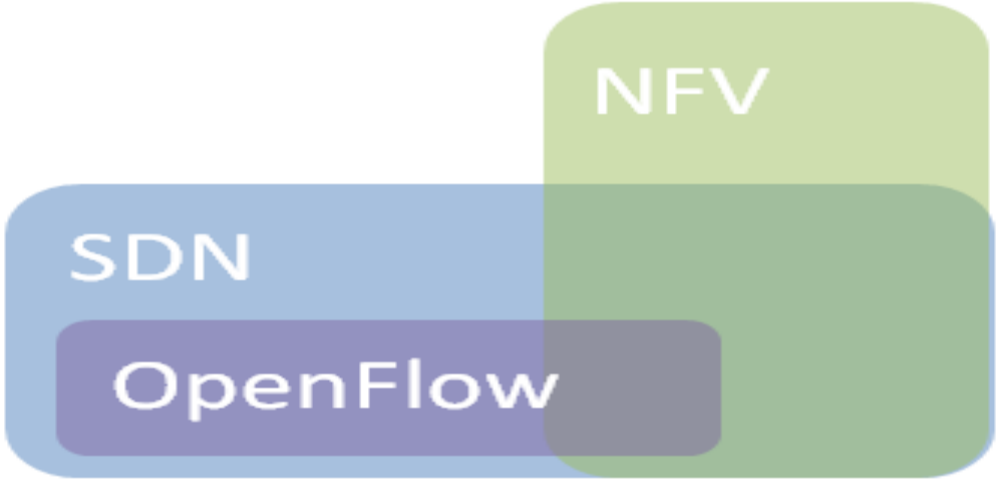
Summary: NFV Opportunity

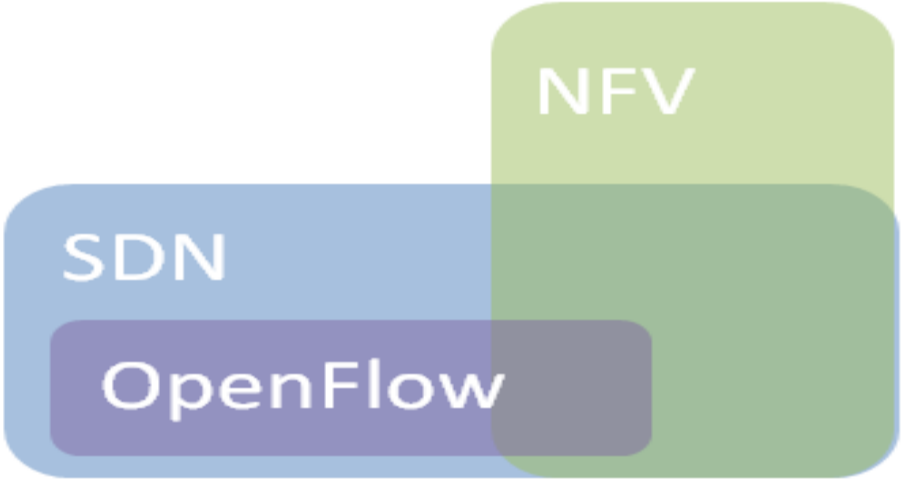
Clouds: HPC(Hybrid Private Cloud)VPC(Virtual Private Cloud) Business

Tenants need their own virtual L2/ L3 virtualized network inside a public cloud. Need vADC

Service Provider: vEPC, vBRAS, vCDN

Mobile Core and Access Network need ADC and Security functions for nested service train.

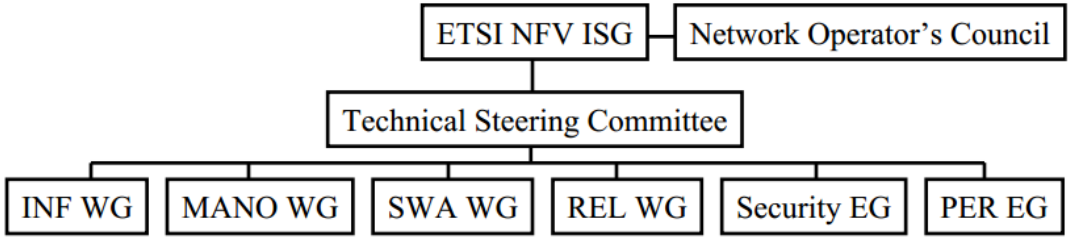




Corresponding Initiatives

ETSI NFV ISG

ETSI NFV ISG



- Industry Specification Group (ISG)'s goal is to define the requirements.
- Four Working Groups:
  - **INF**: Architecture for the virtualization Infrastructure
  - **MANO**: Management and orchestration
  - **SWA**: Software architecture
  - **REL**: Reliability and Availability, resilience and fault tolerance

Ref: M. Cohn, "NFV, An Insider's Perspective: Part 1: Goals, History, and Promise," Sep 2013, http://www.sdncentral.com/education/nfv-insiders-perspective-part-1-goals-history-promise/2013/09/

ETSI NFV ISG

ETSI NFV ISG (Cont)

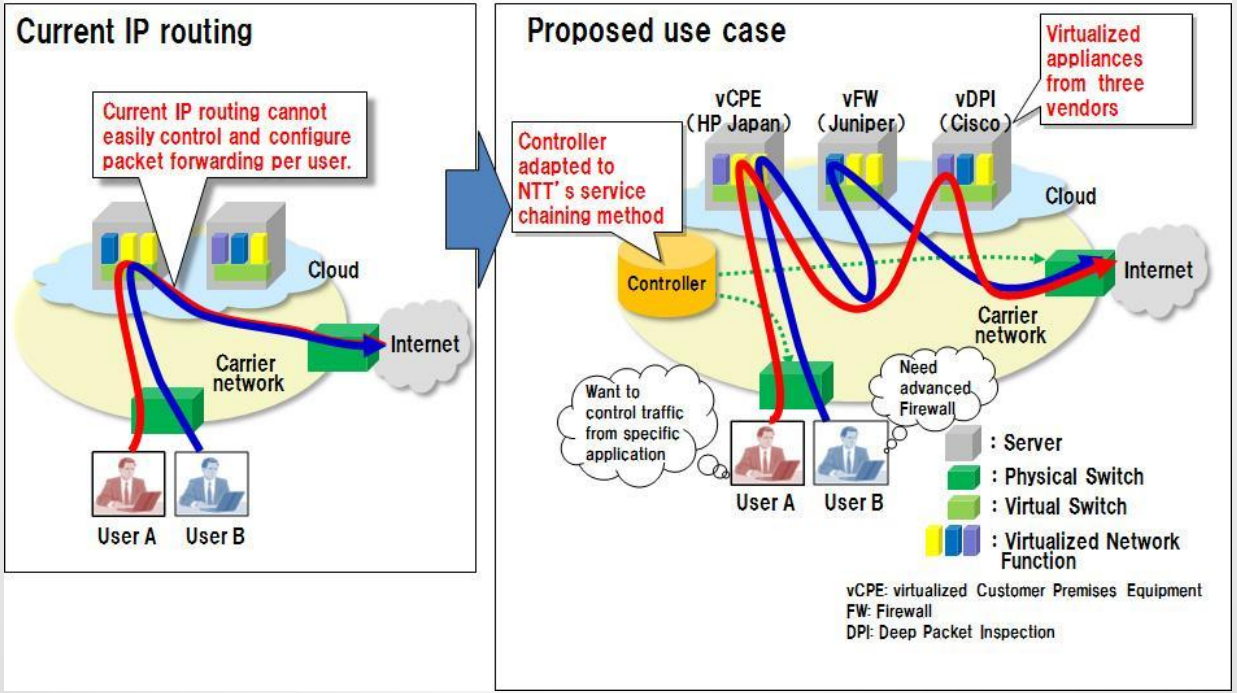
- Two Expert Groups:
  - **Security** Expert Group: Security
  - **Performance and Portability** Expert Group: Scalability, efficiency, and performance VNFs relative to current dedicated hardware

NFV projects start to emerge

- **NTT Docomo Completes NFV Trial With Multiple Vendors in October, 2014**
  - http://www.lightreading.com/nfv/nfv-strategies/ntt-docomo-completes-nfv-trial-with-multiple-vendors/d/d-id/711436
- **NTT Docomo targets commercial NFV launch by March 2016**
  - http://www.mobileworldlive.com/ntt-docomo-targets-commercial-nfv-launch-2016

NTT concept for NFV deployment

- Rapid service provision based on user selection of network function
- Verification of service chaining method in multivendor environment



NVF POCs underway

NFV ISG PoC	NFV Use Case	Operators	Vendors
CloudNFV Open NFV Framework	Use Case #5 Virtualization of the Mobile Core and IMS	Sprint Telefonica	6Wind Dell Enterprise Web Huawei Mellanox Overture Qosmos
Service Chaining for NW Function Selection in Carrier Networks	Use Case #2 Virtual Network Function as a Service (VNFaaS) Use Case #4 Virtual Network Forwarding Graphs	NTT	Cisco HP Juniper
Virtual Function State Migration and Interoperability	Use Case #1 NFV Infrastructure as a Service (NFVIaaS)	AT&T BT	Broadcom Tieto
Multi-vendor Distributed NFV	Use Case #2 VNFaaS Use Case #4 Virtual Network Forwarding Graphs	CenturyLink	Certes Cyan Fortinet RAD

NVF POCs underway (cont.)

E2E vEPC Orchestration in a multi-vendor open NFVI environment	Use Case #1 NFVIaaS Use Case #5 Virtualization of the Mobile Core and IMS	Sprint Telefonica	Connectem Cyan Dell Intel
Virtualised Mobile Network with Integrated DPI	Use Case #2 VNFaaS Use Case #5 Virtualization of the Mobile Core and IMS Use Case #6 Virtualisation of Mobile base station	Telefonica	HP Intel Qosmos Tieto Wind River
C-RAN virtualisation with dedicated hardware accelerator	Use Case #6 Virtualisation of Mobile base station	China Mobile	Alcatel-Lucent Intel Wind River
Automated Network Orchestration	Use Case #1 NFVIaaS	Deutsche Telekom	Ericsson x-ion
VNF Router Performance with DDoS Functionality	Use Case #2 VNFaaS	AT&T Telefonica	Brocade Intel

NFV Related POC Projects(cont.)

* AT&T Domain 2.0 Project: vEPC

*British Telcom: vBRAS, vCDN

*Deutsche Telcom: vDHCP, vBRAS,

*NEC: vEPC, vBRAS, vCGNAT

Completed: PoC

- **PoC#2 - Service Chaining for NW Function Selection in Carrier Networks**

NTT - Cisco - HP - Juniper Networks

- **PoC#3 - Virtual Function State Migration and Interoperability**

- AT&T - BT - Broadcom Corporation - Tieto Corporation
- **PoC#4 - Multi-vendor Distributed NFV**

- CenturyLink - Certes - Cyan - Fortinet -

- **PoC#5 - E2E vEPC Orchestration in a multi-vendor open NFVI environment**

Completed: PoC

- **PoC#8 - Automated Network Orchestration**

Deutsche Telekom - Ericsson - x-ion GmbH - Deutsche Telekom Innovation Laboratories *

- **PoC#9 - VNF Router Performance with DDoS Functionality**

AT&T - Telefonica - Brocade - Intel - Spirent

- **PoC#11 - Multi-Vendor on-boarding of vIMS on a cloud management framework**

Deutsche Telekom - Huawei Technologies - Alcatel-Lucent

- **PoC#22 - Demonstration of High Reliability and Availability aspects in a Multivendor NFV Environment**

AT&T - KDDI R&D Laboratories - Brocade - Hewlett Packard - Wind River System *

Completed: PoC (Cont.)

- 1. Virtual Broadband Remote Access Server (BRAS) by British Telecom
- 2. Virtual IP Multimedia System (IMS) by Deutsche Telekom
- 3. Virtual Evolved Packet Core (vEPC) by Orange Silicon Valley
- 4. Carrier-Grade Network Address Translator (CGNAT) and Deep Packet Inspection (DPI), Home Gateway by Telefonica
- 5. Perimeta Session Border Controller (SBC) from Metaswitch
- 6. Deep packet inspection from Procera
- Most of these are based on Cloud technologies, e.g., OpenStack

OPEN NFV

AN OPEN PLATFORM
TO ACCELERATE NFV

A Linux Foundation Collaborative Project

OPEN NFV


OPNFV


中国移动
China Mobile


juniper
NETWORKS


intel


TELECOM
ITALIA


vodafone


DELL


NOKIA


cisco


NEC


redhat


IBM


NTT
docomo


hp


HUAWEI


ERICSSON


BROCADE

OPEN NFV

40 telecomm and network companies, such as AT&T, Cisco, HP, NTT DOCOMO, Telecom Italia and Vodafone, China Mobile

Joined forces with The Linux Foundation to create a new collaborative project: Open Platform for NFV, (OPNFV). The ultimate goal to build a carrier-grade, integrated, open source NFV reference platform.

Proposed Projects

Copper (Virtual Infrastructure Deployment Policies)

Resource Management

Doctor (Fault Mangement and Maintenance)

High availability for VNFs //中国移动

OPNFV Telco KPI Monitoring

Proposed Projects

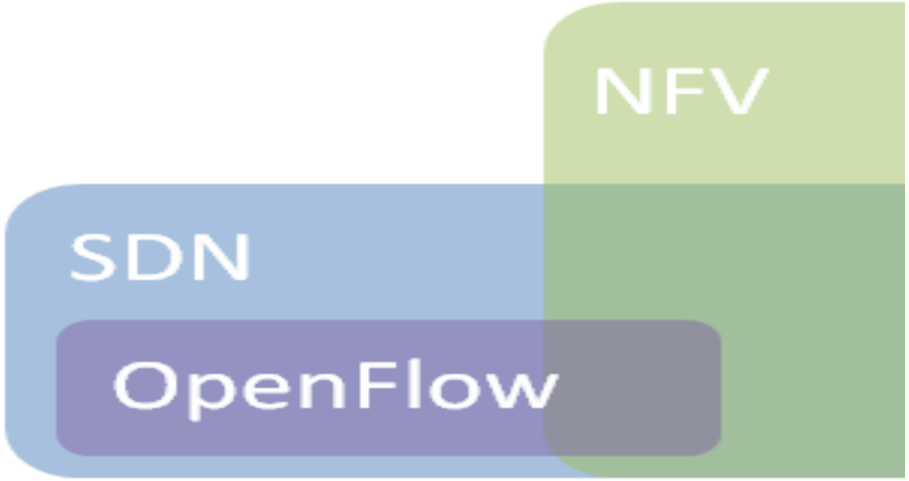
Rescuer

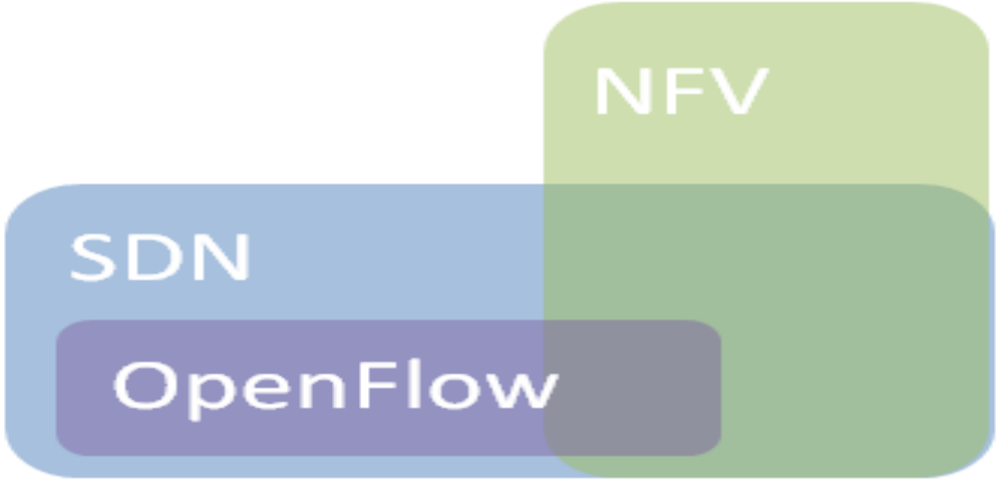
IPv6-enabled Vanilla OPNFV

Parser

Octopus - Contiuous Integration

OPNFV Documentation





ETSI NFV Suggested Resarch Topics

OPEN NFV

--Security of the virtualized infrastructure for network functions

--Abstractions for networks and carrier-scale network services in imperative and declarative languages

--Impacts of data plane workloads on Computer Systems Architectures

--Locality and latency in software implementations of large-scale network services

--Re-architecting network functions (e.g. 3GPP) to recognize availability of cloud technology mechanisms for scalability and reliability of NFV on ecosystems

OPEN NFV

--Evolution patterns to NFV, management of transition and heterogeneous scenarios

--Portability mechanisms and management across NFV infrastructure realizations

--Tools for validating network services and automating their deployment and management

--Applying compositional patterns (Network Function Chains) for parallelism, control logic, performance, monitoring and reliability of network services

OPEN NFV

Monitoring and metering of carrier-scale virtualized networks.
Application of Big Data models
Addressing the privacy implications of the new virtualized network service models. Relying on NFV to increase user privacy at the network scale
Explore how the new virtualization support paradigms can facilitate new network concepts and architectures
Operationalization of NFV with diagnostic and support frameworks
Commercial and Economic impact of NFV on ecosystems
autonomic (self) management technologies in NFV (e.g., processing of alarms)

OPEN NFV

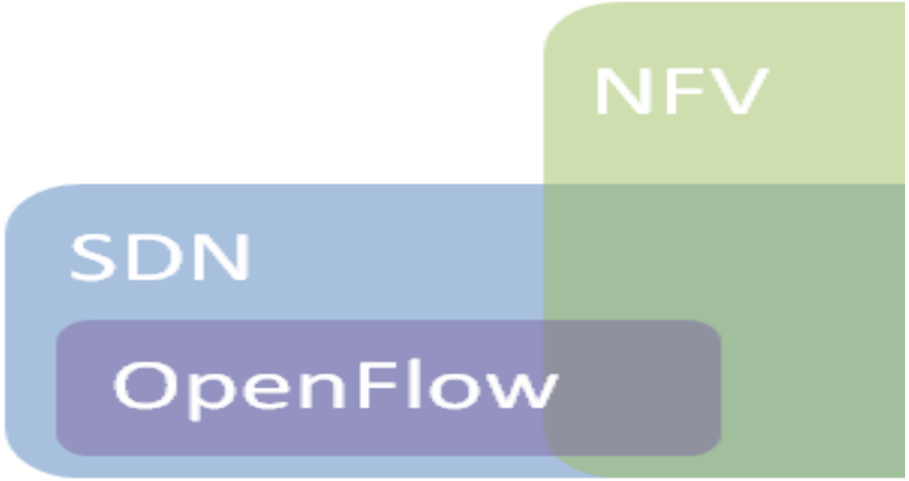
Complexity of NFV systems

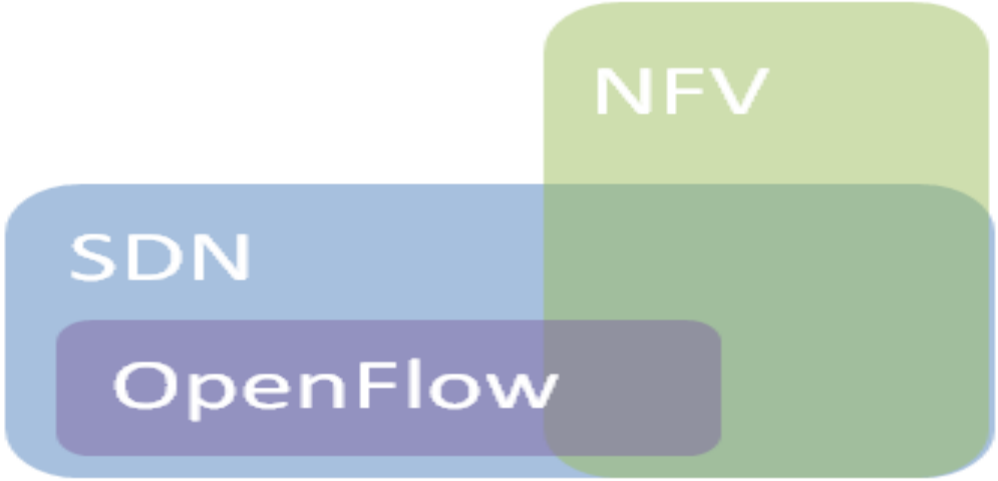
Energy Efficiency of NFV systems

Performance optimization, trade-offs & planning rules for multiple VNF workloads

New service modelling and algorithms for automatic changes of virtual network services architecture

What "Next Big Thing(s)" will be enabled post-NFV?





Thank you !