SDN-NFV: An introduction

Telefónica I+D @ Global CTO
30.10.2014

*BE MORE_*

We are evolving towards a **Hyper Connected and Intelligent Digital World***

The **explosion of digital services** makes **connectivity services more needed** than ever

Smartphone is changing everything

Reduction of **Time to Market**

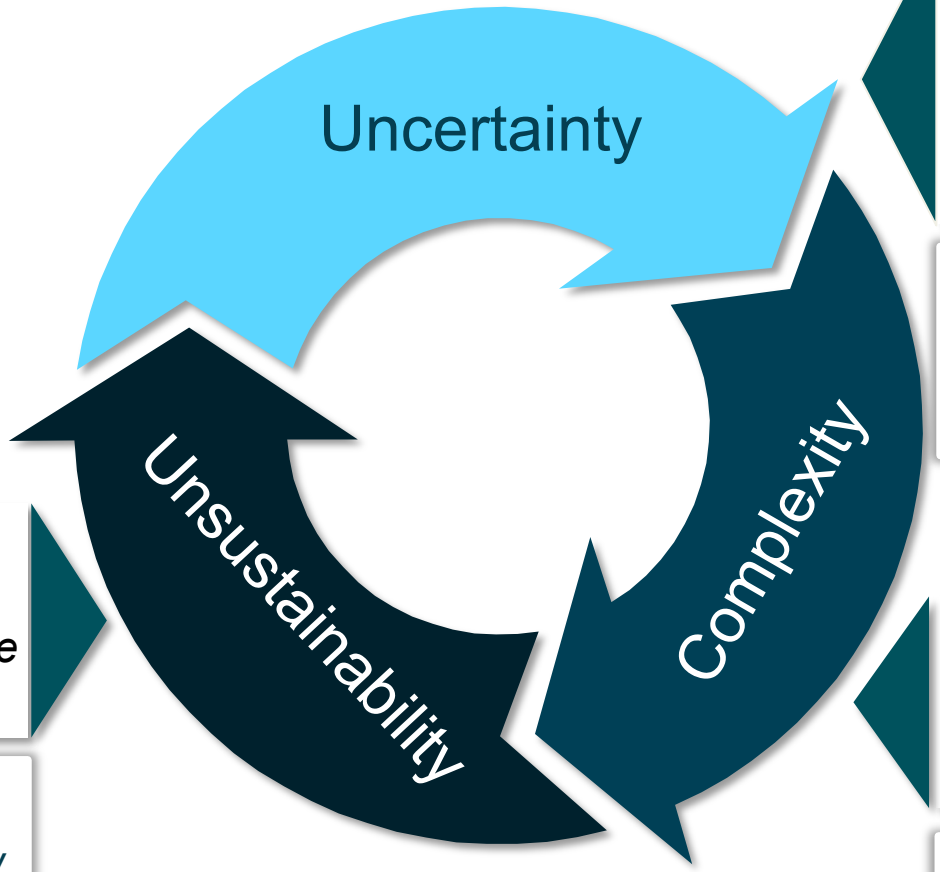
Radical increase of traffic in telco networks

New **ways of communication** and increasing number of "**always-on" users**

But the **phone service** continues to be the only **universal service…**

(*) César Alierta, TEF CEO.
TEF Digital Investor's Day 2012

This digital world is introducing **relevant challenges** for telecom operators…



*Impossibility of predicting the new Internet Killer Application and how it will **impact in the network***

*But it is highly probable that it is **associated to new devices***

*New and legacy technologies are **piling on top of each other***

***Operation complexity** grows consequently*

*There is a significant **shift in revenue streams** (driven by the expansion of internet)*

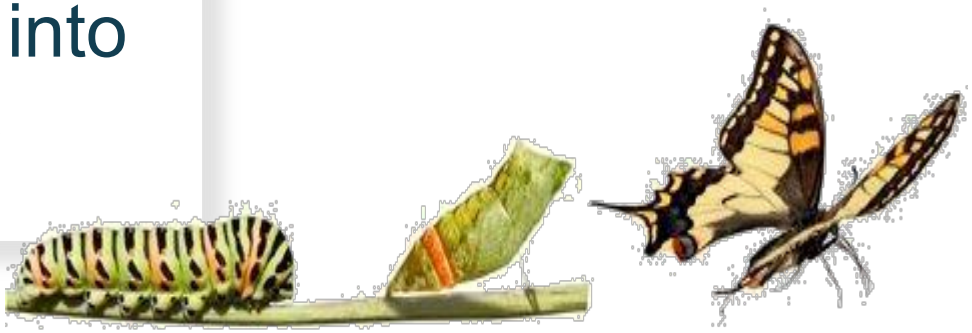
Telco expenditures and investments grow higher than revenues

Beyond evolution: evolution is mandatory to keep in the market. Transformation is the only way to lead…

Network evolution is reasonably under control…

…from 3G to 4G
…from copper to fibre

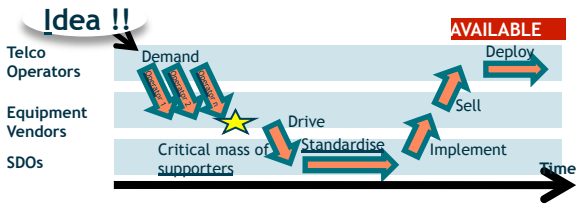
The challenge is transforming the network and its operation taking into account the inertia of its legacy



What are the **current limitations** of Telco's **networks**?

Long innovation cycles (2-6 years)

- Long **standardization cycles**
- **Scale is needed** to introduce **innovations**



Hardware and Software vertically integrated

- **Capacity** is tied to a **function**
- **Vendors lock in** (it is difficult to switch from one vendor to another when deployments are made)

Complex Network Management

- **Small changes in a network element requires an adaptation of the EMS** (Element Management System)
- **Complex stitching** of network functions across segments and technologies, since **network nodes are tightly coupled to the network segment and technology**

Difficult IoT

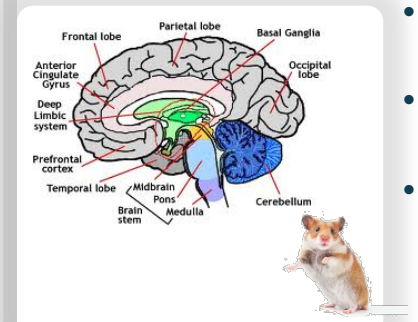
- Interoperability tests required per protocol and node

We need **to adapt and define the change** to lead in the Digital era

Telco players

- Very **intensive in hardware**
- **Capital intensive**
- Software is not a core

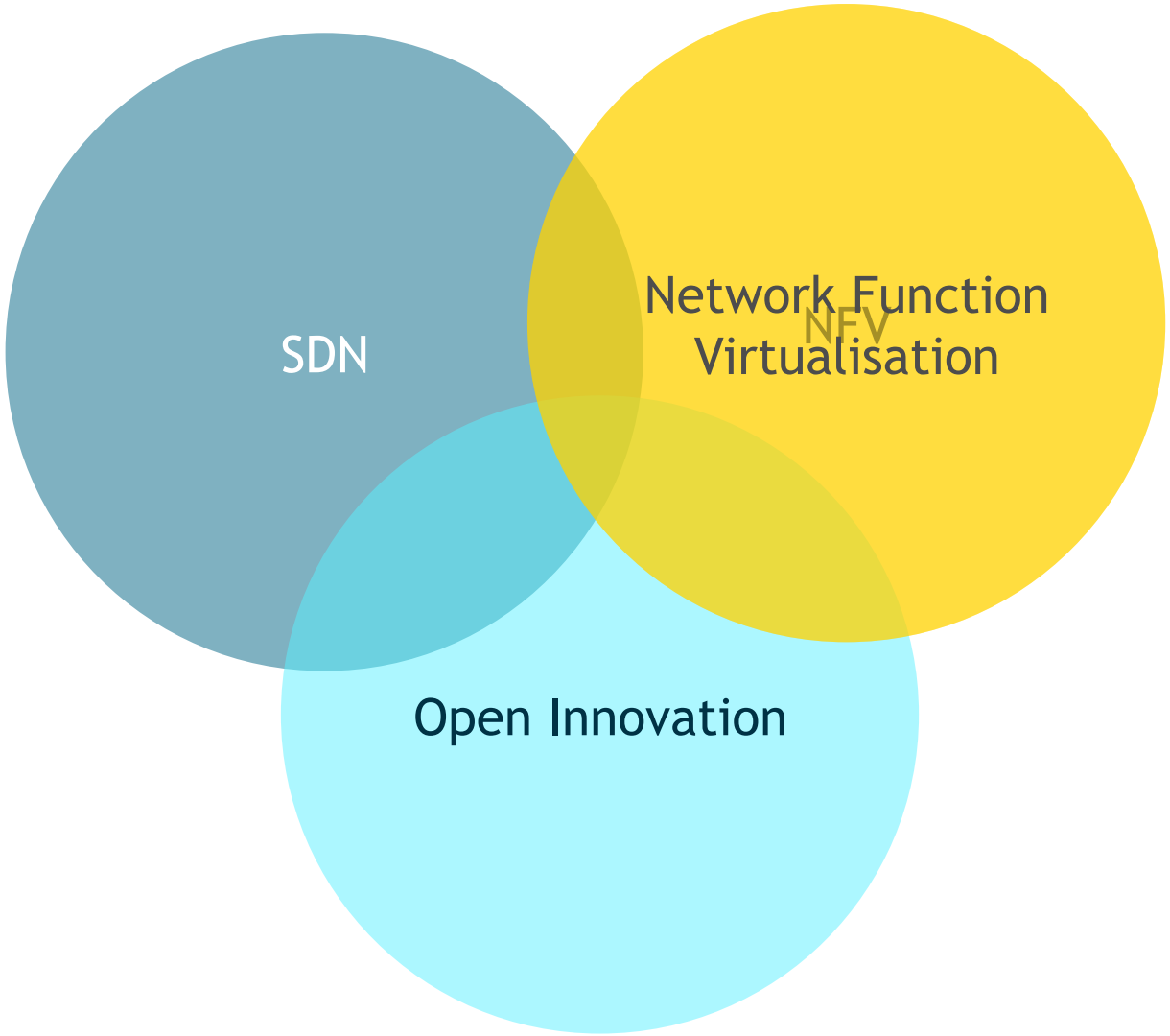
Internet players



- Very **intensive in software**
- Can have **global impact** with not too much capital
- Hardware is a support, and is located in the network periphery


Components for this vision

Components for a “liquid network”

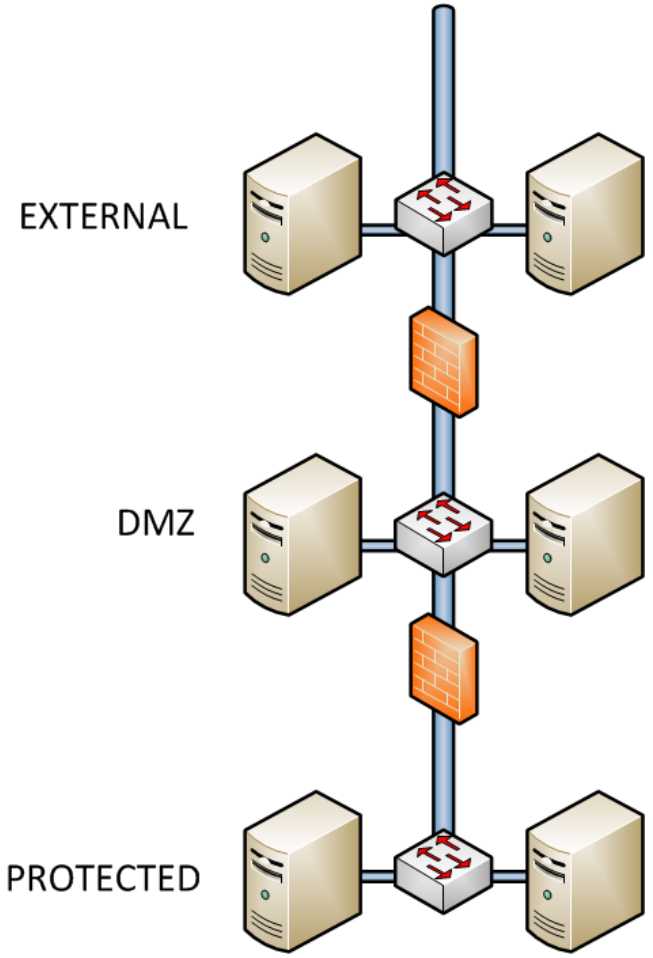


Or maybe by non-example

SDN BY EXAMPLE

IaaS in a data centre: per user requirements

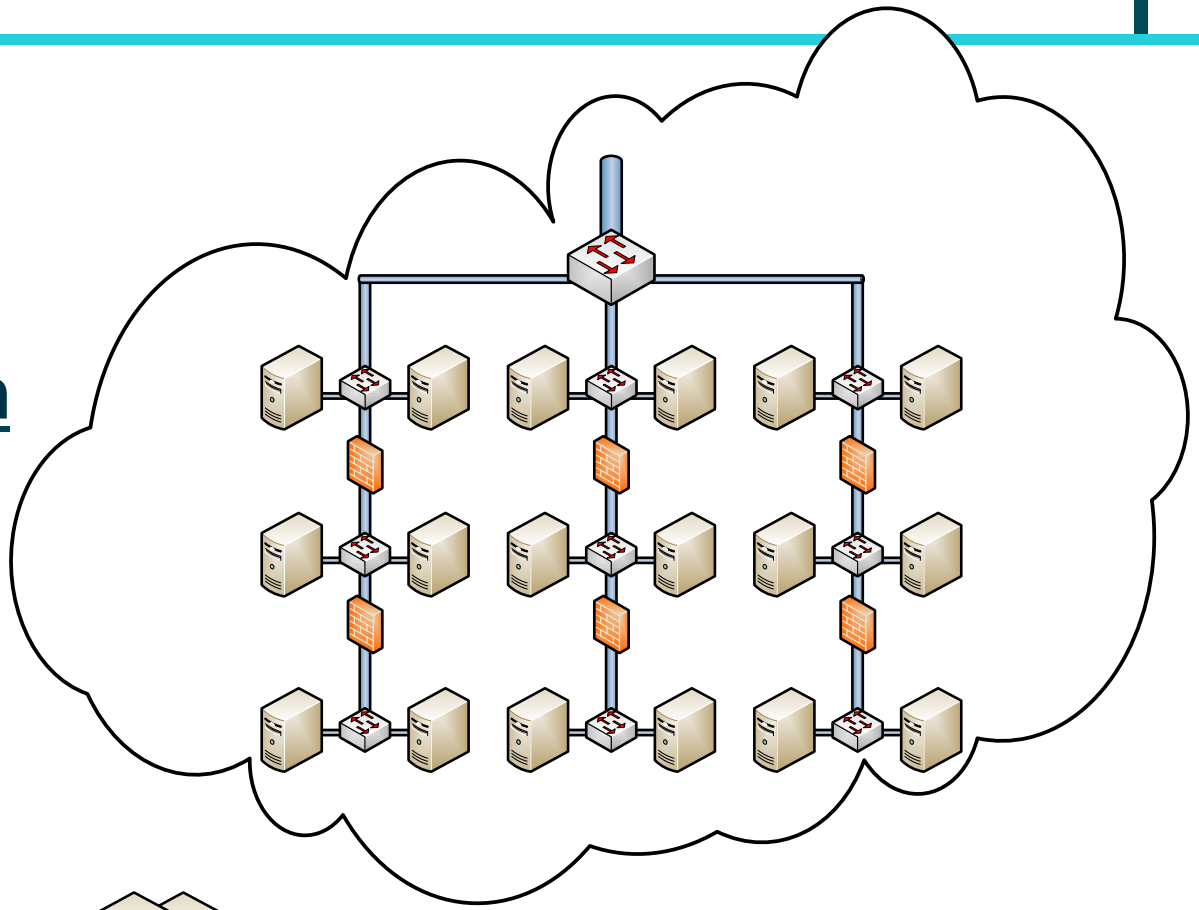
- Well-known design
  - Chaining FWs to increase the level of protection
  - DMZ to place resources that need to be connected to the Internet with some level of protection
- This is current best practice that is implemented on separate boxes nowadays
- Users expect to have the same level of protection when outsourcing this infrastructure to an IaaS provider

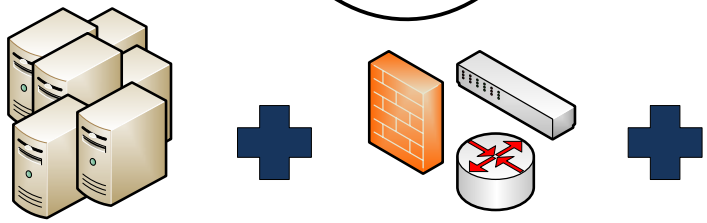


The datacenter replicates the logical IaaS structure for every client…

… and this challenge has limitations with the current paradigm

Fine grained connectivity & isolation require extensive use of VLANs & firewall rules (and combine them!)

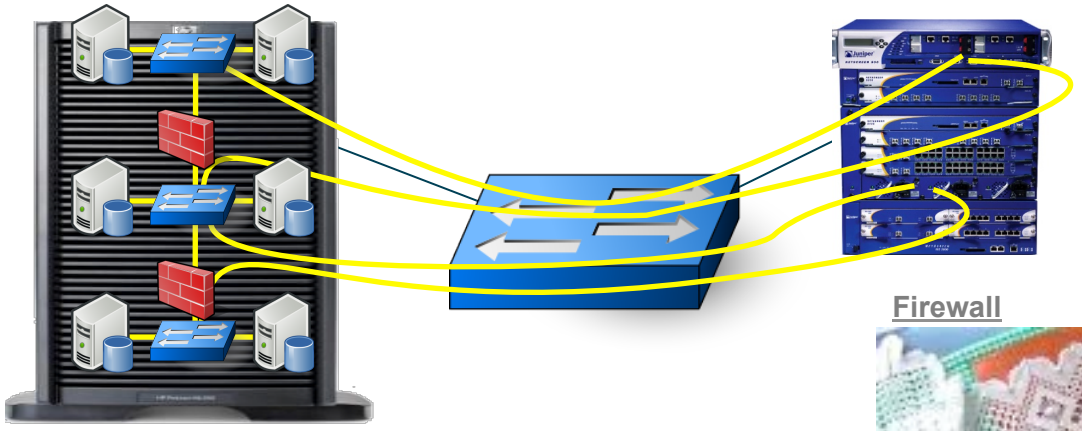




Expensive equipment

A large number of VLANs

“Client stitching”… or how to combine a VM server with a common networking infrastructure



Firewall

- First solution
  - Provide virtualised FW functionality
  - Provide network isolation using VLANs
  - Provide isolated switching realms
- And this for each client…
- Since there is virtualisation and the system was controlled by a “software”, the vendor claimed this was

SDN

The acronym war

S

D

N

Software

Driven

Defined

Network

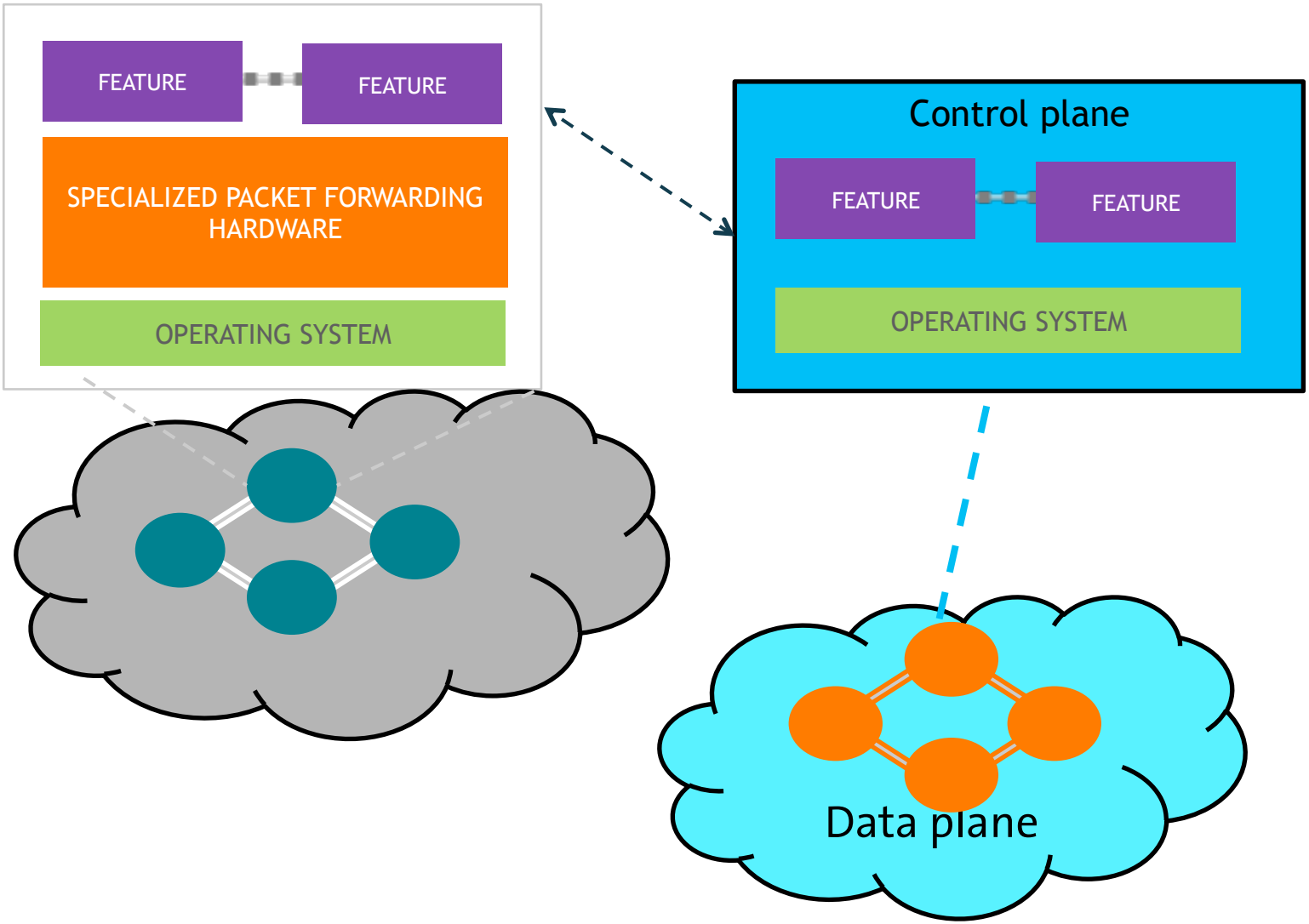
So… What is SOFTWARE DEFINED NETWORKING?

- Software Defined Networking is recognising that
  1. The network is not a shapeless entity AND network shape matters

  2. Network nodes don’t need a massive amount of intelligence for bringing packets from port A to port B

  3. Distributed is nice, but not a DOGMA

How do you SDN ?



What are the implications?

- The data plane can be simplified
  - Best case scenario is using commercial off-the-shelf boxes
  - The x86 architecture
    - Is known to provide significant throughput
    - Provides a lot of interesting features to make the network flexible (virtualisation…)
- The control plane
  - Also benefits from the advances in the x86 architecture
  - Better control of the control plane features means
    - More overall stability
    - More flexibility, when wisely used

But this is complex, right?

- Of course… Did I ever say it would be easy
- However, the process is worth the gain
- A significant community has been working on this for the last couple of years
  - Network Operators
  - Hardware suppliers
  - Software suppliers
  - …

ETSI NFV-ISG

NFV ISG vision & objectives…

NFV ISG vision:

"Leverage standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches, and storage"

Traditional Network Model


DPI


BRAS


GGSN/SGSN


PE Router

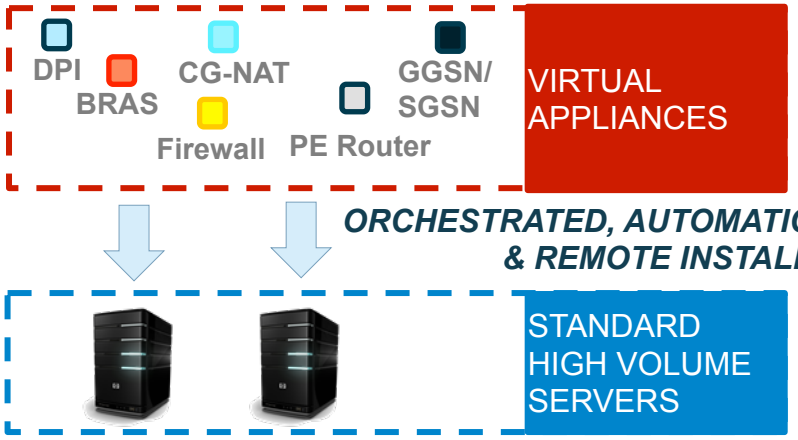

Firewall


CG-NAT

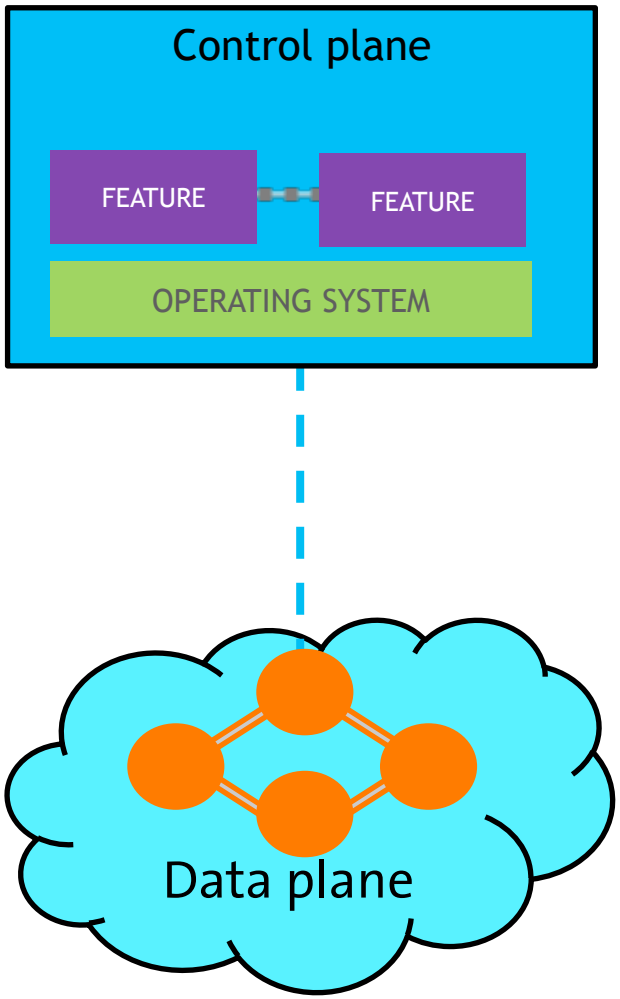

Session Border Controller

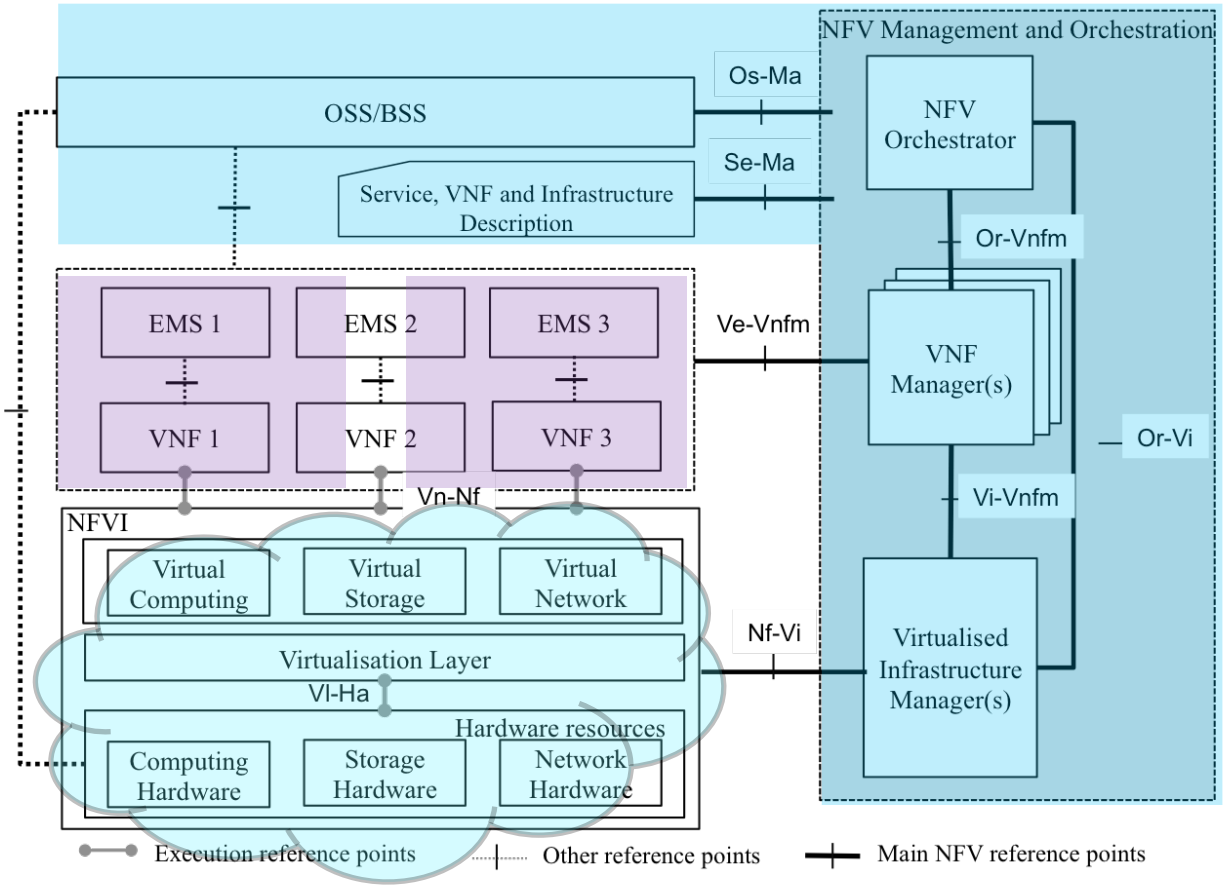

STB

NFV Model



The ETSI NFV Reference Architecture

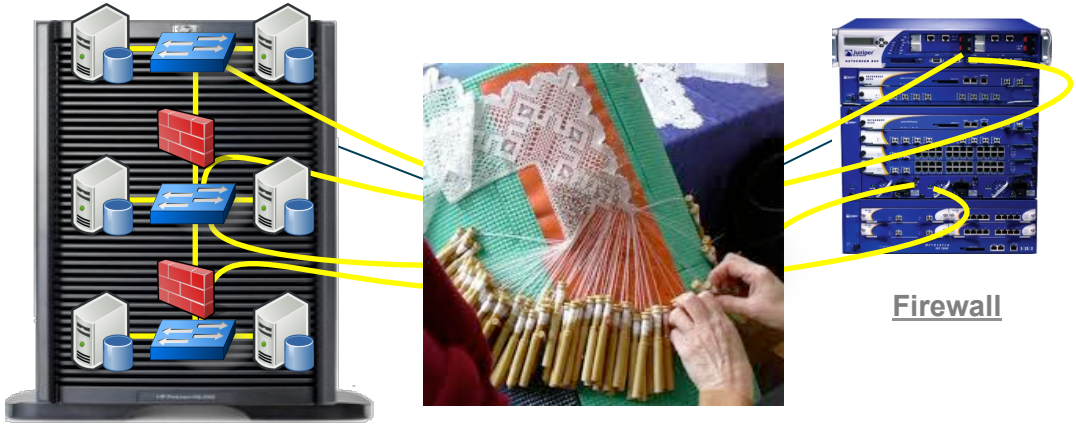




Bringing packets from A to B

SOLVING THE NETWORKING PART

Getting back to packet handling…

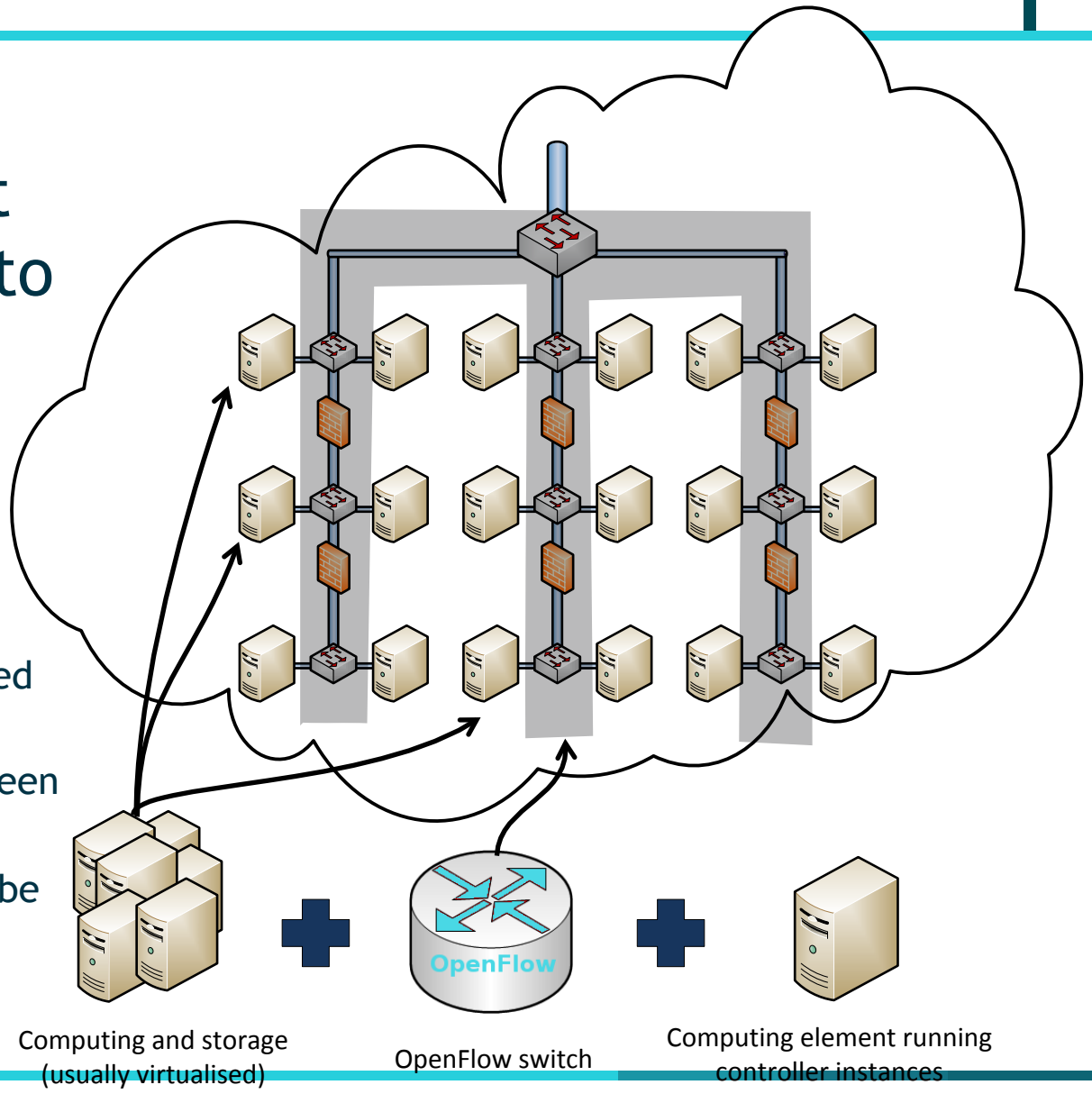


- Handling packets can be part of the headache
- However, virtualisation can help us getting rid of it

One candidate for packet handling can OpenFlow

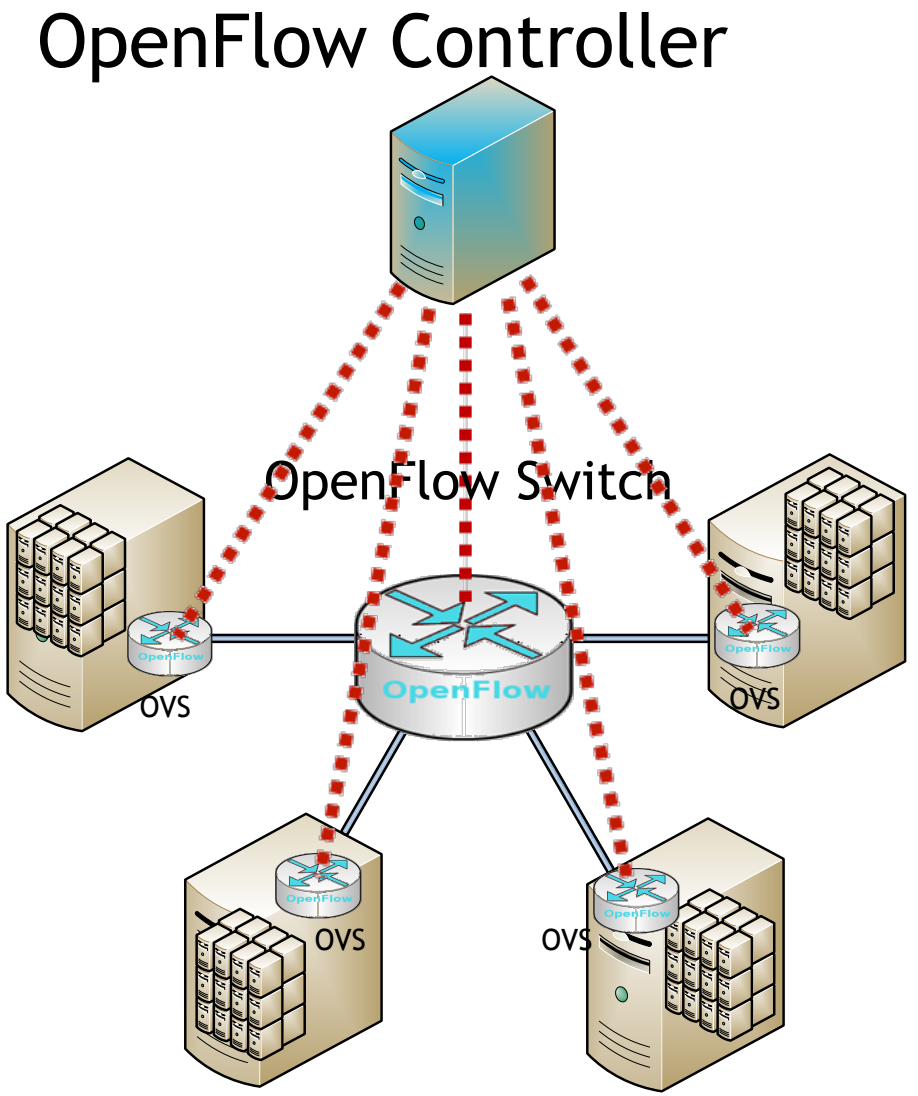
OF places packet handling logic into a centralised controller

- Easy to manage
- Some network functions become a program executed in the controller
- Smooth coordination between network and computing
- OpenFlow switch role can be played by the own hosts! (Open vSwitch)



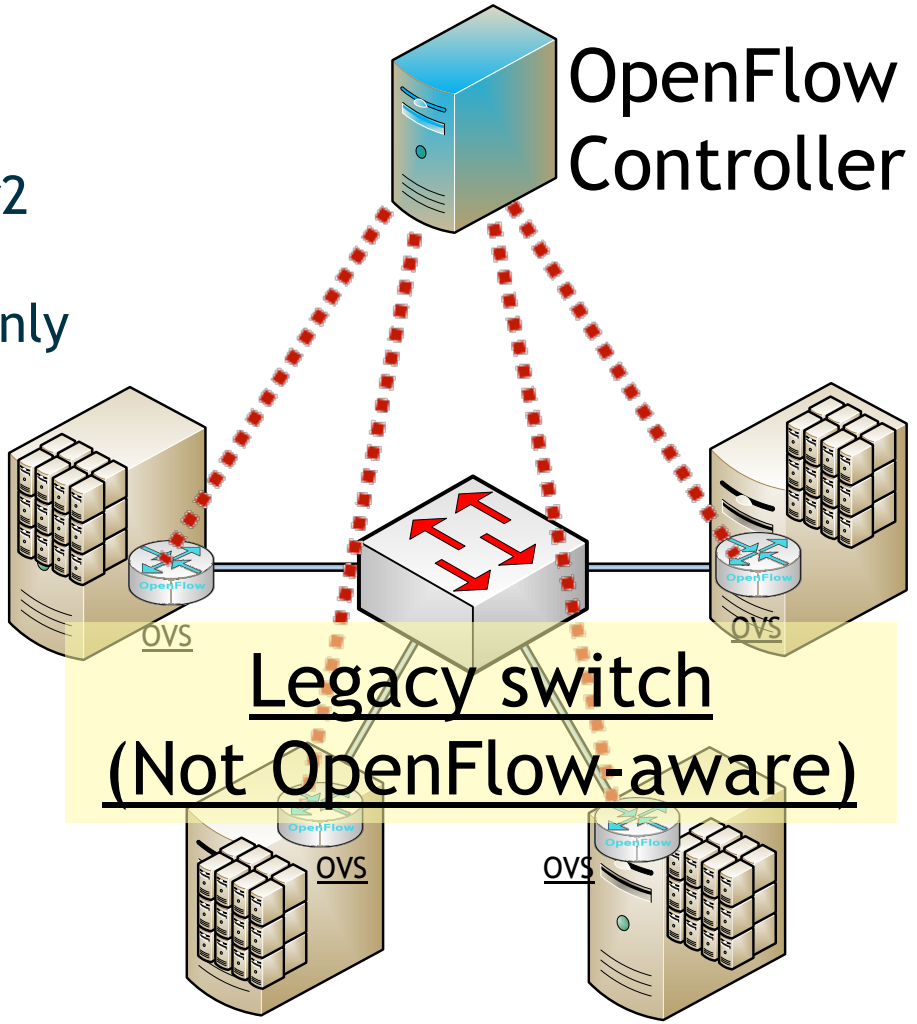
OpenFlow in green-field deployments

- OpenFlow in the switching infrastructure
- OpenFlow integrated in the server
  - Open vSwitch is already built-in in the commonest virtualisation environments and the latest Linux kernels (3.3)
- Other SDN control protocols also applicable



… or in evolutionary scenarios, where legacy switching elements can be preserved

- Maximise reuse
  - Rely upon existing Layer2 or Layer3 connectivity
  - Use OVS in the servers only
- Nicira Networks' approach




Network Function
Virtualisation
CHALLENGES

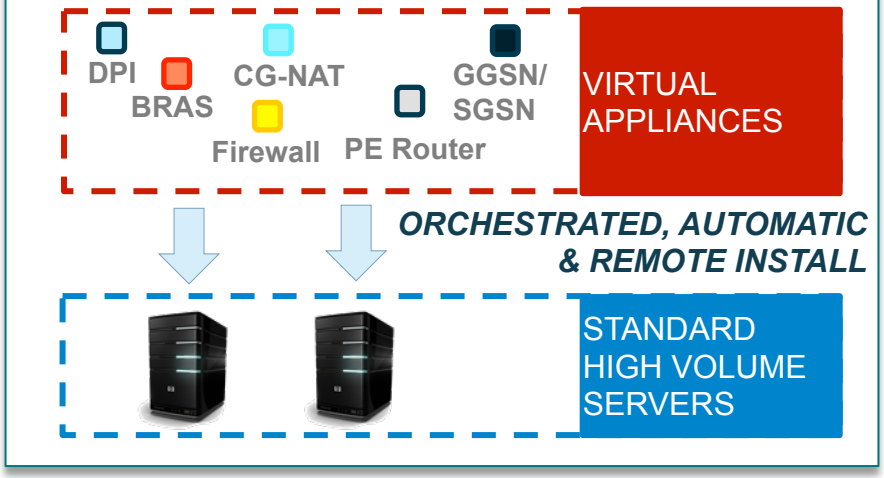
Performance & Portability are required to fully accomplish NFV ISG objectives…

NFV ISG vision:

"Leverage standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches, and storage"

Traditional Network Model

NFV Model



TO FULLY REALISE THIS VISION:

Virtualised network appliances should provide **high performance**…

… while being **portable** between servers (& hypervisors)

… while providing the telco ecosystem actors a more predictable and manageable environment

VIRTUAL NETWORK FUNCTIONS PROVIDERS

Would not need to be aware beforehand of the infrastructure server on which their SW would be deployed in the end…
… but still can provide realistic performance estimations for different sets of HW (& hypervisor) setups.

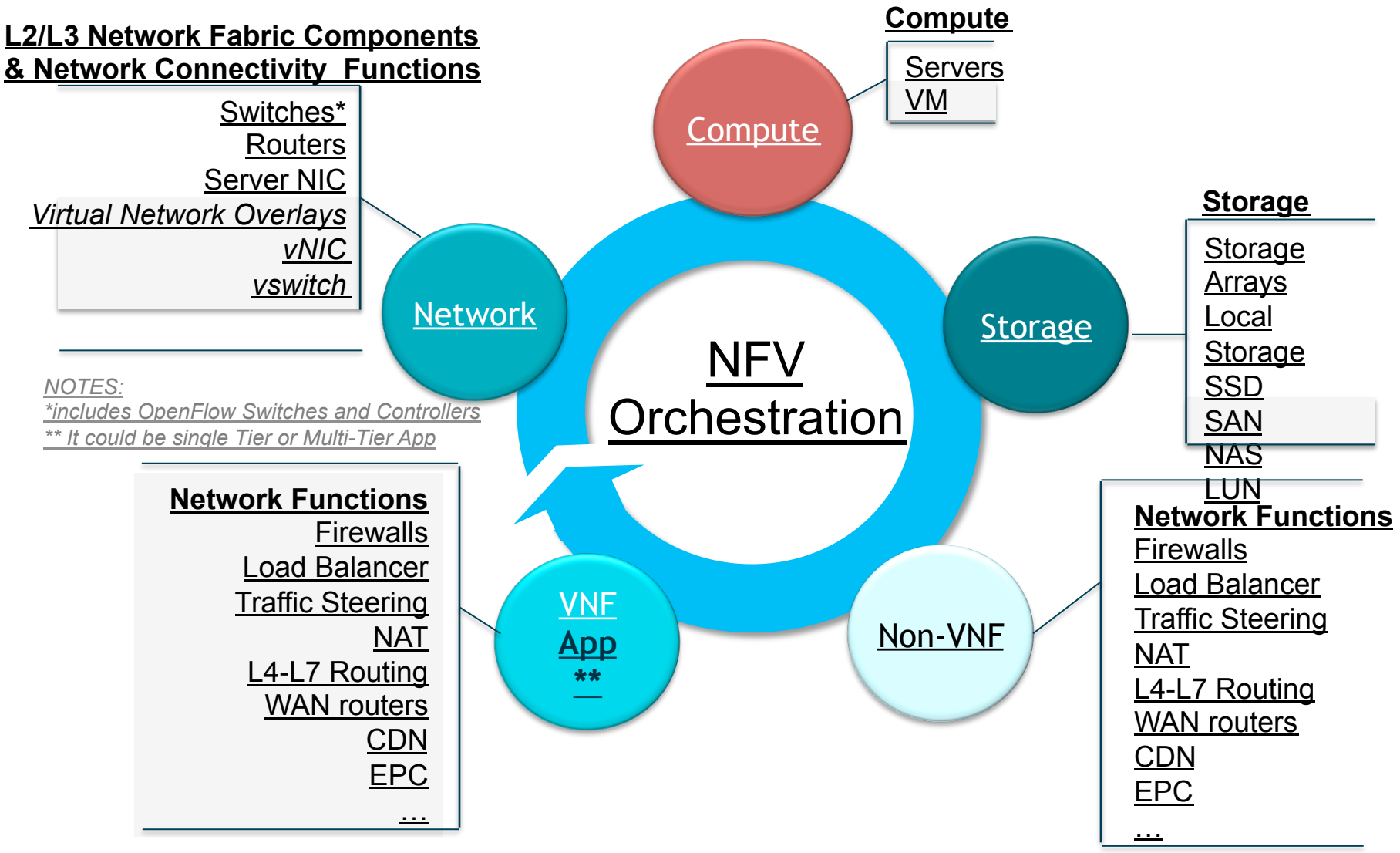
HARDWARE (& HYPERVISOR) PROVIDERS

Could describe their equipment in objective terms, suitable for automated network operation
Would not need to be aware beforehand of the virtual network functions which might be deployed in their servers.

NETWORK OPERATORS

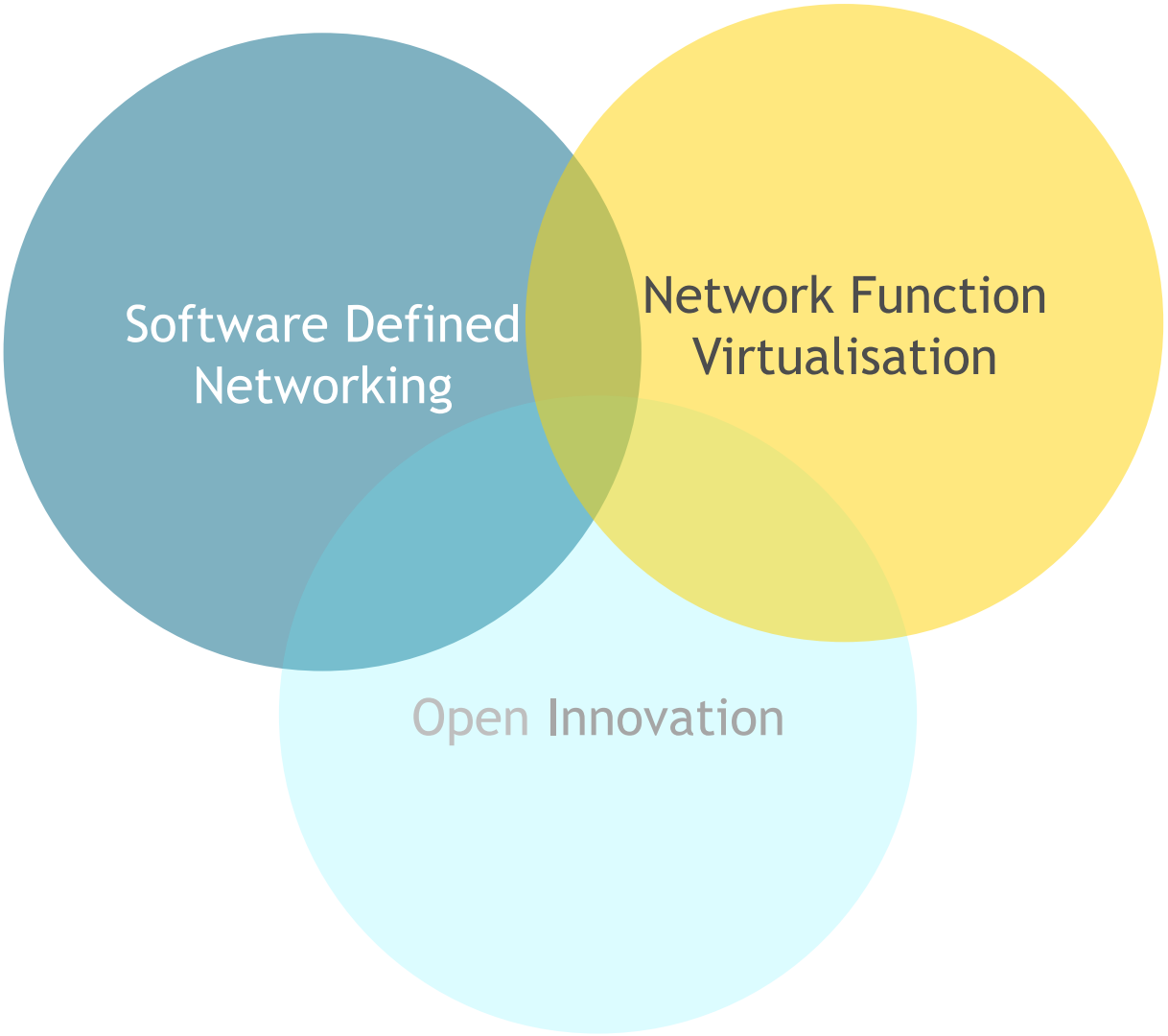
Define a set of requirements for network functions to be deployed and their target performance
Might be partially unaware of low-level details of each network function's HW requirements: **Provision & management can be uniform & automated**.

MANO
NFV Orchestration Overview



Riding the liquid network

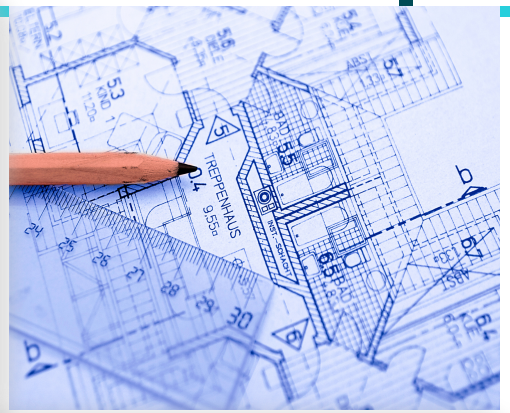
Components for a “liquid network”



What is the **promise of Network Virtualisation?**

It is an opportunity to **build mouldable Networks and redefine the Architecture**:

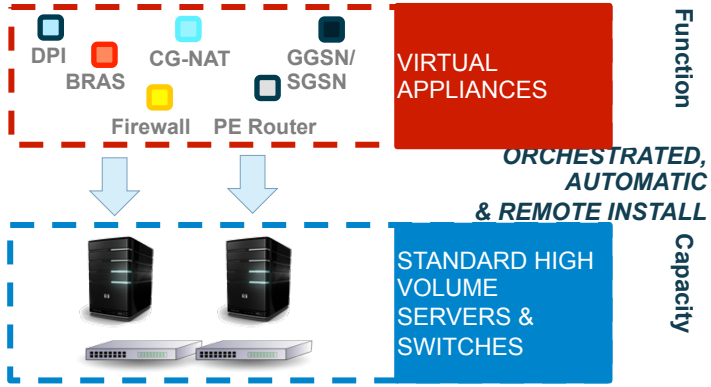
- Makes the **infrastructure uniform**
- **Reduces IoT complexity**
- Improves **management of risk** in a changing and ambiguous environment
- Introduces **capacity in an easy** and **flexible way**
- Fosters **competition** (new entrants) and **innovation**
- Prevents **hardware scale** from being an entry barrier



Traditional Network Model: APPLIANCE APPROACH

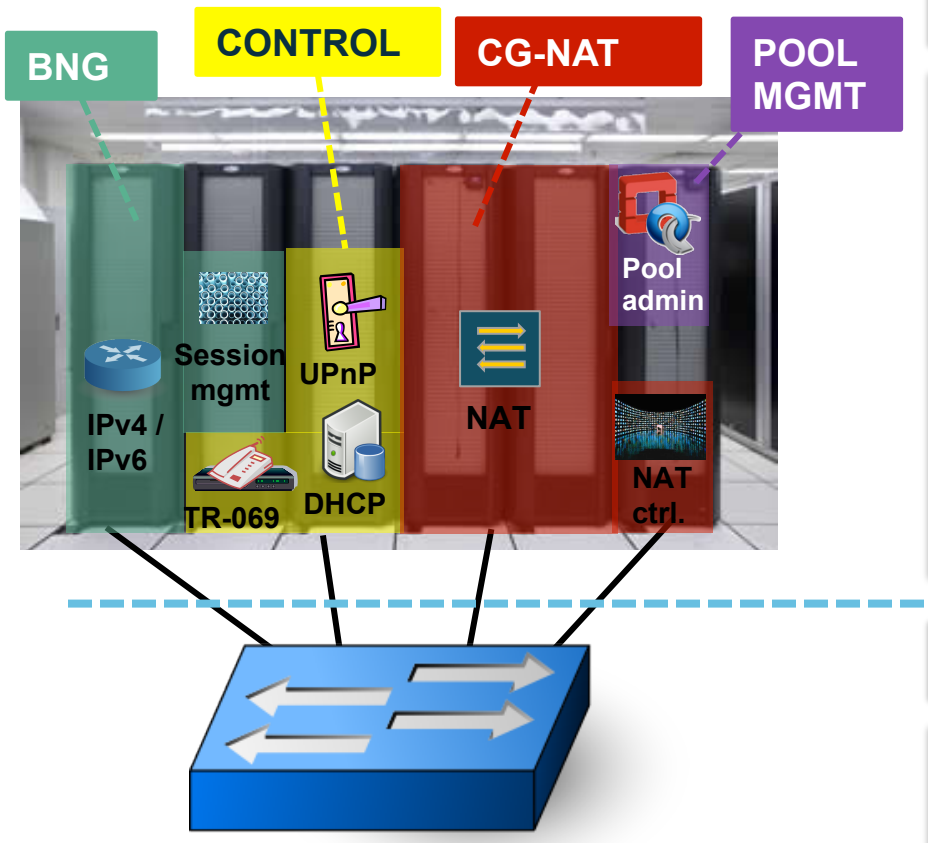
- Network functionalities are **based on specific HW with specific SW linked to HW vendors**
- **One physical node per role**

Virtualised Network Model: VIRTUAL APPLIANCE APPROACH



- When possible, network functionalities are **SW-based over COTS HW**
- **Multiple roles over same HW**

A simple equation to define Network Virtualisation:
NV = NFV + SDN



NFV

SW-defined network functions

- Separation of HW and SW
- No vertical integration
  - HW vendor ≠ SW vendor ≠ Mgmt vendor
- Once network elements are SW-based, HW can be managed as a pool of resources

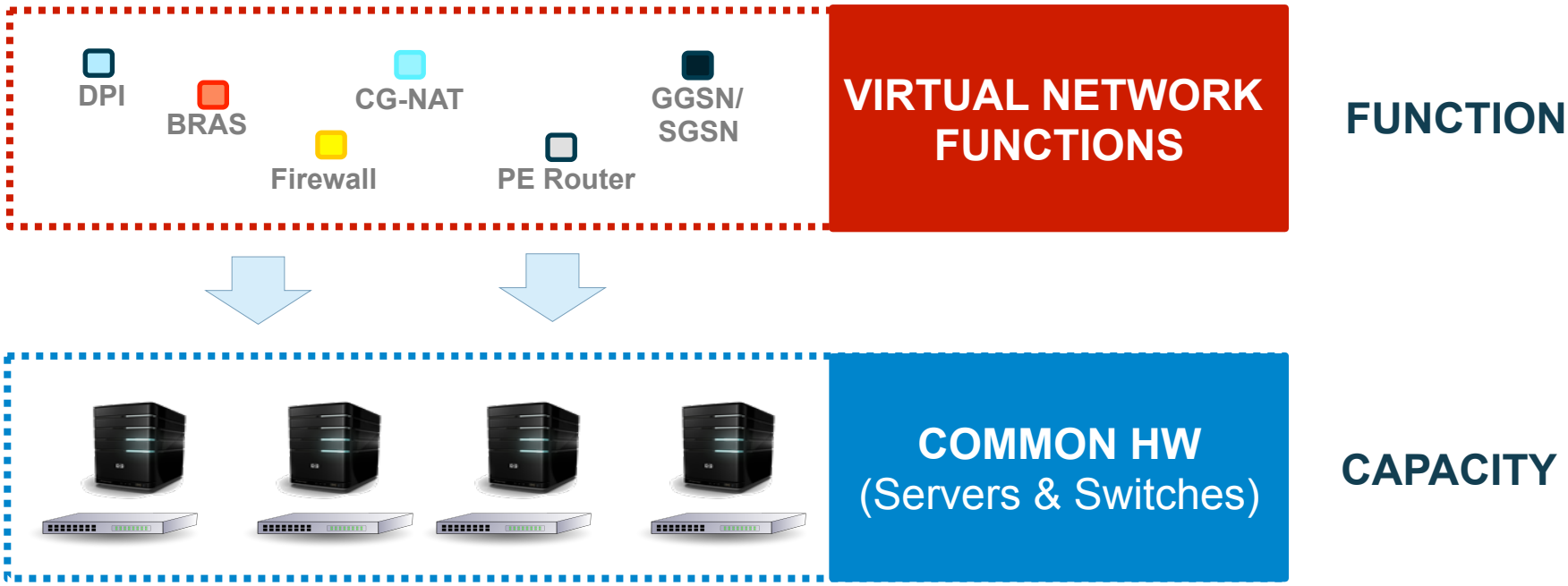
SDN

Interconnecting Virtual Network Functions (a.k.a. backplane)

- Separation of control and data plane
- Easy orchestration with SW domain

Network Virtualisation provides a mean to make the network more flexible, taking for granted a common HW layer

Network functions are fully defined by SW, minimising dependence on HW constraints

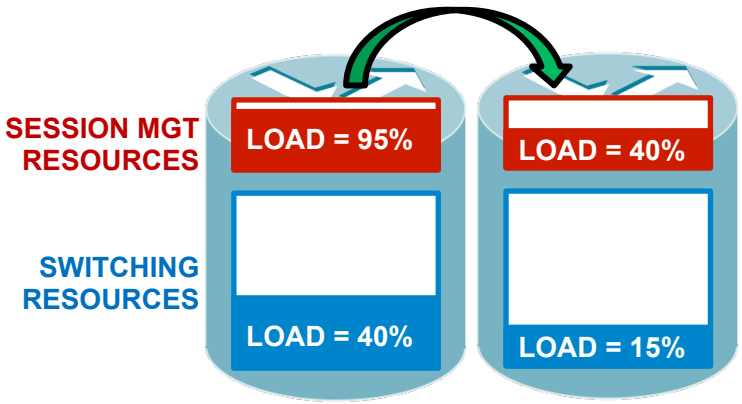


Network virtualisation helps **reducing network management complexity**, as HW can be treated as a pool of resources

APPLIANCE APPROACH

- Node sizing is **determined by the bottleneck of its functionalities**
- Capacity growth **often leads to node growth** or silo HW purchase

SESSION MGT LIMITATIONS PER NODE LEADING TO 2nd NODE PURCHASE



Vs.

VIRTUAL APPLIANCE APPROACH

- HW becomes interchangeable and aggregatable (**pool**)
- Resource assignation becomes fully **flexible and dynamic**

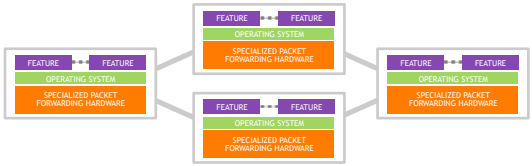
PROCESSING CAPACITY BECOMES COMMODITY & MANAGED AS A CONTINUUM

Software Defined Networking provides a first mean to improve **operation and control** of networks

Network equipment as Black Boxes

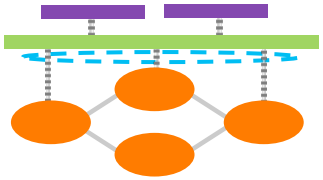
SDN

Open interfaces (OpenFlow) for instructing the boxes what to do

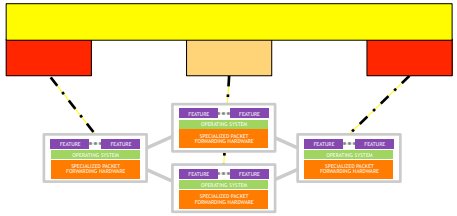


Boxes with autonomous behaviour

SDN

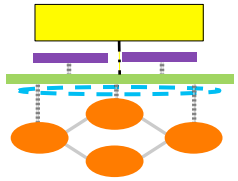


Decisions are taken out of the box



Adapting OSS to manage Black Boxes

SDN



Simpler OSS to manage the SDN controller

This new network model will help us to **deeply transform our factory**

Network Paradigm Change

- ***Computing principles*** *used in IT world are beginning to be applied in telecoms by the means of* ***Network Virtualization***
- ***IP*** *as common language for* ***all services****, included traditional Telco ones*
- ***Network virtualisation*** *enabling network re-programmability & agile service creation*

Operation Model Change

Global E2E vision instead traditional silo model, not linked to monolithic OSS

Organization Model Change

Breaking the traditional model mapping isolated network domains

DISCOVER_

DISRUPT_

DELIVER_

BE MORE_

BE MORE_