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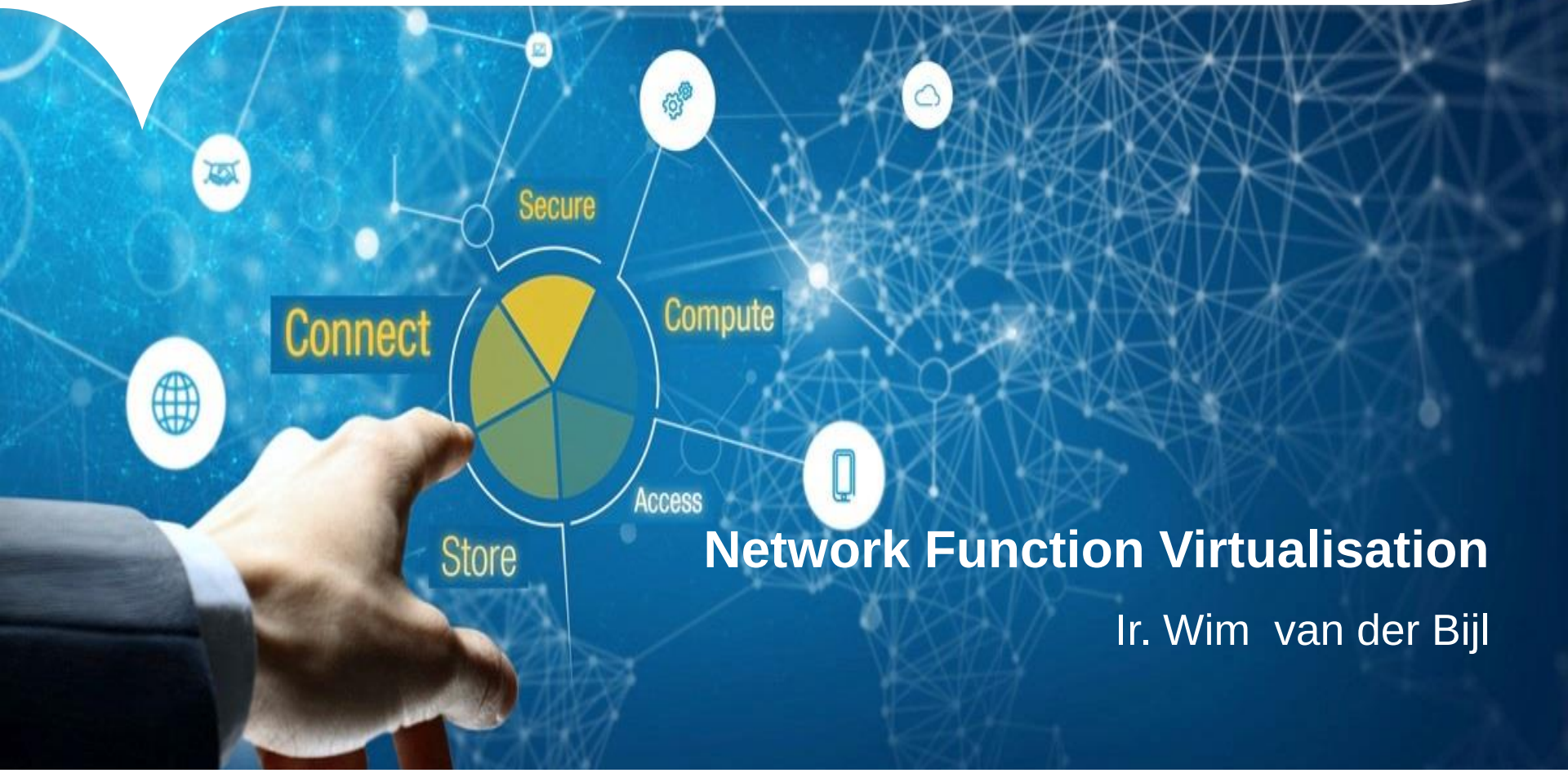
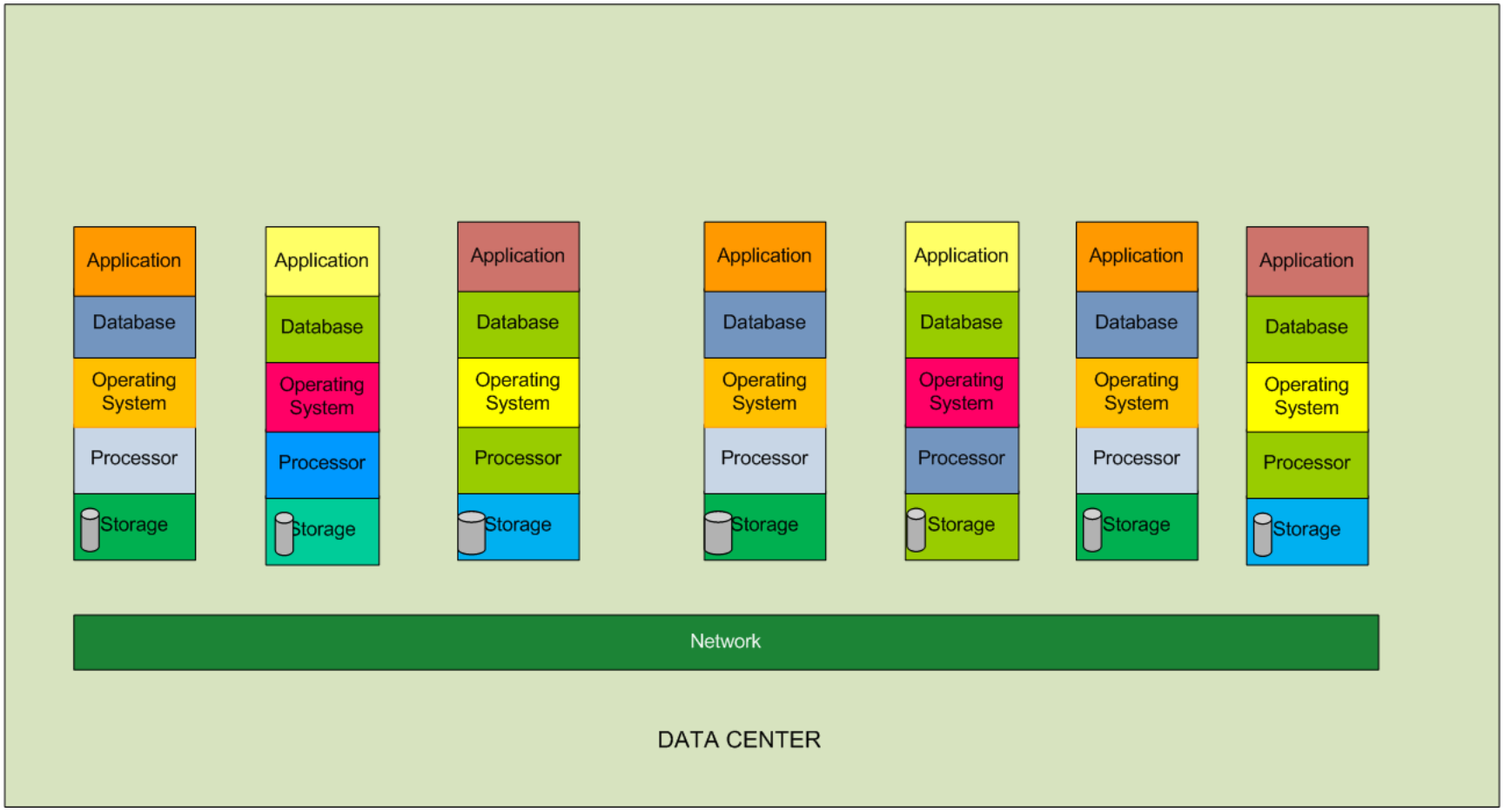


Network Function Virtualisation

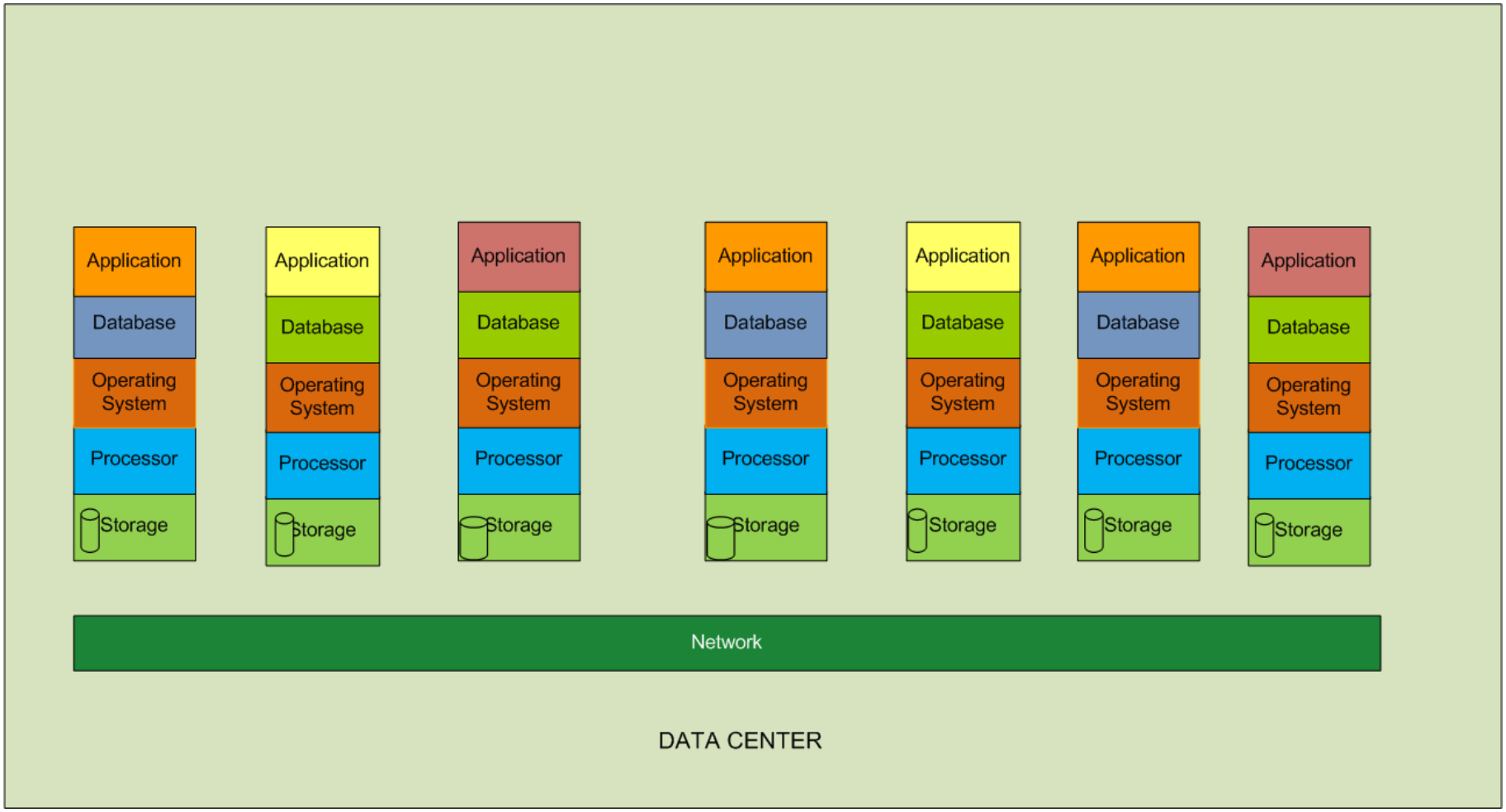
Ir. Wim van der Bijl

Content

Traditional datacenters



Standardisation compute buildings blocks

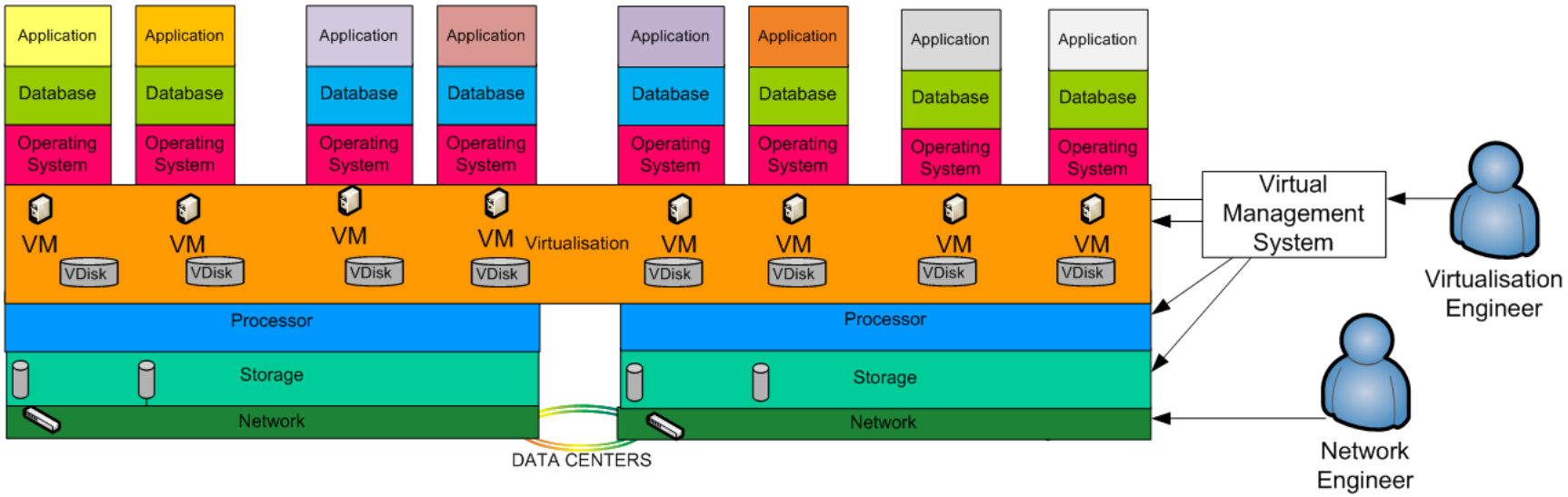


Virtualisation

- Main trends:
  - Function of devices is not longer defined by hardware and embedded codes but defined by the software layer in the device
  - This software layer enables new ways of creating functionality less depended on the underlying hardware
  - Hardware capabilities growing faster (Moore Law's) than applications
  - Main virtualisation techology used today in datacenters: Hypervisors
  - Hypervisor creates many virtual instances of a server, called VMs (Virtual Machines)
    - Application is still experience a server with certain processing and storage capability
    - The hardware (RAM, Processor, Storage etcetera) is shared among many VM's

Currently in Datacenters 60 – 80% of servers are virtualised
Some Physical servers may have > 400 VMs running

Introduction of Virtualisation Layer

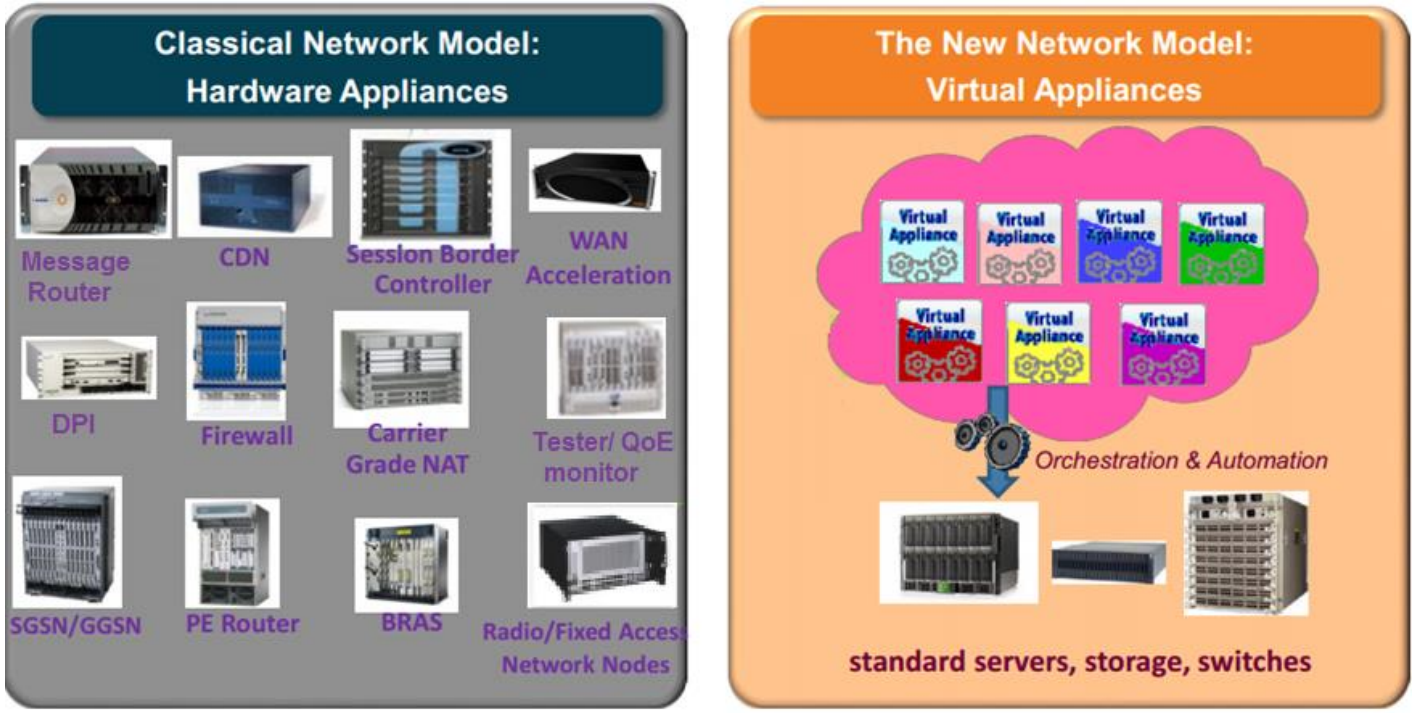


- Virtualisation of Compute and Storage:
  - High Utilisation of resources
  - Easy management of VMs and vDisks through Virtual Layer Management system
  - Easy Disaster Recovery (Moving VMs/vDisks)

Networking is mostly managed separately (until now)

Network Function Virtualisation

NFV is an initiative to **virtualize network functions** previously performed by proprietary dedicated hardware



Based on specialized HW
One physical node per role
Static. Hard to scale up & out

Software - based
Multiple roles over same HW
Dynamic. easy to scale

Why NFV

Network Functions Virtualization

- **Separates network functions** (NAT, firewalling, intrusion detection, DNS, caching, etc.) **from proprietary HW** to run those functions as virtualized applications on a commodity server
- **Focuses on virtualizing network functions** (firewalls, WAN acceleration, message routers, message border controllers, content delivery networks , etc)

Why NFV ?

- **Standard IT virtualization technologies** can help the service providers **overcome the constraints of hardware-based appliances** while attempting to accelerate the deployment of new network services to support their revenue and growth objectives.

Benefits

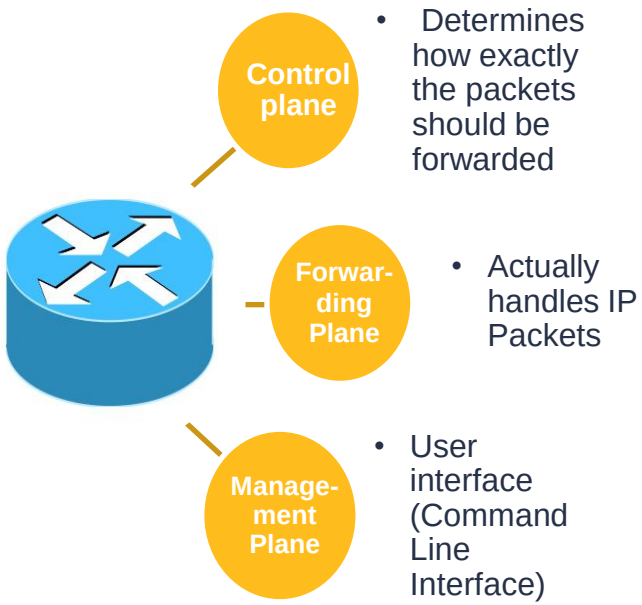
- **CapEx reduction**: through reduced equipment costs & reduced power consumption
- **OpEX reduction**: by managing a network and deploying new capabilities easier & faster
- **Accelerated Time-to-Market** : by reducing the time to deploy new networking services
- **Agility and Flexibility**: by enabling quick scale up or down services to address changing demands;

Relation SDN and NFV

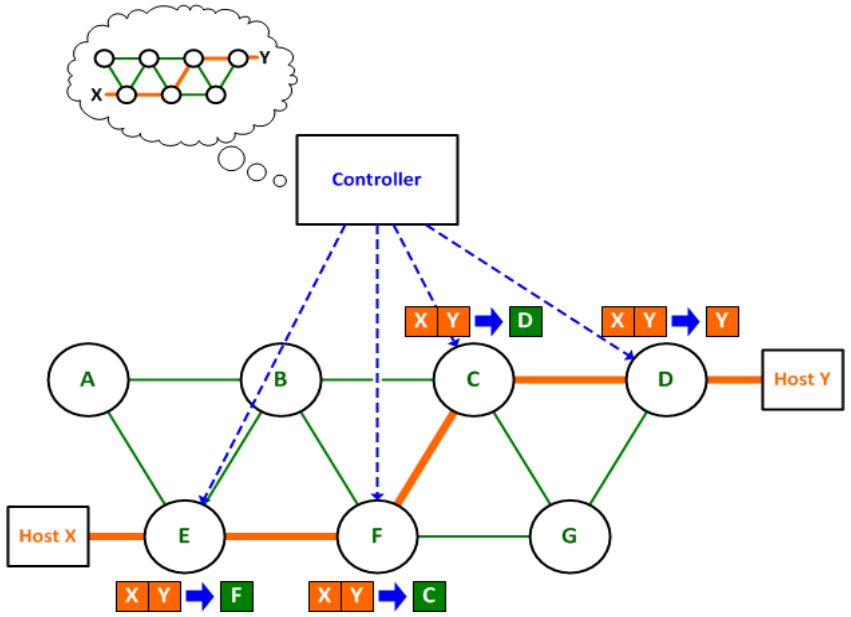
- NFV is creating virtual network functions (supporting clients) in virtualised Infrastructure
- Main challenge in the virtualised infrastructure is still the network supporting the Infrastructure
  - Currently mainly managed traditionally via a Command Line Interface
  - IP-Addresses, VLANs, firewall rules in the Infrastructure are still created manually
- Solution for the network supporting the infrastructure: Software Defined Networking

Concept of Software Defined Networks

Traditional networking:
- every device has 3 planes:
- every device needs to be managed separately
- every device has only knowledge of its neigbors
- routes are learned from each other
- basically routes are available to each device
- firewalls are required to create separate network domains



Software Defined Network
- one central controller with full overview of network
- devices only forwards packets based on instructions from controller
- network domains are made by defining forwarding rules
- behavior of network can be changed by programming the controller
- different standards for Interface between Controller and Network Devices: OpenFlow, Proprietary (southbound)



Software-defined Networking

- **Control is decoupled** from hardware
- Computer networks that separate and abstract elements of these systems
- Network control is decoupled from forwarding and is directly programmable

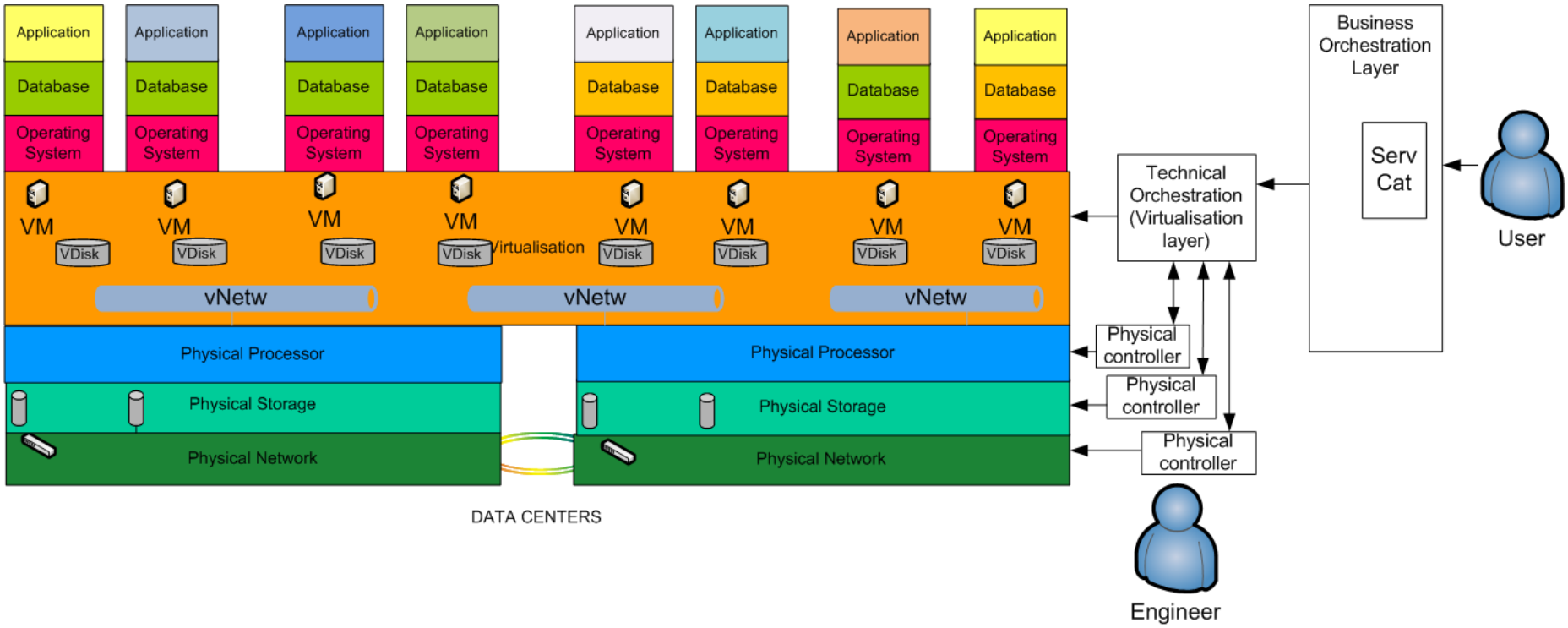
Why SDN ?

- **Automating** the process of creating connectivity between the servers and the storage
- **Enabling to change the behavior** of the Infrastructure without adding/deleting hardware
- **Adapting more easy** to changing traffic patterns within the datacenters.

Benefits

- Infrastructure providers will get truly **flexible and service-oriented Infrastructures (IaaS)**
- No longer a **vendor lock-in** on network hardware
- **Cost reduction** through elimination of manual processes
- New service architectures, service exposure, new revenue opportunities

Full virtualisation and orchestration



NFV, NFVI, VNF. MANO

- NFV: Network Function Virtualisation
- NFVI: Infrastructure with Virtualisation layer able to support NFV
- VNF: Virtual Network Function created in a NFVI
- NFV MANO: Management and Orchestration: managment and control

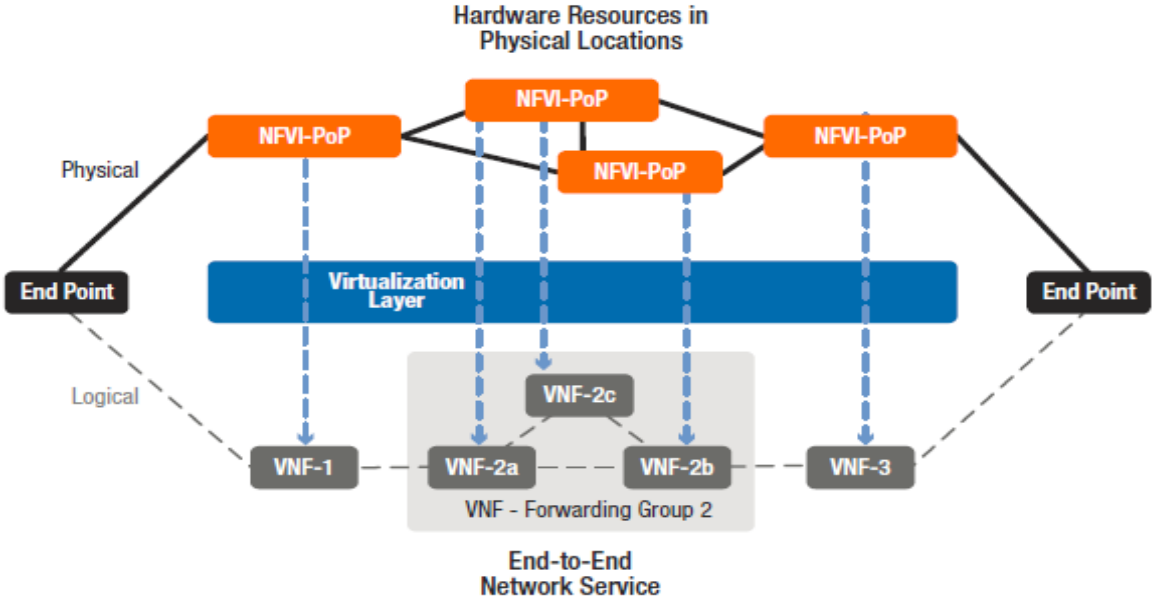
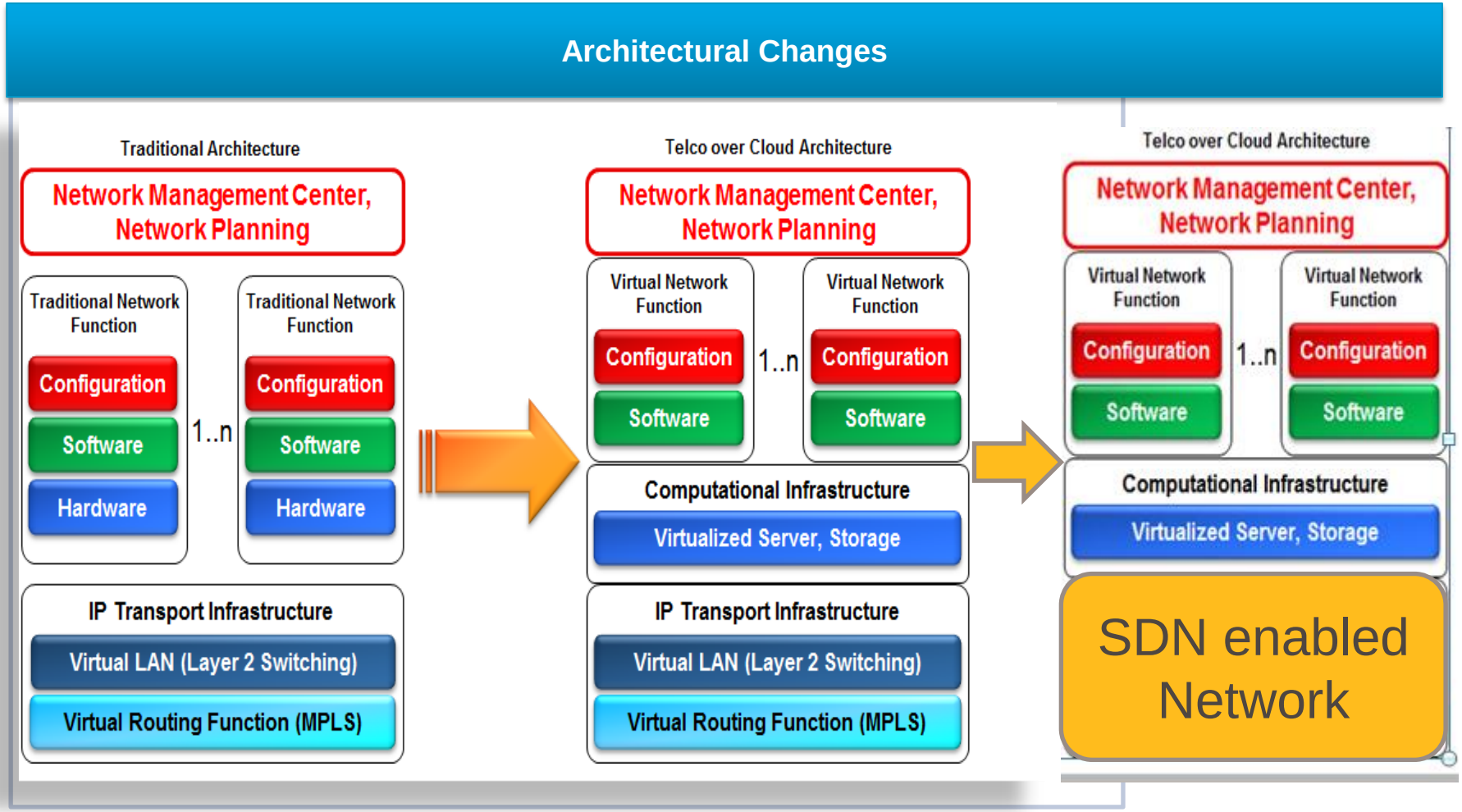
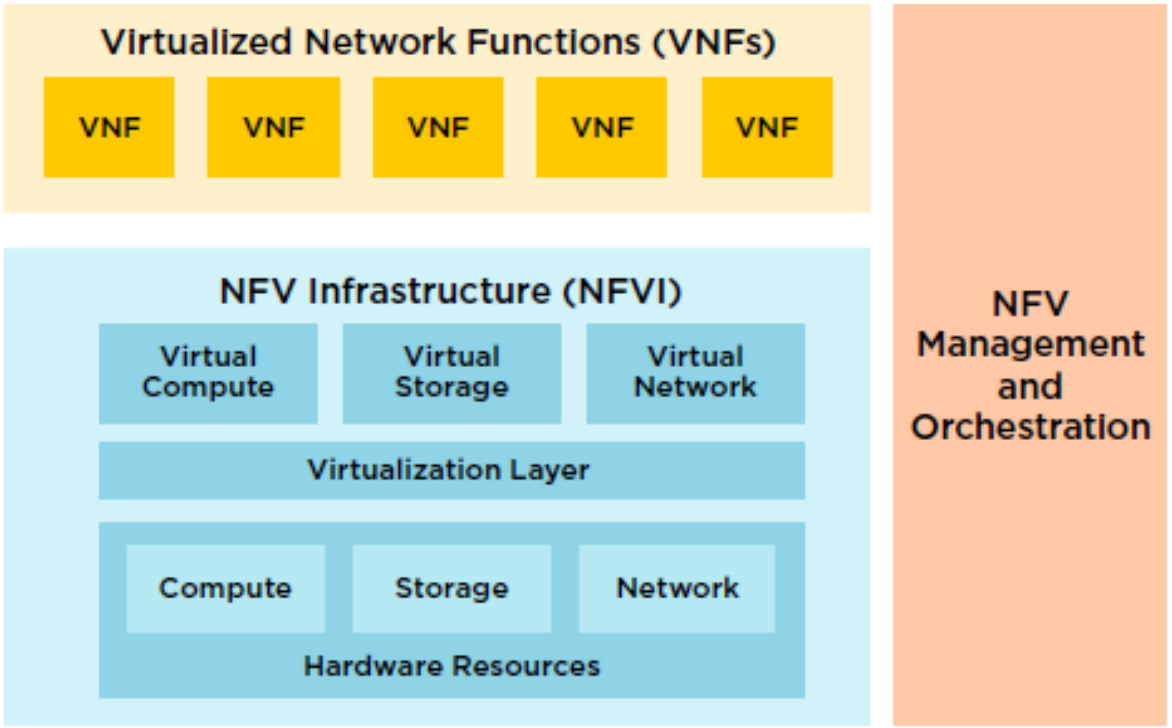


Figure 4. End-to-end network service. (original source: ETSI www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.01.01_60/gs_NFV002v010101p.pdf)

Architectural changes for a Telco



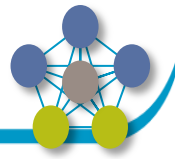
Architectural Framework



HIGH LEVEL NFV FRAMEWORK

Adapted from ETSI publication GS NFV 002: Network Functions Virtualization (NFV); Architectural Framework

Main impacts of NFV on network operations

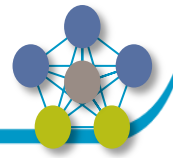


- Decoupled engineering and deployment cycles for infrastructure and VNFs:
  - Some critical governance mechanisms needed between VNFs and Infrastructure:
    - Architecture and Design
    - Testing
    - Capacity planning
- Need to ensure compatibility and performance of VNFs over infrastructure platform
- Dedicated unit for Virtual Infrastructure lifecycle

- DevOps
  - Software oriented engineering: increased importance of SW development and integration, SW based testing
  - Horizontal integration of NFVs across engineering, development and operations for increased agility
  - Opportunity for quicker innovation and new models for development (Agile / DevOps) and testing (e.g. beta testing for selected customers

- Management and Orchestration of Network Services (MANO)
  - Brand new processes supported by new tools will be required to manage virtualized functions and infrastructure, very much in line with ETSI definitions, with short-term approaches taking into account the current maturity of available solutions

A target operational model for Telcos



Portals — Reporting Dashboard | Service Requests | Service Definition | Service Administration

	Strategy (Think)	Engineering (Build)			Deployment (Build)			Operations & Maintenance (Run)	
Business/Service	**Strategy** • Service & Offer Portfolio Planning	**Design** • Service & Offer design	**Development** • Service & offer development	**Validation** • Service & Offer trial and validation	**Planning** • Service planning	**Procure-ment** • Service Capability Delivery • Order management	**Build** • Service activation • Service management	**Operations** • On-demand fulfillment • SM&O Support & Readiness • Service quality management • Usage driven billing • Analytics-based assurance	**Maintenance** • Service problem management • CRM • Reporting • Security

OSS / BSS

Functions

Strategy
- Network Services strategy
- (VNF based)

VNF services lifecycle

Fixed access / Mobile access / Core / VAS Platforms

Design	Develop-ment	Validation	Planning	Procure-ment	Build
• Assessment, Architecture & PoC • Specs & solution selection	• Development & Integration	• Lab Testing • Field Trials	• Dimensioning & Planning • Technical planning • Optimization	• Contract mgmt • SLAs • Capacity management	• Programming • Construction & Testing • Project mgmt • VNF on-boarding • Scaling

Infrastructure

- VNF Infras-tructure strategy

NFV infrastructure lifecycle

vCompute / vNetwork / vStorage

Design	Develop-ment	Validation	Planning	Procure-ment	Build
• Assessment, Architecture & PoC • Specs & solution selection	• Development & Integration	• Lab Testing • Field Trials	• Dimensioning & Planning • Technical planning • Optimization	• Ordering • Logistics • Contract mgmt • SLAs • Capacity management	• Programming • Construction & Testing • Project mgmt

MANO

Management and Orchestration of network Services

Network Service Orchestration:
- Management of VNFs

Resource Orchestration:
- Policy management and enforcement for NS* and VNF instances

Operations	Maintenance
• Performance mgmt • Fault mgmt • Configuration mgmt	• L2/L3 Technical Support • Bug fixing

Fault
Configuration
Administration
Performance
Security

Hosting

Customer premises | Local PoP | Regional DC

* NS = Network Service

Case Study | *Virtual GGSN*: Capgemini approach and lessons learned

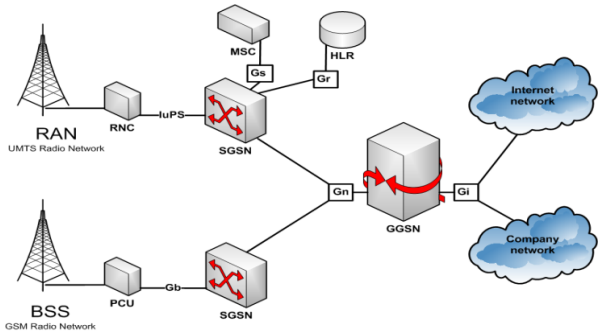
As part of a network upgrade project Capgemini leaded activities in testing and implementation of a virtual GGSN

Use Case Scenario

- Introduce a virtualized GGSN in M2M solution
- Standard GGSN functionalities required
- HP HW
- Flex SW solution used

Main Activities results

- **Tech Gap analysis** between the vendor solution and the Centre of Excellence recommendation
- Flex SW solution posed Bandwidth issues
- Appliance SW limitation in using V-Motion



Lessons Learned

- Virtual GGSN was not able to leverage on **V-Motion capability** which resulted in a strong limitation in the flexibility of the solution.

Vendors sometimes promise a not realistic fully compliancy with ETSI NFV specifications

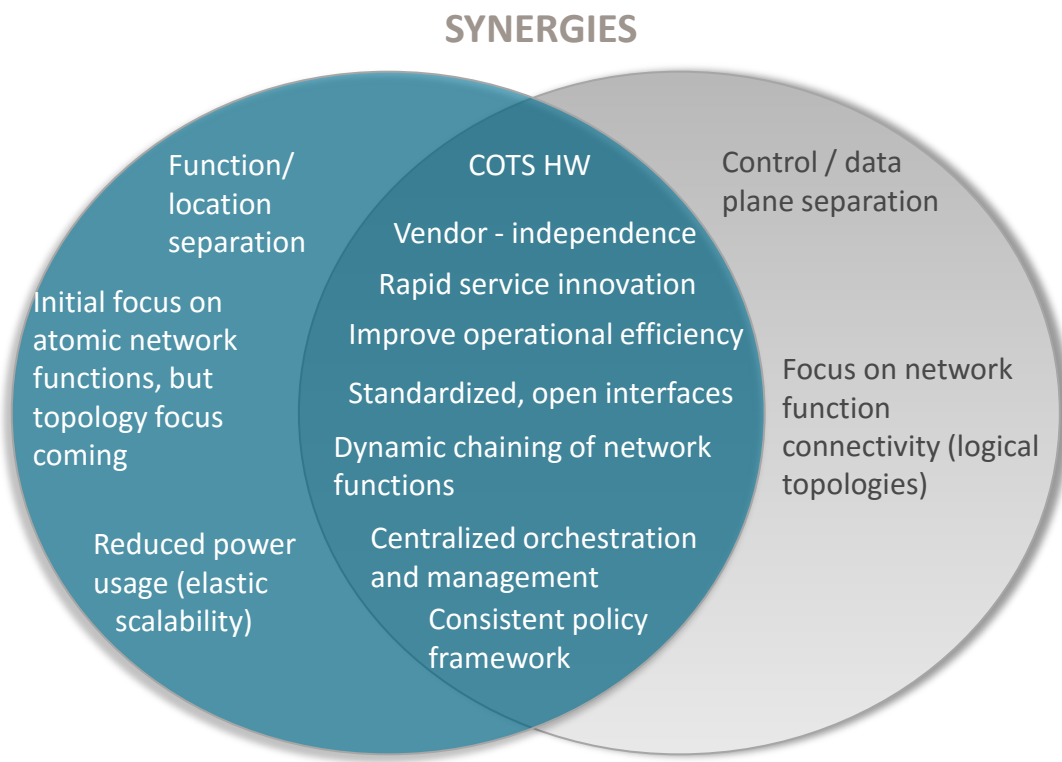
Summary

NFV

- **NFV** aims to transform the way that network operators architect networks by evolving standard IT virtualization technology to consolidate many network equipment types onto industry standard equipments

SDN

- SDN is an approach to building data networking equipment that separates the control plane from the data plane so that control can be managed centrally.

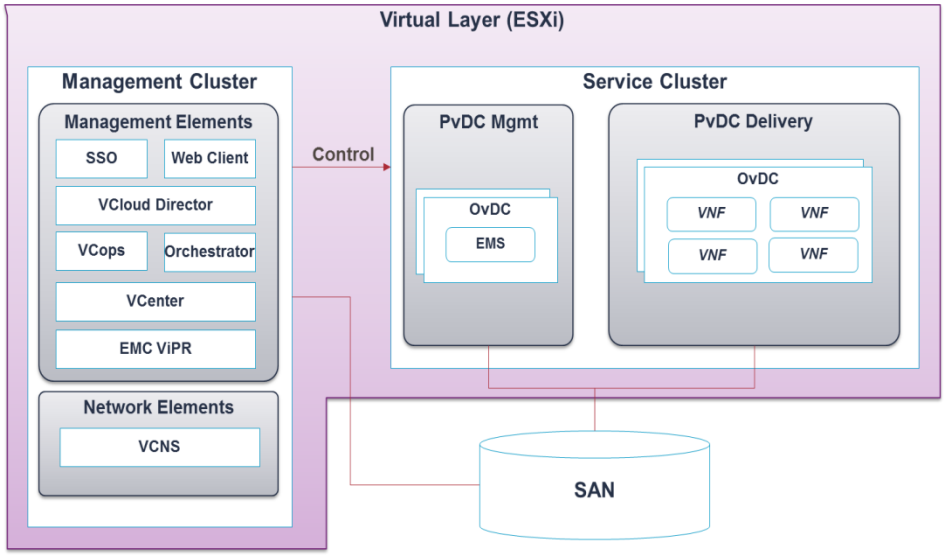


SDN implementation in NFV framework shall be done since the beginning to gain full cost savings benefits

Back-up slides

NFV Reference Architecture – VMware Virtual Layer

VMware based Architecture



Description

- **Service Cluster** is composed by 2 different resource sets PvDC (provider Virtual Data Center):
  - Management pVDC hosting Application EMS components
  - Delivery pVDC hosting Telco Applications (VNF) instances controller by appropriate EMS
- **Management Cluster** hosting all the VMware management application, each cluster type is handled by its own vCenter service deployed in the Management Cluster itself
- **Each Vendor Application** has two OvDC (tenants) within the NFV infrastructure, one for the EMS and another for the VNFs

Resource overcommitting and Hyper-Threading not allowed. From the VNF perspective, only physical cores shall be used and taken into account

NFV Architecture of a Global Telecom Operator

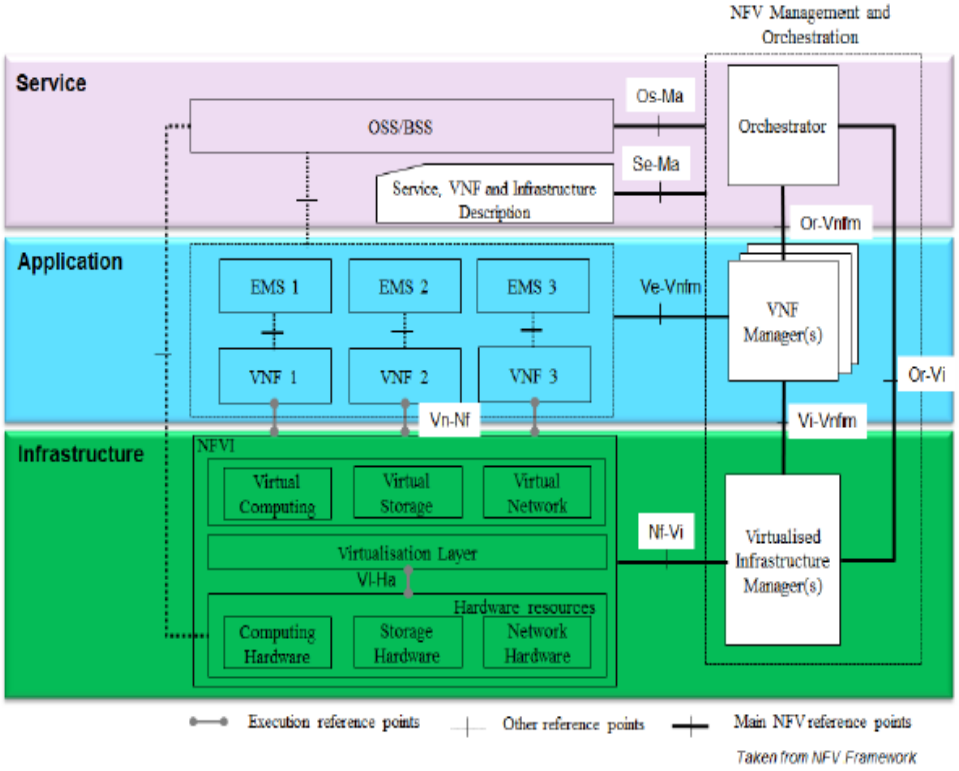


Figure 3-2 - ETSI NFV architecture

Service layer: Orchestrator not deployed yet

Application layer: EMSs are entitled to cover the VNF-M functionalities (provisioning, configuration, and fault and alarm management)

Infrastructure is ETSI compliant

Infrastructure in line with specification but application and service layers not due to vendor products immaturity