

Software Defined Networks (SDN) and Network Function Virtualization (NFV) Recap

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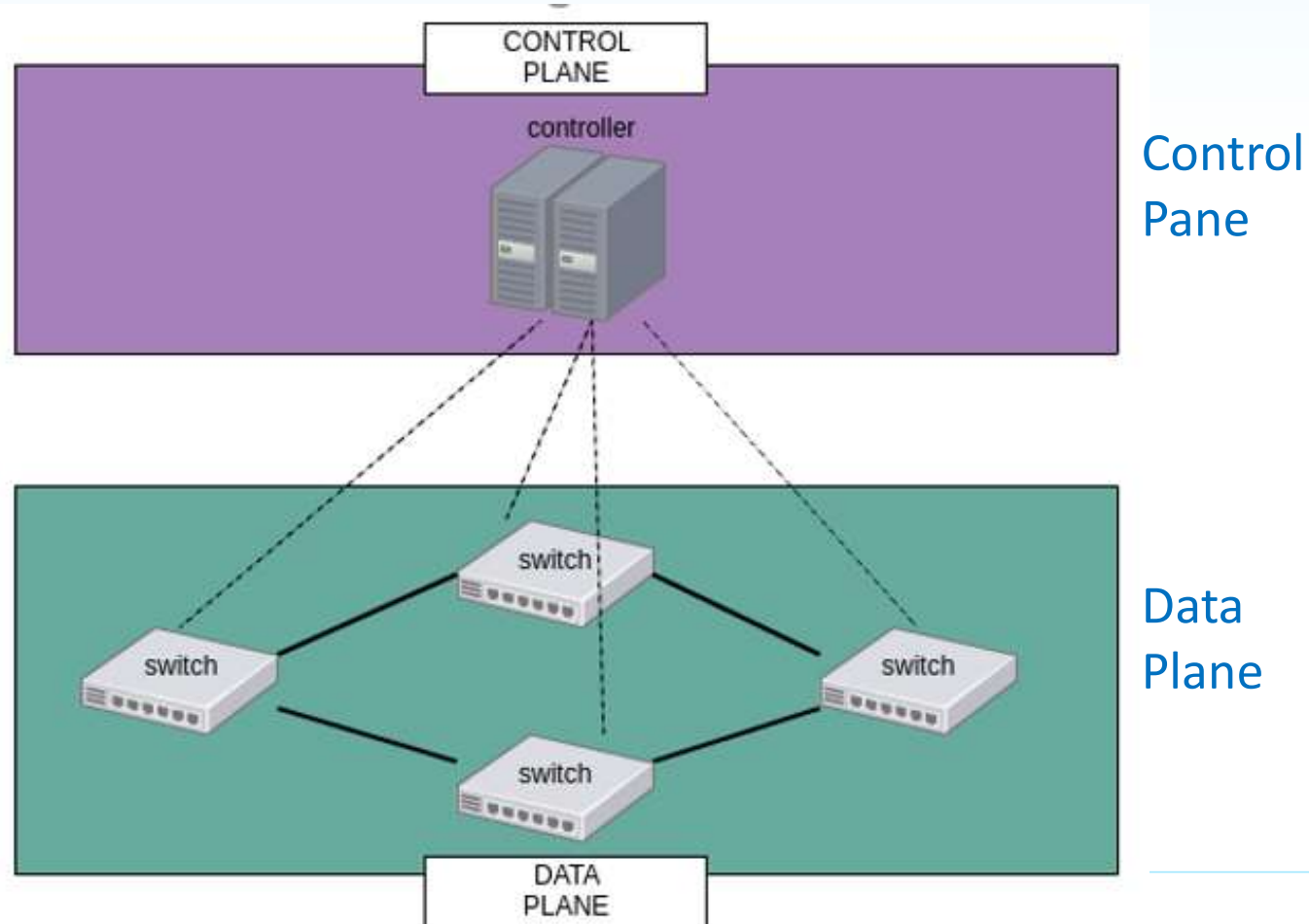
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- Prof. Christian Esteve Rothenberg, UNICAMP, Brazil
- Diego R. Lopez, Telefonica I+D, NFV
- Yun Chao Hu, NFV INF WG Co-chair



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Software Defined Networking (SDN)

- Centralized Programmable Network Control

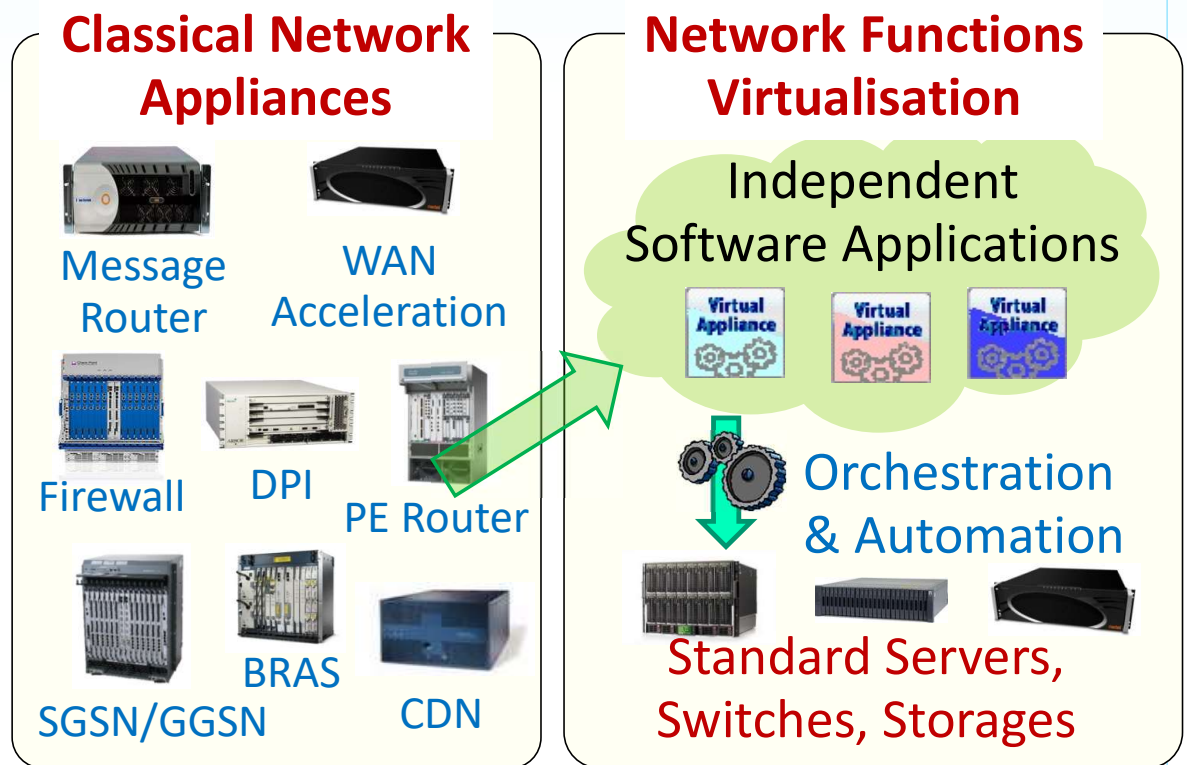


Network Functions Virtualisation

○ Network Functions Virtualization (NFV)

leveraging standard IT **virtualization** technology to consolidate many network equipment types onto **industry standard** high volume servers, switches and storage – which could be located in Datacenters, Network Nodes and End User Premises.

- PE Router: Provider Edge Router,
- DPI: Deep Packet Inspection
- GGSN: Gateway GPRS Support Node,
- SGSN: Serving GPRS Support Node,
- BRAS: Broadband Remote Access Server,
- CDN: Content Delivery Network



Source: Network Functions Virtualisation – Introductory White Paper
http://portal.etsi.org/NFV/NFV_White_Paper.pdf

Two-dimensional Model of Layer-Plane Abstraction

○ SDN: Plane-dimension Abstraction

- Plane abstraction of traditional circuit-switching-based telecom system
 - Data, Control, Management Planes

○ NFV: Layer-dimension Abstraction

- Layer abstraction of IP-based Internet architecture
 - TCP/IP Layer Stack

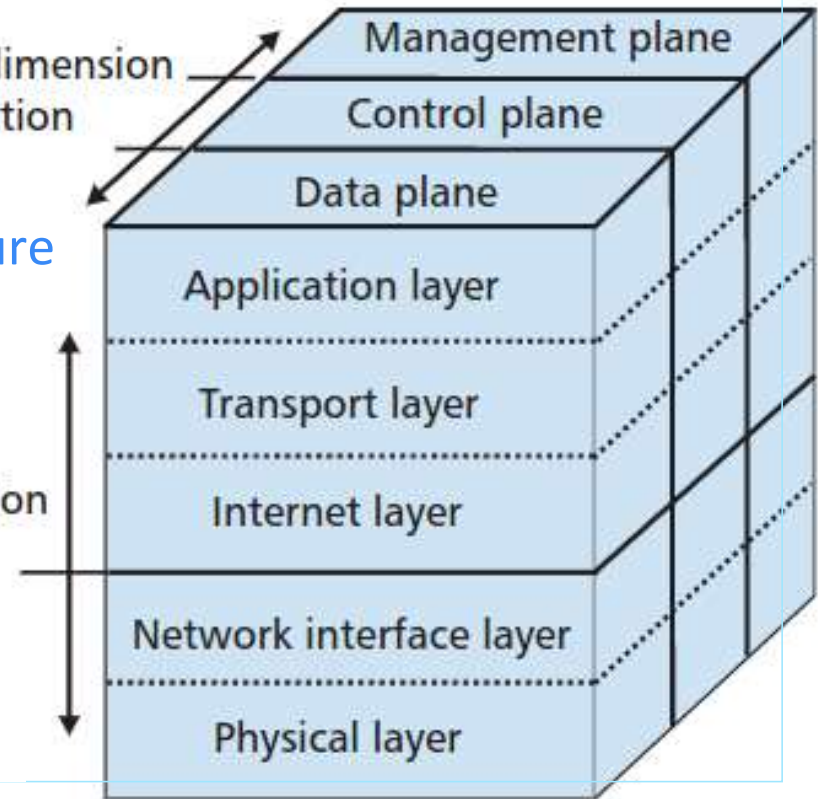
- Two abstraction dimensions are orthogonal
 - in principle are independent

SDN

Plane-dimension
abstraction

NFV

Layer-dimension
abstraction



Source: *Software-Defined Network Virtualization: An Architectural Framework for Integrating SDN and NFV for Service Provisioning in Future Networks*, IEEE Network, 2016

Network Virtualization = SDN + NFV

- Provide a **general interface** to network resources
 - Abstracting actual infrastructure details
- **Decouple** the **planes** conforming the network
 - Relying on software mechanisms to support functionality



SDN

- Decouple control and data planes
 - Gain programmability
 - Simplify data plane elements

Software in the network

NFV

- Separate functionality from capacity
 - Increase network elasticity
 - Reduce heterogeneity

The network in software

Traditional Networking vs Software Defined Networking

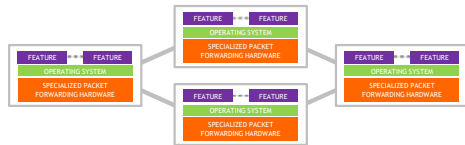


Network equipment as **Black boxes**

SDN

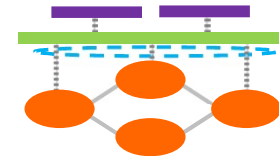


Open interfaces (OpenFlow) for instructing the boxes what to do

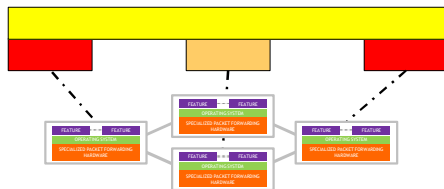


Boxes with **autonomous** behaviour

SDN

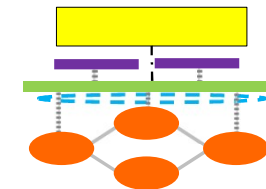


Decisions are **taken out** of the box



Adapting OSS to manage black boxes

SDN



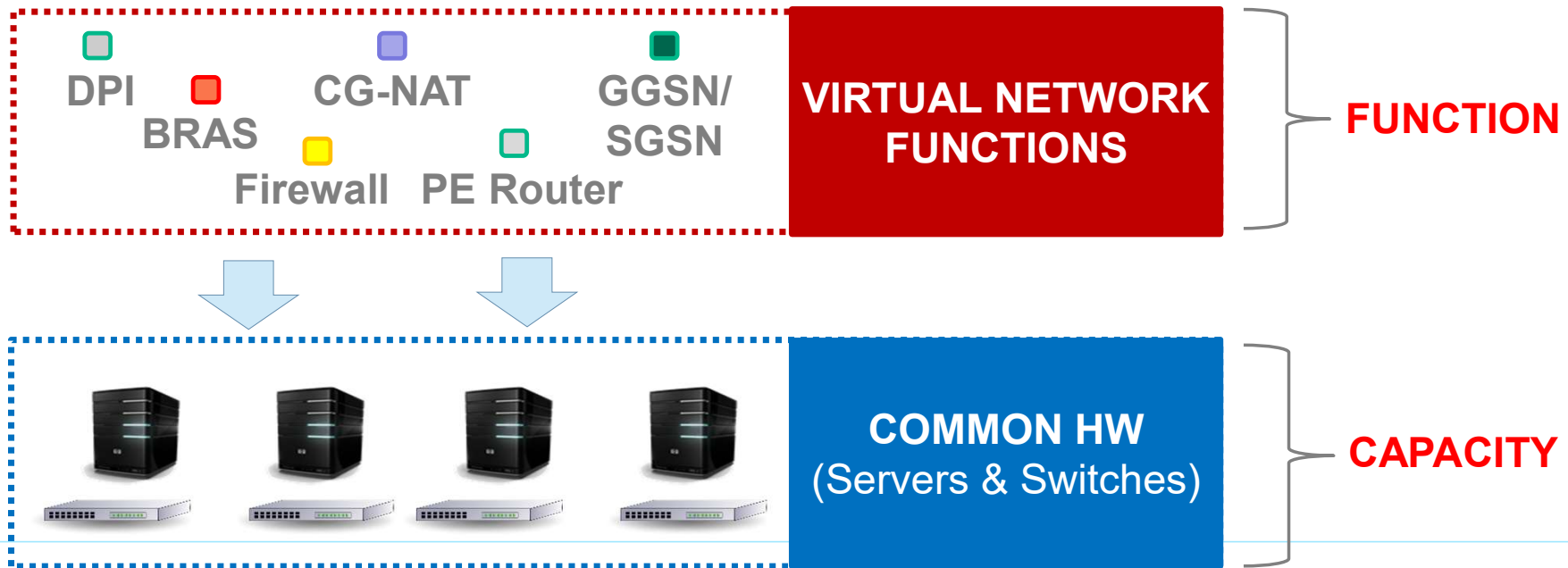
Simpler OSS to manage SDN controller

OSS/BSS: Operation Support System/Business Support System

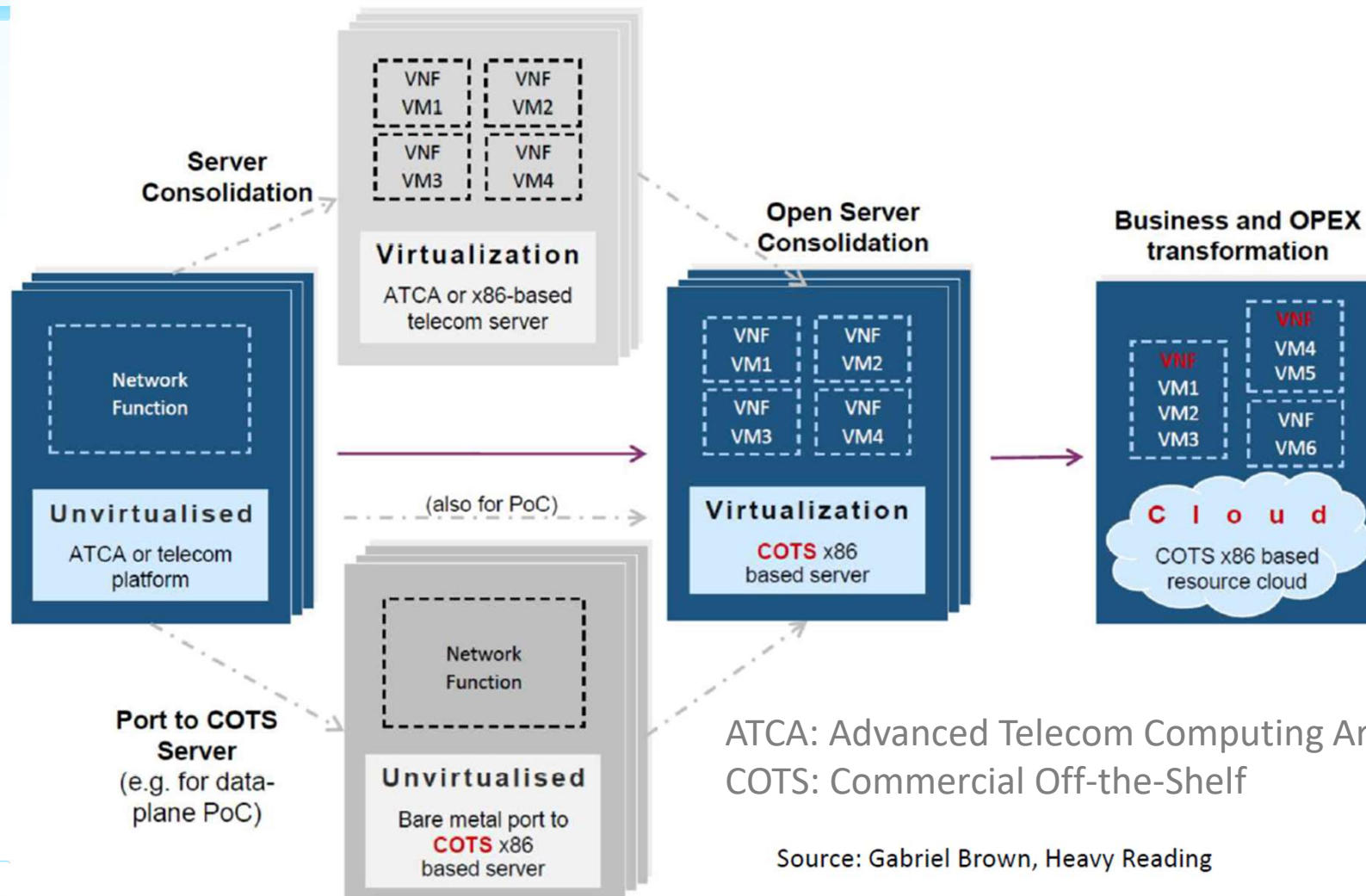
The NFV Concept

- **Network functions are fully defined by SW,**
 - Minimising dependence on HW constraints
 - No vertical integration:
HW vendor \neq SW vendor \neq Mgmt vendor
- Software-based functions: commodity HW can be managed as a pool of resources

- DPI: Deep Packet Inspection
- BRAS: Broadband Remote Access Server,
- CG-NAT: Carrier-grade NAT
- PE Router: Provider Edge Router,
- GGSN: Gateway GPRS Support Node,
- SGSN: Serving GPRS Support Node,

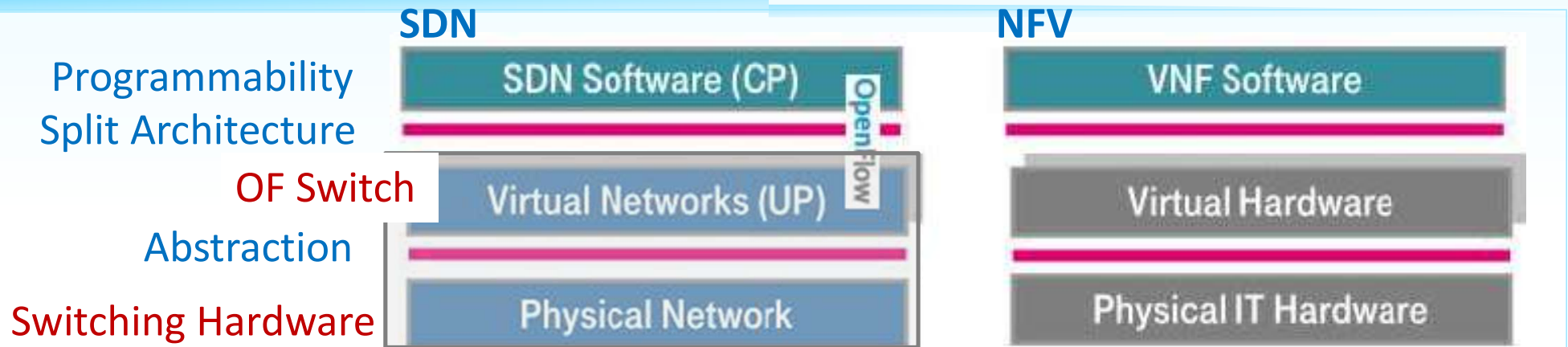


The Road to NFV

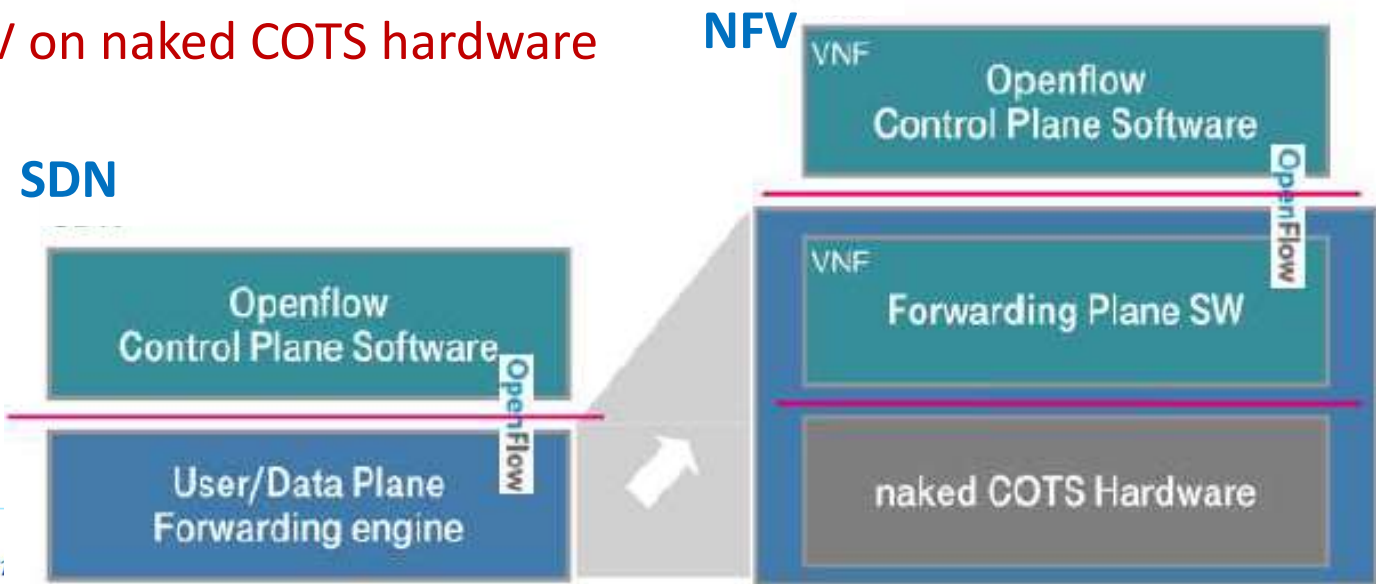


Source: Gabriel Brown, Heavy Reading

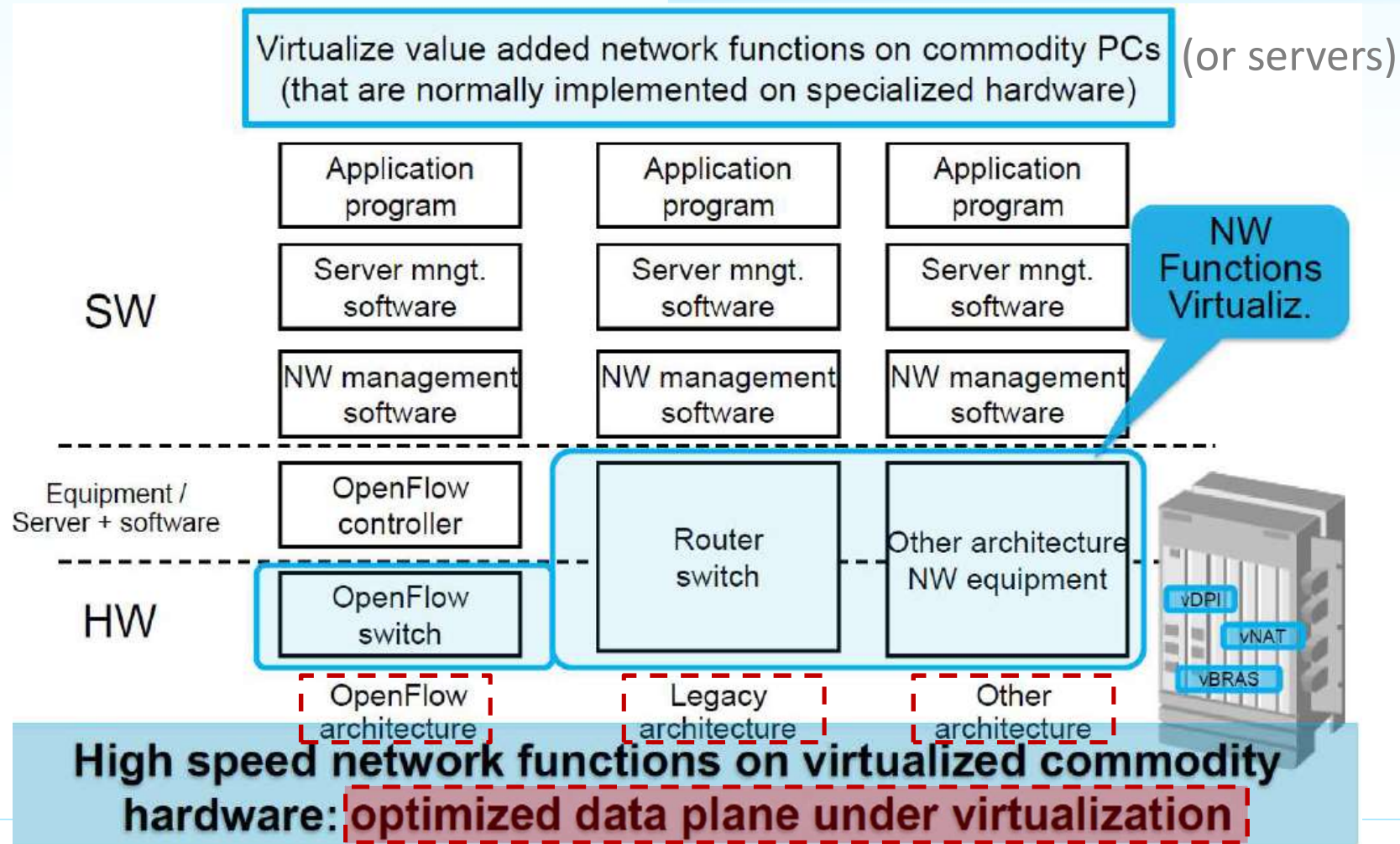
SDN and NFV do NOT depend on Each Other



■ SDN via NFV on naked COTS hardware



Scope of NFV and OpenFlow/SDN



Source: NEC

NFV vs SDN

- **NFV**: re-definition of (network) equipment architecture

NFV was born to meet Service Provider (SP) needs

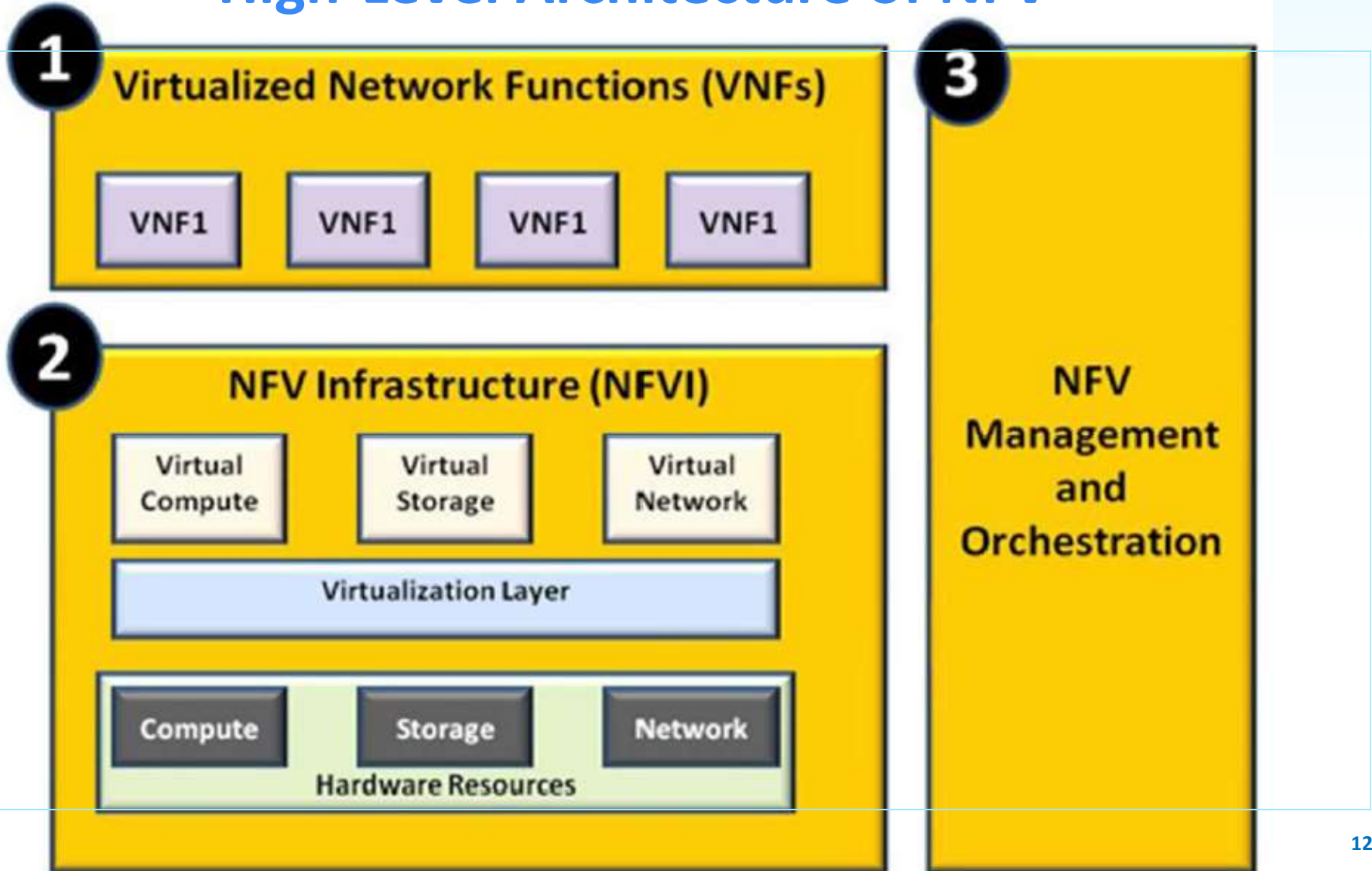
- Lower CAPEX by **reducing/eliminating proprietary hardware**
- Consolidate **multiple network functions** onto **industry standard platforms**

- **SDN**: re-definition of network architecture

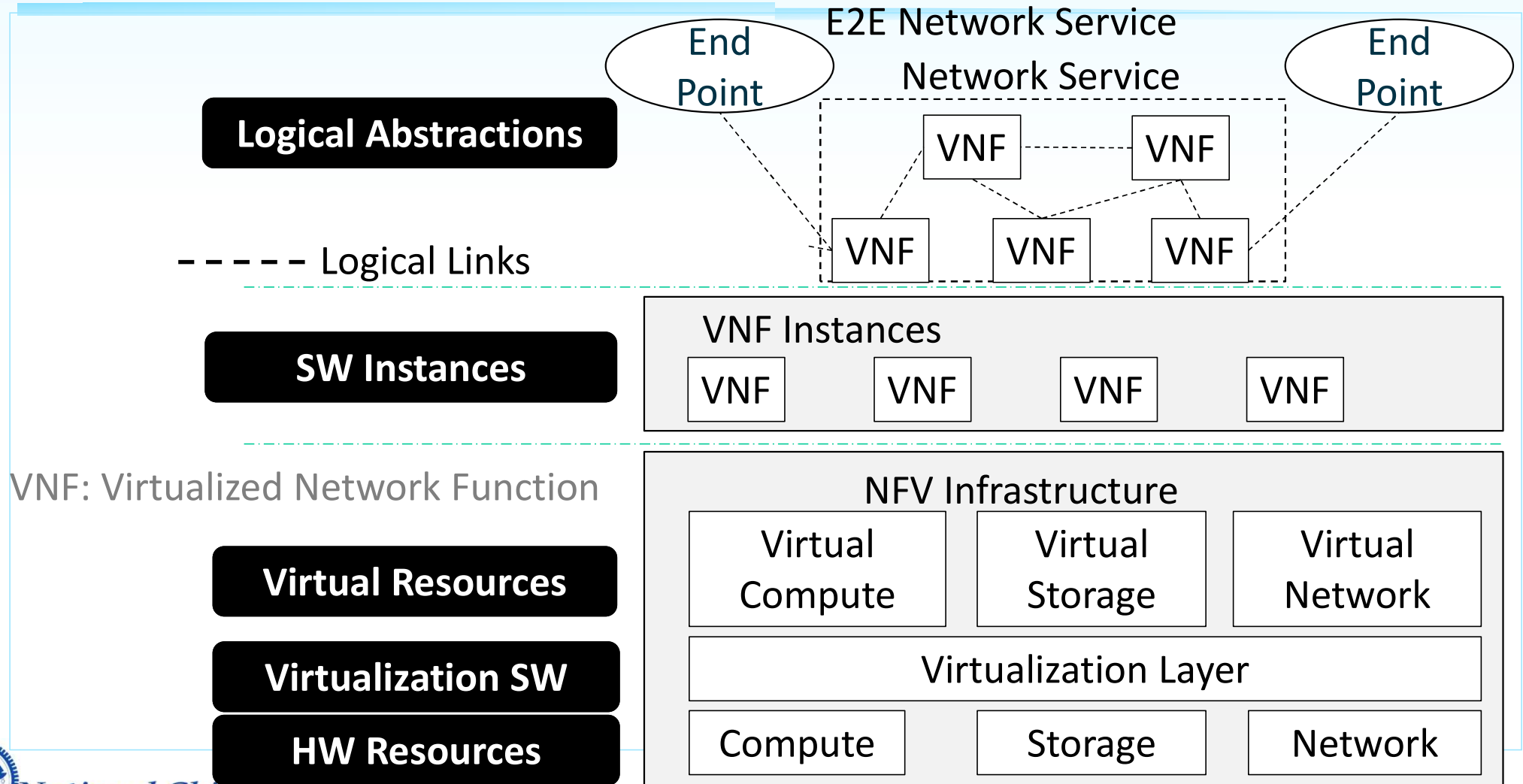
SDN comes from the IT world

- Separate the data and control layers,
 - while centralizing the control
- Deliver the ability to program network behavior
 - using well-defined interfaces

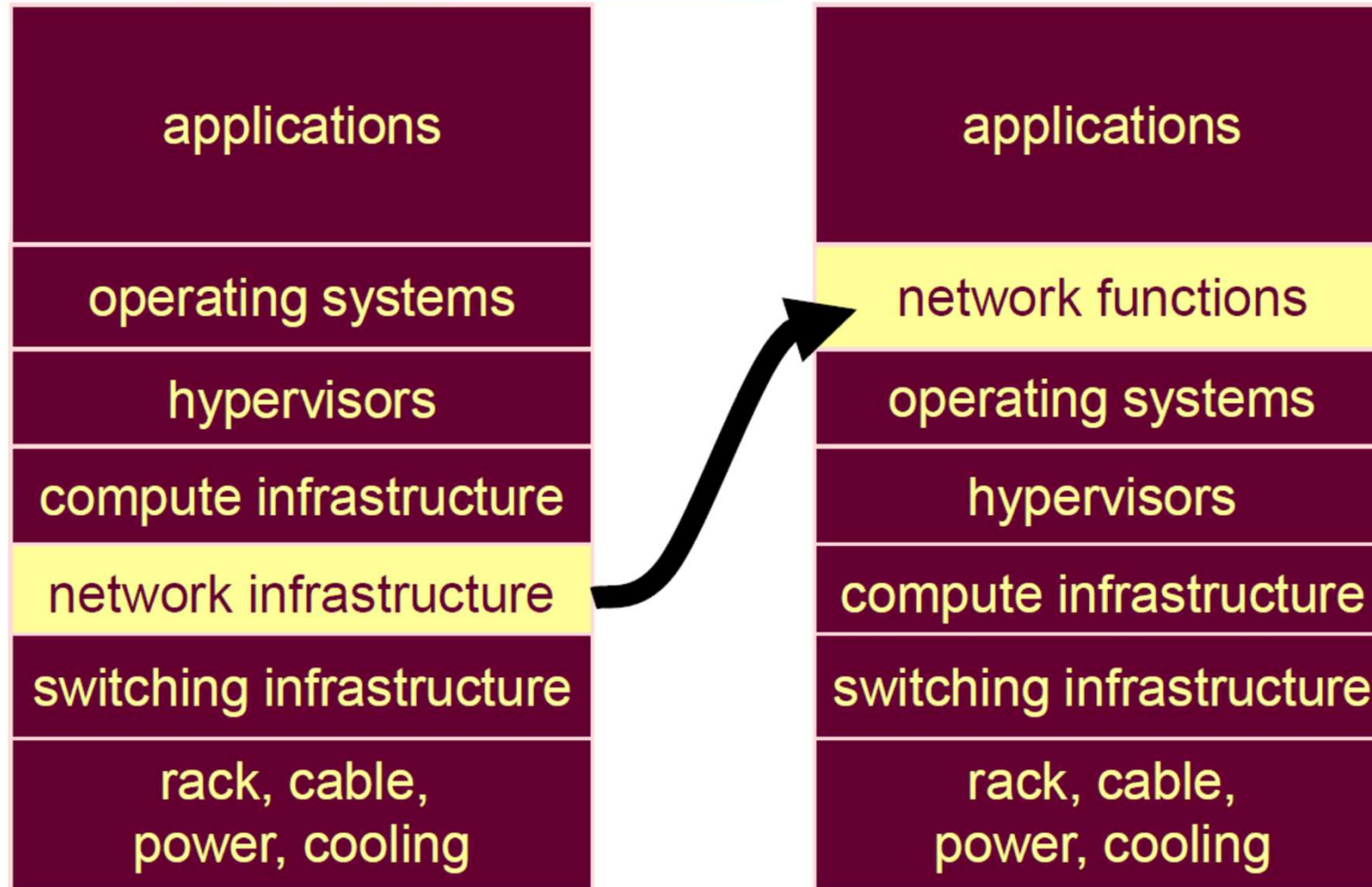
High-Level Architecture of NFV



The NFV Framework



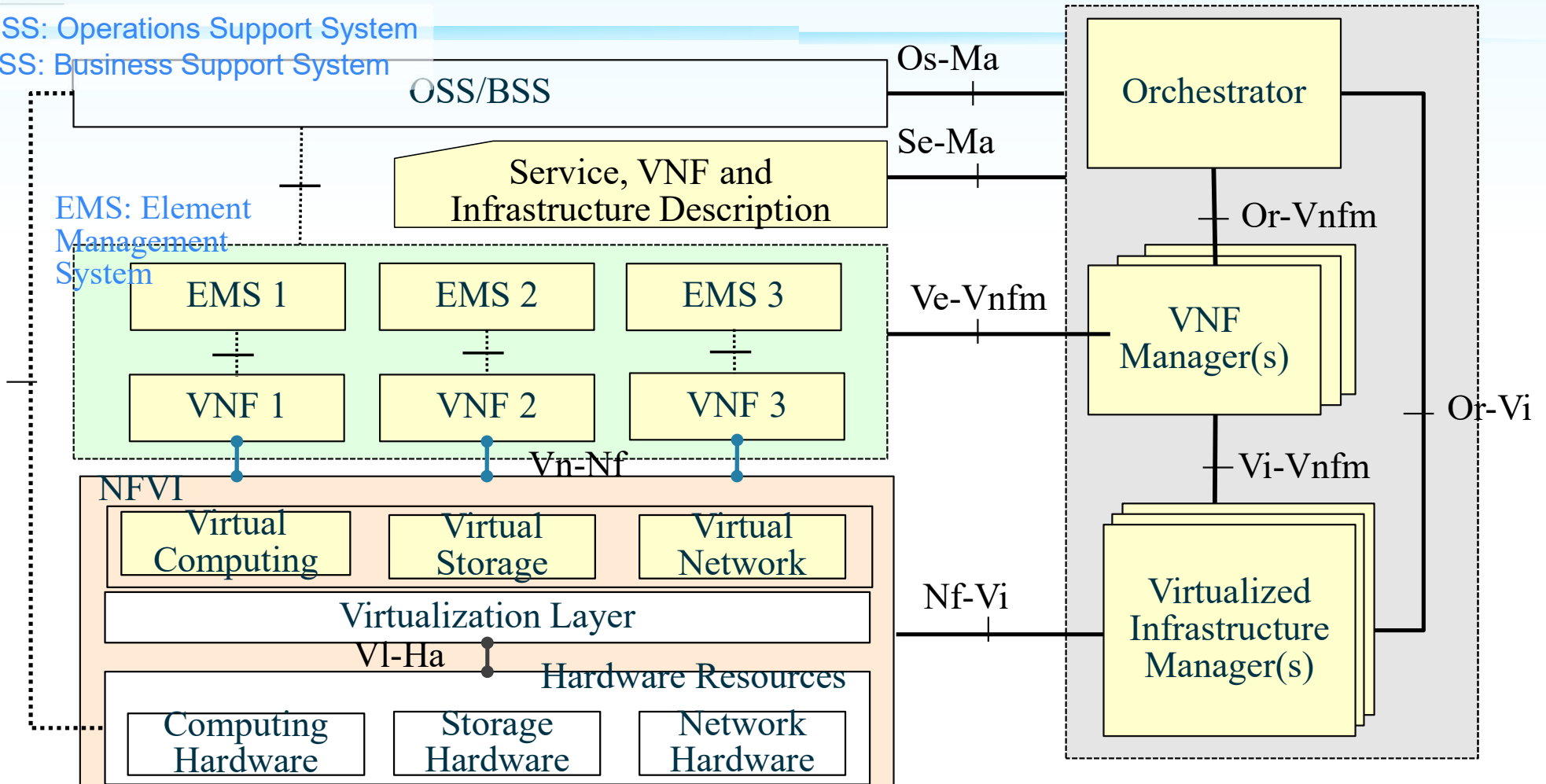
Rethinking relayering



The NFV Reference Architecture

OSS: Operations Support System

BSS: Business Support System



—•— Execution reference points

- - - Other reference points

— Main NFV reference points

Reference Points: Points for inter-module specification

- **Os-Ma:** Operations Support System (OSS)/Business Support Systems (BSS) – NFV Management and Orchestration
- **Se-Ma:** Service, VNF and Infrastructure Description – NFV Management and Orchestration
 - VNF Deployment template, VNF Forwarding Graph, service-related information, NFV infrastructure information
- **Or-Vnfm:** Orchestrator – VNF Manager
- **Vi-Vnfm:** Virtualized Infrastructure Manager – VNF Manager
- **Ve-Vnfm:** VNF/Element Management System (EMS) – VNF Manager
- **Or-Vi:** Orchestrator – Virtualized Infrastructure Manager
- **Nf-Vi:** NFVI – Virtualized Infrastructure Manager
- **VI-Ha:** Virtualization Layer – Hardware Resources
- **Vn-Nf:** VNF – NFVI