Software and Virtualization Technologies in Mobile Communication Networks

Comunicações Móveis

DETI – UA

2023/2024

Outline

- Network Function Virtualization
- Management and Orchestration
- Software Defined Networking

Network Function Virtualization

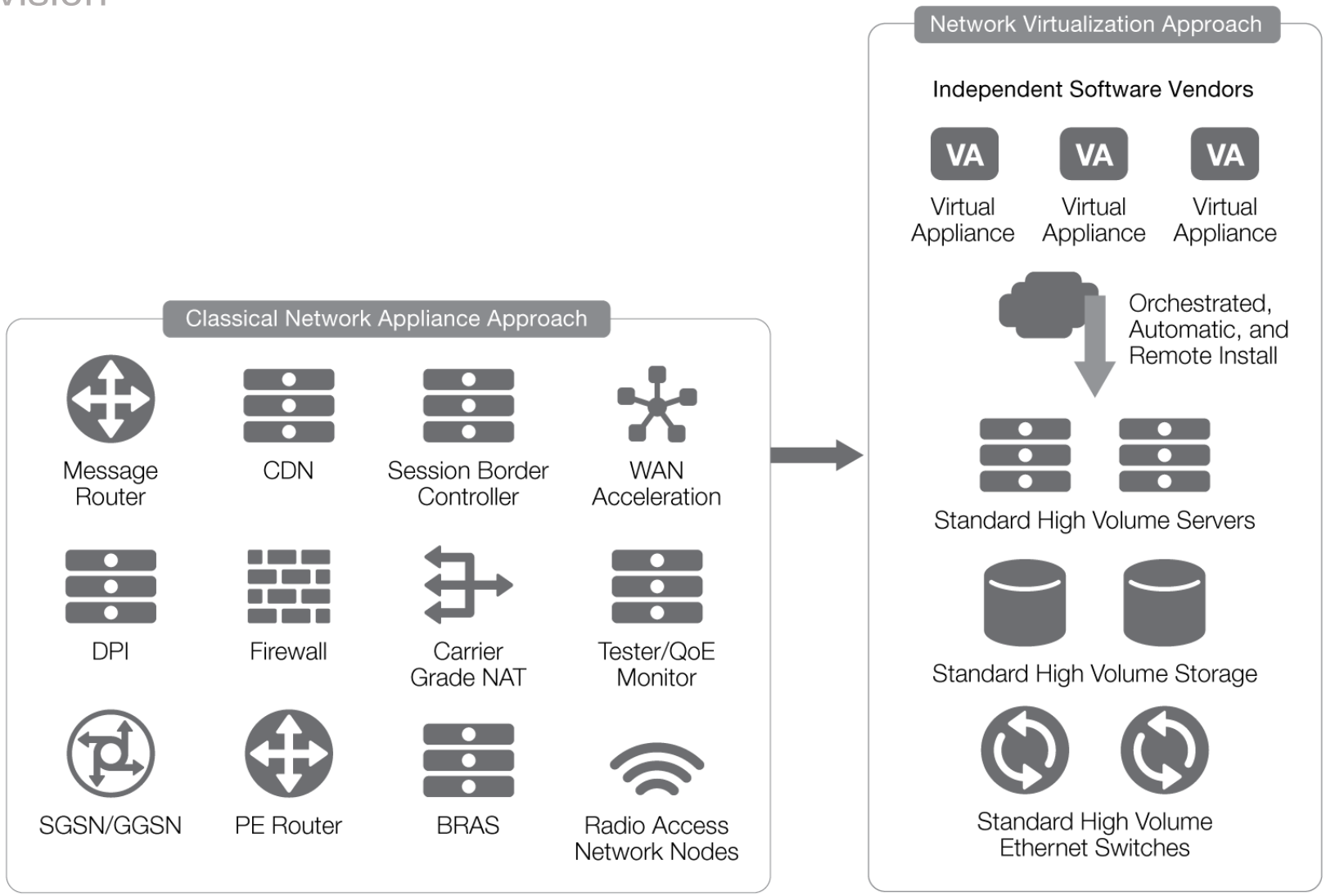
NFV

Virtualization

- 5G brought new trends
- Virtualization
  - Simulate a hardware platform, in software: VM’s, containers
    - Higher portability
    - Higher scalability
    - More cost-effective
- Virtualized networks
  - Logical software-based routers, switches, etc.
  - Network services are easier to deploy and manage
  - The physical part only needs to handle packet forwarding

Network Function Virtualization

vision



Source: https://www.f5.com/es_es/services/resources/white-papers/network-functions-virtualization-everything-old-is-new-again

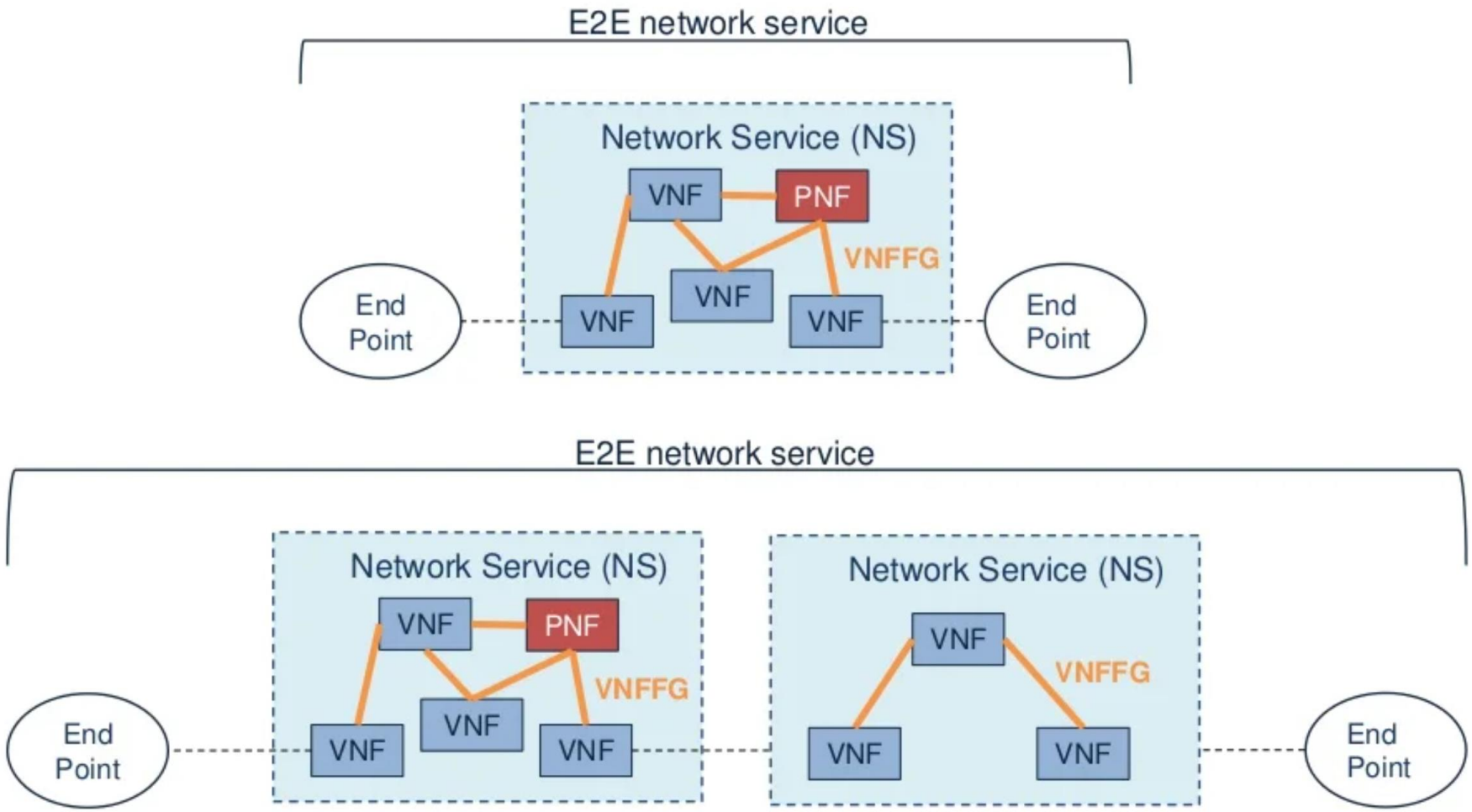
Economy of Scale and Flexibility

- Economy of scale
  - CAPEX – Capital Expenditure
    - <CAPEX → Less investment amounts in infrastructure
      - Less dedicated hardware
  - OPEX – Operational Expenditure
    - <OPEX → Lower costs in operating the infrastructure
      - Less upgrades
      - Less licenses
      - Less air conditioned
      - Less technicians
      - …

Network Services

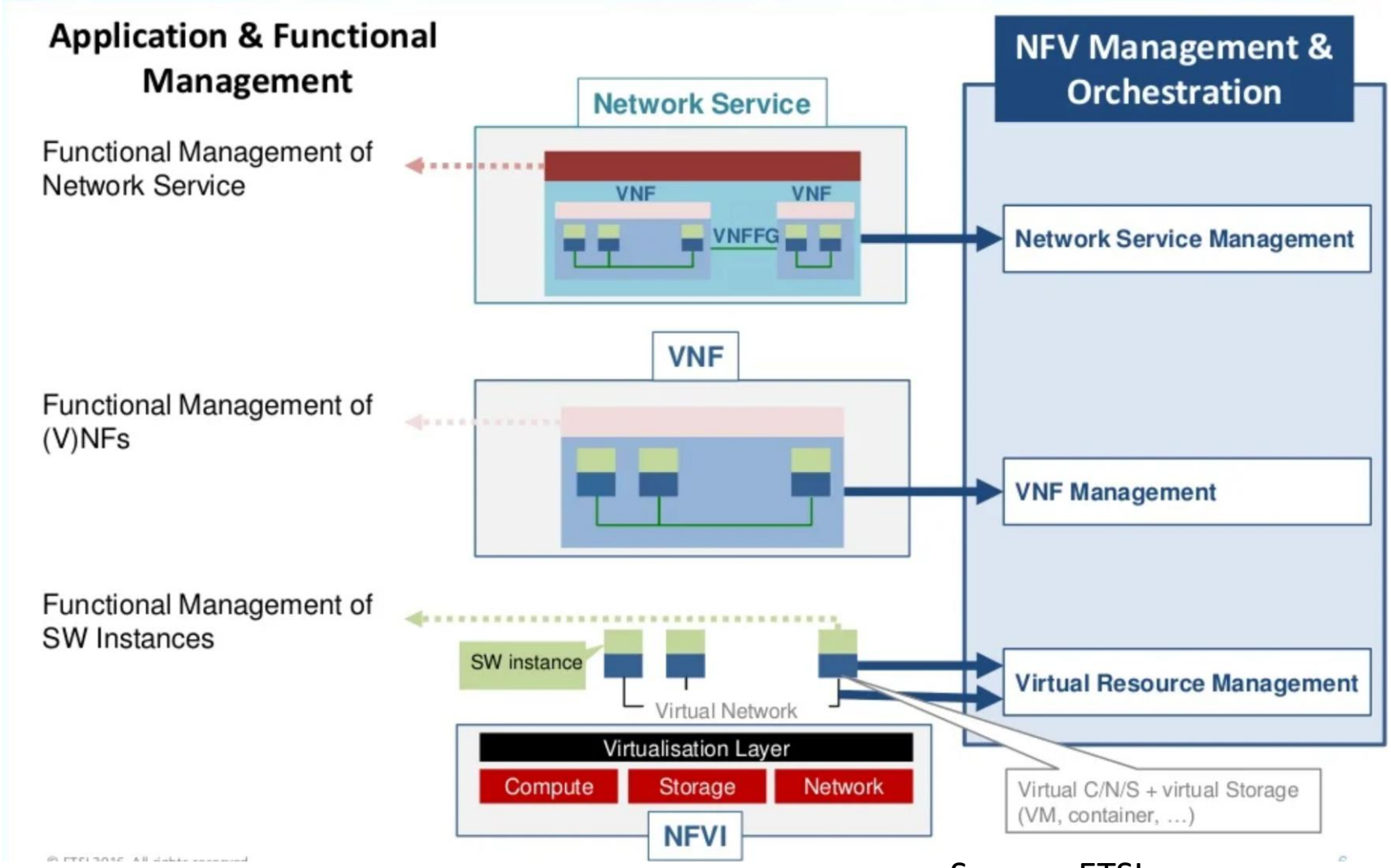
- A set of chained VNFs
- VNFs are interconnected and need to communicate with each other
  - Connectivity Forwarding Graph (FG) indicates how they are connected
    - VNFFG – VNF Forwarding Graph
- Can connect to physical network functions
  - Can also be part of the forwarding graph
- VNFs+VNFFG = Network Service
  - Is managed and orchestrated together
  - Lifecycle mgmt for VNFs
  - Management of the VNFFG and NS lifecycle mgmt is going to orchestrate across the whole lifecycle mgmt of those VNFs that form the NS
  - The NS defines some external connection points that can be connected to the end-dpoints, defining na end-to-end service.
  - We can concatenate differente NS to for an end-2-end network service

Network Services



Source: ETSI

Overall Concepts and how they interconnect



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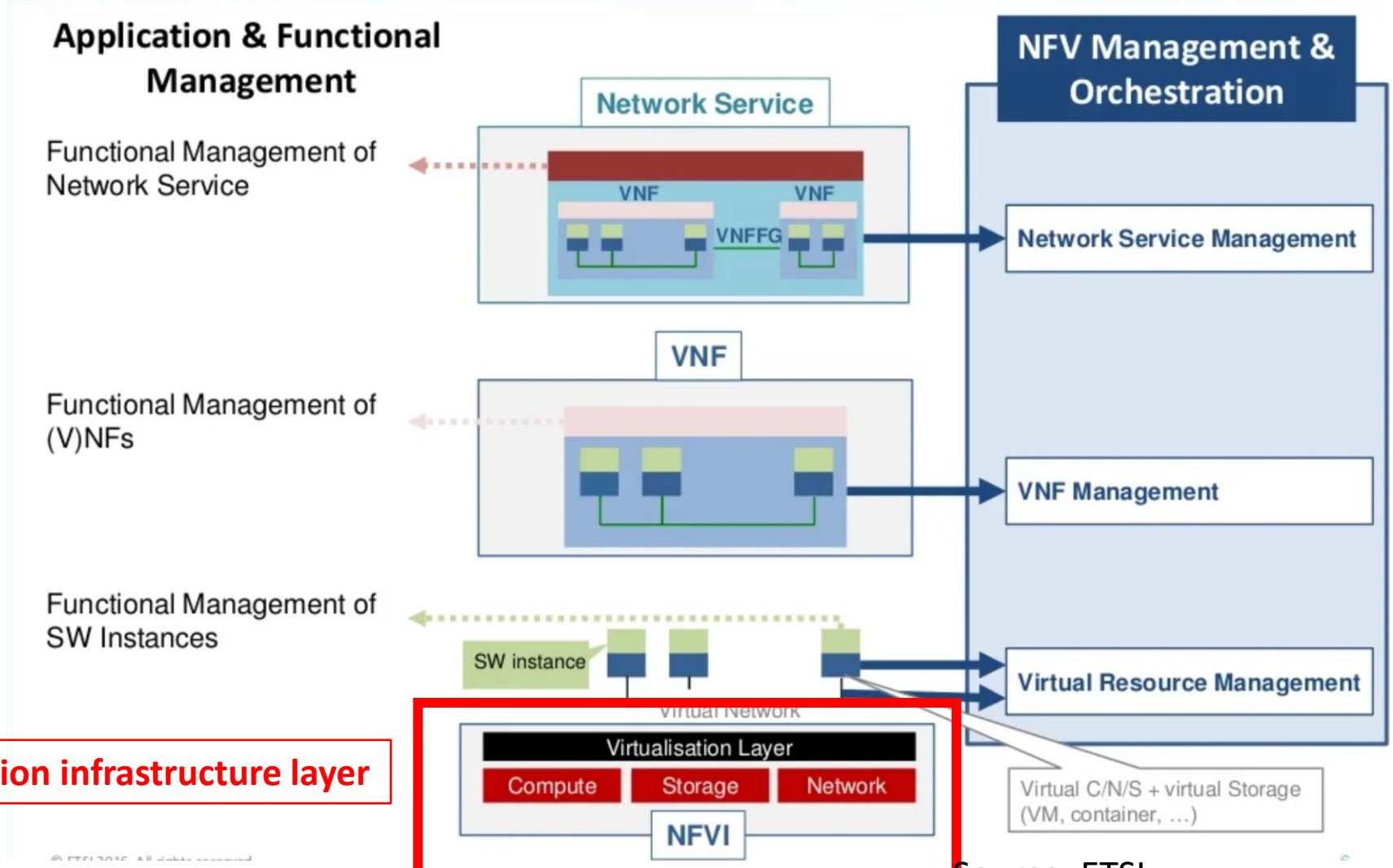

Virtualization infrastructure layer

Source: ETSI

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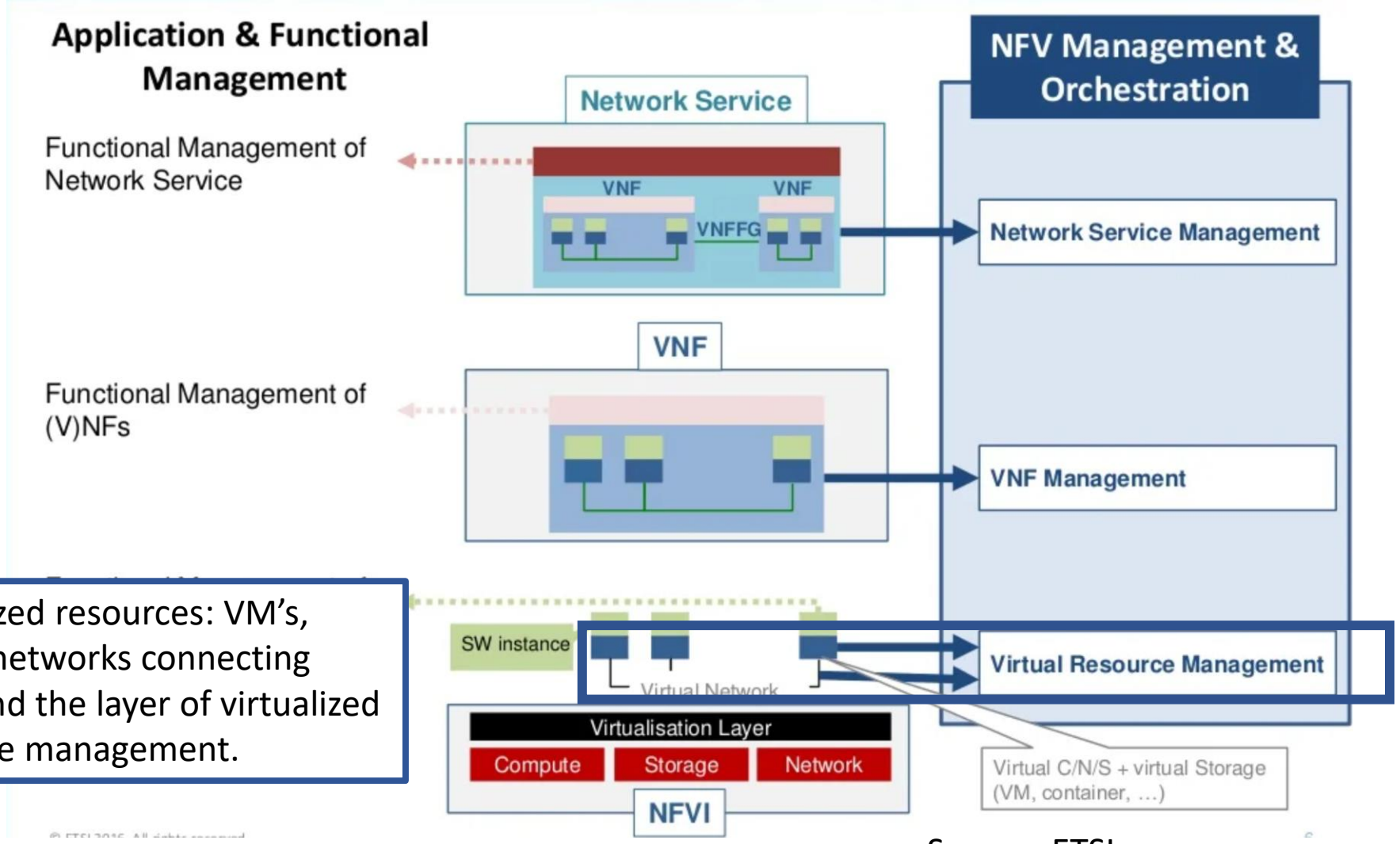

Virtualized resources: VM's, virtual networks connecting VMs, and the layer of virtualized resource management.

Source: ETSI

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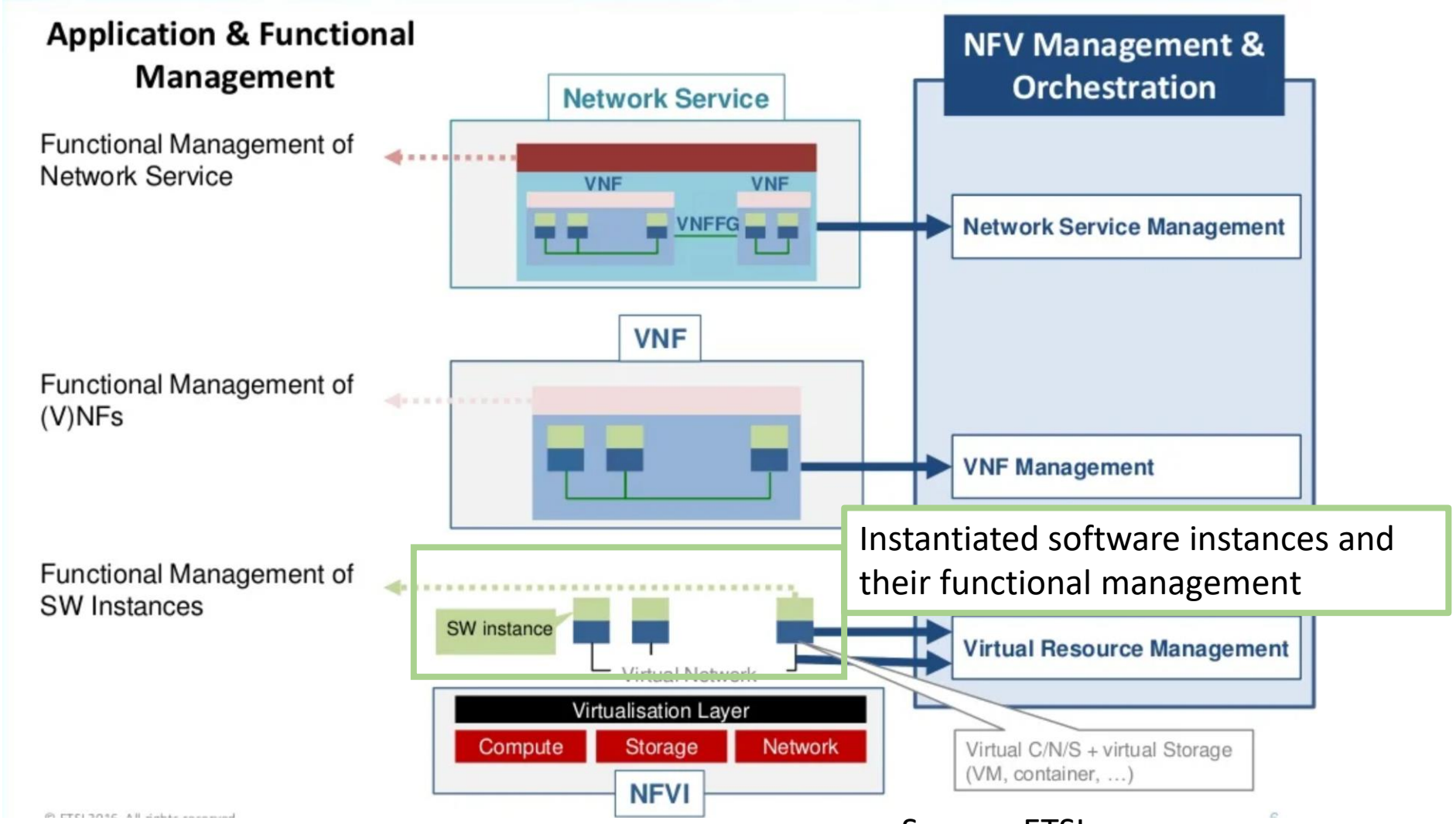

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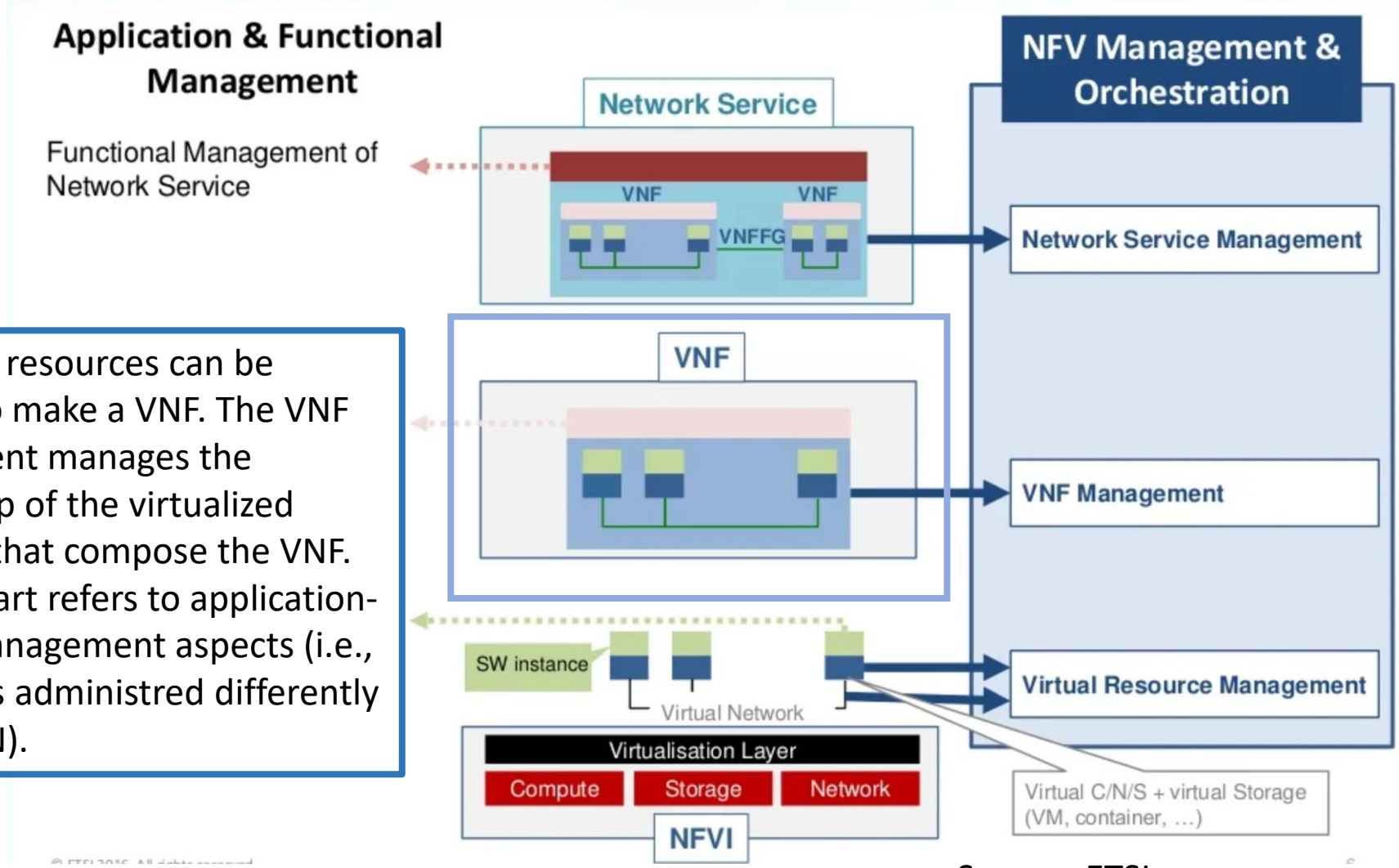
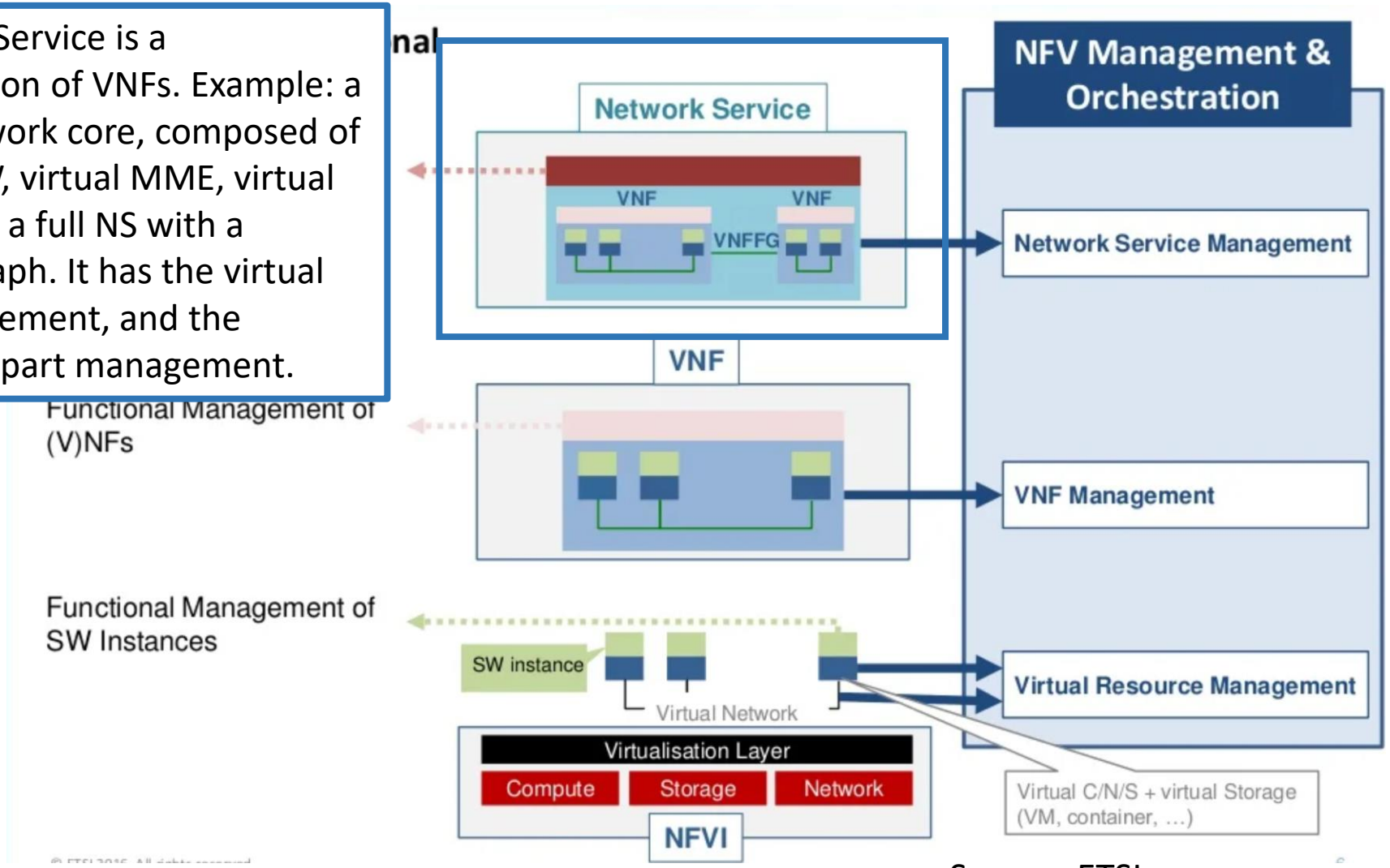


Virtualized resources can be grouped to make a VNF. The VNF management manages the relationship of the virtualized resources that compose the VNF. The pink part refers to application-specific management aspects (i.e., a firewall is administred differently than a CDN).

Source: ETSI

Overall Concepts and how they interconnect

A Network Service is a concatenation of VNFs. Example: a virtual network core, composed of virtual PGW, virtual MME, virtual SGW, forms a full NS with a network graph. It has the virtual part management, and the application part management.



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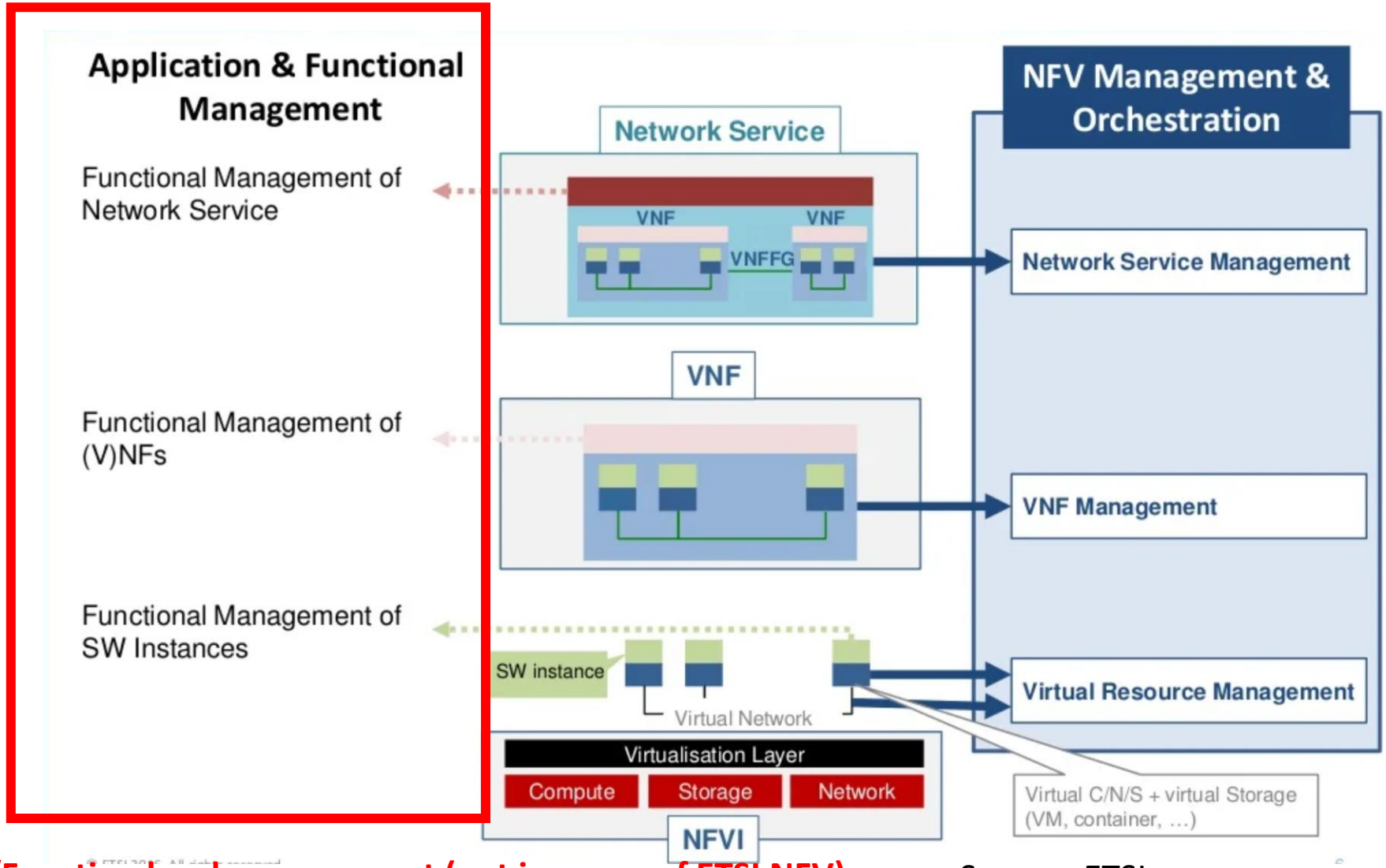
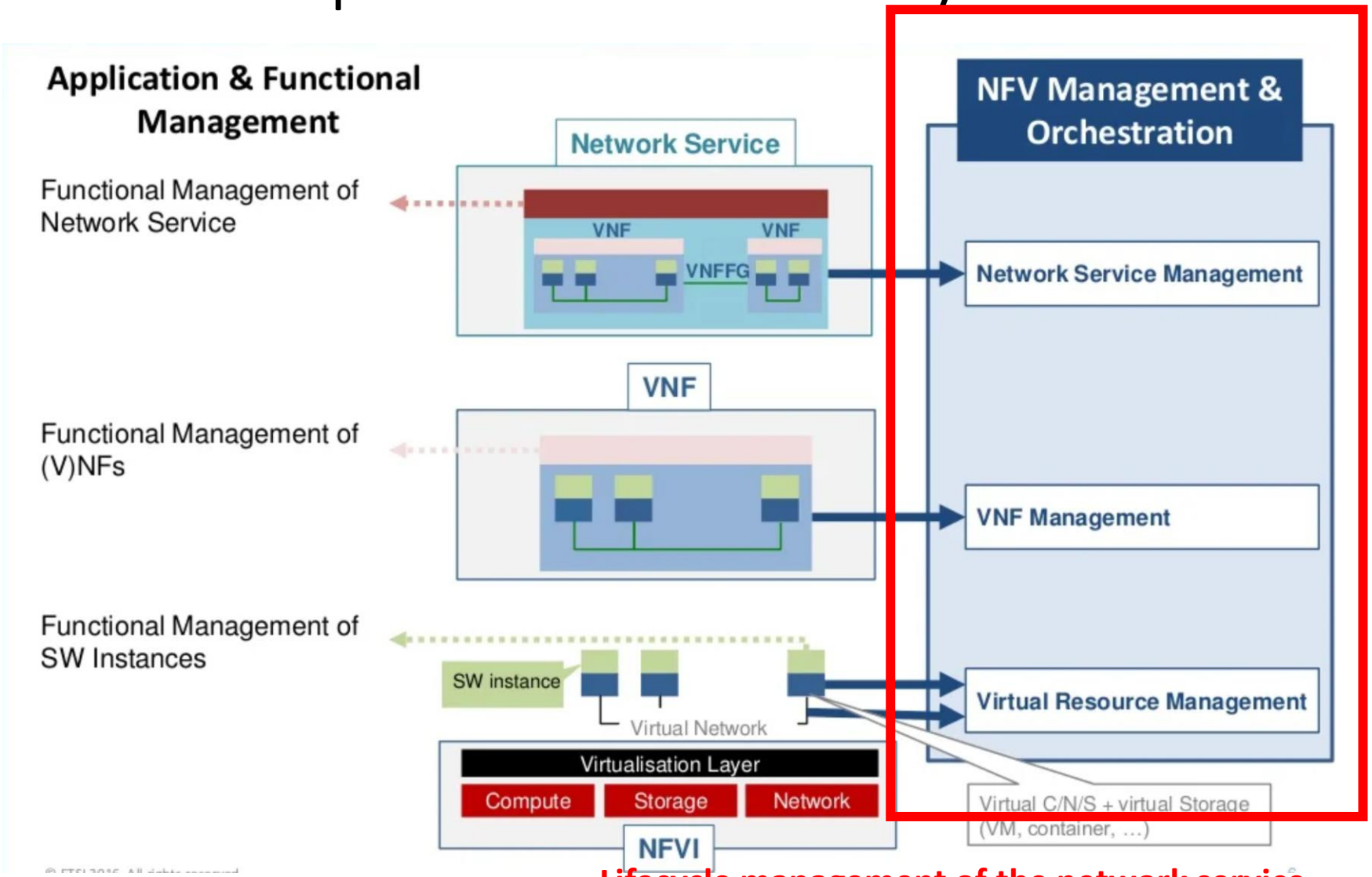


Application/Function level management (not in scope of ETSI NFV)

Source: ETSI

Overall Concepts and how they interconnect



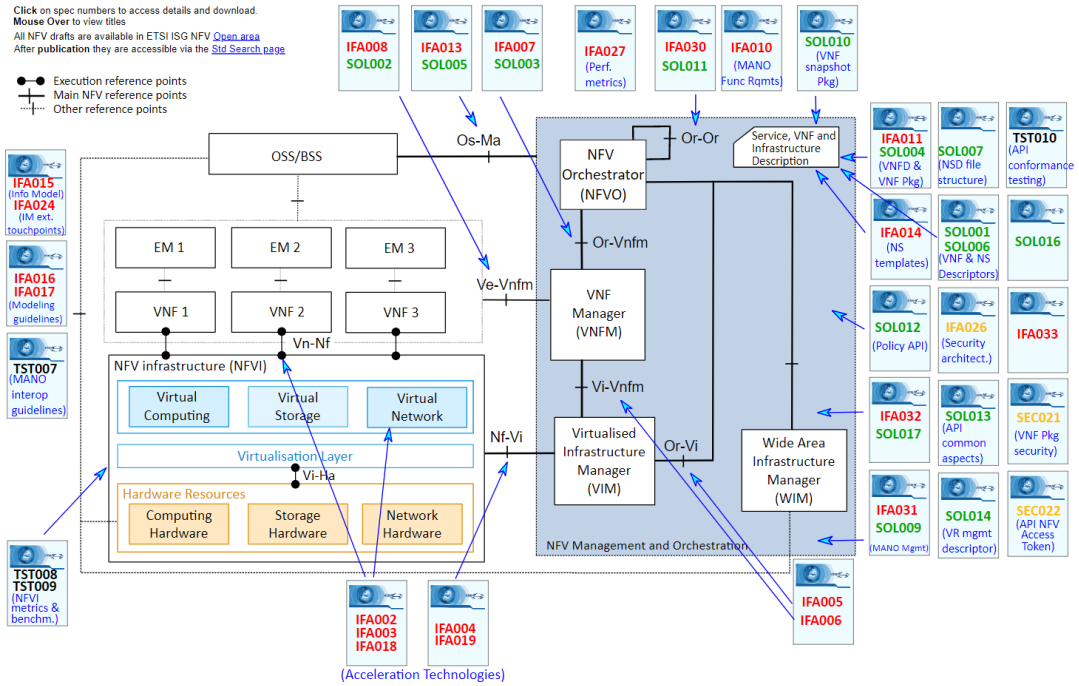
Source: ETSI

Lifecycle management of the network service

NFV Standardisation

- ETSI NFV research groups
  - TST – Testing
  - SOL – Protocols and Data models
  - REL – Reliability
  - IFA – Interfaces and Architecture
  - EVE – Evolution and Ecossystem
  - SEC – Security

World Class Standards



- Clickable architecture:

https://www.etsi.org/images/articles/NFV_Architecture.svg

VIM – Virtual Infrastructure Managers

- OpenStack
  - https://www.openstack.org/
- Vmware vCloud Director
  - https://www.vmware.com/products/cloud-director.html
- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- Sandboxes
  - DevStack
    - https://docs.openstack.org/devstack/latest/
  - MicroStack
    - https://opendev.org/x/microstack

Management and Orchestration

MANO

Virtualized Network Services

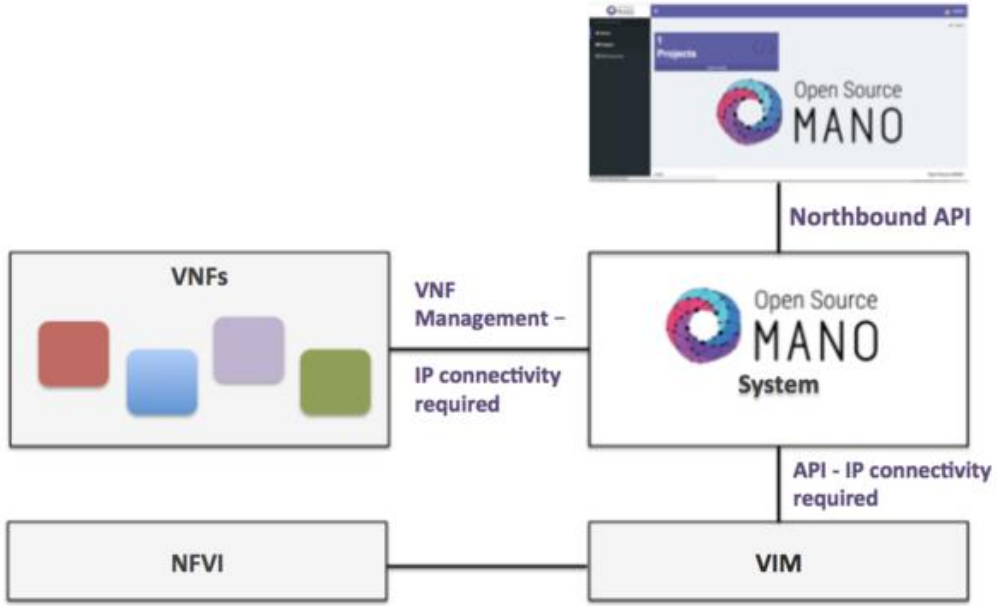
- Managing and coordinating resources and networks needs a special entity
  - NFV Orchestrator
- A powerful tool
  - Spans large numbers of networks
  - … software elements
  - … hardware platforms
- Needs to be able to work with many different standards

ETSI NFV MANO

- Framework for managing and orchestrating all resources in the cloud datacenter
  - Includes computing, networking, storage and VM resources
- Objective
  - Allow flexible on-boarding of network services
  - Handle network componentes spin-up
- The standard composes 3 elements
  - NFVO – NFV Orchestrator
  - VNF Manager – VNFM
  - Virtualized Infrastructure Manager – VIM

ETSI OSM – Open Source MANO

- Open source NFV Management and Orchestration stack
- Uses well established open source tools and working procedures
- Complements the standardisation work



https://osm.etsi.org/docs/user-guide/latest/01-quickstart.html

ONAP – Open Network Automation

- https://www.onap.org/
- Also Open Source
- More than just MANO
- Common platform for end-to-end servisse and infrastructure management and provisioning
- Support from major vendors
- Supports TOSCA and YANG unified design specifications