

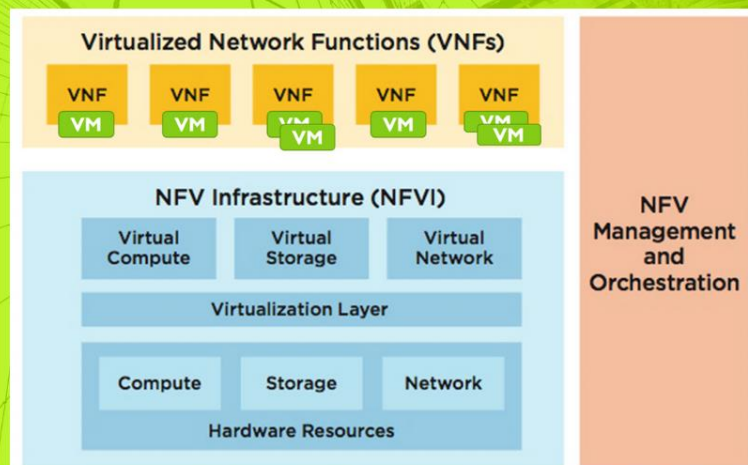


## Telco Cloud Series Module – 02

# Introduction

# NFV

## Telco Cloud Networks



## Introduction to NFV: Network function Virtualization

Covering Introduction & Tutorial for Virtualization & NFV in Telco Networks. Covering Difference between NFV & SDN or How they work. Both architectures use network abstraction, they do so differently. While NFV covers Softwarization, Virtualization and makes building blocks ready, SDN forwards data packets from one network device to another. At the same time, SDN's networking control functions for routing & policy definition

1. NFV: Network function Virtualization: Introduction & Basics
2. Why we need NFV & Features of NFV
3. ETSI Framework & Specs
4. NFV Architecture
5. Need of SDN

### Overview

If we see SDN & NFV, both architectures use network abstraction, they do so differently. While NFV covers Softwarization, Virtualization and makes building blocks ready, SDN forwards data packets from one network device to another. At the same time, SDN's networking control functions for routing & policy definition

Here, we will see what is NFV & What benefits it brings to the Mobile Operators. NFV movement started with push coming from mobile service providers, in 2012, These 12 Tier-1 Operators felt that they can greatly simplify their operations and reduce cost if all network

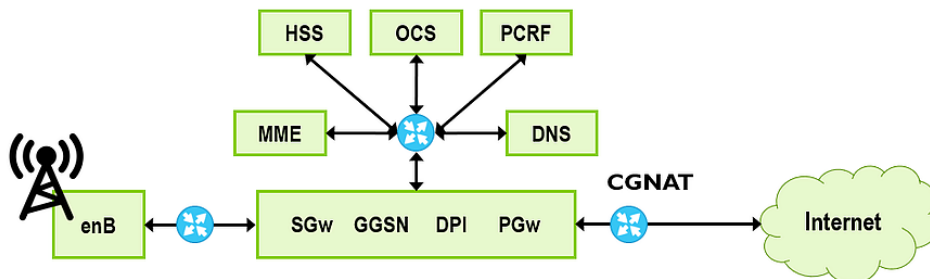


functions are virtualized as software appliances. NFV is all about Three main Concepts which we are going to cover moving ahead. Softwarization, Virtualization & Orchestration

## Traditional LTE Network

### NFV : Network function Virtualization

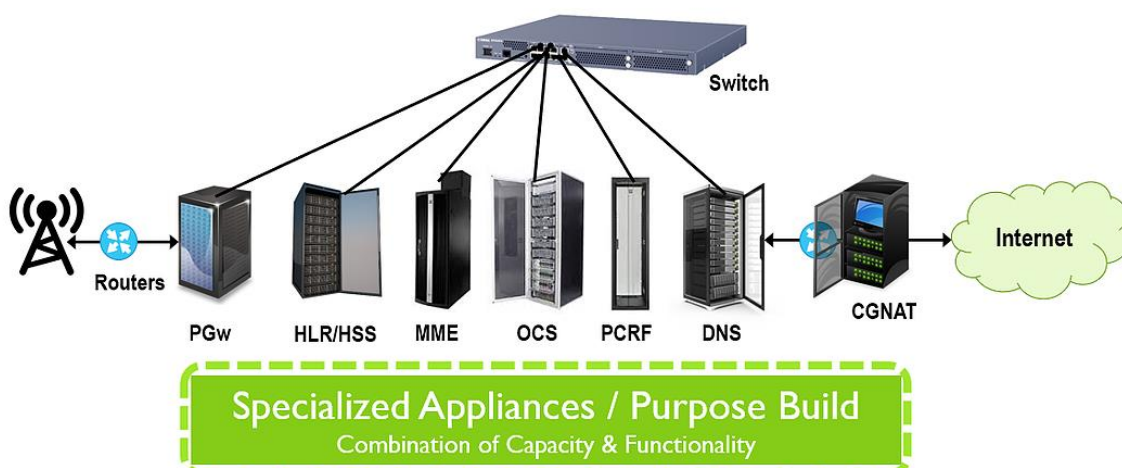
also known as virtual network function (VNF)



### Traditional LTE Network

This is a classic network of 4G which is deployed across all the Mobile operators across Globe, we will see how this 4G network is deployed in Traditional Mode & Virtualized Mode

### Traditional Network - Purpose Build Hardware



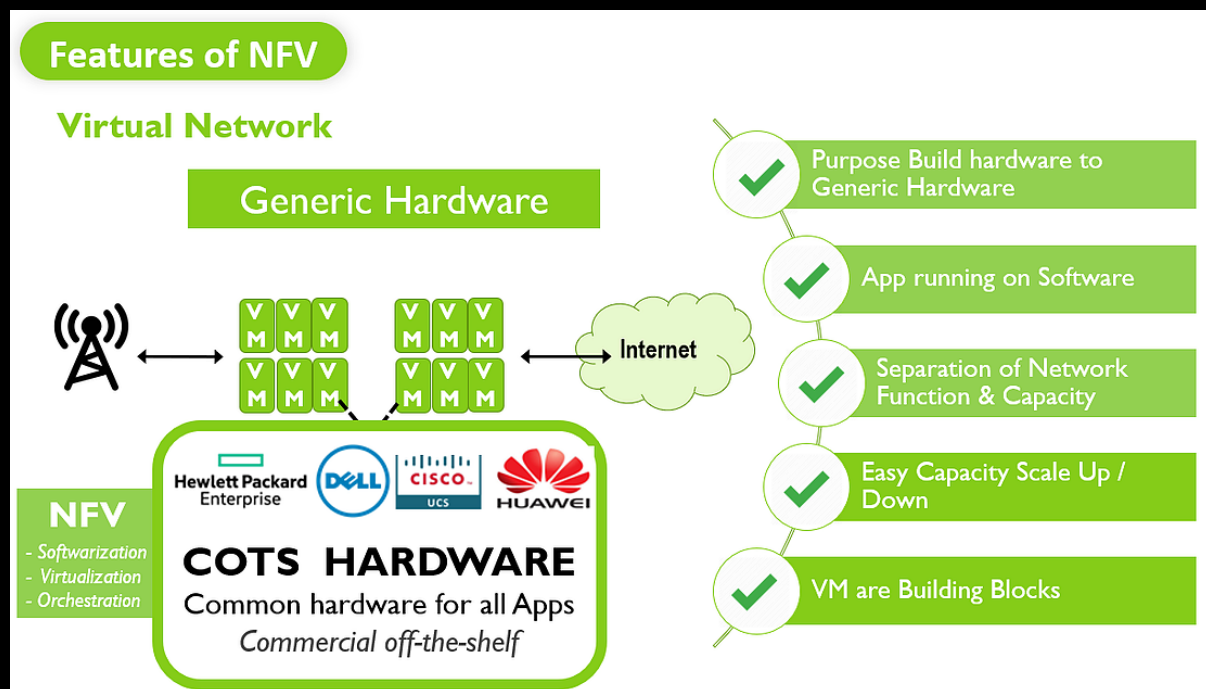
### Traditional LTE Network

You can see that all these nodes are deployed on traditional hardware, we also call this as purpose build hardware. This is specialized appliance which is meant to perform specific



function, For Example: We can see these individual hardware racks serving individual functions such as Routers, PGW, HLR, MME, OCS, PCRF, DNS etc...The problem with this type of deployment is Lack of Scalability, Lack of Speed, Lack of Flexibility and so many issues which we discussed in last Document. Usually, this hampers business as there is always delays in New Product launch & Meeting customer requirements

## Features of NFV



Let's understand, what is NFV & How NFV solve these issues. NFV stand for Network Function Virtualization and perform 3 Key Tasks. Softwarization, Virtualization & Orchestration. NFV replaces costly dedicated and purpose build hardware with generic servers that use software to provide a bunch of different virtualized network functions (VNFs)

Virtualization is all about the software package that performs a specific function, we call this as VNF i.e. Virtual Network Function. This VNF is equivalent to physical Network & is capable for performing any network task such as It can work as Router, Switch, HLR, MSC, SMSC etc... It can potentially take any network function and decouple network services from the hardware that deliver them

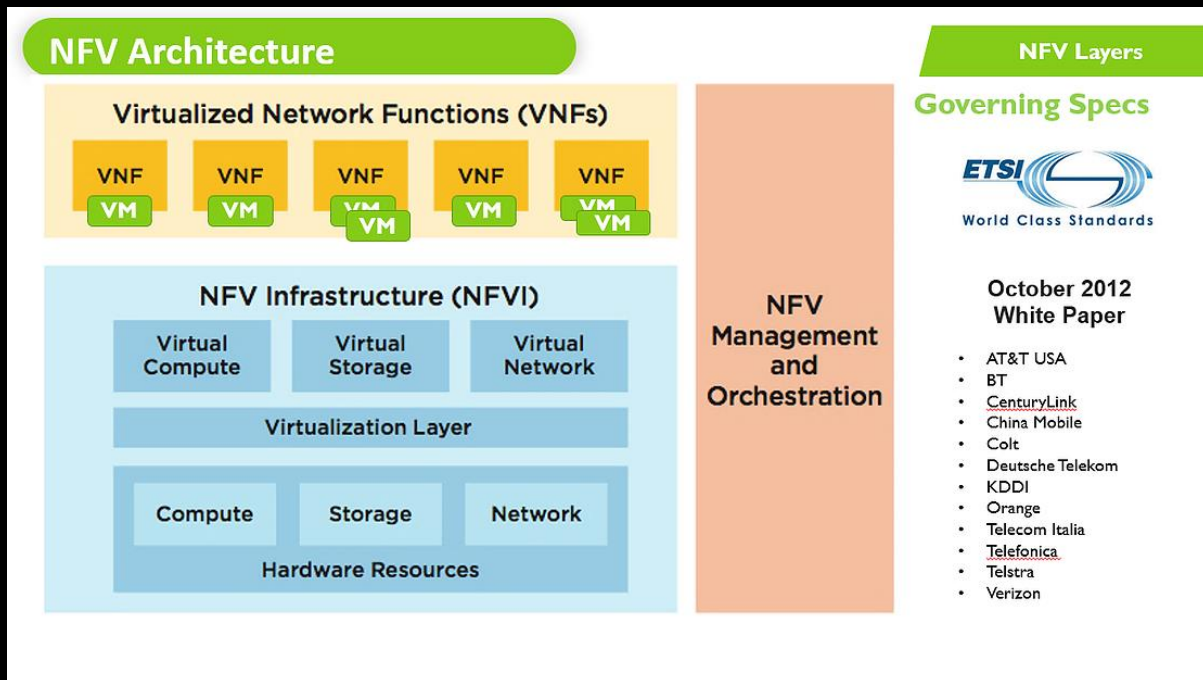
It also separates out Network functionality from capacity. This means you can deploy Very Small, relatively small, Large or Very large capacity of any instance; you only need to increase Licenses, Compute and Storage in order to increase or Decrease capacity. And then you can take the capacity and increase scale up, out or down

NFV uses Virtual machines as key building blocks where Applications can be hosted. These VMs are having flexible capacity & can host any application

NFV turns Traditional network hardware into virtualized network functions running on Generic Hardware such as HP / DELL. We also call this generic hardware as COTS Hardware i.e. commercial, off-the-shelf. NFV also enables service chaining which helps multiple functions to be used in chronology



## NFV Architecture, Evolution, Background



### History & Evolution of NFV

In October 2012, 7 tier-1 Operators Grouped together and started working on their problems, they came up with concept of "Network Functions Virtualization" to solve most of their day to day issues and challenges. These 7 Operators published a white paper at a conference in Germany and post this Standards body: European Telecommunications Standards Institute (ETSI) started working on this whitepaper

There is community formed by the name of ISG NFV which has evolved the Technology through several phases, its publications have moved from pre-standardization studies to detailed specifications with Release 2 and Release 3 coming up and the numerous POCs have been done on this subject. This large community today consists of 300+ companies including 38 of the world's major service providers. In End of this Document, I will share links to all these Whitepapers and Specs which you can use for further studies

### What is Need for a Framework?

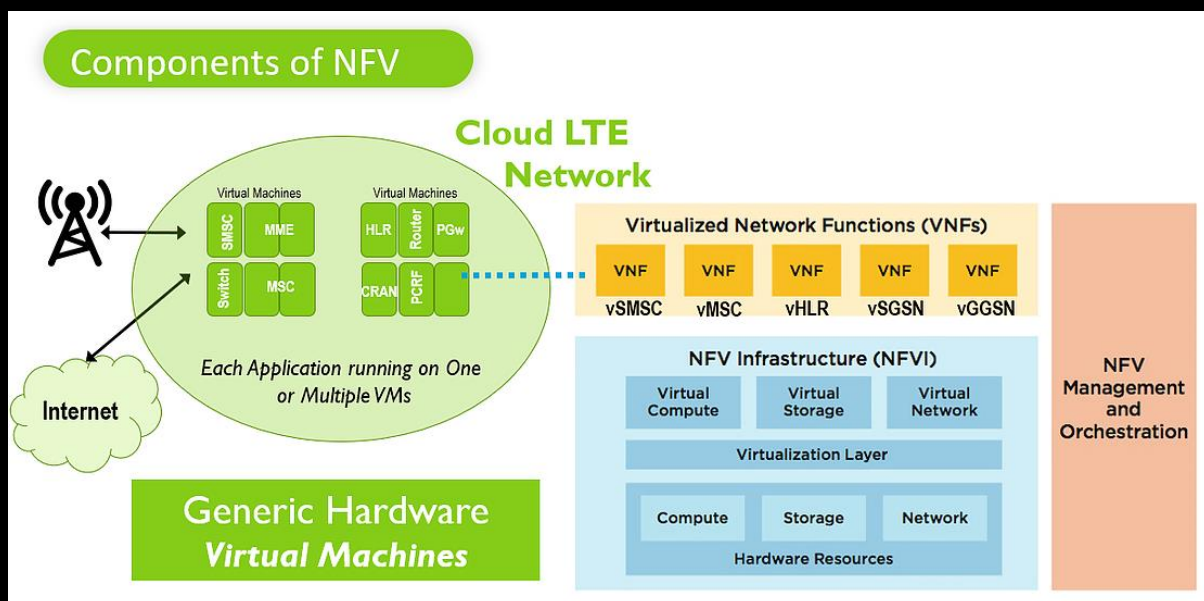
This group have come up with Architecture, framework and specification for NFV. There are 3 main components to the Architecture names NFVI, VNF & MANO. This architecture ensures tight coupling between Hardware and Software which are again highly highly customized. The NFV architectural framework is developed to ensure that while maintaining high level of customization & flexibility, there is standardization and compatibility prevails between various deployments, Vendors & Solutions



## Building Blocks of NFV?

1. **Network functions virtualization infrastructure (NFVI)** is the layer who is responsible to handle hardware, this hosts all Storage, Compute & Network hardware & abstract same as virtual resources for consumption of virtual machines. We deploy generic COTS based hardware or Servers or Blades in NFVI Layer. In order to leverage Massive scale required by Telecom network providers, we can deploy these hardware blades or servers in bulk.
2. **Virtualized network functions (VNFs)** is layer where we host actual Application working network functions running as Software. One single VNF can be deployed over multiple virtual machines
3. On the right-hand side, you can see **NFV-MANO** Layer which is Network functions virtualization management and orchestration architectural framework Managing & Controlling the entire piece

## Components of NFV



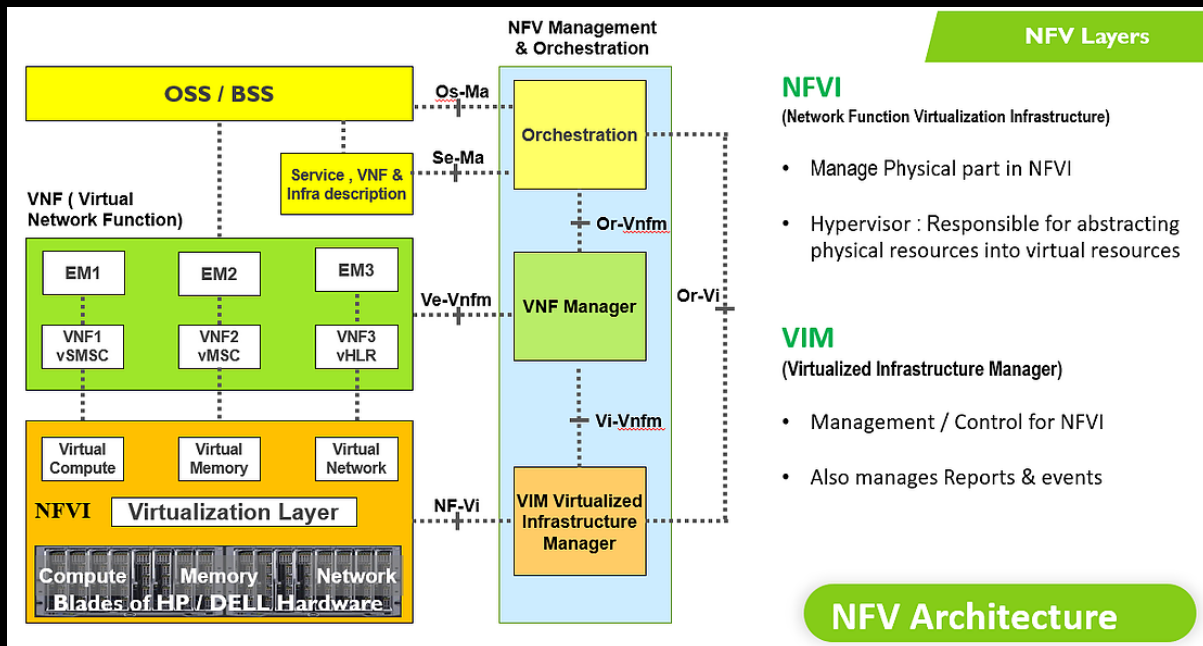
Let's understand concept of VNF in more detail here

This shows actual Telecom Applications as vSMSC, vMSC, vHLR, vSGSN or vGGSN are deployed as Software module in VNF. VNF is hosting these Telecom Nodes as Virtual Applications. We can allocate resources to these Virtual Nodes on basis of requirement such as vHLR needs more storage while vMSC requires more Compute. All of these Individual virtual network nodes can have reserved Compute, Storage & Network which will be used by that Application Only. For Example, you can allocate 5 vCPUs, 8 TB & 2 NIC to virtual SMSC as application. SMSC will not eat up resources allocated to MSC or HLR. This allocation of resources is done by Virtualization layer sitting in NFVI layer





## NFV Layers & Architecture



Now, Let's understand the NFV Architecture in detail. We will start with bottom layer which consists of NFVI & VIM

### Network Function Virtualization Infrastructure (NFVI)

The role of this layer is to host hardware and Manage Physical part. We can deploy Blades of generic HP DELL hardware which are visible in the Bottom. The NFV Infrastructure (NFVI) is combination of physical networking which is NIC Card for I/O, computing and storage resources exposed as a common networking/NFV infrastructure. These resources can be at one place or can also be geographically distributed

### Hypervisor

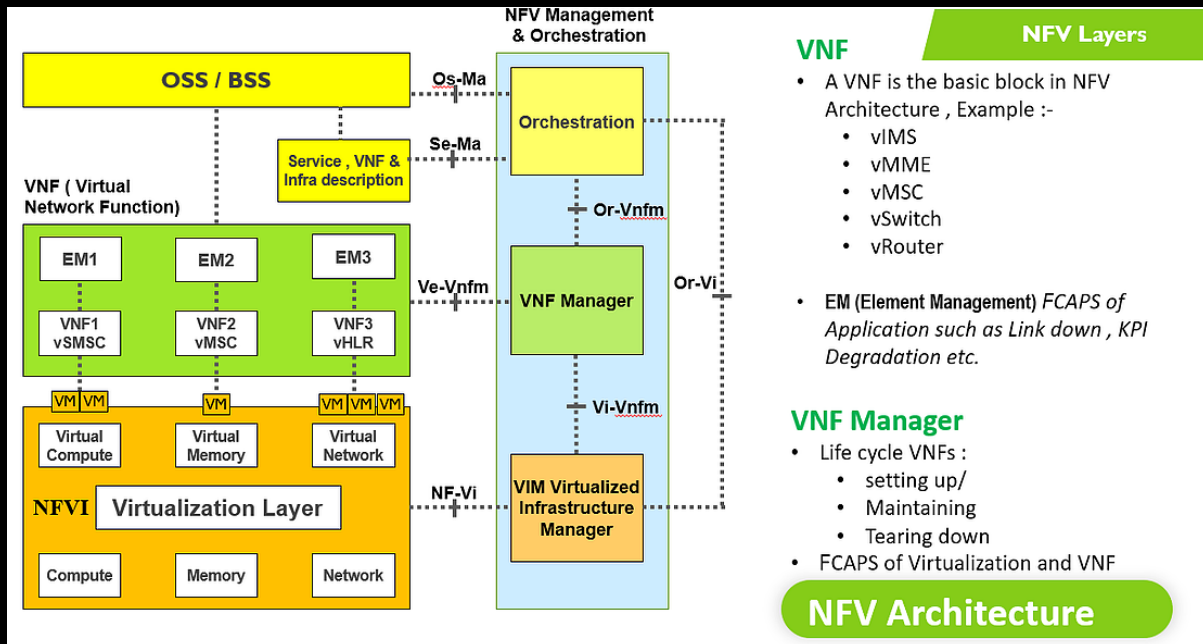
This layer also contains critical component by name of Hypervisor which is Responsible for abstracting physical resources into virtual resources. The virtualization layer sits right above the hardware and abstract the resources so they can be logically partitioned and provided to the VNFs performing their specific network functions. NFVI abstracts actual hardware or Generic Dell / HP Blades into Virtual Resources by name of Virtual compute, Virtual memory & Virtual Network

### Virtualized Infrastructure Manager (VIM)

On right hand side, there is another component by name of VIM also known as Virtualized Infrastructure Manager. The role of VIM is to Management / Control the NFVI. VIM also manages FCAPS, Reports & events of these NFVI



## NFV Layers & Architecture



Now, Let's understand critical key component of virtualization – VNF and VNF Manager. Before we start with VNF, Let's understand what is network function? This refers to Telecom nodes such as MSC or SMSC which provide functionality such as voice or SMS. Traditionally, these nodes are always deployed as physical appliances, running on proprietary hardware tightly coupled software.

### Virtual Network Function (VNF)

A VNF, on the other hand, is a network function using software that is decoupled from the underlying hardware. These virtualized network functions run inside virtual machines (VMs) and are known as Virtual Network Functions (VNFs). One single VNF can be deployed over multiple virtual machines. For example, vSMSC is running on 2 VMs, vMSC is running on 1 VM while vHLR is running on 3 VMs as visible on screen.

### VNF Manager (VNFM)

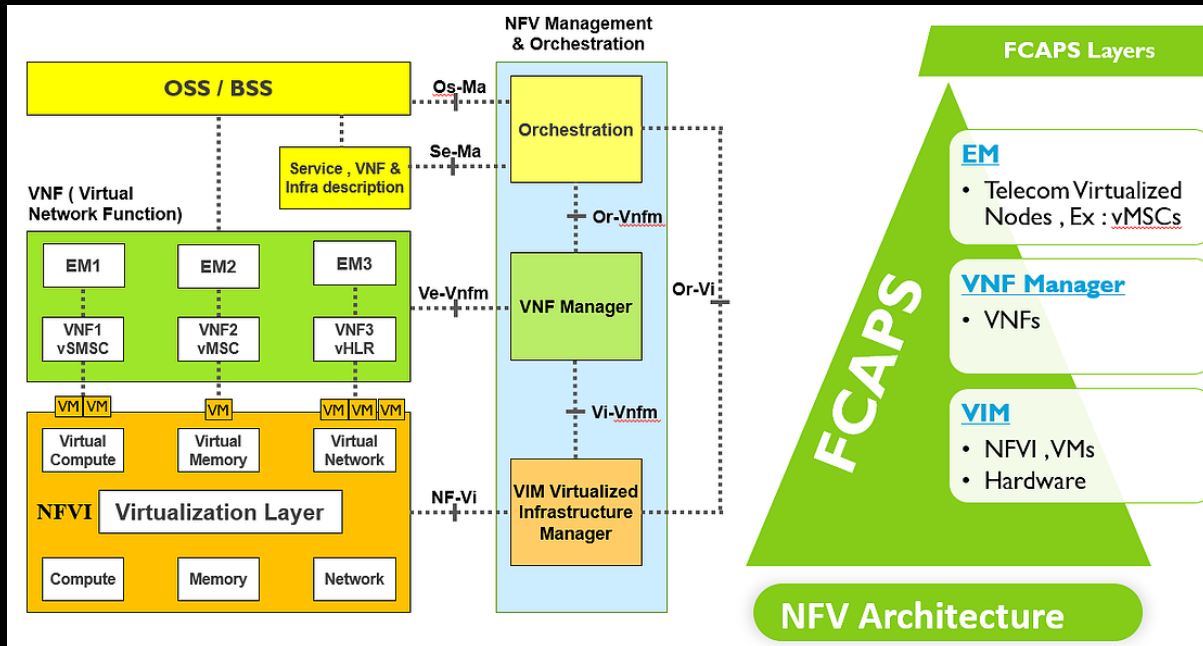
VNF Manager is responsible for things related to FCAPS & Management of VNFs such as setting, monitoring and logging all kind of fault, configuring the network element, collecting performance data etc. VNF Manager manages Life cycle VNFs which includes setting up or Creation, Maintaining and Tearing down of VNF & Overall FCAPS of Virtualization and VNF.

### Element Management (EM)

The FCAPS and O&M of Applications such as vMSC or vSMSC or vHLR is done by EM shown on top of VNF. The EM stands for Element Management and does FCAPS of Application such as MSC Link down, MSC KPI Degradation etc.



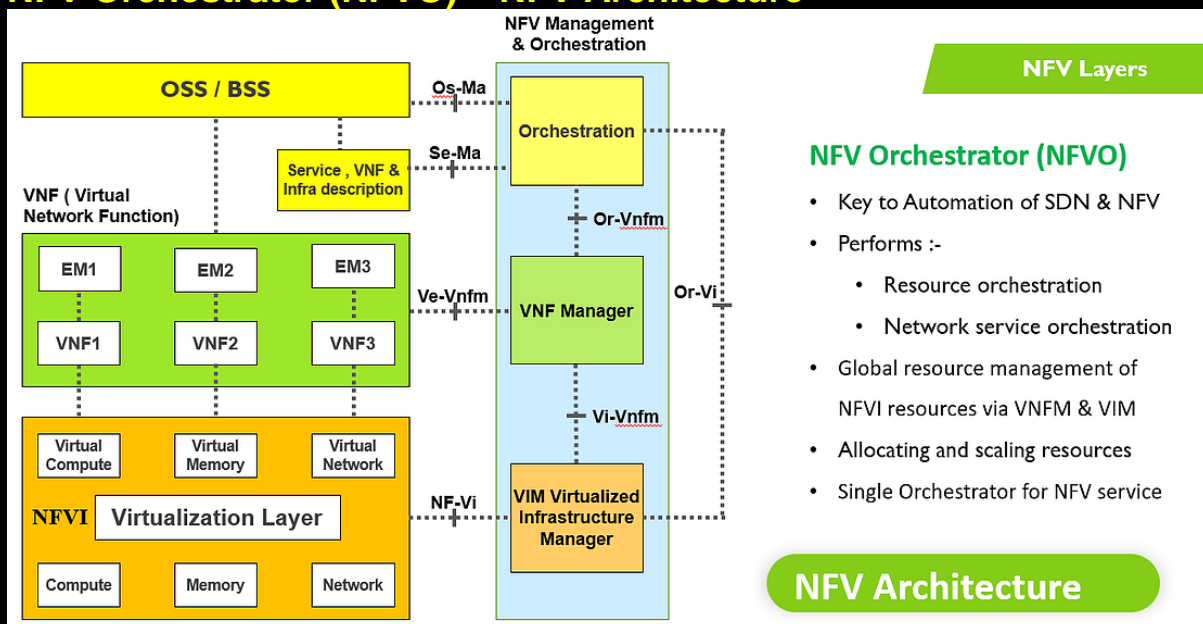
## FCAPS Layers – NFV Architecture



FCAPS is an acronym for fault, configuration, accounting, performance, security, the management categories. This is complete Operations, Maintenance & Life cycle of any Telecom Node

1. **FCAPS of NFVI, VM & Hardware** is done by VIM which is Virtualized Infrastructure Manager
2. **FCAPS of VNFs** is done by VNF Manager
3. **FCAPS of Telecom Virtualized Application** such as vMSC or vHLR is done by EM

## NFV Orchestrator (NFVO) – NFV Architecture







This Orchestration is Top most is key to any type of Automation expected out of SDN & NFV. This is part of NFV framework is also known as NFV MANO – Management and Orchestration. This is also called as NFVO or NFV orchestrator

This helps to standardize the functions of virtual networking to increase interoperability of software-defined networking (SDN) elements. The NFVO performs resource orchestration and network service orchestration. It is a central component of an NFV-based solution. It binds together different functions to create an end-to-end, resource-coordinated service in an otherwise dispersed NFV environment. This Management and Orchestration is responsible for managing and maintaining the Global view of resources, maintaining flows, Keeps tap on hardware resources, Allocating and scaling resources to a specific VNF, keeping track of VNF instances, Helps in end-to-end network service creation in automated way

NFVO also does Resource orchestration which is ensuring that there are adequate compute, storage, and network resources available to provide a network service. For this, the NFVO works with the VIM or directly with NFV infrastructure (NFVI) resources, depending on the requirements. It has the ability to coordinate, authorize, release, and engage NFVI resources independently of any specific VIM. It also provides governance of VNF instances sharing resources of the NFVI

Typically, there is a single Orchestrator that oversee the whole NFV service

## ETSI Specs

**ETSI Specs**

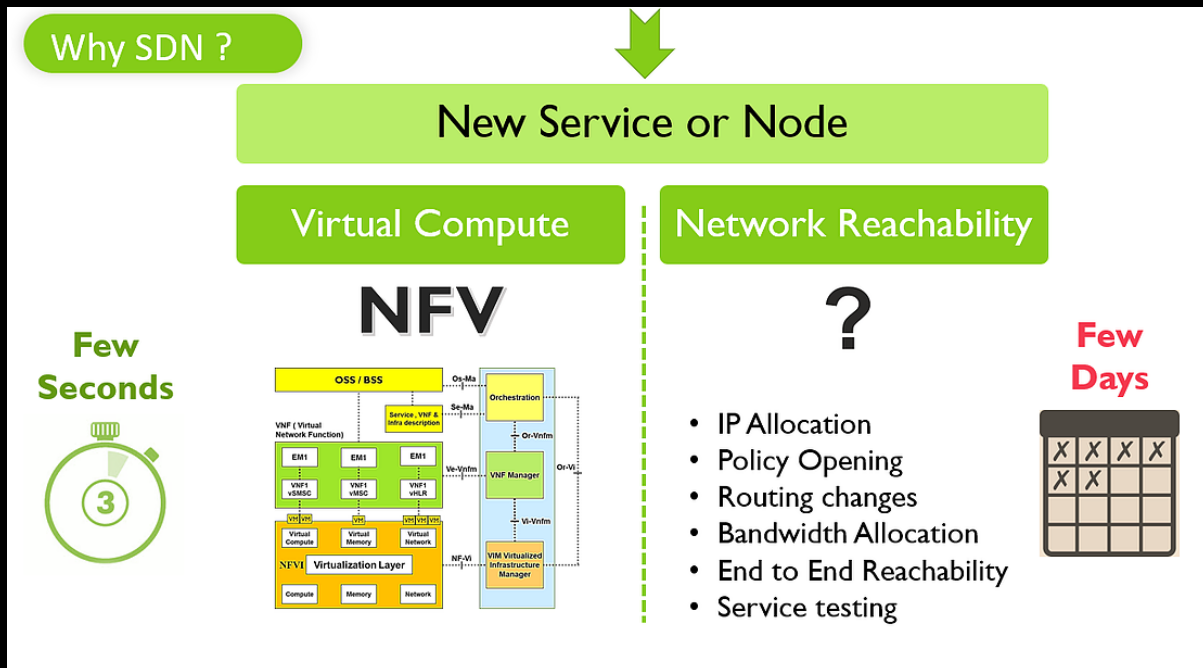
[https://docbox.etsi.org/ISG/NFV/Open/Publications\\_pdf/Specs-Reports](https://docbox.etsi.org/ISG/NFV/Open/Publications_pdf/Specs-Reports)



For, Detailed ETSI Specs on NFV, Pls refer to link shown on screen. You can use these for further studies



## Why SDN?



Well, we have seen NFV helps in Virtualizing networks which help us in rapid deployment & ultimately reduces New Service / New Node Creation time to few seconds. For example, we can create vMSC or vMME in few seconds & make it ready with help of Orchestrator & Automation

But the Another problem is Network connectivity where we need multiple things such as IP Allocation, Bandwidth Allocation, Policy Opening, Routing changes to achieve End to End Reachability and proceed with Service testing. All this is not automated & it takes lot of time to prepare design, perform changes in every router / switch & make it thru

In typical scenarios, this make take few days or week to finish IP Routing & enabling end to end reachability of all required links. SDN helps us here by making this routing / switching network flexible & programmable.