Design and Implementation of Cloud Provider Networks Using SDN and NFV

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Hello, my name is **Derradji Amine Abdelbasset**. I am an ICT student and a Huawei Certified Associate in Networking and Cloud Services , I share my documentations about ICT fields with my community in linkedin to help students specially the associates to better understand using very simple language and clear information's presentation .

This research is about Software-Defined Networking (SDN) and Network Functions Virtualization (NFV) technologies in detail.

It also shows the relationship between these two technologies and their roles in cloud infrastructure, especially in the provider's infrastructure.

For more informations you can visit my website through the link : www.derradjiamine.me

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| Software Defined Network :

1. Definition :

Software-Defined Networking (SDN) is a network architecture where the control of the network is separated from the physical devices.
Instead of each router or switch making decisions on its own, a central controller manages and programs the entire network, making it more flexible, efficient, and easier to manage.

SDN is commonly used in large networks such as ISP networks and enterprise networks to easily monitor and control all network components.

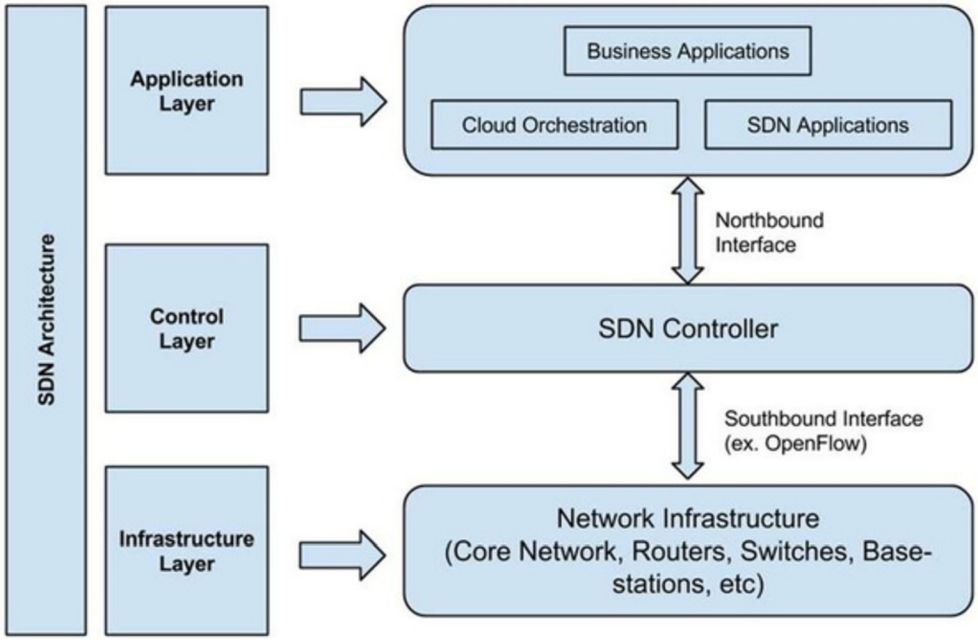
2. SDN Architecture :

Basically, SDN has three layers (planes) that transmit data and control information between them. This architecture provides reliability and enables the pooling of network devices into a single plane. The higher plane is the Application Plane, which contains applications that determine network policies rather than direct device configurations. Network monitoring applications emerge in this plane, as well as security and cloud applications.

The second, or what we can call the middle plane, is the Control Plane, which contains the SDN Controller software that controls the entire network. This plane communicates with the Application Plane through a specified interface called the Northbound Interface, which consists of API tools.

The last plane in this architecture is the Data Plane. All network resources are pooled into this plane, as mentioned previously. The connection between this plane and the Control Plane is achieved through the Southbound Interface, which includes several protocols, the most commonly used being OpenFlow and NETCONF.

This plane can also include virtual resources such as virtual switches (vSwitch) and virtual routers (vRouter).



3.SDN Components

The SDN architecture consists of several components, the main one being the SDN Controller, which is a software entity such as Huawei iMaster NCE. This type of software is hosted in the Control Plane and is responsible for receiving tasks from applications through the Northbound Interface (NBI), making decisions, and then executing them in the Data Plane through the Southbound Interface (SBI). In addition, the applications of the first plane and the interfaces of the Control Plane can also be considered as SDN components.

4.SDN Implementation

In real networks, the SDN Controller is installed on a centralized server. This server must connect to all network devices within the same network using IP addresses. When a device receives a packet, it requests a rule from the Controller to make a forwarding decision.

In cloud environments, the SDN Controller is installed on a centralized virtual machine (VM) and connects to the network components virtually.

| Network Function Virtualization

1.Definition :

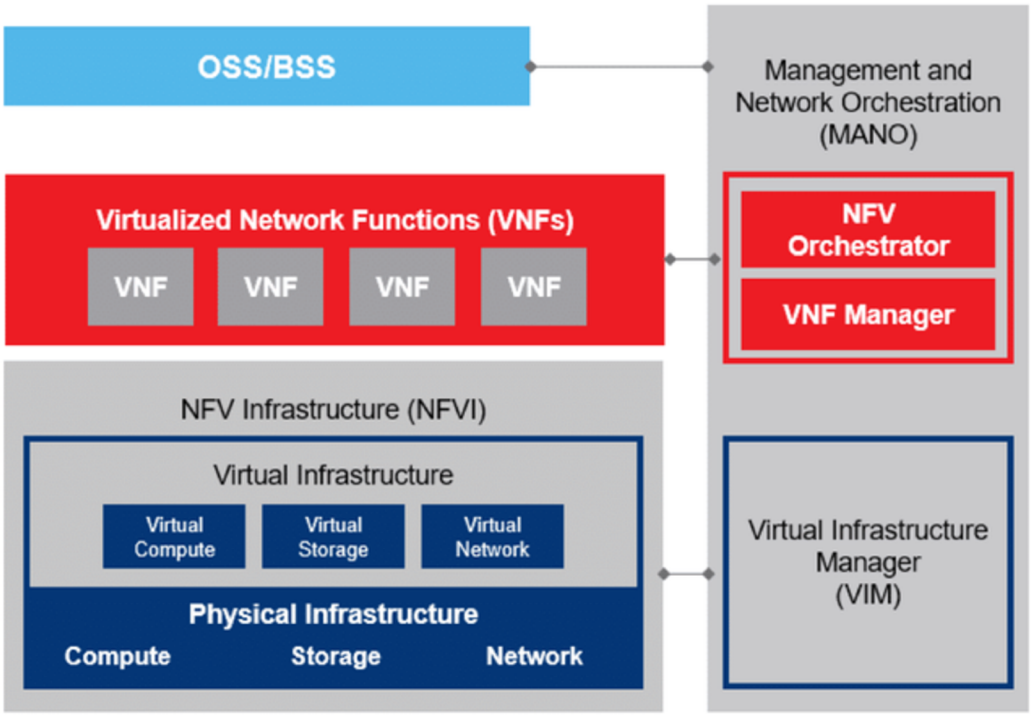
NFV is a networking technology designed to replace hardware-based network devices such as switches, routers, and firewalls with virtual devices like vSwitches and vRouters. These virtual devices are software-based functions that run on virtual machines (VMs) or containers.
NFV effectively reduces costs, improves network flexibility and convergence, and is compatible with networking technologies such as SDN.

2. NFV architecture :

Also, NFV has an architecture that consists of three main blocks. The first one is NFVI (Network Function Virtualization Infrastructure), which contains the environment that executes the NFV functions. This infrastructure is based on servers equipped with storage disks and network connections, and the NFV virtualization software is hosted in this layer.

The second layer is VNFs (Virtual Network Functions), which are the functions created using the infrastructure of the previous layer. A VNF can be a vSwitch, vRouter, or vFirewall.

The third layer is NFV MANO (Management and Orchestration). This layer is responsible for managing the lifecycle of VNFs. At this layer, we find the centralized manager called the Orchestrator, which is responsible for receiving work requests, deciding which components should be created, and coordinating other NFV services.



3. NFV Deployment Models :

In enterprises, there are three main deployment models.
The first model is to set up a hypervisor on the server and then create multiple VMs. In this case, each VNF is deployed in a single VM, which provides better security and isolation, but at the same time, the start-up process takes longer.
In contrast, in the second model, each VNF is deployed and runs inside a container on the same server, which ensures faster start-up times and a lightweight environment.
In the third model, both of the previous models are used together to provide more flexibility.

4. Relation between NFV and SDN :

NFV provides VNFs. These VNFs can be considered as infrastructure components at the data plane in the SDN architecture. SDN can communicate with NFV to create virtual functions and manage them through the Orchestrator, and this is how modern campus and enterprise networks usually work.

| SDN and NFV in Cloud Network :

1. Cloud Provider's Network implementation :

When a cloud engineer deploys an infrastructure on a public cloud, the platform provides network options such as creating VPCs, ACLs, and NAT gateways. However, the engineer does not configure the network directly; instead, they interact with a graphical user interface (GUI).

This GUI communicates with the SDN through APIs. The orchestrator then contacts the NFV MANO to obtain the required virtual functions according to the user’s needs. After that, the orchestrator pushes these resources into the SDN data plane, where a logically isolated network is built to connect all the VNFs together and manage them according to the user’s requirements.

At this level, we can say that the network provided to users is an SDN- and NFV-based network, which users access through cloud APIs.

2. Proccess's steps :

We can reduce the previous procces on clearly and simple steps as follows :