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Network Virtualization in Wireless Communication- a review

K.Charan kumar

Abstract:

Wire networks have been around for a long time. Wireless telephony and computer networks emerged with the development of networking technology. It is currently standard practice to virtualize wired networks. To get the most out of the hardware appliances that are already in use, virtualization is essential for wireless computer networks. Additionally, there are other advantages. This article compares and contrasts network function virtualization (NFV) with software-defined networking (SDN), delves into the advantages of NFV over SDN, and analyzes the prerequisites for virtualizing network functions.

Hypervisors and container programs, wireless access points, load balancing, virtualization, cellular networks, the internet of things, software defined networking, smart homes, logically isolated network partitions, and virtualization are all important terms.

I.Introduction

One way to pool resources, both physical and digital, is via virtualization. Network Function Virtualization (NFV) is a clever way to move the "Network Services" industry by virtualizing the network services and trading in dedicated hardware for virtual machines.Virtual networks allow for the consolidation of many network functions into a single entity. Administrative entities that are based on software constitute the virtual network. [1]Virtualization enables individualized service and multi-occupancy of network devices, which in turn improves usage and efficiency. Dissimilar communication technology, heterogeneity of devices from different manufacturers, application-specific quality of service needs, huge data influx, and unpredictable network conditions are some of the difficulties that plague conventional networks. In addition to this, expanding current networks requires a substantial investment of cash. Additionally, operating costs rise in tandem with network development. Other issues arise with the governance and administration of massive networks. Virtualizing a computer network or wireless communication system is no easy feat. The process of virtualizing wireless connections is one of the most difficult aspects of wireless virtualization. Things that aren't present in wired networks must be considered, such as restricted resource consumption and signal interference.

Department of Mechanical Engineering, Holy Mary Institute of Technology and Science, Hyderabad.

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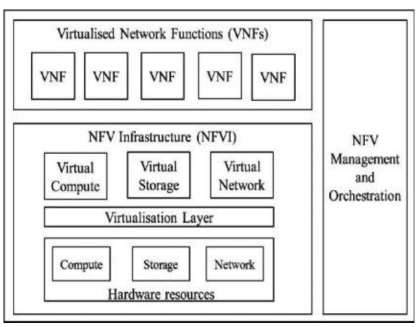
Coherence and isolation are two needs that should be satisfied by wireless connection features. The ability to schedule transmission over many LINPs is an essential feature of network virtualization.Virtual machines, rather than actual routers, firewalls, and load balancers, are used in network function virtualization (NFV). Standard x86 servers may run the services under the Hypervisor's management of the network operations. The flexibility to expand or contract as needed matches our requirements. Take our recent acquisition of a cloud/server capable of supporting up to 5,000 clients as an example.[2, 3] We want to make maximum use of its capability after paying for so many users/customers. We need to invest in hardware as our communication company grows. However, by using NFV, we may use the current hardware for server virtualization rather than purchasing new gear. You may see the design of the in figure (1) down below.



Figure(1) Architecture of Network Function Virtualization

The aforementioned figure (1) shows the architecture of the virtualization of network functions. It is composed of different blocks. To the right of the picture is the NFV manager, which is in charge of all the operations, including the distribution of virtual links and the creation of virtual storage on demand. For example, during a crucial and entertaining cricket or football event, the management may act quickly to alleviate traffic congestion or saturation. There will be a dramatic increase in network traffic during these types of matches, forcing the need for more storage space and more connections than the server technology can now handle. Virtual voice, HLR/HSS, and access point applications are located in the higher architectural layer. Three sublayers make up the layer below. Virtual computing facilities, virtual storage spaces, virtual networks, and virtual linkages are all part of the virtual infrastructure that the NFVI sub-layer supports. The middle sub-layer acts as a bridge between the virtual machines and the hardware resources at the bottom.[4] The hardware resources that perform computation, storage, and network operations are located in the lowest sub-layer. The second way to use virtualization is to use a single physical access point to host several virtual access points.With this method, scarce wireless resources may be more efficiently shared. Here, virtualization takes place at the access point or wireless access point, which is an alternative method of implementing virtualization in WiFi networks.

part two: what needs to be virtualized?

This table lists the many conventional network functions that can be virtualized using NFV technology. Equipment used for tunneling, traffic analysis, signaling, control plane, and application optimization are primarily focused on virtualizing in communication networks. This includes switching elements such as switches, routers, broadband network gateways, and others; mobile network nodes such as HLR/HSS GPRS support nodes and others; and appliances and devices used at the customer's home, such as home routers and set-top boxes.

Network element to be virtualized	**Its Function**
Switching elements	Broadband network gateways, carrier grade NAT (network address translation), routers
Mobile network nodes	HLR/HSS, Gateway, GPRS support node, radio network controller, various node Bfunctions
Customer Premise Equipment	Home routers, set-top boxes
Tunneling Gateway elements	IPsec/SSL virtual private network gateways
Traffic analysis	Deep packet inspection (DPI), quality of experience measurement
assurance	service assurance, service level agreement (SLA) monitoring, testing and diagnostics
signaling	session border controllers, IP multimedia subsystem components
control plane/access	AAA servers, policy control and charging platforms

functions	
application optimization	content delivery networks, cache servers, load balancers, accelerators
security	firewalls, virus scanners, intrusion detection systems, spam protection

Advantages of Using VirtualizationVirtualization has several advantages, some of which are highlighted below (but not limited to):Gain more leeway to adjust network capacity in response to fluctuating demand, whether that's from light traffic or high traffic.Enhanced service agility allows for speedier rollouts of new services. Adapting to network conditions with high traffic requires just a few seconds of faster network improvements.Due to the need to make modifications to software systems with billions of lines of code, operations become straightforward and easy to handle. Automated program adjustments are also possible. The elimination of hardware upgrades required by a software-administered network allows for faster innovation.Capital expenditures (CAPEX) for buying new gear to expand communication company and operating expenses (OPEX) for running and maintaining gear from various manufacturers. Because virtualization lowers both of these expenses, NFV makes networks more cost-effective. Virtual routers, firewalls, and load balancers made possible by virtual computers and virtual storage may significantly cut down on the expense of actual hardware.Network security has been a big problem. Providing services to clients is important to operators, but they also want to ensure the safety of their virtual space and firewall.

A service provider may better serve its clients if they have access to resources in the form of physical hardware, regardless of where those resources are located in the globe.

A Networking Method Based on Software:

Network managers may regulate network services via the abstraction of lower-level purposes, thanks to Software Defined Networking (SDN), a feature of computer networking. Modern data centers and other extreme computing settings have more dynamic and scalable processing and storage demands than traditional networks can provide. Software-defined networking (SDN) is an attempt to address this problem. One way to do this is by creating a separation between the control plane, which is responsible for making choices regarding the direction of traffic, and the data plane, which is responsible for actually forwarding the traffic to the chosen destination.[6, 7]

This section lists the many types of SDN. Secure Deep Networking (SDN):Here, vSwitches, or virtual switches, form an overlap network in software-defined networking. Traditional routed/switched networks, as well as switched fabric networks, carry the traffic pathways between vSwitches. Primary use case for this software-defined networking solution is in data centers, because to its reliance on vSwitches as the crossover network endpoints.When compared to shallow SDN, which requires complicated combinations of protocols, deep SDN allows for more control over packet forwarding behavior and the ability to implement policy routing. With a bird's-eye view of the network architecture, the logically centralized controller can better decide which pathways to use for different kinds of traffic.

The following table compares SDN versus NFV based on a number of criteria.

Features	**SDN**	**NFV**
Focus or major role	SDN focuses on data center.	NFV focuses on service providers oroperators.
Strategy	It splits the control and dataforwarding planes.	It replaces hardware network deviceswith software.
protocol	Uses OpenFlow	Not finalized yet, does supportOpenFlow
Where the applications will run?	Applications run on industrystandard servers or switches	Applications run on industry standardservers
Prime initiative supporters	Vendors of enterprise networkingsoftware and hardware.	Telecom service providers or operators.
Business initiator	Corporate IT	Service provider
Customer benefitor end user benefit	Drives down complexity and costand increases agility.	Drives down complexity and cost andincreases agility.
Initial applications	Cloud orchestration and networking	routers, firewalls, gateways, CDN,WAN accelerators, SLA assurance
Formaliza tionbody	Open Networking Foundation(ONF)	ETSI NFV Working Group

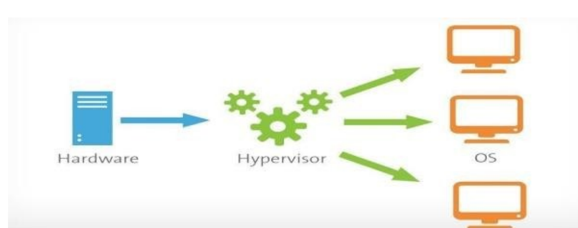


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Figure (2) Architecture of Hypervisor

As seen in the graphic above, the hypervisor is a piece of software that has the capability to host several virtual computers. Virtualization in its most conventional form is the network function virtualization. Figure (2) shows that a hypervisor may manage, control, and construct virtual computers. With virtual SMSCs, MSCs, or HLRs, each virtual machine operates autonomously. Libraries, guest OSes, and virtual storage areas are all unique to these virtual computers. A virtual machine cannot use the storage space of another machine if it has used all its own. This hypervisor relies on a single server, a single RAM module, and a single host operating system. This distributes the host's hardware resources, allows virtualization, and ensures that virtual machines are completely isolated from one another.

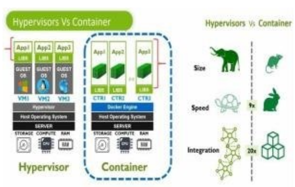

Figure (3) comparison of
Hypervisor and Container

Figure (3) shows the hypervisor block diagram on the left side. Here we have three virtual machines (VMs)—VM1, VM2, and VM3—and the applications App1, App2, and App3 are running in isolation on each of them. The illustration shows a container block diagram on the right side. There are three containers shown here, CTR1, CTR2, and CTR3. These virtual containers are functionally equivalent to their physical counterparts. The size and form of physical containers are defined characteristics. Because of their portability, they may be moved from one nation to another using Docker. Because of how light they are, cranes can easily move them. To top it all off, they keep the things inside safe and sound. Cloud containers also encapsulate and protect the apps running within these CTRs. A ship's "docker engine" is responsible for transporting these containers. A server and an operating system will be required to operate the Docker engine. Containers allow many apps to execute simultaneously. Not only that, they are normal size, lightweight, and portable. An elephant stands for the hypervisor's massive girth, whereas a pen drive represents the container's little stature. When compared to the hypervisor, the container's speed is roughly nine times faster. It is twenty times simpler to integrate various resources in a telecommunications network than it is to integrate network resources in a hypervisor. For virtual nodes and resources, containerization makes connecting a breeze.

II. Conclusion

Data plane and control plane separation is the primary goal of software-defined networking (SDN). It is also designed for network programmability and centralised control. With NFV, network tasks may be moved to generic servers instead of specialized hardware appliances. When compared to NFV, which is aimed at the service provider network, SDN is more likely to be found on campus or in a data center or the cloud. Typically, servers and switches are the intended recipients of SDN and NFV traffic. Implementing and networking in the cloud are two areas where SDN finds use. Even though NFV has not yet settled on a new protocol, software-defined networking (SDN) has adopted OpenFlow. ONF, which stands for "Open Networking Foundation," is responsible for formalizing SDN. Regarding NFV. The standards are being decided by the NFV working group of the European Telecom Standard Institute (ETSI). When it comes to virtualizing network functions, containers are light years ahead of conventional hypervisors..

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