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Exploration of Reliability Design for Network Function Virtualization

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Abstract: Network function virtualization is the extension and optimization of traditional network architecture,which is to realize the virtualization of network functions in the network infrastructure of operators.From the current network function virtualization technology,there are some challenges in the aspects of high availability,reliability,scalability,etc.How to effectively deal with these challenges and improve the reliability of the virtualization system is an important issue faced by the current network function virtualization research.This paper discusses the reliability design of network function virtualization from the aspects of system architecture,security mechanism and service implementation,and hopes to provide reference for the subsequent work.

Keywords: Network function;Virtualization;Reliability;Design exploration

1. Introduction

Network function virtualization is the abstraction of physical network devices by encapsulating network functions(such as MAC addresses,routing tables,etc.)on virtual servers.The virtualized physical network devices can support the network functions required by the business without the need for modification of physical network devices.By using virtual machines(VMs)to host business,we can improve resource utilization,reduce deployment costs,and improve deployment efficiency.

With the continuous development and application of SDN technology,network function virtualization technology has also been widely concerned.However,SDN technology is still in the stage of research and exploration,and there are still many challenges in the aspects of system architecture,security mechanism and service implementation.How to deal with these challenges and improve the reliability of virtualization system is an important issue faced by the current research.Therefore,this paper proposes a network function virtualization system architecture based on the structure of the grid(SG),the container(CI) and software defined network(SDN)technology,and carries on the reliability design of network function virtualization system from the aspects of security mechanism and service implementation,including:system architecture,security mechanism and service implementation.Finally,this paper analyzes the system architecture of network function virtualization,and propose the further research direction.

2. System Architecture

The network function virtualization system has three layers:data plane,control plane,and physical layer.The data plane includes virtual switches,virtual gateways,and virtual network element.The control plane consists of virtual routers and virtual routes.The physical layer includes physical devices.This paper focuses on the first two layers.

Data plane:it is to realize the management of resources by physical devices,and manage physical devices by managing virtual machines.At the physical level,the data plane is equivalent to a server.It provides physical and management interfaces for virtual machine and implement communication and management between virtual machines.The unified allocation and management of data plane resources can improve resource utilization and reduce mutual interference between virtual machines.Since the data plane is independent of the control plane,its reliability is critical to the overall system.From the existing research,there are mainly two schemes:one is to realize the joint virtualization of data plane and control plane by introducing multiple control nodes(multiple VMs);The other is to implement the joint virtualization of the data plane and the control plane by introducing multiple control nodes(multiple VMs).

Control plane:Virtual switches manage physical devices.From the current research,it is mainly based on two ways:one is to realize the management of physical devices by introducing multiple virtual switches,which is mainly suitable for small networks;The other is to realize the management of physical devices by introducing multiple virtual routers,which is mainly suitable for large networks.Among them,for the small network,because of its small scale,simple structure,low price,adopting this method has certain advantages;However,for large networks,because of their large scale,complex structure and high price,the adoption of this method is faced with greater challenges.

3. Security Mechanism

During physical machine virtualization,network function virtualization systems are isolated by hardware security mechanisms to prevent data interaction and sharing between VMs.The traditional security mechanisms between physical machines include firewalls between physical machines,security gateways,encryption gateways,secure access gateways,and so on.Although these security mechanisms improve the security of the system to a certain extent,there are still some problems in practical application,such as complex hardware configuration,large space occupation,and high implementation difficulty.At the same time,the existing security mechanism between physical machines also has some defects.For example,there are multiple physical machines that cannot interact with each other and cannot achieve mutual isolation through multiple physical machines.

Therefore,it is necessary to introduce security mechanism in the virtualization architecture of network function virtualization system to solve these problems.A network functional virtualization system requires the establishment of isolated virtual machine systems between multiple physical machines and realizes the isolation between physical machines through virtualization isolation technology.This virtualization-based security mechanism has the following advantages:VMs are isolated from each other in a virtual environment,which improves the security of data interaction and prevents data leakage caused by data interaction between physical machines.Multiple VMs can be used to isolate physical machines,which reduces the complexity of device configuration and reduces the system deployment and maintenance cost of network function virtualization.The use of virtualization technology can effectively reduce the amount of data transfer between physical machines,improve the availability of network function virtualization system.

However,there are some problems to adopt the virtualization-based security mechanism.The first is the high cost of the security mechanism itself.Because VMs need to be isolated from each other,they occupy certain physical resources and incur high operation,maintenance and management costs.Secondly,the equipment configuration is complicated and its realization is difficult.Due to the complex network function virtualization system architecture,many types of devices,and difficult implementation,it is necessary to further study and explore new network function virtualization technologies that are more efficient,flexible,easy to deploy,easy to maintain and expand,and more secure and reliable.By studying the system architecture and security mechanism of network function virtualization,we can realize the data interaction and sharing mechanism and the isolation mechanism between physical machines to ensure the safe and reliable operation of network function virtualization system.

4. Service Implementation

Network function virtualization services include the data plane and the control plane.The data plane includes ONT,VNF controller and data node.The control plane includes the ONT and data node.The reliability of the data plane plays a crucial role in the reliability of the whole system,so how to improve the reliability of the data plane should be emphasized in the design process.The reliability of the control plane mainly depends on how to ensure the communication between the ONT controller and the VNF controller,which needs a focus on how to ensure the communication between the ONT controller and the VNF controller in the design process.In addition,the scalability of the whole system is also an important factor affecting the reliability of the system,so in the design process,we should also focus on how to improve the scalability of the system.

At present,some manufacturers have launched virtual control plane,but because its core technology is not mature enough,it cannot be applied on a large scale.From the current research of network function virtualization technology,it mainly focuses on the system architecture,security mechanism and service implementation,and how to apply network function virtualization technology to the actual network needs to be further studied.From the practical application point of view,the network function virtualization must be realized through the communication between the ONT controller and the VNF controller.Therefore,how to ensure the communication between ONT controller and VNF controller becomes an urgent problem.

5. Conclusion

This paper holds that the key to reliability design of network function virtualization lies in the optimization of system architecture and the establishment of security mechanism.Through reasonable system architecture design,the stability and

availability of network function virtualization can be effectively improved.At the same time,the establishment of a security mechanism is the basis for ensuring the reliable operation of network virtualization functions.Only on the basis of security can services run stably.

With the continuous development of virtualization technology,the future network function virtualization will pay more attention to the optimization of system architecture to improve the stability and availability of the system,which includes the optimization of virtualization platforms,the optimization of resource management,and the optimization of network connectivity and so on.The future virtualization of network functions will require the establishment of more powerful security mechanisms to ensure the stable operation of services,which includes strengthening access control,implementing data encryption,and establishing secure communication protocols,and so on.Network function virtualization can be applied not only to traditional network services,but also to emerging fields such as cloud computing and big data.In future research,we will need to explore how to implement reliability design for network function virtualization in new business domains.

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