Research on Resource Allocation Technology of Cluster Virtual Cloud Based on SDN

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Abstract. The ever-expanding demand for cloud computing needs to build a large-scale data center. How to operate the data center efficiently is an urgent problem to be solved. Statistical reuse is a prominent feature in cloud computing, and the utilization of physical resources can be improved by using virtualization technology. The core technology of network virtualization is to decouple the virtual network based on software from the underlying network based on hardware, and the proposal of Software Defined Network (SDN) provides a practical solution to solve this problem. Cloud computing puts forward the highest goal of sharing resources in the whole Internet, makes full use of computing/storage resources to the maximum extent, and is an effective method to integrate high-performance computing resources of the whole society. This chapter describes the background and significance of virtual resource allocation in cloud computing environment, studies the cluster virtual cloud resource allocation technology based on SDN, and analyzes how to realize reasonable cloud computing resource allocation to ensure network performance.

Keywords: Cloud computing; virtual resources; SDN

1. Introduction
Cloud computing is a popular technology in today's IT industry. With the help of cloud computing, network service providers can process tens of millions or even billions of information in an instant, realizing the same powerful functions as supercomputers [1]. In the past decades, the Internet has brought great changes to the society and has become a global information infrastructure. With the rapid development of mobile Internet, Internet of things and cloud computing, a variety of emerging services continue to emerge. The traditional network architecture can not meet the development requirements of new services, and the technical rigidity of traditional Internet is becoming increasingly prominent [2]. The problem to be solved by cloud computing is how to effectively and safely manage and share various resources accessing to the cloud, and provide corresponding services. It emphasizes comprehensive resource sharing and comprehensive application services [3]. As the core and supporting technology of cloud computing, virtualization separates the underlying architecture such as the underlying physical devices from the upper operating system and software, and integrates multiple physical devices into a unified resource pool for management through its management software, thus enhancing the coupling between physical devices and physical devices [4]. With the continuous
development of the scale of cloud computing platform, how to effectively manage cloud resources and allocate resources on demand under the premise of ensuring the network performance of cloud computing data center has become a big problem for cloud computing researchers [5].

Resource management is the unified allocation, scheduling and management of large-scale hardware resources at the bottom to improve resource utilization [6]. Through virtualization technology, it provides users with the computing power of infrastructure as a service, which enables users to use efficient, reliable, economic and flexible computing resources without additional cost of purchasing and maintaining resources [7]. Cloud computing centralizes a large number of resources, such as computing power, storage space, information services, and unified automatic management [8]. It has the characteristics of scalability, high reliability and service-oriented. Unreasonable resource allocation strategy not only affects the service quality of tenants, but also is not conducive to the interests of cloud resource providers, or causes the waste of cloud resources or affects the performance index of the whole network, or is difficult to guarantee the service quality of tenants [9]. The underlying virtualization technology and the underlying virtualization technology are used to decouple the heterogeneous network services. This chapter describes the background and significance of virtual resource allocation in cloud computing environment, studies the cluster virtual cloud resource allocation technology based on SDN, and analyzes how to achieve reasonable cloud computing resource allocation to ensure network performance.

2. System design of SDN network virtualization

Through the use of cloud computing technology, all kinds of TT resources can be effectively integrated, and based on virtualization technology, the resource pooling of computing power, storage space, network bandwidth and other resources can be realized, and the three kinds of resources can be used as services through the network for tenants to pay on demand. The carrier level network virtualization operation of SDN needs efficient resource allocation technology support, and its core essence is virtual network mapping. SDN provides a standard interface between control application layer and switch and forward layer, so SDN technology itself provides a platform for the realization of network virtualization. In order to provide services to users, cloud computing center must make them access the Internet. In addition, the various components of cloud computing services and the overall framework of cloud computing center are interconnected through the network and exist in the Internet. Distribution through the network is a basic feature of cloud computing services in the Internet era. The coefficient first resource allocation algorithm is based on SDN technology. By comprehensively considering the nodes, links between nodes and traffic transmission paths in the process of network resource transmission, it evaluates the priority of each node, each link and each path, and calculates the optimal path for data transmission [11]. The success of computer virtualization lies in the realization of the abstraction of the underlying hardware. The hardware abstraction layer ensures the sharing and fragmentation of the hardware resources by the operating system. From the perspective of the operating system, the underlying hardware is its exclusive private hardware. A complete hardware abstraction layer allows different operating systems and hardware to be updated and optimized independently, which ensures the rapid innovation of the virtualization layer. For providers of cloud computing services, various underlying resources, including computing, storage and network, can shield the heterogeneity of various resources through virtualization technology to form a resource pool. In particular, the emergence of computing resources and virtual machines makes it convenient for cloud computing providers to schedule and manage all resources in a unified way.

The goal of cloud computing is that tenants can rent computing resources according to the pay as you go model, and cloud providers can manage computing resources to ensure the scalability and effectiveness of services. However, because a large number of services and applications of tenants usually share the same resource pool, the data center environment becomes very complex, which makes the goal of cloud computing extremely difficult to achieve. The emergence of SDN separates the underlying hardware and the upper control logic of the network. Openflow, as a widely used southbound interface, abstracts the underlying hardware of the network and provides the ability similar
to the hardware abstraction layer in computer virtualization. In principle, any other abstraction layer can be used in the flowvisor prototype system, not just in openflow. Cloud computing center can dynamically allocate or release resources according to the change of tenants' needs. When the demand of tenants increases, the cloud computing center can select the resources that are most suitable for the needs of tenants and provide them for use, so as to realize the rapid and flexible provision of resources. If the tenant reduces the resource demand, the cloud computing center can quickly release and recycle resources for the tenant to use when needed [12]. Flowvisor system puts forward the method of realizing network virtualization based on SDN technology, which provides ideas for the deployment of network virtualization based on Sdn. It realizes network virtualization by adding a virtualization layer between the hardware abstraction layer and the controller. This method is simple and easy to deploy. However, because SP interacts with the underlying switch through its own strategy through its own controller, SP needs to understand the underlying resource allocation. Network virtualization technology abstracts cloud physical infrastructure to form a unified virtual resource pool, which provides convenience for resource management and allocation of cloud providers. Figure 1 shows the image cognitive structure system.

Figure 1 Image cognitive structure system

Telecom-grade SDN network virtualization is realized through a unified shared controller platform instead of making each SP have an independent controller entity, and SP realizes comprehensive management and control of its own virtual network through application without knowing the specific resource allocation of the underlying physical network, which is similar to the idea of realizing virtual machines based on containers in the computer field. In the process of providing cloud computing services, different service requirements are put forward for tenants, and through transparent service pricing, metering methods can be used to automatically manage and optimize resource allocation, which is a pay-as-you-go service mode. Network virtualization aims to virtualize physical network resources into logical networks, which will be provided to tenants to build their own computing networks. In addition, SDN, as the manager of data center network, logically controls the whole cloud computing resources, and provides adaptive strategies for cloud providers to manage the whole network. SDN architecture separates control from forwarding, so as to maximize network efficiency. Cloud computing center virtualizes physical resources through virtualization technology, and tenants can use them as needed, which can effectively improve the utilization rate of physical resources and meet the needs of tenants by using less physical resources. Virtualization technology automates the management of resources by software, so large-scale resource management no longer needs a lot of manpower.
3. The method of virtual resource allocation in cluster based on SDN

3.1 Network virtualization scheme based on SDN Technology

After the virtualization technology of the infrastructure layer in cloud computing makes the underlying physical resources transparent to the upper application, the layer provides users with no single physical resources, but encapsulates the underlying memory, hard disk and CPU into a whole through virtualization technology, and provides them to users in the form of virtual machines. Different tenants have different application topologies, which brings great challenges to the efficiency of resource allocation. For cloud providers, dynamic allocation will inevitably lead to "fragmentation" of cloud resources, resulting in lower resource utilization. Therefore, how to use fragmented resources will become a big problem [13]. In addition, with the continuous expansion of cloud computing, the underlying physical resources are also increasing, so the difficulties brought by dynamic physical facilities will be a major obstacle to cluster resource allocation. The effective utilization of physical resources is to provide as many available resources as possible to the upper layer under certain conditions such as the number and configuration of servers, so that the remaining resource fragments in the cluster are as small as possible.

Every instance of virtual network is realized through virtual network mapping. Multiple virtual nodes can be mapped to an underlying network node, and multiple virtual links can also share a physical link of the underlying network. How to allocate limited resources to multiple waiting jobs like the network to ensure the maximum total utility is the key to scheduling. Virtualization technology also makes it possible to uniformly measure and allocate all computing resources. Instead of considering the heterogeneity and limitation of physical hardware, a unified description framework is adopted to quantify all physical resources, and the overall allocation is carried out under the goal of maximizing benefits. Figure 2 is an image path for behavior detection and judgment.

![Figure 2 Image path used for behavior detection and judgment](image.png)

In the cloud computing environment, the impact of resource allocation based on different goals is different. Resource allocation aiming at maximizing resource utilization often tends to concentrate tasks in smaller areas, divide resources into multiple time slots for utilization, and improve resource utilization in terms of space and time. When a virtual network mapping request appears, the
underlying physical network must determine whether it can accept the mapping request, which depends on constraints and optimization objectives. The following will further describe the network resources in the underlying network and virtual network in the process of virtual network mapping. This description is aimed at all virtual network mapping problems and is a mathematical model description of the commonality of network resources. The original purpose of virtual network mapping is to realize the suitable mapping of nodes and paths between virtual network links and nodes on the premise of satisfying constraints. In the process from enabling to actual operation, the benefit problem is raised, which is the core issue of whether network virtualization technology can be deployed by telecom operators. The cloud computing center can be obtained by transforming the traditional data center with cloud computing technology, or directly applying cloud computing technology to the newly established data center. However, most of the traditional data centers currently use fixed network topology, network resource allocation methods and security policies. Although they can meet most cloud computing service requirements, they ignore the management and optimization of network resources.

3.2 Carrier level deployment of virtual network mapping

In the process of calculating the best path, the combination of nodes with high priority and unit path will greatly improve the network utilization. After the average group priority is obtained, the standard deviation of the priority of all nodes in the path and the standard deviation of the priority of all unit paths are subtracted respectively. This is for the stability of the path. By simply multiplying the priorities of nodes and unit paths, the group priorities can be amplified when their priorities are both high and low, but the situation that the priorities of nodes and unit paths differ greatly is not considered. Cloud computing center has the characteristics of high throughput, low latency and frequent changes. The use mode of physical resources in cloud computing center not only brings changes to the management of computing resources, but also brings new challenges to the management of network resources. Network topology, network resource allocation and network security are all important contents of modern cloud computing center network.

In the traditional network resource allocation scheme, the shortest route is adopted because the path length has a great influence on the transmission speed, because a shorter path means passing through fewer switches, experiencing fewer retransmissions and taking less risk of network congestion. Therefore, the path length plays a vital role in the final transmission speed, so it is necessary to put forward the path length separately, multiply the previous results, and enlarge the advantages of the path infinitely. The data mining process in cloud computing service is shown in Figure 3.

![Figure 3 Data mining process in cloud computing service management](image)

With the wide use of cloud computing services, the scale of cloud computing centers is expanding rapidly, and the east-west traffic in cloud computing centers is also increasing rapidly, which makes the traditional switch-centric tree-like three-tier network topology difficult to meet the requirements of
large-scale cloud computing centers. The relatively small split bandwidth of the three-tier network architecture leads to the congestion of the links in the core layer, which leads to the degradation of network performance. Simply relying on the development of network technology, the problem of network link congestion is solved by increasing network bandwidth. In order to ensure the accuracy of flow control at all times, the coefficient-first flexible network resource allocation algorithm adopts a regular refresh query mechanism, and preliminarily sets the optimal path of each flow to be recalculated at regular intervals [14]. The order of calculation is from the high priority traffic. When the last calculated traffic completes the path calculation, the second round of calculation is restarted. According to different objectives and requirements, a large number of virtual network mapping problems and models have been put forward. Telecom-level virtual network mapping resource allocation technology needs to aim at maximizing global benefits, and solve the problems of cost and benefit, energy consumption, service level default and cross-domain cooperation. Figure 4 is an equalizer architecture model.

![Equalizer architecture model](image)

Resource allocation in cloud virtual environment is to allocate the hardware resources in computer cluster to users in the way of virtual machine as a whole. Therefore, the physical resources hard disk, memory and CPU are combined into a whole and distributed. Cloud providers tend to virtualize these physical resources for easier management and lease. The virtualized physical resources are called virtual resources. Cloud providers centrally manage these virtual resources, and when tenants rent, they only need to provide tenants with abstract interfaces of leased resources. In this case, tenants don't know the details of the leased resources, even they think that the leased resources are real physical resources. In the cloud virtual environment, the system is a computer cluster composed of multiple physical servers with different configurations, and various physical resources in the cluster need to be provided to users through a certain resource allocation algorithm, so as to maximize resource utilization.

4. Conclusions

Network virtualization is the development trend of today's communication network. Its essence lies in the decoupling between software-based virtual network and hardware-based underlying network. SDN provides technical support for the realization of network virtualization. Reasonable resource allocation is not only beneficial to improve the utilization rate of cloud computing resources, reduce energy consumption, etc., and ensure the benefits of cloud providers, but also keep the overall network in good performance, and guarantee the user experience and service quality. The traditional network structure can only calculate the path of traffic and manage the routing queue separately, which easily leads to network congestion and low utilization rate of links. Resource allocation is the key and difficult point to be overcome in the process of SDN-based network virtualization from theoretical research to practical operation, and its core technology is virtual network mapping. Due to the qualitative improvement of computing performance, SDN architecture can support more complex algorithms, and coefficient-first flexible network resource allocation algorithm is one of them. In the future cloud computing environment, it will become more challenging for data center multi-controllers
to work together to complete resource allocation. Next, we will continue to study the cooperative resource allocation strategy under multi-controllers.

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