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Research on traffic scheduling based on private cloud platform

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Abstract: *With the development of cloud computing applications in recent years, the problem of IDC traffic scheduling in small and medium-sized data centers has become increasingly prominent. This paper starts from the consideration of data traffic scheduling of small and medium-sized private cloud centers, and uses the small and medium-sized private cloud built by 40 HUAWEI servers as the experimental environment. It tries to consider the classification of different service applications, the requirements and requirements of different types of traffic, and build a hybrid traffic scheduling strategy to provide a reference for traffic scheduling research of small and medium-sized private cloud.*

Keywords: *Private Cloud, Data Center, Traffic Scheduling, Scheduling Strategy*

1. Introduction

In recent years, with the rapid development of cloud computing, big data, the Internet of Things and artificial intelligence, cloud computing, as one of them, is increasingly recognized and welcomed by the people. The infrastructure "data center" in cloud computing has also been the focus of the industry in recent years. International and domestic network equipment manufacturers and cloud computing providers have built their own public cloud computing centers to provide flexible cloud computing services for all sectors of society. However, the charging standards and methods of different resources in the public cloud make some small and medium-sized enterprises still feel unable to meet their own needs and need to build their own pure hardware environment, so the erection of private cloud also reflects its advantages. Many applications in enterprises require a large number of servers to run on their own private cloud for collaborative completion, and each physical machine in the server cluster also needs to communicate very frequently. Therefore, network performance has become an important factor affecting enterprise applications in the data center. For this reason, if the communication between servers is delayed more than that of the General Assembly, it will have a great impact on the visited website, and then affect the site access. Various applications in the data center also have different requirements for the quality of network performance. Some require minimum low latency, some require minimum bandwidth, and some require dual requirements (that is, the first two are met simultaneously). In addition, the data traffic DT (data traffic) generated by some applications has strong explosiveness, so the prediction of traffic patterns is not fixed. When applications in a specific period are competing for network resources in the data center, data traffic scheduling is required.

According to the new infrastructure construction strategy implemented by the state, in the future, technological innovation will be taken as the new driver, and information network will be taken as the basis to promote the infrastructure system that faces the needs of high-quality development and provides digital transformation, intelligent upgrading, innovation integration and other services. Through tracking the national policies, the planning layout, comprehensive benefits, energy consumption, industrial allocation and other aspects of the data center project are challenged to scientifically guide project construction and promote urban green digital development. Since "strengthening the construction of a new generation of information infrastructure" was written in the government work report, the development of digital, networking, intelligence and cloud based on the new infrastructure is profoundly changing the industrial pattern and people's production and life style, further promoting the rapid development of the data center as a shutdown infrastructure to improve the intelligence level of the whole society, which requires accurate knowledge of the construction of the data center, Effectively accelerate the coordinated promotion of infrastructure projects, and orderly standardize the construction and layout of data centers [2].

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This paper attempts to start from the traffic scheduling of IDC, consider the reasonable scheduling of different data center network traffic from different traffic considerations, and properly consider the green energy consumption issue, so as to provide a reference for the private cloud construction of small and medium-sized enterprises.

2. Review of research at home and abroad

Akyildiz proposed a software defined network (SDN) based approach, which is a new network architecture based on network abstract ideas [1]. It provides centralized management and programming interfaces for distributed networks by separating network control and data layers. Scheduling the information flow through the global network information state of the SDN controller can provide convenience for optimizing the network performance, but the network performance may be degraded due to the uneven distribution of uneven traffic in different path pieces. Masoudi proposed SDN analysis, which enables users to define their own cost-effectiveness and application flexibility to meet the requirements of application service systems [2]. However, due to the congestion of a small number of short traffic in the peak period, it is easy to cause the insufficient interest rate of most links.

Domestic scholars have put forward a method to choose the path for distributing traffic [3]. Based on the shortest path selection method, network flows are classified and processed to achieve the decoupling between the SDN control layer and the forwarding layer, so that the control layer can obtain the load content of the entire network, so that it can manage and control according to the traffic characteristics and requirements [4]. However, in this mode, the elephant flow lasts for a long time and carries a large number of bytes, which will cause network congestion in the data center. In addition, this mode is mainly aimed at elephant flow research, which uses a dynamic scheduling algorithm to complete. It requires hardware and software to coordinate work processing. The processing process is too many, and the requirements for hardware and software are too complex. Other scholars have proposed a static scheduling algorithm for short streams with short duration and small number of bytes to hash the hash value in the header of the packet to obtain the port address of the relative path for forwarding [5]. Although this method has high efficiency, due to the idea of treating available paths as equal cost paths and ignoring the characteristics of link status and traffic, it is very easy to cause network congestion due to the collision of long flows, which reduces the network throughput, and further increases the delay and packet loss of short flows. Some classify data streams according to their granularity [6]. Because different data have differences, they do not schedule data streams differently. In addition, the data connection of public cloud also depends on the public interface, and the interface of different public providers is also a bottleneck.

Therefore, at present, private cloud still has the space and need to expand traffic allocation, as well as the need to provide network service quality while ensuring computing and storage resources. It can be predicted that in the future, the service quality assurance of private cloud and the reduction of operating costs will be the focus of consideration. This is also the content that this paper wants to consider and study.

3. Introduction to Experimental Environment and Classification of Traffic Analysis

For better research content, this experimental environment uses 40 HUAWEI Fusion_Server 1288H servers and HUAWEI S5720 series switches as the network experimental environment to build a private cloud environment. With K8S as the cluster container management tool, we consider using NPCAP technology to capture data packets.

When using NPCAP technology to capture data packets, NPF, the kernel driver of NPCAP, is used to monitor the network card. When capturing packets, the driver uses a network interface to monitor the data packets and deliver them to user level applications intact. The data packets that are captured and meet the conditions are completely handed over to the application program of the user layer. They are implemented in the protocol stack of the whole process without the operating system, and the data frames that should be used in the program link layer are received. The packet capturing process depends on two main components: a packet filter, which determines whether to receive incoming packets and copy them to the listener [7]. The packet filter is a function with Boolean output. If the function value is true, packet capturing drives copying packets to the application; If it is false, the packet will be discarded. The other is a circular buffer, which is used to save data packets and avoid loss. A packet stored in the buffer has a header, which contains some main information, such as timestamp and packet size [8]. After reading the data packet, the collection thread obtains a pointer to the head of the link layer of the data, analyzes the

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data in the buffer that the pointer points to, and then obtains the information of each part of the data packet.

In order to reduce the duplication of data packets, a structure PTR pointer is defined. Its members are pointers to the corresponding positions of the buffer. During the analysis, these pointers are pointed to the correct positions of the buffer. Since a large number of data packets will be collected in the link with large traffic, we consider using two threads. One is data collection, and the other is to save the data to the database, forming these two core functions (named by the collection thread and storage thread respectively).

After the initialization of the main process is completed, start these two threads immediately. After that, the main process is only used to interact with users. The two core threads will end after the main process exits. Among them, the data packets captured by the collection thread are analyzed; Then save the specified data in the memory buffer, and set a timer in the thread. If the timer times out, the current state of the storage thread will be checked. If the thread monitored by the timer is not sleeping, it indicates that the storage thread has not completely written the last submitted data to the database. The system determines that the user's configuration is incorrect, and sends the exit signal to the two threads respectively [9].The log is recorded at the same time to prompt the user to adjust the time interval of the timer, the type and quantity of data collected and other parameters; If the collection thread is dormant, the storage thread will wake up, the collected data will be submitted to it for processing, and the collection work will restart.

The data submitted by the collection thread is written to the database by the storage thread. Since the buffer to store the collected data needs to be accessed by two threads, it is necessary to consider the synchronization mechanism to avoid access conflicts. At this time, you can consider using the semaphore and other mechanisms provided by the operating system. However, the storage thread that writes data to the database takes a long time. If the collection thread uses these mechanisms, it will stop working for a long time. We use the double buffer scheme to realize synchronization. Therefore, when the main process is initialized, each thread uses a preassigned buffer with the same structure. When the timer of the collection thread times out, we detect the boolean variable “isTimeOut”. If the value of this variable is false, the storage thread indicates that it is working, which will be ignored; If the value of “isTimeOut” variable is true, the storage thread indicates that it has entered hibernation. The buffer pointer addresses of the two threads need to be exchanged by the collection process, and then the storage thread is awakened.

After the collected data is collected, it is classified into TCP connection, session, stream, service, host, etc. according to the general network traffic granularity classification method. We try to clean the collected data first, and we can see that different types of traffic show a high degree of discrimination. The time series generated by the same type of traffic are more similar, which can well distinguish different types of traffic and achieve network traffic classification. Prepare for the next step.

4. Research on dispatching control model

After the above work is completed, we consider mainly using the network tool TC (Traffic Control) in Linux for traffic scheduling control, which is used for traffic control, traffic shaping, and bandwidth sharing. We can perform corresponding operations on output traffic to support various types of network layer communications.

When the data traffic classified above passes through a host with flow control function, first process the data traffic through the beforehand configured filtering rules, such as detecting the source/destination IP address, source/destination port number, protocol type, etc. in the packet header, and then send the packet to the queue of the queuing rules. The packet is scheduled through the queuing algorithm of the queuing rule queue, and finally the packet is sent to the exit of the network card. In consideration of traffic scheduling realized through the traffic control module, the core module of traffic scheduling is used to set, delete, and modify the bandwidth limit of an intranet host. These operations are controlled remotely by sending commands through the network[10]. All the reachable paths between the designated communication hosts are displayed in a list, and all paths are sorted by path optimization algorithm to find the optimal path with the lowest energy consumption to ensure the network quality of service, so that users can use this path to complete the packet forwarding. The data packet flow and real-time energy consumption of the switch in the virtual network are handed over to the scheduling processing module. After the optimization path strategy is issued and the data flow integration is completed, the data obtained from the processing module can be used to analyze the devices that are currently active, and the remaining switching work can enter the sleep state, so as to obtain the traffic scheduling strategy considered.

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Using the network energy consumption comparison function module, we will consider and compare the energy consumption analysis of traditional networks and SDN networks that adopt the same data forwarding. With the help of the energy consumption measurement model built by this function, we will calculate the energy consumption measurement values of the two network architectures respectively, and verify the effective performance consumption of the system. When some data in the software, such as the size and location of the control and the location of the topology icon, cannot be directly obtained or the coefficient parameters of the energy consumption calculation module need to be set additionally, they are directly given by the configuration file to optimize the code programming; Enable the automatic adjustment function on the basis of realizing no manual intervention and automatic system operation. After the Floodlight controller sends the data package, analyze the data package, calculate the optimal path, and complete the dispatch strategy. The basic idea is as follows: In the preliminary preparation stage, based on the idea of depth first search, recursive method is used to traverse all the reachable acyclic paths (i.e. full paths) between designated communication hosts. Then, in order to ensure the network throughput of the data center and protect the network performance from being affected, the bottleneck link bandwidth of the path is calculated. Due to the hibernation and activation state transition of network devices, a certain amount of energy is required. In order to improve the utilization rate of network devices, enable as few network devices as possible to meet the communication requirements, and calculate the number of switches that will wake up additionally due to the use of the current path. According to the calculation results of the middle two steps and the principle of shortest path, finally, sort the full path and select the first path in the sorting results (if there are multiple paths in the sorting results that meet the conditions, repeat the above steps and select another path; if there are still multiple paths, randomly select one of them), and send the flow table corresponding to this path to the Floodlight controller to guide the forwarding of data packets. When the system issues the flow table, the client's "traffic monitoring" and "energy consumption monitoring" functions will show that 1/3 of the switches are sleeping; The 2/3 switches are active. Because some switches are edge switches and need to monitor host packets at all times, they cannot enter the sleep state. In addition, when the switches in the current distribution path are forwarding, these switches must be active.

5. Conclusions

In conclusion, this paper proposes DCN traffic scheduling based on the private cloud environment, tries to explore the current network traffic scheduling problem of private data centers, and studies hybrid scheduling strategies to ensure the load balance and quality of service in peak periods, maintain the utilization and throughput of computing resources in low periods, and dynamically adjust the traffic scheduling on the path and the overall operation and maintenance of servers, networks, storage, etc, Make the data center energy consumption dynamic optimization and other aspects develop.At present, the application deployment of our digital campus is the virtual server deployment application in the central computer room of the information center (in the charge of the credit department), which runs the public business on campus. Some of these businesses are assigned to each college for maintenance through the station cluster system, and these virtual resources are managed, operated and maintained by the person in charge of the information center, while the center personnel also spend time and energy managing these virtual resources. The central computer room integrates the office and business of the whole school into the non open source management platform of the central computer room server through server virtualization technology. At present, it is still on the traditional network. When distributing computing resources, the network configuration needs to be adjusted manually to meet the requirements of access and isolation.

In the future, it can be considered to be integrated into the subsequent research of this project to achieve the automatic deployment of the data center and multi cloud deployment. In order to realize the automatic network deployment of cloud network linkage, we can consider combining software and hardware SDN in the future, so the research of this project can also provide the interface and management realization for our digital campus integration private cloud services, achieve the integration of server virtualization technology and cloud platform, and achieve the integration and utilization of computing and storage resources of the entire school. The research of this project not only has important application value for the digital construction of our school, but also can be extended to private cloud applications of small and medium-sized enterprises. Through reasonable optimization of traffic communication between virtual machines, targeted scheduling of virtual machines can meet the purpose of reasonable resource utilization, better serve small and medium-sized enterprises, and also make full use of private cloud resources for users to build win-win services, promoting the further development of cloud computing industry.

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