Teaching Experiments to Explore the Difference between SDN and Traditional Network

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Abstract: "Computer network" experimental teaching is a very important link in computer courses. SDN is network innovation architecture, is a network virtualization implementation. It separates the control surface of network equipment from the data surface and provides a good platform for Internet and application. The emergence of SDN makes the management of Internet more convenient and flexible. It reduces the cost of network construction and maintenance, and promotes the innovation of Internet business. This paper compares SDN with traditional Internet in teaching courses, and analyses their characteristics and differences, so that students can learn computer network knowledge more deeply. This paper focuses on the application principle of SDN architecture and traditional network IP architecture. The two frameworks are applied to teaching practice to show teaching research and teaching effect. Simulate Internet technology into teaching courses. To enable students to quickly understand the most advanced science and technology in today's society, to achieve the purpose of training applied and innovative network talents.

Introduction

Experimental teaching is intuitive, practical, comprehensive, designed and innovative. Experimental teaching is an important link in realizing quality education and cultivating innovative talents. In order to cultivate high ability, high quality and innovative applied talents, colleges and universities focus on the reform and construction of experimental teaching. This paper designs the knowledge content of "computer network architecture" in the course of "computer network". Different virtual experimental platforms are set up for SDN and traditional computer networks. It uses virtual technology to simulate hardware devices and the real network communication workflow. It maximizes the scale and minimizes the funding of experimental classes. It has the same effect as the real LAN operating mode. It solves many problems brought about by traditional experimental teaching and effectively improves the quality of experimental teaching. Through hands-on participation, students build modules and write code to realize the network communication mode. Through experiments, students are allowed to understand the network architecture and working principles of SDN and traditional computer networks, so that they can master relevant theoretical knowledge. Through comparative learning methods, we understand the similarities, differences, and advantages and disadvantages of SDN and traditional computer networks. At present, private universities have set up computer network courses, but the study of network structure only stays in traditional networks, and there is very little learning of SDN. In the original content of the textbook, this paper adds SDN knowledge points to the study. The virtual environment is constructed by using virtual technology, and the network architecture is studied and analyzed.

Purpose and Significance of the Study

At present, with the rapid development of society, there is an urgent need for high-quality and high-level talents. The demand for talent training in universities is getting higher and higher. People

with high scores and low abilities can no longer live comfortably in the information society. Practical ability and practical ability have gradually become the basic qualities of graduates. SDN technology is a new concept in recent years. Its appearance makes the Internet more convenient and flexible. SDN is now in the transition period of alternating with traditional networks. In the future, SDN will replace the traditional network. The purpose of this paper is to improve students' interest in the course and to solve the limitations of traditional experimental courses in terms of technology and hardware. First, several servers, switches and PCs are simulated. Install SDN and IP network architecture software, respectively. Cloud platform is used to simulate 7-tier IP network architecture and 3-tier SDN architecture. On the basis of textbook content and the latest computer technology, a comprehensive teaching is formed. In the course of teaching, we should pay attention to the cultivation of students' comprehensive ability. Make use of students' curiosity. Mobilize students' enthusiasm for learning. Encourage students to explore, build their own framework, write code, and form effective results. In the process of realization, problems are found and solved. By comparing the ways of learning, we can improve the students' judgment ability. This paper explores the teaching mode of "Computer Network" course from the level of teaching practice. It is used to improve students' interest in computer learning and make the course closer to real life. It enables students to grasp the latest scientific knowledge and guide students to study independently and actively. Finally, the improvement of students' learning literacy will be realized. Achieve true learning and application.

The Difference between SDN and Traditional IP Network

The structure of traditional network is TCP/IP model. It consists of application layer, presentation layer, session layer, transport layer, network layer, data link layer and physical layer. There are seven floors altogether. Each layer corresponds to the relevant network protocols. SDN network structure is different from the traditional network distributed structure. It uses the method of bringing together the control layers in the original network structure. It is divided into application layer, control layer and data forwarding layer. The traditional TCP/IP network structure is shown in Figure 1. When two hosts transmit data to each other, The first one gives its data to its own application layer. The application layer adds the necessary control information and then becomes the data unit of the next layer. When the transport layer receives the data unit, it adds its own control information and then passes it to the network layer， And so on. Data transmission to the data link layer, control information is divided into the first and the last two parts, without adding their own information to the next layer. The physical layer continues to transmit data as a bit stream. The bit stream leaves the first host and is transmitted to the router. Send it to the second host via router. Data is transmitted from the physical layer to the application layer in turn. It accomplishes data transmission between two hosts in this way.

The structure of SDN network is shown in Figure 2. The interface between the controller in the control layer and the data forwarding layer is the interface of the control data surface, which interacts with each other. The network infrastructure in the data forwarding layer acts as the router of the original network architecture. It is called OpenFlow exchange. The API provided by the controller interacts between the control layer and the application layer. Control Data Surface Interface can shield heterogeneous protocols and types from network infrastructure resources. The control data interface enables the network infrastructure in the data forwarding layer to receive data from the controller without obstacles. API is open. Users can modify the control function of API directly through software. You can see the SDN and IP structures, the top layer of which is the application layer. The infrastructure of SDN network includes the functions of data link layer, network layer and transport layer of traditional network. The three-layer network structure of SDN can better distinguish network layers. It enables switches in the infrastructure layer to focus only on the forwarding and processing of data packets. Switches are not required for autonomous learning at the network level. This greatly reduces the complexity of the underlying forwarding device. The number of underlying equipment has been greatly reduced. Forwarding can be achieved by

switching only. This model is suitable for today's high bandwidth, high dynamic applications. There are many benefits for large-scale production and use of future forwarding equipment.

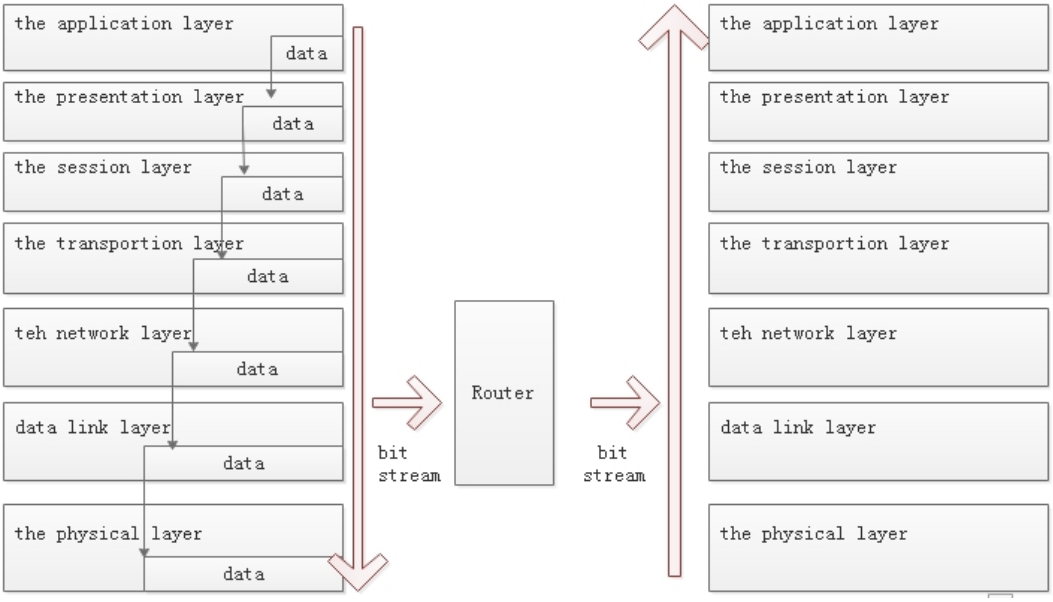

Figure 1. Traditional IP Network Architecture

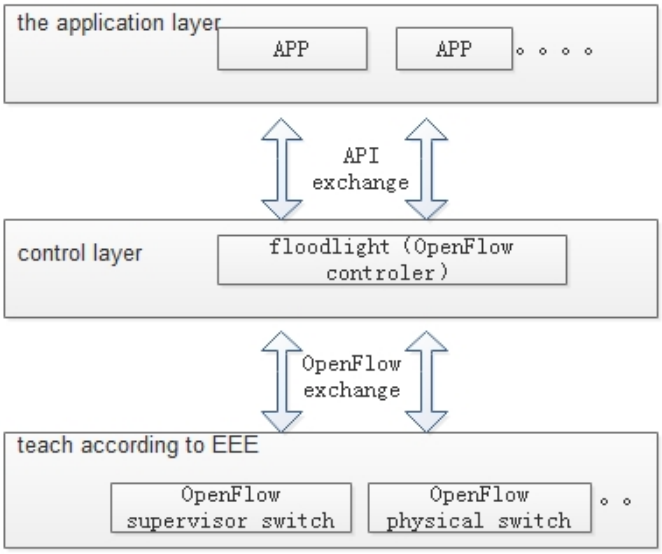

Figure 2. SDN Network Architecture

Introduction to Floodlight

Floodlight is an OpenFlow controller based on Java. It is open source, enterprise-level, and licensed by apache. The significance of Floodlight is to achieve flexible control over a large number of switches, routers and virtual switches. Devices are required to support the standard OpenFlow protocol. Because Floodlight is developed in Java, Floodlight can be applied across platforms, and it can run on a variety of operating systems. Floodlight has open source, which makes the whole more reliable, transparent and pluralistic. Floodlight is not only an SDN controller, but also contains many modular applications. These applications can provide the REST API upwards, thus helping the application layer to better manage the entire network. It controls and queries the network by implementing a series of functions. At the same time, rest application implements different functions to meet the different needs of users for the network. Through these applications, users can abstract and virtualize the entire OpenFlow network. Through these applications, users can obtain the network topology and control and manage network traffic. Through these applications, users can complete the configuration of network QoS-related parameters. Floodlight is mainly divided into

controller module and Application module as shown in Figure 3. The Application module achieves different purposes according to different schemes. It can load different modules according to different network control requirements. It makes Floodlight have excellent scalability. The controller module provides module calls for Beiqiao Java API provisioning. Both modules support opening Rest API to the upper layer as a northbound interface.

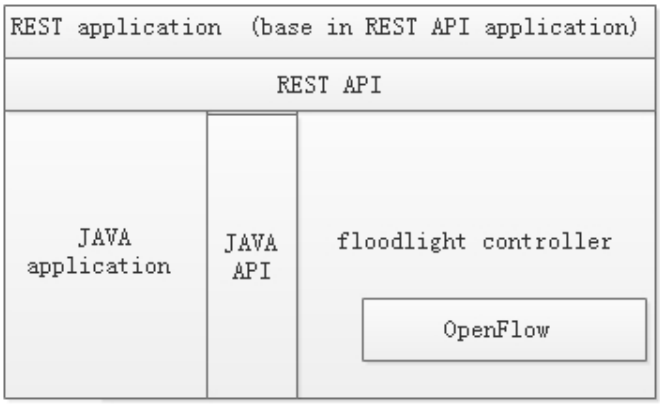

Figure 3. Architecture of floodlight

Floodlight controller mainly contains these functions. Floodlight can count the state and information in the SDN, and count the flow through the host device and so on. It is between the switch and the controller, through the OpenFlow protocol version, used to achieve the controller control network and switch forwarding information. When the control module receives the Packet in message, it determines whether a response flow table entry needs to be generated based on the actual situation.

At the same time, it controls packet forwarding in the switch. After Floodlight receives the data, it provides an API interface to the application layer and then displays the host information and data flow information inside the switch through the WEB. Floodlight has some features. Its application modules can be extended and developed according to the needs of users. Users can develop new application modules and add new content to Floodlight architecture. Floodlight and the functions of each module are shown in table 1

Table1. Floodlight and the functions of each module

	Code name	Implemented functions
Controller module	Floodlight Provider	It is the core component of Floodlight. Drive service operation, Initialize and register each module.
	Link Discovery Manager	It uses LLDP and broadcast packet (aka BDDPs) to discover and maintain the link state in OpenFlow network, thus obtaining the link information between switches.
	Device Manager Imp l	Tracking the network host in the network location, support MAC address and switch port and IP address conversion.
	Rest Api Server	Provide REST API services over the HTTP protocol. Rest API services use the Restlets libraries, Classes that support the Restlet Routable interface, Use REST services to provide Api.
	Topology Service	Discover routes in the network, Maintain topology information of

		switches in the network.
	Memory Storage Source	Provide database-based storage and management, Provide notification of data changes。
	Packet Streamer	Data flows can be exchanged between any controller and switch
	Static Flow Pusher	Support for adding and removing static streams, Provides a rest-based API.
Application layer modules	Virtual Network Filter	Support the virtualization of the two-layer network, Can be used as a plug-in for OpenStack Quantum.
	Firewall	The firewall, Based on the REST API interface。
	Forwarding	Packet_in messages based on switches Making and forwarding decision messages, Support for packet based end-to-end routing.
	Port Down Reconciliation	Process the flow in the network when the port is closed

The configuration of Floodlight

We adopted Eclipse. It is an open source, java-based, extensible development platform. It is itself just a framework and a set of services.

Its purpose is to build the development environment through plug-in components. Eclipse runs and develops through a graphical interface.

Compare the Teaching Research of SDN Network Architecture and Standard Computer Network Architecture

The teaching mode of computer network course is to simulate SDN network architecture and standard network architecture respectively through the construction of virtual platform. By comparing and observing the network architecture and operation mode of SDN and traditional IP, learning the differences between them and their advantages and disadvantages. It adopts comprehensive experimental methods and means. This kind of way has carried on the synthesis type training to the student's knowledge, the ability. The characteristics of this teaching practice reform should be reflected in the following aspects: the complexity of experimental contents, the diversity of experimental methods, the diversity of experimental means, and the innovation of talent cultivation. Its main purpose is to cultivate students' ability to apply new knowledge comprehensively, systematically and flexibly. According to the experimental objectives, requirements and conditions given by teachers, students design their own experimental scheme, select experimental methods, determine experimental steps and operating procedures, independently complete the experimental process, process experimental data and analyze experimental results. This kind of experimental teaching focuses on the exploration of experimental contents, the initiative of students' learning and the diversity of experimental methods. The emphasis is on cultivating students' innovative consciousness and spirit, and improving students' ability to analyze and solve problems with new technologies.

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