IOSR Journal of Mobile Computing & Application (IOSR-JMCA)
e- ISSN: 2394-0050, P-ISSN: 2394-0042.Volume 9, Issue 2 (Mar. – Apr. 2022), PP 14-18
www.iosrjournals.org

VLAN Communication Experiment based on the WEB Environment

Mohammad Shariful Islam
Post Graduate Student, Dept. of EE & CE
Military Institute of Science and Technology, Mirpur Cantonment, Dhaka,Bangladesh.

Abstract
VLAN communication experiment is one of the most important teaching difficult points of Computer Network Technology Courses, in the circumstance of lacking of the experiment equipment's, traditional experimental teaching method cannot fulfill the learning needs of related personnel. However, virtual demonstration experiment generates to solve this problem. In this paper, a design of VLAN communication experiment with virtual demonstration mode is shown. The realization of the practical project both in software and hardware aspects is also presented and its characters and practical values are emphasized. At last, an analysis has been made for several involved factors that exist in this experimental teaching mode.

Keywords
VLAN; Computer Network Technology; VLAN communication experiment; Virtual demonstration experiment; Experimental teaching mode;

I. Introduction

With the development of information technology, network access equipment and network structures are becoming increasingly complex, in order to meet the different needs of network users, VLAN technology has appeared. Now, VLAN has become the hotspot of research and implement in all kinds of enterprises and college, as the result, VLAN communication experiment plays a very important role in enhancing the employability of computer networkgraduates.

With the characteristics of the abstract speculative knowledge and exact demands of the hardware and experiment conditions, it's quite difficult for traditional experimental teaching mode to realize the practical teaching step of this course in distance learning, thus based on achievement of multimedia technology, to complete VLAN communication experiment with virtual demonstration experimental mode base on web environment is the primarily direction of thispaper.

II. Objectives

The main objectives of this study –

1. To study on VLAN Communication
2. To Experiment of VLAN communication based on the WEB Environment

III. Methodology

In the modern world of computer networks there are many moving parts that must be carefully controlled in order to get the most out of it. One of the methods that can be used to provide this is by following a network lifecycle; these lifecycles define an approach that can be followed for each stage of the network's life (Thus lifecycle). Cisco's version of this is the PPDIOO lifecycle or Prepare, Plan, Design, Implement, Operate and Optimize. In this study I follow the PPDIOO network methodology. The following diagram show the method of this work.

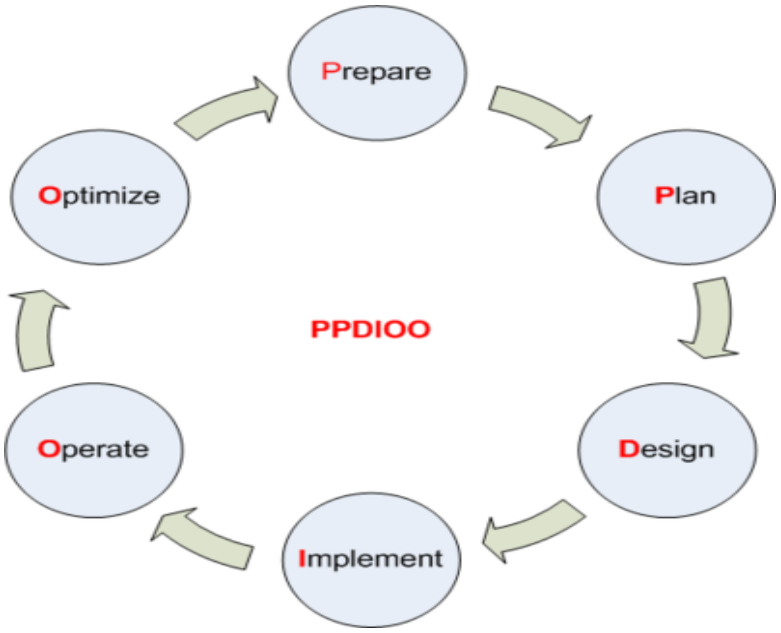

Figure 1: PPDIOO Methodology diagram

Although Design is one of the six PPDIOO phases, all the other phases influence design decisions, and the Design phase interacts closely with them, as follows:

■ The requirements derived from the Prepare and Plan phases are the basis for network design.

■ The Implement phase includes the initial verification of the design on the actual network.

■ During the Operate and Optimize phases, the final decision is made about the appropriateness of the design, based on network analysis and any problems that arise. The network might have to be redesigned to correct any discovered errors.

IV. The connotation and characteristics of VLAN communicationexperiment

VLAN CommunicationTechnology

VLAN (Virtual Local Area Network), which physically divides separate users or servers into logical work groups. Each VLAN is a single broadcast domain, and the unicast and multicast of inter-VLAN cannot directly forward to other VLANs, so VLAN need use router to achieve data communication [1].

There are five structures according to different location of router.

1. Border routing structure: this structure is a kind of distributed routing method. Being superior to some other centralized router, it will not cause network collapse when the router is broken down. However, the cost of this structure is very high because that it needs dynamic management for multiple networkdevices.
2. "One-arm" routing structure: this kind of structure is suitable for most messages transferring in a single VLAN, but the chief defect is that it will cause net bottleneck problems when data transport become highly huge between differentVLANs.
3. Server-based/Client-based routing structure: from the view of physical structure, the function of this kind of structure is similar to One-arm routerstructure.
4. The MPOA (Multi-protocol over ATM) structure: this kind of structure which defined by ATM is used in ATMNetworks.
5. The structure based on three-layer switch: this kind of structure uses the three-layer switches which integrate switching and routing capabilities to transfer messages between different VLANs. This technology has the virtue of simplifying the network structure and reducing the network delay[2-3].

Compared with the other routing technology, thanks to higher data transmission speed, three-layer switch can solve the net bottleneck problems which caused by router. Therefore, this method is the main way in actual work.

V. The connotation and characteristics of experimental teachingmode

With the development of multimedia technology, experimental teaching methods develop into virtual experiment, remote control experiment and demonstrate experiment from traditional experiment (using the real laboratoryequipment's).

Just as the name implies, virtual experiment means to use virtual reality technology to simulate various kinds of

real experiment environments within a computer system. While students log on the virtual laboratory, they could make built-up connection by using mouse dragging relevant virtual equipment's. According to the relating enactment and formulas, computers can imitate various scheduled experiment projects as in the real environment like "Virtual Frog" experiment in Biology [4].

Compared with virtual experiment, remote control experiment can give the student at-site feelings and experimental effect, but this mode has following disadvantages: firstly, the construction cost and maintenance cost of this mode are very high. Secondly, as the limitation of network bandwidth, the number of online experimenters is limited.

Demonstrate experiment posts the recoding of real experiment on the internet, and experimenters can realize the operation and basic configuration of experiment through this video.

In addition, one new mode compromises different experimental teaching moods. The mode which integrates virtual experiment and demonstrate experiment (virtual demonstrate experiment) is widely used because it has a great future with low cost, simply operation, wide suitability and other many merits. By taking VLAN communication experiment as an example, experimenters can not only understand the fundamental theory and the basic configuration of VLAN through the demonstrate experiment, but also have further realization about the experiment by realizing the commands of switch. Table 1 shows the cost and adaptability to the experimenters (mainly distance education students) of these experimental teachingmodes.

Table 1. Comparison between different experimental teaching modes

Experimental teaching mode	Construction cost	Maintenance cost	Adaptability
Tradition experiment	High	High	Weak
Virtual experiment	High	Low	Strong
Remote control experiment	Higher	High	Weak
Virtual demonstrate experiment	High	Low	Strong

VI. The design of VLAN communicationexperiment

The design of the experimentationcontents

VLAN can control broadcast storm through assigning the network traffic, and data transmission between different VLANs should be with the aid of routing functions. We usually use router as a kind of trunk equipment. Thus router is used as necessary equipment's in general. "One-arm" routing structure brings great attention in computer engineering, it can eliminate high-latency routing of backbone networks and also attracts more and more attention, thus this experiment is indispensable[5].

But due to its low speed and some other limitations, router will become the bottleneck of network and the three-layer switch technology solves this problem effectively. Moreover the three-layer switch obtains increasing broad application by its high performance/price ration in enterprises and college. As a result, in the network planning the design of VLAN communication experiment based on the three-layer switch is necessary.

The target of VLAN communication experiment is to enable experimenters to learn to divide VLAN, realize theory knowledge about LAN, and improve the practical operating ability. The structure of VLAN communication experiment is a kind of hierarchical structure, that every level is the key of next level to reach the target. The target hierarchical structure of VLAN communication experiment is shown in Figure 2.

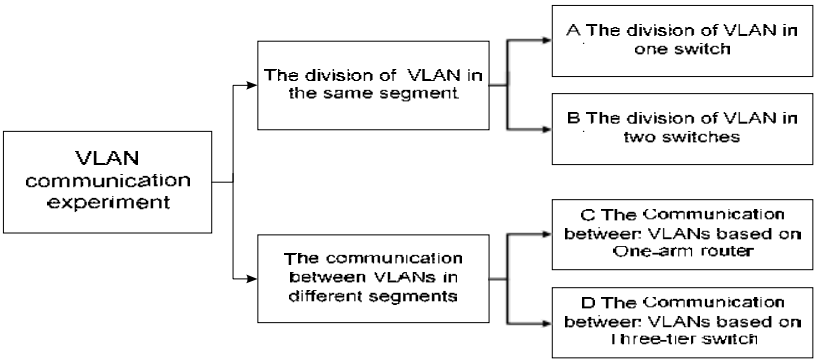

Figure 2. The target hierarchical structure of VLAN communication experiment

There are two bi-level targets that one is the division of the VLAN in the same segment, and the other is the communication between VLANs in different segments. This experiment includes four laboratory projects which all have high utility value and maneuverability, and A project (shown as Fig 1) is the basic project of the other three projects, the target of B project which depends on A project is to improve students' abilities of

dividing VLAN. C project and D project depend on B project, and the objective is to make further improvement of computer network skills and the abilities of configuring devices(e.g. switch and router).These four laboratory projects constitute objective framework at thethird-level.

The design of experimental teachingmode

Along with the development of network and multimedia technology, the experimental teaching mode is becoming more and more diversified, and the target of experiment is that it should face more experimenters especially distance education students. Thus this paper selects virtual demonstrate experiment inTable1.

Demonstrate experiment includes not only the video of real experiment which recorded by teacher, but also includes knowledge points, topology of experiment, configuration commands of switch or router and many other aspects.

This experiment can help experimenters completely and accurately comprehend the mechanism of experiments, the configuration of devices (e.g. switch or router), each step of experiments and the challenge attention of experiments.

Virtual experiment requires experimenters to connect virtual devices according to experiment instructions, and then input the command of switch to test the communication between VLANs. Although experimenters can't real connect switch to computer by cables, but this mode enable experimenters to be more intuitive grasp of the configuration of switch, and improves the basic ability of LAN configuration.

And then, this paper takes D project (from fig.2) as an example to introduce concrete application of this experimental teaching mode (virtual demonstrate experiment mode) in VLAN communication experiment.

VII. VLAN communication virtual experiment based on three-layerswitch

In preparing phase, the teacher should provide study materials for cultivating students' self-study ability to meet the demand of a larger scale of learning students. These materials include experiment instructions; demonstrate experiment of this experiment, experiment reports and so on. To ensure all the students get sufficient teaching-assistance service by providing professional materials.

The demonstrate experiment is a video which recorded by teacher in real lab environment (include two three-layer switches, four computers and cables). This video detailed depicts configuration process of experiment and communication procedure between different devices. After processed by multimedia technology, this video form a new multimedia courseware (as shown in Fig.2) and distributed in Internet. The left of courseware shows the video of demonstrate experiment which recorded by teacher, and the right demonstrates knowledge points and topology of every step. Through self-studying this multimedia courseware, experimenters can understand practice knowledge of VLAN communication experiment.

After watching multimedia courseware, experimenters should complete virtual experiment to further reinforce and utilize the configuration of switch. As shown by Fig 3, experimenters drag virtual devices to connect different devices, when double-clicking virtual switch device will bring out the dialogue box, experimenters can input commands to set switch. Although many virtual experiment are unable tobring the result of real experiment, but VLAN experiment is focused on the students' mastery of switch's command and testing the connectivity between VLANs. Therefore, virtual experiment keep consistent with real experiment only except connection between devices using real cables.

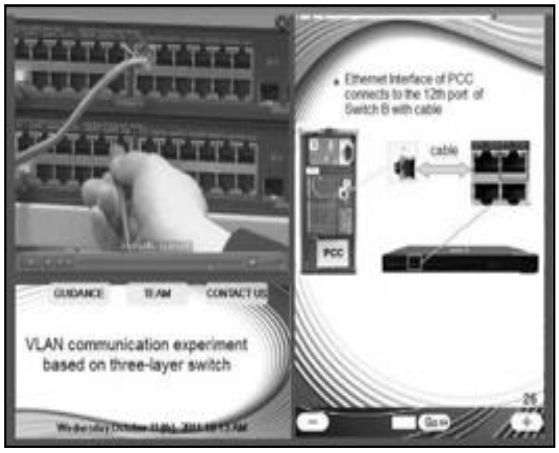

Figure 3. Schematic diagram of thedemonstrateexperiment

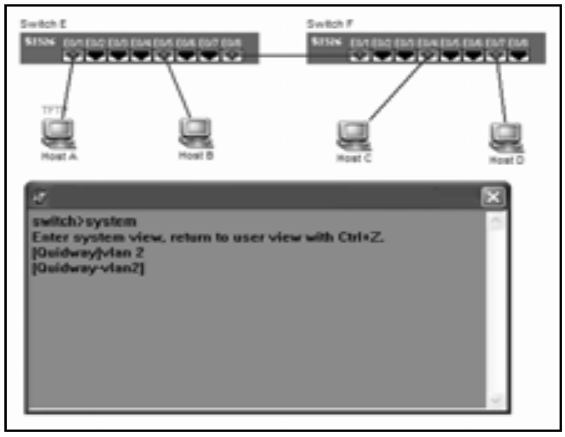

Figure 4. Schematic diagram of the virtualexperiment

VIII. The problems exist in VLAN communicationexperiment

Although this experiment mode breaks the limitations of experiment space in traditional experiment, but it still has some problems.

The limitation ofdevices

The demonstrate experiment recorded by teacher only apply to one type of switch, but commands of switches are different with other manufacturers. Thus the demonstrate experiment describes the basic principle of experiment with one type of switch, it cannot cover all hardware devices.

The limitation of experimental teachingmode

As a kind of virtual demonstrate experiment, experimenters can never have an immersed sense to complete the experiment, so that they are also inexperience for many unique feature, such as suddenly power-down while the equipment's are working. What's more, this kind of experiments is lack of interaction. Although it is feasible for teachers to connect students online by BBS, E-MAIL or some other ways, the shortage of the interaction between students and the equipment's during the process of the operation should never be ignored.

There are still shortcomings and deficiencies at present about this teaching mode, but it still has enormous potential and applications owing to its advantage for distance teaching students who are lack of real devices and real lab environment.

IX. Conclusion

VLAN communication virtual experiment based on web is one of the teaching points in research of computer network experiment courses. What's more, the virtual demonstration experiment in this paper breaks the space limitation of traditional experiment. It not only shows the process of experiment with reality, lifelikeness and intuition but also supplies a kind of virtual learning environment for experimenters. It basically solves the problems of traditional experiment in practice sessions.

Through studying this virtual experiment, the distance education students will master the experiment skill of VLAN communication experiment based on three-layer switch which has strong practicability, and one-arm router VLAN communication experiment which has a higher theoreticallevel.

Along with the information technology continually development, this experimental teaching mode has a prospective future. Meanwhile, researchers should continue to improve and enhance laboratory projects for the further improvement of the students' ability of knowledge combination,practical operation and comprehensive application in computer networkfield.

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