

# Research on the Course of Network Performance Testing and Analysis

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**Abstract.** From the teaching practice of the course of network performance testing and analysis, the teaching purposes and contents are described in detail. In addition, we research and explore the teaching methods and teaching experiences during the teaching process effectively. In this paper the practice shows that we gain the good teaching achievements.

**Keywords:** network performance testing and analysis; teaching method; case teaching; interactive teaching

## 1. Introduction

With the rapid development of computer network technology, network applications become wider and wider. People are increasingly dependent on Internet technology which is required to provide high level performance and high quality of network service. Whether network equipment manufacturers, network operators, or operators with large and medium enterprises network, they all need to find problems on products and network by using performance test in order to speed up product development, improve network quality and service, ensure the network performance to work normally. In recent years, people pay more attention to the network performance testing and the demand on qualified test engineer is gradually growing. [1] To meet society needs, the professional network practitioners need to grasp basic knowledge and skills related to the network test. Therefore, it is necessary for undergraduates to set up the course of network performance test.

## 2. Curriculum Issues

### 2.1. Overview on the Course

The importance of network performance testing on the network is no less than the importance of software testing on software. Due to the above reason, nearly all the computer specialty or communication specialty set up software testing as a compulsory subject to study, but currently most institutions have not arranged network performance testing except for Beijing University of Posts and Telecommunications, Beijing University of Technology, Wenzhou University and so on. We believe the course of network performance test should be popular for more and more universities with increasing demand for talents of society.

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## 2.2. Course Feature

Network performance testing is an emerging discipline which has not only deep theoretical basis but also strong application value. New concepts, new methods, new technologies, new applications and new problems are involved in this course. Network performance testing has the following characteristics:

### 2.2.1. High level theory

This course is based on web knowledge architecture, which includes in TCP/ IP protocol analysis, routing and switching, network planning and design, network and information system security. In particular, it is important for undergraduates to study the configuration methods of routers, switches, firewalls, intrusion detection systems and other common network equipments. If students do not master the basics theory knowledge well, they feel heavy pressure on learning from this course. Thus teachers must have a strong ability to control the course at any time. According to the characteristics of students, teachers should be good at changing the complex and abstract theory into the specific and real problems. In addition, teachers could solve various teaching difficulties through metaphor, analogy, inspiration, examples and other teaching methods.

### 2.2.2. Strong practice

Although the course has high theoretical basis, the course objective is application which is different with the traditional theoretical courses such as numerical theory, information theory and so on. Thus after studying network performance testing theory, teachers should design some network experiments for students in order to solid foundation of knowledge. Teachers could also arrange experiments after each chapter studying because it is easy to stimulate interest of study and master knowledge points better. [2]

### 2.2.3. Quick update knowledge

With the development of network technology, network is used in many fields, which promotes the new testing methods and tools for the emergence of network. Thus network performance testing course must keep pace with development of technology and update the course contents at any time.

### 2.2.4. Wide range of knowledge

The course contents of network performance testing involves network protocol layers, algorithms, network operating systems, network attack and network security technology. Therefore, the program must fully consider the characteristics of knowledge and course contents. Therefore, teachers should pay attention to combination theory with practice during the teaching of network performance testing. At the same time, it is important for the students to follow the principle. In other words, the students should not only master the theory of network performance testing, but also concern about the cultivation of practical skills. As for teachers, they should carrying out the basic theory and network performance testing methodology, help students deepen understanding the test methodology through experiments and require students to grasp the basic skills of testing network performance. All experiments were conducted in laboratory and verified the effectiveness of experimental teaching. Especially, all experiments are also fully integrated with mainstream technology.

## 2.3. Course Construction Objective and Content

### 2.3.1. Course construction objective

- Network performance testing and analysis is based on the network performance testing standards and introduced elements and methods of network performance testing.
- Through the course of study, the students should grasp testing theory and test methods on the second floor of Ethernet, IP-layer forwarding performance, routing protocol, fourth to seventh layer, network security and network service quality.
- Through the course of study, the students should operate the test equipment skillfully, develop test methods, improve the ability of development and analysis on the test results and reach the level of network engineers in the end.

### 2.3.2. Course construction content

We use the textbook, network performance testing and analysis, which is written by Lin Chuan and published by the Beijing Higher Education Press. Course modules are as follows:

#### a) Theory teaching

The basic theory of network performance and methods testing is described from the first chapter to the seventh chapter in detail.

#### b) Practice teaching

Combined with the test instruments of currently industry leading vendors and 14 experiment demonstrations, the implementation of network performance testing process is introduced through bottom-up layer by layer.

#### c) Schedule arrangement

The total course is 64 hours, which include 32 hours theory teaching and 32 hours practical teaching. Table 1 shows the schedule arrangement.

## 2.4. Course Object

On the one hand, high grade undergraduates or graduates on communication specialty and computer specialty have learned professional knowledge related to network performance testing and analysis. They also have a certain

TABLE I. schedule arrangement[5]

Chapter	Theory teaching	Practical teaching	Total
chapterI overview of network performance testing	2	2	4
chapterII the second layer Ethernet testing	8	6	14
chapterIII the third layer IP forwarding performance testing	4	6	10
chapterIV routing protocol testing	6	8	14
chapterV fourth layer to seventh layer testing	4	2	6
chapterVI network security testing	4	2	6
chapterVII network service quality testing	4	6	10
total	32	32	64

practical ability to understand and master the course better. On the other hand, many people master the course knowledge through continuing education learning and society training. For example, research and development personnel and testing personnel in communication manufacturing business, the development personnel, testing engineering and maintenance personnel in the communications operators and enterprise network management personnel. They all grasp the network performance testing knowledge by practical learning. [5]

## 2.5. Course Focus

Students should be noted on studying the course:

- Form the basic body of knowledge.
- Understanding the basic theory and method of network performance testing.
- Master the basic skills of network performance testing.
- Focus on the development of network performance testing technology.
- Have capacity on the track and continue learning.

## 3. Teaching Experience and Method

### 3.1. Deepen Scientific Research and Promote Teaching

The mutual support and penetration between teaching and research can improve teaching ability and ensure to update the basis of teaching content constantly. As for network performance testing is a new course, people have not enough emphasis on it. If only we make great efforts on scientific research related to network performance testing, we could hold leading position on the field of domestic network. In addition, we should concern about the domestic and international expertise developments in the field and take reasonable measures to encourage the teachers to engage in teaching and research. Ultimately teaching experiences promote scientific research, whereas research improves teaching ability. Therefore, teaching and research form a virtuous cycle. [3]

### 3.2. Engage in Teaching and Curriculum Research, Construct Teaching Teams

We should conduct educational research, deepen the educational reform, explore the curriculum research and build excellent teaching teams, which is the basic security of innovative teaching. With the extensive use of the network, the channel of acquiring knowledge is increasing and the scope of knowledge is expanding. Conversely, professional university teaching knowledge is lack of width which can not meet the needs of today's teaching. The network performance testing program is complex and integrated curriculum which involves many related courses knowledge, so it is not real for only one teacher to take this course. During the actual teaching process, we should set up special program groups or teaching teams. On this course group, some teachers are proficient in computer network infrastructure, some teachers are good at teaching TCP/IP protocol, some teachers are familiar with routing and switching protocols and some teachers are likely to

operate network equipments. Teachers in teaching team share their teaching experiences, exchange their research ideas, analyze professional network testing methods and solve teaching problems. According to regular schedule arrangement, teaching team persons prepare for the course together and summarize and develop flexible teaching methods to stimulate student interest in learning so that network performance testing curriculum becomes a popular course. [4]

### **3.3. Explore a Variety of Teaching Methods**

On the teaching process, we continuously explore new teaching methods and change the traditional cramming method. There are many good teaching methods such as case teaching, interactive method, heuristic teaching, discussion and so on. Through the above methods, teachers complete the transmission of knowledge.

#### **3.3.1. Discussion method**

For example, teachers give a question about how to balance the relationship between network function and network performance. Students are required to discuss the topic by using both positive and negative viewpoints, prove their point of argument using the knowledge acquired and arrive at the final conclusion. Once students occur deviation, teachers should correct errors and give a guidance to learn from knowledge. BBS is also a network approach for teachers and students to have thematic discussion or answer difficult questions. [6]

#### **3.3.2. Experiment method**

Teachers design several experiment projects, students make efforts to prove experiment results with knowledge taught in the classroom. For example, RFC2889 Ethernet forwarding performance test, RFC2544 IP throughput test, IP packet loss rate test, IP forwarding delay test, QOS testing and so on. Students must submit the preview report before the experiment. Once completing the experiment, the final report is examined and handed in. Usually there are 3 or 4 students in one team which has a reasonable division of labor to complete the same experiment. When evaluating the experiment results, each team selects a primary student to describe their experiment objective, experiment procedure, experiment data and experiment conclusion in detail. The labor of other members in this team is randomly inspected which enables students to develop the spirit of cooperation[7].

#### **3.3.3. Analogy method**

In network performance testing course, program protocols and algorithms involve in some difficult mathematical knowledge. If we only explain and analyze from the mathematical point of view, it is very difficult for students to understand. However, analogy method should play a multiplier effect. In other words, we can use an example with similar properties to compare with the relevant knowledge. For example, the routing protocol draws analogy into the postal system in the mail to illustrate the routing principle and the routing algorithm. [8]

#### **3.3.4. Case teaching method**

Case teaching is specific, vivid and easy to accept for students. After the students master basic knowledge and theory, teachers give them some typical and representative cases. During the case of reading, thinking, analysis and discussion, students establish a suitable and strict logic way of thinking in order to improve students' abilities of analyzing and solving problems. Through the study of a large amount of cases, the students achieve the transformation from theory to practice. In the case teaching, there exists various ways of contacts, such as individual teacher and individual student, individual teacher and student groups, individual student and individual student, student groups and student groups which is called the interaction between teachers and students. Compared with traditional teaching methods, case teaching method has a unique advantage to help students study. [9]

#### **3.3.5. Employ visiting experts**

In order to improve the teaching level, we invite visiting experts to hold seminar or lecture in our university. We could learn from experts teaching experience and business practices. For example, we employ the manager of SPIRENT corporation to give lectures in our school class. Teachers and students interact with the manager on issues of interest which improves student learning initiative.

In addition, we apply for the heuristic teaching and task teaching in order to enrich the teaching content and improve the learning interest. After a period of reform on teaching methods, the effect shows that no one student is absent from class. At the same time, the students encourage to ask questions and create an active classroom atmosphere. [10]

### **3.4. Practice Innovation**

- Establish network performance testing practice and innovation base, construct network engineering, develop talents cultivation mode, promote teaching reform, curriculum development, teaching materials enrichment and teaching team structure.

- Participate in the network competition which is a platform to demonstrate a good knowledge of personal skills, network analysis and project planning and design capabilities, practical engineering problems analysis and solving skills, network engineering and innovation, teamwork cooperation, and engineering system integration analysis ability.
- Cooperate with well-known enterprises which provide internship opportunities. The students involve in real projects which is expanded graduate design project.

As network performance testing and analysis is a new curriculum, we have not enough teaching experience and fewer reference books. In the future we should carry out more explorations and researches in order to achieve better teaching results.

#### 4. Conclusion

We know that higher education is a major area of knowledge so that students are familiar with the thinking of the fact within the type of education. Higher education is all areas of knowledge and skills about human life. It is also non-professional, non-utilitarian in nature and not directly for the professional preparation of educational knowledge and ability. However, employers need students to work once they graduate from university. Companies want students to be qualified for the network performance test without training. Thus practical talents meet needs of the community. To adapt for this situation, it is necessary and urgent for universities to conduct a curriculum reform and teaching method reform.

#### 5. Acknowledgment

The authors are grateful to the support of the Social Science Foundation of Jilin Province under Grant No.2007234, the Social Science Programming Foundation of Jilin Province under Grant No. 2007306, the Science Technology Research Foundation of Jilin Province under Grant No. 2007222, 2007247 and 2007251, the Doctoral Funds of Changchun Taxation College under Grant No.2007001, and the Natural Science Funds of Changchun University of Technology under Grant No.2007127, the Education Science Programming Funds of Jilin Province under Grant No.GH08125, the Education Research and Reform Funds for Quality Engineering of Changchun University of Technology and the Education and Teaching Research Funds of Changchun Taxation College under Grant No. CSJB200803.

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