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Teaching Analysis and Reform of Network Management and Maintenance Course

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ABSTRACT

According to Specialty Norms for Network Engineering in Higher Educational Institutions (for Trial Implementation) and teaching practice, the main problems existing in teaching of network management and maintenance course for network engineering is analyzed. And then from three aspects of curriculum objectives, teaching contents and teaching organization to discuss the curriculum construction, and the design ideas and reform measures are carried out.

KEYWORDS : Network management and maintenance, course construction, teaching reform

INTRODUCTION

With the rapid growth of size and complexity of the current networks, importance and complexity of network management are rising. According to [1], undergraduate students of the network engineering should have at least one out of six kinds of capabilities: analysis, design and implementation capabilities for network protocols, research and development capabilities for network equipment, design and development capabilities for network application systems, planning, design and implementation capabilities for network engineering, management and maintenance capabilities for network systems, network security capabilities. To achieve these goals, students should have knowledge of 12 areas, and among them network management is an essential knowledge.

Since foundation of network engineering major in our college, Network Management and Maintenance has been set as one of main courses, and currently the course has been constructed to university-level quality course. The course teaches network management models, management protocol, five major functions of network management and management systems. Contents involved have characters of with urgent social needs, covering a wide range of knowledge, involving many new elements and updating faster, etc., are very comprehensive and practical. The course has no mature teaching materials and curriculum system both in China and abroad, teaching exploratory is strong. To construct and reform the curriculum has a key role to drive the construction of network engineering major and implement professional training objectives of network engineering.

COURSE OBJECTIVES

Through more than seven years development, network engineering major in our university set its goal to cultivate the senior specialized talents who are with a certain project management capacity and good overall quality, can afford to works of design, development, deployment, operation, maintenance of computer network systems, network application software development and embedded systems development. Typical jobs include network hardware engineers, network software engineers, network administrators, network system integration engineers and so on.

According to the university orientation, professional training objectives and its position in major cultivation, we establish the training objectives of the course to: to understand the existing network management standards, understand the principle and implementation of common network management protocol, to understand the techniques and tools used for network management, understand the latest developments in network management, have a preliminary understanding of NMS development technology, and improve the ability to manage the network from a theoretical and practical aspects.

TEACHING CONTENTS

- **Teaching contents selection**

To achieve the goals of [1], defines contents architecture of the course. The main contents include concepts and architecture of network management, the five major management functions (configuration management, fault management, performance management, security management and billing management), Management Information Base (MIB), Simple Network Management Protocol (SNMP), Remote Network Monitoring (RMON), as shown in Tab. 1.

In these teaching contents, OSI network management system and TCP/IP network management system are the mainstream, and both have achieved five major management functions. The four parts contained in the architecture, namely management object, management process, MIB and management protocol are the core of the course [2]. The managed objects are described by MIB, using Structure of Management Information (SMI) to define the structure of management information. Objects in MIB are accessed via SNMP package. The most important network management protocol is SNMP, firstly should let the students know clear position of SNMP in the architecture. Secondly, need a detailed description of SNMP protocol data unit format, command package, sending and receiving messages. Finally, due to the evolution of SNMP protocol, there are three different SNMP versions, SNMPv1, SNMPv2 and SNMPv3. The changes and evolutions of SNMP are also best practices of protocol improvements. Ultimate manifestation of network management is a generic network management system. Combined with practical link, makes students understand how the NMS manages the entire network through device configuration and monitoring.

TABLE – 1 GENERAL DETAILS TEACHING CONTENTS OF NETWORK MANAGEMENT AND MAINTENANCE

Subjects	Teaching contents
Network Management Model	OSI Network Management Model TCP/IP Network Management Model 5 major network management functions Development of network management model
MIB	Information structure of Management Object Functional group of MIB-2 Abstract syntax description of managed objects
SNMP	SNMP architecture SNMP message format SNMP protocol operations SNMP security mechanisms SNMPv1, SNMPv2, SNMPv3
RMON	LAN Management The basic concept of RMON RMON MIB
Network management platform	Design of network management platform Typical NMS
Network Testing	Network Testing Methods Network Testing Equipment

- **Teaching material selection**

According to the teaching contents, we use Network Management (third edition) [3] as the main textbook. The textbook covers the basic network management framework and a lot of network management technologies, its main advantage is to introduce other mainstream network management frameworks such as CMIP, TMN, etc. in addition to SNMP, this is important for the expansion of students' knowledge in the areas. However, the material tends to theory, the SNMP protocol description is not detailed enough, and there is no typical network management platform related content. Therefore, we chose Computer Network Management [4] as supplementary teaching material. The material is used widely in the domestic network management teaching. Taking SNMP protocol as the main line, it gives a detailed discussion of the architecture, management domain, protocol specification and MIB of the network management system. And it describes the

management operations under different operating systems, as well as the typical network management applications. Currently, according to the needs of teaching, curriculum group is preparing our own network management curriculum materials.

TEACHING ORGANIZATION

Around the teaching targets of Network Management and Maintenance, we have launched goal-oriented teaching practices. In teaching link, selects a variety of teaching methods based on teaching contents; in practice link, arranges experiments carefully, and controls the practice strictly; in assessment link, adopts a way of comprehensive evaluation to give a reasonable evaluation of teaching results.

- **Theoretical teaching**

Classroom teaching and expository method are the major theoretical teaching methods, supplemented multimedia teaching methods to make teaching lively. In the classroom teaching, a variety of teaching methods and means are designed and used.

Case-based teaching

Many of concepts in the course are relatively abstract, but will be easy to understand if linked to specific examples. For example, when explaining managed objects in MIB, with specific equipment, such as router and its ports which students know well, it is easy to explain what are the managed devices and the managed objects. Again, to adapt to theoretical knowledge explain of SNMP, analysis and shows source code of SNMP4J - an open-source Java package in the classroom can not only deepen students' understanding of abstract knowledge of SNMP, but also enable students to understand development processes and development methodology of the network management software.

Research Teaching

It's important to cultivate self-awareness of students to explore in teaching. In teaching process, teachers should present knowledge of related fields timely to prompt students to access information in related fields and to deepen understanding of knowledge. Teachers should select actual questions based on the subjects, so that students can feel there is a problem, and learn to use the knowledge learned to analyze, think, expand exploration, provide hypotheses, test the hypothesis, and then draw conclusions. For example, teachers may ask the questions such as "How to manage campus network of our university", "How to control flow of each node in the campus network" and so on, and require students to combine actual campus network to expand analysis and research and write the theme report.

Network-assisted teaching

Network-assisted instruction can take many forms, such as using modern means of communication such as QQ to help tutoring for students, job explaining and troubleshooting; Letting students aboard on the website for quality courses and use a variety of teaching resources such as electronic lesson plans, curriculum support materials, instructional videos, online interaction and so on.

In short, the most effective learning is the cycle repeated process that to generate curiosity, and then explore, then ask questions, then be answered, and ask questions again, and then be answered again.

- **Practice teaching**

In practice link, we carried out a series of experiments, including validation experiments, operating configuration experiments and design experiments. The main purpose of validation experiments is to verify the functional format and using methods of the basic principles and processes, the basic methods, the basic tools involved in the course through experiments. Operating configuration experiments conducted on installation, configuration and operation of a single device or system, so that students will organically combine the principles of network management learned and network systems and devices, lay a good foundation for the subsequent comprehensive design experiments. Design experiments enable students to further understand how C/S network computing model works and principles and design methods of network application systems. By design experiments, students should understand development ideas of the larger network application and master basic methods of network management application development. There are 12 hours of experiments, and nine experiments can be chosen from Tab. 2.

TABLE – 2 EXPERIMENTAL DESIGN

Experimental contents	Hours
Network Management Model	2
Using basic network testing tools	1
Accessing to SNMP MIB	1
SNMP network management configuration	2
Verification and analysis of SNMP protocol	2
RMON principle and configuration	2
Using Network Monitor and Performance Monitor	2
Monitoring network with SolarWinds	2
Managing network with H3C intelligent management center	4
Developing network management applications based on SNMP++	2
Using basic network testing tools	1

- **Teaching evaluation**

Teaching evaluation is carried out on a variety of factors for educated person. According to the diversified curriculum goals we set, we use a variety of ways to assess student achievement and establish a scientific evaluation system. The final total score is constituted by score for middle and final exams, score for experimental evaluation and score for usual schoolwork result. In middle and final exams, in addition to knowledge must be mastered, the focus of the experiment contents is added, so that there is a certain percentage of checking the degree of master of practical applications, and to further test the students' comprehensive theoretical knowledge and practical skills. Usual schoolwork result has the composition of the assessment of attendance, classwork and homework. This helps achieve the goal of training applied technical personnel.

CONCLUSIONS

Network Management and Maintenance course has been opened for 5 years in our university, has been built into university-level quality course. Its teaching team has a certain amount of teaching experience. But as one of backbone professional course for network engineering, Network Management and Maintenance is a course which has strong theoretical and practical, its course objectives, teaching contents, teaching organization and evaluation methods should be explored continually to stimulate students' motivation to learn, and finally improve teaching effect.

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