Chapter 6
Virtualized Open Source Networking Lab

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ABSTRACT

This chapter considers a virtualized open source networking lab to support Web based IT education. It discusses the difficulties in teaching networking related IT courses online. The discussion leads to the solution of virtualized open source technology. The chapter also examines some strategies in developing an open source virtual networking lab for hands-on practice in networking related IT courses. It then presents a case study on the use of an open source virtual networking lab in e-learning.

INTRODUCTION

Meeting the hands-on requirements from networking related IT courses is challenging since a networking course in the IT curriculum has its own special needs. This kind of course has to reconfigure the operating system; therefore, it is difficult to share the computer lab used by a networking course with other courses. It is also difficult to set up a networking lab online or in a cloud computing environment because the reconfiguration of the network may cause the remote access to fail. Moreover, there are some serious security concerns about sharing the same network on campus since the students in a networking course are given the administrator's privilege. In addition, the fast development of new technologies requires computer labs to be updated frequently.

Networking labs are necessary for learning networking theories and concepts. Network system development and management is a subject that highly depends on hands-on skills. When creating a computing curriculum, it is strongly recommended by IEEE/ACM IT (IEEE/ACM,

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2008) that the undergraduate networking courses should be backed by networking labs for hands-on practice. As described above, it requires great effort to construct networking labs. A networking lab needs its own space, network infrastructure, hardware and software. It requires extra protection and sophisticated technical support. The expense on developing and managing a networking lab is usually much higher than other types of computer labs. Due to the shortage of funding, manpower, and knowledge, developing and managing a networking lab is a burden to many higher education institutions, especially those small universities that have a limited budget. The use of open source software and the virtual technology gives some relief to the burden. The goal of this chapter is to demonstrate how to integrate the construction of an online networking lab with open source products and virtualization techniques.

This chapter starts by providing the background information about open source software in constructing networking labs. It will also give an overview about open source and free virtualization tools. Then, this chapter will discuss strategies in developing an open source virtualized networking lab. By following the strategies, a case study will illustrate the implementation of a networking lab with open source products. Through the case study, this chapter will describe the networking lab design, implementation, and evaluation. It will emphasize the use of open source products to meet the requirements of networking related IT courses.

BACKGROUND

Constructing networking labs often requires tremendous effort. It needs a careful design of a network's infrastructure to meet the requirements by networking related courses. It also requires experience and hands-on skills for troubleshooting. Similar to the development of many IT projects, designing network infrastructure includes the planning, designing, and implementing phases. For example, Kapadia (1999) describes the design for the network infrastructure at Purdue University where a demand-based network computing system was implemented for reducing duplication of effort. For developing network infrastructure for large universities, Penrod and Harbor (2000) provide a case study to illustrate how to plan and implement the network systems. The case study discusses the issues related to the planning and creation of an IT governance structure. Penrod and Harbor (2000) illustrate some organization structures that can overcome barriers while implementing an e-learning system.

The construction of a network system requires the knowledge about network devices and network protocols. The book by Teare and Paquet (2005) discusses network hardware devices such as routers, network interface cards, switches, and bridges. Teare and Paquet (2005) explain how these devices are used in an enterprise-level network design and implementation process. As described by Olifer and Olifer (2006), network protocols are used to control and manage the communication over a network. The network protocol plays an important role for network security, performance, and management. For network management, various tools have been developed for managing networks. Many of these tools are open source products included in the Linux operating system (Maxwell, 2000). In the area of network management for e-learning, issues related to management of networked education in higher education are discussed by Uys (2001).

For many education institutions, especially those in rural areas, developing and managing a networking lab can be a challenging task. Since a networking lab cannot be shared by other IT courses due to the reconfiguration of its network infrastructure, it costs a lot more to support a networking lab. As calculated by Gerdes and Tilley (2007), a physical networking lab can cost as much as $150,000. Also, a networking lab can cause serious security concerns because the students