Chapter 7

Carrying That Ten Thousand Dollar Lab in a Backsack: A Mobile Networking Laboratory with the Use of Open Source Applications

Dongqing Yuan
University of Wisconsin-Stout, USA

Jiling Zhong
Troy University, USA

ABSTRACT

In the past decade, with the development of wireless and other mobile technologies, including mobile computer, cellular phone, and GPS, educational practitioners have had the opportunity to develop a ubiquitous learning environment. This chapter provides a detailed account of developing a mobile network laboratory with a set of open source software (OSS) that allows students to conduct the labs either as an individual or as a group at anytime and anywhere.

INTRODUCTION

Computer networking is one of the most challenging subjects not only to students, but also to teachers. One of the most difficult issues teachers are facing is how to convey many of the theories when there are not so many labs right on the point text books can provide. On one hand, students may find the topic too technical and dry when presented; on the other, most IT instructors still primarily use lectures as the exclusive means to teach. As stated in IEEE/ACM IT Computing Curricula (IEEE/ACM, 2008), it is strongly recommended to incorporate hands-on lab components into teaching an undergraduate networking course as they help students apply the theory in solving real-world problems. As such, it will require significant investments on space, equipment and
software in setting up such a dedicated laboratory that will lend support for the course. Unfortunately, the limitations of budget, space and facility do not allow for permanent institutionalization of such a physical laboratory. At the same time, current educational philosophy suggests that hands-on labs may be an effective and yet more efficient way to achieve the same goal. In this case, a mobile open source network lab will be a valuable solution.

The mobile open source lab is composed by mobile hard drives and laptops with a suite of open source software that, in aggregate, provide students with a means to experiment what they have learned in the lecture and at the same time to allow them gain real world hands-on skills. In this chapter, we describe the requirements for developing and implementing such a mobile open source network lab. The design process, focusing particularly on the mobility, usability and affordability issues, is addressed. We also discuss the impact provided by the mobile open source lab, such as how the lab enhances practical experience, engage active learning, and promote collaboration among students.

The chapter starts with a review of the related work, followed by a description of the mobile open source network lab including objectives, lab components, design, and implementation of the lab. Particular attentions are paid towards the use of OSS applications on the mobile lab. Finally, the evaluation of the mobile open source network lab is presented, and future work is discussed.

BACKGROUND

IEEE/ACM IT Computing Curricula (IEEE/ACM, 2008) recommends the incorporation of hands-on lab components into the undergraduate networking course as they help students apply the theories to solving real-world problems. Honey and Mumford (1984), and Kolb (1985) claim that students have different learning patterns, and science and technology students have the ability to learn primarily through hands-on experience. Denning (2003) also indicates that, ignoring application, computer education will end up like the failed “new math” of the 1960s- all concepts, no practice, lifeless, and dead. Dewey (1985) argues that “the first stage of contact with any kind of education, from children through adults, must be hands-on and experiential. Learning is a process of discovery and enactment and of wrestling with problems first hand” (p. 160). Having laboratory components and well-designed lab materials are essential to the success of networking education (IEEE/ACM, 2008).

However, most computer networking courses do not have laboratory components coupled with a modular curriculum, which allow students to practice the real-world problem-solving skills expected in the IT career field (Casado & Mckeown, 2005; Goyal, Lai, Jain, & Durresi, 1998; Kneale, Horta, & Box, 2004). Two factors contribute to this problem. One is the fact that it requires significant cost, space and time to set up a networking laboratory in an academic environment (Hughes, 1989; Lawson & Stackpole, 2006). It would cost more than $150,000 to set up a networking laboratory for 20 students initially just for the hardware and software (Gerdes & Tilley, 2007). Most schools do not have the budget, space and facility to create and maintain a “hands-on” learning environment. Another is that it would take many hours for the instructors to design a lab exercise that meets the objectives (Helps, 2006). To aggravate the problem further, to stay abreast with the rapid change of technology, the instructors, in addition to their busy teaching schedule, need to design and re-design the curriculum to explore the new technology (Helps, 2006).

The relevance of the study is further evidenced by A Governor’s Guide to Creating a 21st-Century Workforce (National Governors Association, 2002). The guide states that the United States does not produce enough qualified graduates in science and technology to meet the specialized workforce demands. The skill gap is especially
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