

Enhancing Learning and Teaching Wireless LAN Design

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INTRODUCTION

Wireless communication and networking courses are becoming increasingly popular in universities, polytechnics, postsecondary colleges, and private training institutions around the globe. This is partly because of rapid developments in wireless communication-network technology and the high demand for wireless networking skills in the industry, both nationally and internationally. Unfortunately, it has often proven difficult to motivate students to learn about wireless local-area-network (WLAN) design because they find the subject dry and theoretical. A Web-based software tool (named WLAN-Designer) has been developed at the Auckland University of Technology (AUT) that gives students an interactive, hands-on learning experience in WLAN design. The WLAN-Designer is suitable for classroom use in introductory-level courses in wireless networking. The effectiveness of the WLAN-Designer has been evaluated both formally by students (student-evaluation forms) and informally through discussion within the teaching team. This chapter describes the WLAN-Designer and its effectiveness as an aid to learning and teaching about WLAN design. The conclusions drawn are based on survey data collected from students. The feedback from students indicates that the development and implementation of the WLAN-Designer were successful. The chapter concludes by discussing the strengths and weaknesses of the WLAN-Designer and its future development. The impact of the WLAN-Designer on students' performance is also discussed.

BACKGROUND AND MOTIVATION

WLANs are often included as a topic in computer science, information technology, engineering, and business courses as WLANs are a fundamental

component of computer networks today. It is believed that incorporating practical demonstrations into these courses, thereby illustrating theoretical concepts and providing opportunity for hands-on, flexible learning experiences, significantly enhances student learning about WLAN design. Yet very little material designed to supplement the teaching of WLAN design is publicly available, as a search of the Computer Science Teaching Center (Grissom, Knox, Fox, & Heller, 2005) and SIGCSE Education Links (Anonymous, 2005) sites reveal. Even less material is available for wireless networking courses and related topics.

We strongly believe, as do many others (Chandra, 2003; Engst & Glenn, 2003; Rappaport, 2002), that students learn more effectively from courses that provide for active involvement in hands-on learning activities. B. F. Skinner, a famous behavioral psychologist, also supports this idea (Skinner, 1964).

Traditionally, wireless networking is one of the most difficult subjects to learn and teach in a meaningful way because students find the subject dry and theoretical. Researchers at AUT have developed a Web-based tool called WLAN-Designer that gives students an interactive, hands-on experience in wireless LAN design. With WLAN-Designer, a teacher is able to use it in the classroom, as a demonstration, to enhance the traditional lecture environment at an introductory level, and students can use its tutorials on wireless networking to verify (interactively and visually) the results of in-class tasks and exercises on WLAN design. The WLAN-Designer reported here can be accessed at anytime either via an intranet or through the public Internet. In addition to enhancing face-to-face teaching by including an element of online learning in the classroom, the WLAN-Designer provides online support for off-campus students and enhances learning by providing a flexible mode for the delivery of papers.

Wireless networking concepts are described in many references (e.g., Bing, 2002; Ciampa, 2001; Doran, 2002; Palmer & Sinclair, 2003), and Web-based tools are discussed extensively in the literature (e.g., Kofke & Mihalick, 2002; Rokou, Rokos, & Rokou, 2003; Sitthiworachart & Joy, 2003). A number of open-source and commercial network simulators exist for building a variety of wireless LAN models (Chang, 1999; Sanchez & Manzoni, 2001; Zheng & Ni, 2003). However, these powerful tools can have a steep learning curve, and while excellent for doing in-depth performance evaluation of wireless LANs, they often simulate a wireless networking environment in far more detail than is necessary for a simple introduction of fundamental concepts. Network Simulator 2 (NS-2; Fall & Varadhan, 2003) is another powerful simulation software package suitable for performance analysis of wireless networks. However, it is of limited use as a learning and teaching tool because of its text-based interface that is not user friendly.

DESCRIPTION OF THE SYSTEM

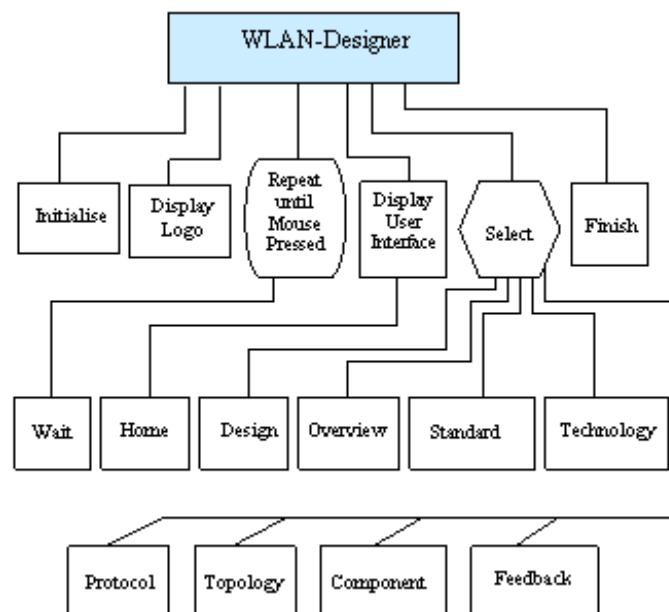
The system described here is easy to use and reliable, and can be used to enhance the learning and

teaching of various aspects of wireless LAN design. The diagram in Figure 1 outlines the structure of the system.

The WLAN-Designer reported here has the following main features:

- **Home:** The home page contains the project title, author's name, and links to various pages of the WLAN-Designer including design, standards, technology, protocols, topology, and feedback. The user can easily navigate the Web pages using the point-and-click graphical user interface (GUI; see Figure 2).
- **WLAN Information:** The Web pages listed below provide some general and technical information about wireless LANs.
 - **Overview:** This page provides an introduction to wireless LAN design.
 - **Network Standard:** This page highlights the most common wireless LAN standards such as IEEE 802.11b/a/g.
 - **Technology:** Wireless networking technologies, including frequency-hopping spread spectrum (FHSS), direct sequence spread spectrum (DSSS), and orthogonal frequency division multiplexing (OFDM), are discussed.

Figure 1. Diagram of the structure of the WLAN-Designer



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