Introduction

Computer simulation is a very important tool for the study and analysis of communication networks (Pawlikowski, Jeong, & Lee, 2002). Network simulators are tools that allow researchers in the telecommunications field to create virtual environments where they can design, configure, implement, and analyze different types of networks. Thus, research efforts can be focused on the study itself rather than in the implementation (i.e., in terms of time and cost) of the infrastructure for the test.

Currently, there are plenty of network simulators for communication networks (Kash, Ward, &
Simulation of Vertical Handoff Algorithms for Heterogeneous Wireless Networks

Andrusenko, 2009; Rahman, Pakštas, & Wang, 2009). However, most of them have been developed for very specific objectives (e.g., just to test a single network component or protocol). There are several simulation tools that can be extended by users to incorporate new models, protocols, network components, or features. On the other hand, there is another approach to simulate communication networks, which relies on the use of general purpose programming languages and/or programs for numerical computations.

The objective of this chapter is to present and compare, by means of two study cases, both approaches to simulate communication networks. We focus on simulation of Vertical Handoff Algorithms (VHAs) for heterogeneous wireless networks. The first case study considers the use of the network simulator NCTUns, while the second study uses the programming language and interactive environment MATLAB.

This chapter is organized as follows. In Section 2, we explain what is a vertical handoff algorithm. Section 3 gives the background and related work on VHA simulation. Section 4 presents a case study of vertical handoff simulation with NCTUns, while in Section 5 there is another case study, using MATLAB. Section 6 gives an analysis of these simulation tools. Finally, some conclusions are given in the last section.

VERTICAL HANDOFF ALGORITHMS (VHAS)

The envisioned environment of heterogeneous wireless networks is expected to integrate multiple communication networks over a common IP (Internet Protocol) platform, such as Wireless Local Area Networks (WLAN), Universal Mobile Telecommunications System (UMTS) networks, CDMA 2000 networks, Wireless Metropolitan Area Networks (WMAN), etc., allowing the best connectivity to applications anywhere at anytime. In this scenario, mobile users will switch between different wireless networks to satisfy their communication needs.

A vertical handoff is the process of changing connections among heterogeneous wireless networks (Nasser, Hasswa, & Hassanein, 2006; Kassar, Kervella, & Pujolle, 2008). It can be divided into three phases: network discovery, handoff decision, and handoff execution. In the first phase, the mobile terminal discovers its available neighboring networks. In the decision phase, the mobile terminal determines whether or not it has to redirect its current connection based on comparing the decision factors offered by the discovered networks, e.g., available bandwidth, latency, packet error rate, monetary cost, battery consumption, mobility speed, and network coverage. The last phase is responsible for establishing the connection according to the vertical handoff decision.

In the last few years, several VHAs have been proposed in the research literature, some of them consider the three phases while others restrict their attention to a specific phase. In the same way, different authors have chosen different simulation tools to study, evaluate, and compare their proposed VHAs. In the following section, we present a brief literature review of several simulation approaches that have been used to study VHAs for heterogeneous wireless networks.

SIMULATION OF VHAS AND SIMULATION APPROACHES

Usually, a computer network simulator presents wired and wireless networking and, in its basic software release, horizontal handoff (handoff between access points of the same technology) is suitable for wireless networks including WiMAX, GPRS, 802.11a, 802.11b in ad hoc and infrastructure mode. Some network simulators do not have the functionality of vertical handoff, but the user can manipulate the tool to include it.