Chapter 17
Modeling and Simulation of IEEE 802.11g using OMNeT++

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ABSTRACT

Due to the complex nature of computer and telecommunication networks, it is often difficult to predict the impact of different parameters on system performance especially when deploying wireless networks. Computer simulation has become a popular methodology for performance study of computer and telecommunication networks. This popularity results from the availability of various sophisticated and powerful simulation software packages, and also because of the flexibility in model construction and validation offered by simulation. While various network simulators exist for building a variety of network models, choosing a good network simulator is very important in modeling and performance analysis of wireless networks. A good simulator is one that is easy to use; more flexible in model development, modification and validation; and incorporates appropriate analysis of simulation output data, pseudo-random number generators, and statistical accuracy of the simulation results. OMNeT++ is becoming one of the most popular network simulators because it has all the features of a good simulator. This chapter aims to provide a tutorial on OMNeT++ focusing on modeling and performance study of the IEEE 802.11g wireless network.

INTRODUCTION

The use of discrete event simulation packages as an aid to modeling and performance evaluation of computer and telecommunication networks, including wireless networks has grown in recent years (Bianchi, 2000; Fantacci, Pecorella, & Habib, 2004; Tickoo & Sikdar, 2003). This popularity is due to the availability of sophisticated simulation packages and low-cost powerful personal computers (PCs), but also because of the flexibility in rapid model construction and validation offered by simulation. A detailed discussion of simulation methodology, in general, can be found in (Carson II, 2004; Law

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& Kelton, 2000). More specifically, Pawlikowski (1990) in a comprehensive survey of problems and solutions suited for steady-state simulation mentioned the relevance of simulation techniques for modeling telecommunication networks. While various network simulators (both open source and commercial) exist for building a variety of network models, selecting an appropriate network simulation package for a particular application is not an easy task. For selecting an appropriate network simulator, it is important to have knowledge of the simulator tools available along with their strengths and weaknesses. It is also important to ensure that the results generated by the simulators are valid and credible. Sarkar and Halim (2008) classified and compared various network simulators to aid researchers and developers in selecting the most appropriate simulation tool.

We have looked at a number of widely used network simulators, including ns-2 (*Network simulator 2*, 2008) and OPNET Modeler (*OPNET Technologies*). Ns-2 is a popular network simulator among the network research community which is available for download at no costs. However, ns-2 is difficult to use and has a steep learning curve. A tutorial contributed by Marc Greis (www.isi.edu/nsnam/ns/tutorial/index.html) and the continuing evolution of the ns documentation have improved the situation, but ns-2's split-programming model remains a barrier to many developers. OPNET is a commercial package which has a comprehensive model library, user-friendly graphical user interface (GUI), and customizable presentation of simulation results. However, OPNET is a very expensive package even though the package is offered under University academic programs. However, OPNET IT Guru is available at no costs for educational use but it has very limited functionality. The motivation of using OMNeT++ (*OMNeT++*, 2008) as a network simulator in our study is that it offers the combined advantages of ns-2 and OPNET.

The remainder of this chapter is organized as follows. A review of literature including strengths and weaknesses of OMNeT++ is presented first. We then outline the system requirements and installation procedure. A brief overview of the INET Framework (a framework for OMNeT++ containing models for several Internet protocols) is presented next. A tutorial on OMNeT++ focusing on developing, configuring and running simulation models is presented. The network performance and test results are presented followed by brief conclusions.

STRENGTHS AND WEAKNESSES OF OMNET++

The strengths and weaknesses of OMNeT++ are highlighted below.

Strengths: The main strengths of OMNeT++ are the GUI, object inspectors for zooming into component level and to display the state of each component during simulation, the modular architecture, as well as a configurable and detailed implementation of modules and protocols. OMNeT ++ is an open source software package allowing users to change the source code to suit their needs. It supports a variety of operating systems (OSs) such as Linux and MS Windows. Another advantage of OMNeT++ is that it can be integrated with other programs. For example, it is possible to embed OMNeT++ in an application which creates a network model, simulates it and produces results automatically. OMNeT++ builds on small modules that can be reused and combined to more complex modules. Thus a hierarchy could be generated and different levels of abstraction can be realized. Object inspection is a useful feature offered by OMNeT++. For example, the current state of each module, parameters, and statistics can be viewed at any time during simulation experiments. This feature allows us to observe the data flow and node communications. OMNeT++ can store simulation results in a file that can be analyzed later using various tools supported by OMNeT++.