Chapter 24

Wire and Wireless Local Area Networks Simulation: OPNET Tutorial

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ABSTRACT

There has been a tremendous increase in the use of wire/wireless Local Area Networks (LAN) with different network configurations. Therefore, it is vital to have an accurate and a reliable generic platform to enable network developers, managers, security managers, researchers, and students evaluating and investigating the performance of LANs of different technologies and configurations. Many network simulators have been developed throughout the years, such as: the Optimized Network Engineering Tool (OPNET), the Network Simulator (NS), the Global Mobile Simulator (GloMoSim), etc. One of the most widely-used and powerful general-purpose network simulators is OPNET, which is an object-oriented simulation environment. This chapter provides two walk through tutorials on using OPNET IT Guru (Academic Edition of OPNET) for wire/wireless LANs simulations. These tutorials demonstrate in step-by-step fashion, the procedures of initiating new simulation, setting up the simulation parameters, running the simulation, and viewing the results. The first tutorial (Tutorial #1) simulates a wired LAN of 10 computers and one server connected to a single switch, and the second tutorial (Tutorial #2) simulates a wireless ad hoc network of 10 mobile nodes and one server. This chapter demonstrates that OPNET IT Guru is a powerful tool that can be used by a range of professional users to simulate, evaluate, and investigate the performance of wire and wireless LANs. Moreover, it encourages and helps students to easily perform network simulation for better understanding of the network performance under different network conditions.

DOI: 10.4018/978-1-4666-0191-8.ch024
INTRODUCTION

There has been an impressive advancement in computer networks’ and Internet architecture, technologies, and protocols. Furthermore, it can be easily noticed that there has been an exponential growth in the use of Local Area Networks (LANs) that utilizes different communication technologies (wire and wireless), and also different network configurations. One enabling technology for such advancement and growth is the tremendous development in computer simulation methodologies and tools. Simulation tools enable and encourage network researchers and developers to easily and cost-effectively simulate, evaluate, and investigate the performance of LANs of different technologies and configurations to look for the most efficient, reliable, and cost-effective design.

Network developers use simulation and performance evaluation as an integral component of the development effort. The developers rely on the simulation model to provide guidance in choosing among alternative design choices, to detect bottlenecks in network performance, or to support cost-effective analyses. As part of this process, the developers may use the simulation output to modify the network abstraction, model, and implementation as opposed to the system itself, in order to include detail that may have not been considered in the previous abstraction, or to modify the network model or the implementation, for example to collect additional or alternative types of data (Sinclair, 2004; Law & Kelton, 2000).

The application of computer simulation can potentially improve the quality and effectiveness of the network model. In general, modeling and simulation can be considered as a decision support tool in deciding the optimum technology, design, and configuration of computer network. It provides us with a more economical and safer option in order to learn from potential mistakes - that is to say, it can reduce cost, risk, and improve the understanding of the real life networks that are being investigated. It also can be used to investigate and analyze the performance of the network model under extreme working environment.

Network simulation translates some aspects of the physical world into a mathematical model (description) followed by regenerating that model on a computer – which can be used instead of performing an actual physical task. For instance, simulations are widely used to evaluate the performance of routing protocols in wireless ad hoc networks characterized by presence of noise and high node mobility (Al-Bahadili & Kaabneh, 2010), measure packet delay in data networks (Fusk, et al., 2003), simulate TCP/IP applications (Ahmed & Shahriari, 2001). In addition, computer modeling and simulation can be used as a computer network learning tool (Asgarkhani, 2002).

It is generally unfeasible to implement computer networks algorithms before valid tests are being performed to evaluate their performance. It is clear that testing such implementations with real hardware is quite hard, in terms of the manpower, time, and resources required to validate the algorithm, and measure its characteristics in desired realistic environments. External conditions also can affect the measured performance characteristics. The preferred alternative is to model these algorithms in a detailed simulator and then perform various scenarios to measure their performance for various patterns of realistic computer networks environments (e.g., connection media, node densities, node mobility, radio transmission range, transmission environment, size of traffic, etc.).

Many network simulators have been developed throughout the years, such as: the Optimized Network Engineering Tool (OPNET) (OPNET Technologies, 2008), the Network Simulator (NS) (Fall & Varadhan, 2008), the global mobile simulator (GloMoSim) (GloMoSim, 2010; Nuevo, 2004), etc. One of the most widely–used and powerful general-purpose network simulators is OPNET, which is an object-oriented simulation environment. This chapter is concerned with OPNET, in