Chapter 19
On the Use of Discrete-Event Simulation in Computer Networks Analysis and Design

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ABSTRACT
This chapter presents a description of a newly developed research-level computer network simulator, which can be used to evaluate the performance of a number of flooding algorithms in ideal and realistic mobile ad hoc network (MANET) environments. It is referred to as MANSim. The simulator is written in C++ programming language and it consists of four main modules: network, mobility, computational, and algorithm modules. This chapter describes the philosophy behind the simulator and explains its internal structure. The new simulator can be characterized as: a process-oriented discrete-event simulator using terminating simulation approach and stochastic input-traffic pattern. In order to demonstrate the effectiveness and flexibility of MANSim, it was used to study the performance of five flooding algorithms, these as: pure flooding, probabilistic flooding, LAR-1, LAR-1P, and OMPR. The simulator demonstrates an excellent accuracy, reliability, and flexibility to be used as a cost-effective tool in analyzing and designing wireless computer networks in comparison with analytical modeling and experimental tests. It can be learned quickly and it is sufficiently powerful, comprehensive, and extensible to allow investigation of a considerable range of problems of complicated geometrical configuration, mobility patterns, probability density functions, and flooding algorithms.

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system itself. The simulation output may also be used include detail that may have not been considered in the previous abstraction, model, or the implementation, for example to collect additional or alternative types of data (Sinclair 2004, Law & Kelton 2000).

Another important use of simulation is as a tool to help validate an analytical approach to performance evaluation. In an analytical approach, the system model is implemented as a set of equations. The solution to these equations captures in some way the behavior of the model and thus optimistically of the system itself. Analytical modeling often requires simplifying assumptions that make the results suspect until they have been confirmed by other techniques, such as simulation. Figure 2 illustrates the role of simulation in validating results from an analytical model. The system models A and B in Figure 2 may actually be identical, or they may be quite different (Nutaro 2007, Chung 2004).

Computer simulation is widely-used in investigating the performance of existing and proposed systems in many areas of science, engineering, operations research, and management science, especially in applications characterized by complicated geometries and interaction probabilities, and for dealing with system design in the presence of uncertainty (Banks et. al. 2005). This is particularly true in the case of computer systems and computer networks (Forouzan 2007, Stallings 2005, Tanenbaum 2003). In order to study a system using simulation, first some features from the system are abstracted, which believe

Figure 1. The role of simulation in validating a design model

Figure 2. The role of simulation in validating an analytical model