Chapter 7
Simulation of Multihop Wireless Networks in OMNeT++

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ABSTRACT
In this chapter, the authors present a brief description of the OMNeT++ network simulator with the main emphasis on the InetManet framework. This framework is especially oriented to the simulation of MANET and wireless mesh networks. It offers all the basic models and tools necessary to begin the simulation of this type of network. Since the source code is offered, the researcher can modify and include their models and they can simulate their own protocols. The InetManet is specifically oriented to the simulation of MANET over IPv4 networks. The flexibility of the code and the oriented based model of OMNeT++ (and its frameworks) allow reusing the wireless model with other types of networks.

INTRODUCTION
The inclusion of accurate models (propagation, mobility, traffic, etc) has enabled that simulation results are similar to those expected in a real scenario. Due to this similarity, simulation tools have become a helpful mechanism to evaluate new communication protocols. Moreover this evaluation is achieved at a reduced cost since the acquisition of expensive equipment for the testing is avoided. As this software allows testing conditions to be maintained constant, simulation tools are a fundamental instrument in the research field of telematics where different solutions are evaluated.

Today, several simulator tools (open source and proprietary) are available. Especially in the European Universities, the simulation tool OMNeT++ (Varga, 2010a) has experienced an increasing popularity in the networking area. This Chapter intends to provide a comprehensive overview on how this simulation tool should be used to study
multihop wireless networks. In order to accomplish this task, some theoretical concepts related to wireless systems are also explained. With this explanation, we aim at easing the selection of models when the simulation tool is used.

This Chapter starts by describing the main characteristic of the OMNeT++ simulator. Then the analysis of the main frameworks that support the simulation of multihop wireless networks is presented. A more detailed description of the frameworks is presented in Section 4. Section 5 describes the steps to be done in a typical simulation of a multihop wireless network. Finally, some main conclusions are draws and presented in the conclusions section.

THE OMNET++ SIMULATION TOOL

OMNeT++ (Varga, 2010a) provides a discrete-event simulation framework. Thus, the operation of a network is modeled as the chronological sequence of events. In this sense, only one type of event is considered in this simulator: the message event. For instance, a timer is implemented as a message that a module sends to itself when the timer expires. The use of just one type of message improves the simulator efficiency.

Concerning its architecture, OMNeT++ differentiates the libraries related to simulation (the core libraries) to the libraries containing the models. Models are coded in C++ so they can be easily extended. It is just necessary to know which model we should work with. Section 4 describes some of the most important models already included in OMNeT++.

A basic functionality in OMNeT++ is the use of the NED (Network Description) language (Varga, 2010a). This language possesses a syntax very similar to Java. Its main goal consists of joining several modules (which are coded in C++) so the functionality that they offer can be extended. In order to illustrate how NED works, here we present a simple example on the definition of a wireless network.

We can see in the code two areas: one concerning the specification of the parameters and another one related to the modules that are going to support the complex model. In particular, this scenario is composed of fixed hosts and mobile hosts. There is a channel in the medium and the configurator module is included in order to cope with the address configuration of the nodes. All these modules need to be configured. This is done in the configuration file omnetpp.ini.

The Integrated Development Environment allows the representation of the scenario defined in NED. For instance, the scenario specified in Figure 1 is shown in Figure 2 when the number of mobile hosts and the number of fixed hosts are set to 10 to 1 respectively.

EXTENDING OMNET ++
FUNCTIONALITY: OMNET ++
FRAMEWORKS

Models which may be applied in similar domains are grouped into frameworks in OMNeT++. The already implemented frameworks in conjunction with the core library enable the simulation of complex systems. The most important frameworks concerning the simulation of multihop wireless networks are:

• INET (Varga, 2010b). It is oriented to modeling TCP/UDP/IP networks. Concerning IP implementation, it provides the model to simulate IPv4 and IPv6. 802.11-based technologies, Ethernet and PPP are also incorporated into this framework. One fork of this framework is InetManet which is intended to the modeling of multihop ad hoc networks. In this sense, InetManet provides models for multihop routing protocols, new wireless propagation models, mobility models and even obstacle models.