Chapter XIV
Simulation of VANET Applications

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ABSTRACT

This chapter systematically presents actual issues regarding the simulation of VANET applications. Some of them refer to challenges in developing VANET simulators. The chapter discusses simulator architectures, models used for representing the communication among vehicles, vehicles mobility features, and simulation tool implementation methods. A critical analysis of the solutions adopted in some well-known actual simulators is also included. Other issues relate to the use of simulation in the evaluation of applications that aim at improving the traffic safety and control. Representative city and highway application scenarios are discussed, and results that can be obtained by simulation, along with ways these results can be exploited by VANET developers and users are highlighted. Future trends in the development of simulators that produce more accurate results and their use for the evaluation of more sophisticated traffic control solutions are also included.
INTRODUCTION

Vehicle-to-vehicle communication is a very actual and challenging topic. Vehicles equipped with devices capable of short-range wireless connectivity can form a particular mobile ad-hoc network, VANET—Vehicular Ad-hoc NETwork. The existence of such networks opens the way for a wide range of applications. Two of the most important classes of such applications are those related to route planning and traffic safety. Route planning aims to provide drivers with real-time traffic information, which, in the absence of a VANET, would require an expensive infrastructure. By contrast, the VANET approach is scalable and has low maintenance costs. Moreover, short-range wireless communication technologies (such as 802.11) have no associated cost, other than the communication devices. Safety applications involve disseminating urgent information, which is not present in the driver’s field of view, or it is difficult to notice for reasons such as fog or other vehicles obstructing the line of sight. For instance, a lot of accidents occur in foggy conditions because drivers notice too late that some kind of incident has occurred in front of them. Safety at intersections could also be enhanced, since the risk of collisions could be detected in advance and the driver could be warned seconds before what would otherwise be an imminent accident.

The evaluation of VANET protocols and applications could be made through real outdoor experiments, which are time-costly and claim for a large number of resources in order to obtain significant results. Instead, simulation is a much cheaper and easier to use method. Obviously, this leads network and application developers to use simulation in order to evaluate different simple or complicated and innovative solutions before implementing them. In turn, this stimulated the interest for the development of simulators that easily integrate the models and respond to the requirements of VANET applications. Simulators have become indispensable tools at least in the initial phases of the VANET application engineering process.

This chapter aims to present the features and trends in VANET applications simulation, to explain the sources of its complexity and to describe actual solutions. The main challenges are presented in the next section, which introduces the three models involved in VANET simulations: the network and traffic models are determined by the currently used technology; the third model corresponds to the application itself. Then, general features of VANET simulators are presented. We describe an architecture that integrates the first two models and allows an easy interfacing with the third model. Details about the network / communication model are also given, and several components of the traffic / mobility model are then discussed. Current challenges in developing VANET simulators, and the description of solutions adopted so far are subjects of a separate section, in which issues regarding the performance of different simulation tools are presented. Another section is dedicated to application scenarios, the results that can be obtained by simulation, and the ways these results can be exploited by VANET developers and users to improve the car-to-car communication and the traffic control. The chapter ends with conclusions and future trends.

BACKGROUND

Simulating a VANET involves two different aspects. First, there are issues related to the communication among vehicles. Network simulators, like The Network Simulator—ns-2 (2008) and Jist/SWANS (2008) cope with communication issues and focus on network protocol characteristics.

The second very important aspect is related to the mobility of the VANET nodes. Traffic simulators take into account the traffic model, not necessarily in conjunction with VANETs. For example, TRANS—Traffic Network Simulator
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