

# Rapid Generation of Realistic Mobility Models for VANET

Feliz Kristianto Karnadi\*      Zhi Hai Mo\*  
\*School of Computer Science and Engineering  
University of New South Wales  
Sydney, NSW 2052, Australia  
{fkka085,zhmo487}@cse.unsw.edu.au

Kun-chan Lan<sup>†</sup>  
<sup>†</sup>National ICT Australia Ltd  
Bay 15, Australian Technology Park  
Eveleigh NSW 1430, Australia  
Kun-chan.Lan@nicta.com.au

## I. INTRODUCTION

Vehicular Ad-Hoc Network (VANET) communication has recently become an increasingly popular research topic in the area of wireless networking as well as the automotive industries. The goal of VANET research is to develop a vehicular communication system to enable quick and cost-efficient distribution of data for the benefit of passengers' safety and comfort.

While it is crucial to test and evaluate protocol implementations in a real testbed environment, simulations are still commonly used as a first step in any protocol development for VANET research. Several communication networking simulation tools already exist to provide a platform to test and evaluate network protocols, such as ns-2 [1], OPNET [2] and Qualnet [3]. However, these tools are designed to provide generic simulation scenarios without being particularly tailored for applications in the transportation environment. On the other hand, in the transportation arena, simulations have also played an important role. A variety of simulation tools such as PARAMICS [4], CORSIM [5] and VISSIM [6] etc have been developed to analyze transportation scenarios at the micro- and macro-scale levels. However, there was little effort in integrating communication techniques and scenarios in a realistic transportation simulation environment.

One of the most important parameters in simulating ad-hoc networks is the node mobility. It is important to use a realistic mobility model so that results from the simulation correctly reflect the real-world performance of a VANET. In this work, we develop a tool MOVE (MOBility model generator for VEhicular networks) to facilitate users to rapidly generate realistic mobility models for VANET simulations. Our tool MOVE is built on top of an open source micro-traffic simulator SUMO [7]. The output of MOVE is a mobility trace file which contains the information of vehicle movement, which can be immediately used by simulation tools such as ns-2 or qualnet.

## II. ARCHITECTURE

MOVE consists of two main components: the Map Editor and the Vehicle Movement Editor, as shown in Figure 1. The Map Editor is used to create the road topology. Currently we have implemented three different ways to create the road map – the map can be manually created by users, generated automatically, or imported from existing real world maps

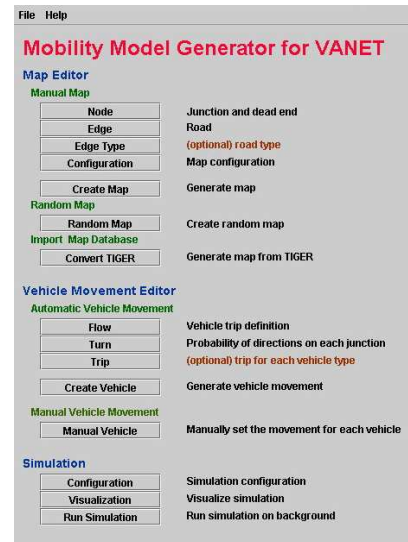


Fig. 1. Mobility Model Generator

such as publicly available TIGER (Topologically Integrated GEographic Encoding and Referencing) database from U.S. Census Bureau. The Vehicle Movement Editor allows user to specify the trips of vehicles and the route that each vehicle will take for one particular trip. The output of MOVE is a mobility trace, generated based on the information users input in the Map Editor and the Vehicle Movement Editor, which can be immediately used by a simulation tool such as ns-2 to simulate realistic vehicle movements. Users can also visualize the generated mobility trace by clicking on the “Visualization” button on the main menu, as shown in Figure 2.

### A. MAP Editor

In MOVE, the road map can be generated manually, automatically or imported from a real world map. Manual generation of the map requires inputs of two types of information, nodes and edges. A “node” is one particular point on the map which can be either a junction or the dead end of the roads. Furthermore, the junction nodes can be either normal road junctions or traffic lights. Figure 4 shows a snapshot of an editor for entering the node information. The edge is the road that connects two points (nodes) on a map. The attributes associated with an edge include speed limit, number of lanes,

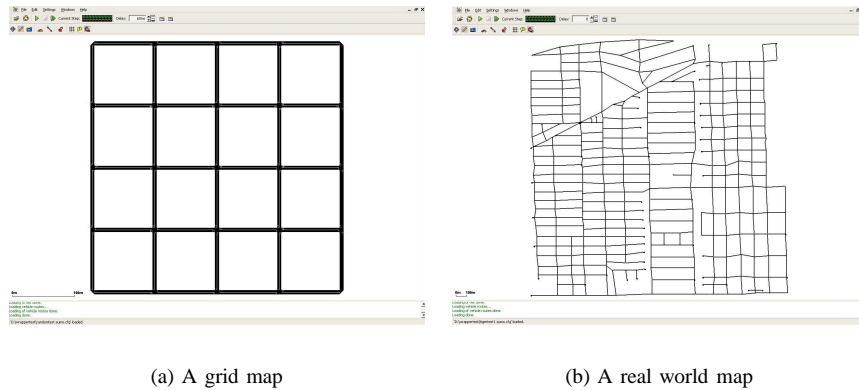


Fig. 3. Maps generated using the Map Editor

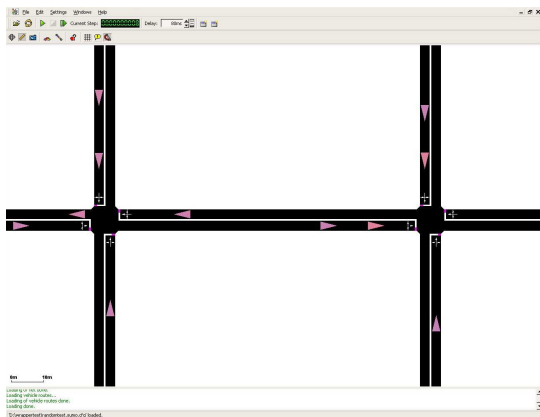


Fig. 2. Visualization of Vehicle movements

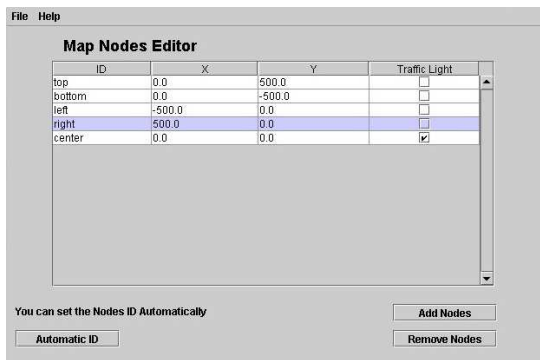


Fig. 4. Node Editor

the road priority and the road length. The map can also be generated automatically without any user input. Three types of random maps are currently available: grid, spider and random networks. There are some parameters associated with different types of random maps such as number of grids and the number of spider arms and circles. Finally, one can also generate a realistic map by importing real world maps from publicly available database. We currently support the TIGER maps which are available from U.S. Census Bureau. Figure 3 show

a grid map generated from the random map generator and a street map in the Houston area based on a TIGER database file.

### B. Vehicle Movement Editor

The movements of vehicles can be generated automatically or manually using the Vehicle Movement Editor. The Vehicle Movement Editor allows users to specify several properties of vehicle routes including number of vehicles in a particular route, vehicle departure time, origin and destination of the vehicle, duration of the trip, vehicle speed (acceleration, deceleration, maximum speed), etc. In addition, user can define the probability of turning to different directions at each junction (e.g. 0.5 to turn left, 0.3 to turn right and 0.2 to go straight) in the editor.

## III. CONCLUSION AND FUTURE WORK

In this paper, we describe our initial efforts in implementing a tool MOVE which is based on an open source micro-traffic simulator SUMO. MOVE allows user to quickly generate realistic mobility models for vehicular network simulations. In our current implementation, the movements of vehicles are based on static configurations defined in the Vehicle Movement Editor. In other words, the mobility model is first generated off-line and then used by a network simulator like ns-2. In the next version of our software, we plan to build an interface to tightly integrate SUMO and ns-2. Such an interface will allow that vehicle state information (such as location, speed, direction, etc) can be fed into ns-2 in real time. Hence, during the simulation the vehicles can dynamically adjust their routes based on different traffic scenarios and communication techniques employed.

## REFERENCES

- [1] The Network Simulator ns 2. <http://www.isi.edu/nsnam/ns/index.html>.
- [2] OPNET Simulator. <http://www.opnet.com/>.
- [3] QualNet Network Simulator. <http://www.scalable-networks.com/>.
- [4] Pamramics: Microscopic Traffic Simulation. <http://www.paramics-online.com/>.
- [5] CORSIM. <http://www.fhwa-tsis.com/>.
- [6] PTV simulation VISSIM. <http://www.english.ptv.de/>.
- [7] SUMO Simulation of Urban MObility. <http://sumo.sourceforge.net/>.