

Comparative Analysis of Network Simulator for Vehicular Ad-Hoc Networks (VANET) Communication

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ABSTRACT

Recently, Vehicular ad hoc network (VANET) can offer various services and benefits to VANET users and thus deserves deployment effort. Intelligent Transportation Systems (ITS) are aimed at addressing critical issues like passenger safety and traffic congestion when integrates ICT with transportation infrastructure. This infrastructure is called Vehicular Ad hoc Networks (VANET), Vehicular communication systems facilitate communication devices for exchange of information among vehicles and between vehicles and roadside equipment. Working in tandem with the fielded Intelligent Transportation Systems (ITS) infrastructure, VANET will enhance the awareness of traffic by aggregating, propagating and disseminating up-to-the minute information about existing or impending traffic-related events. In support of their mission, Here we consider that every study should chose the appropriate simulator based on its requirements.

Keywords

Simulation VANET, Mobility model, JiST/SWANS, iTetris, VanetMobiSim, SUMO, VEINS, TraNS, MOVE.

1. INTRODUCTION

Vehicular networks are very likely to be deployed in the coming years and thus become the most relevant form of mobile ad hoc networks. In recent years, the number of motorists has been increasing drastically due to rapid urbanization. The number of automobiles has been increased on the road in the past few years. Due to high density of vehicles, the potential threats and road accident is increasing. Wireless technology is aiming to equip technology in vehicles to reduce these factors by sending messages to each other.

Vehicular networks share a number of similarities with MANETs in terms of self-organization, self-management, and low bandwidth. However unlike in MANETs, the network topology in vehicular networks is highly dynamic due to fast movement of vehicles and the topology is often constrained by the road structure. Furthermore, vehicles are likely to encounter a lot of obstacles such as traffic lights, buildings, or trees, resulting in poor channel quality and connectivity. Therefore, protocols developed for traditional MANETs fail to provide reliable, high throughput, and low latency performance in VANETs. Thus, there is a pressing need for effective protocols that take the specific characteristics of vehicular networks into account. VANET simulation is a

challenging task, since it involves network simulation and traffic simulation . A number of network simulators are currently available, with ns-2 being the most prominent. However, ns-2 also brings performance issues regarding the nodes behavior as real vehicles. 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 (Katz, 1963) was used to optimize the timing of traffic lights in the absence of inter-vehicular communication. Choffnes and Bustamante (2005) showed that the vehicular mobility (traffic) model is very important, and its integration with the wireless network model could produce more significant results. The authors present an integrated simulator that uses an original vehicular traffic model called Street Random Waypoint (STRAW) implemented on top of JiST/SWANS (2008). The authors have used the simulator to show that studying routing protocols for a vehicular network without an accurate vehicular traffic model is a wrong approach. In this respect, they compared their own results with those obtained with the Random Way point model (Broch, 1998), which is a very inaccurate representation of a vehicular network. The mobility model implemented in some simulators is not a sufficiently accurate representation of actual vehicle mobility. For example, in the model of Saha and Johnson (2004), each vehicle moves completely independent of other vehicles, with a constant speed randomly chosen. Multi-lane roads or traffic control systems are not taken into consideration. Other authors (Mangharam et al., 2005) make similar simplifying assumptions and do not consider multi-lane roads or car following models. The mobility model of Choffnes and Bustamante (2005) is more complex: the motion of a vehicle is influenced by the preceding vehicle, and traffic control systems are considered.

2. Simulation Tool for Developing VANET

Construction of a simulation therefore seems inevitable for VANET. There are two aspects of simulating VANET: one is the traffic simulation and other is network simulation. The traffic simulation aids in creating traces of urban mobility model; this information is fed into the network simulation. The network simulation builds topologies between the nodes and vice versa. Several approaches can be distinguished among the simulation frameworks used for VANET research. The first one is to feed real vehicular traces to a network simulator [11]. This solution has the advantage that it only needs a very simple mobility model. No computation is involved and the network simulator only needs to read from a file the geographical position of the vehicle. However, there are also some important negative aspects about real traces. First of all, such data is very rare. While some highway operators regularly gather this type of information, there are very few dedicated campaigns at the level of a city or region. A second aspect is the fact that the movement of the vehicles is pre-established and it cannot be modified by information received through vehicular communications. This makes real traces unusable for a series of scenarios, like traffic management.

A number of simulations exist for VANET but none of them have been up to the mark and none of them can provide a complete solution set for simulating VANET. From the traffic simulator perspective, the traces generated once seem useless after a certain time as the dynamics of traffic change abruptly. Another problem that remains difficult to solve is the inter communication issue between the two simulators i.e. traffic and network simulator. Without a solid solution to this problem, the inter communication between the two still remains a matter of discussion.

3. Comparison of Simulators

There are various types of VANET simulator are categories in basically three different types.

3.1 NS2/NS3

NS began as a variant of the REAL network simulator in 1989 and has evolved substantially over the past few years. In 1995 ns development was supported by DARPA through the VINT project at LBL, Xerox PARC, UCB, and USC/ISI. Currently ns development is support through DARPA with SAMAN and through NSF with CONSER, both in collaboration with other researchers including ACIRI. It is packaged with a bundle of rich libraries for simulating wireless networks. All the mobile nodes in NS-2 quickly assume that they are the part of Ad-hoc network and the simulation mobile nodes connected with infrastructure networks are not really possible. For simulating a wireless node the physical layer, the link layer and MAC (media access control) protocol are all included at the same time. But despite this NS-2 is unable to simulate multiple radio interfaces. Moreover NS-2 has unrealistic models for wireless channel, which results in a biased radio propagation

The official ns-2 release contains two mobility models

that could be useful in VANET simulation: a freeway model and the Manhattan model, which is basically a grid model. However, in these models, the nodes move independently and the spatial superposition of two or more vehicles is possible

NS-2 has certain limitations when it comes to including more than one wireless interfaces per node and the field of vehicular communications is that its high complexity hardens the implementation of vehicular mobility models inside the framework. Moreover, its memory and CPU consumption do not allow scenarios with more than a few hundred nodes [8].

3.2 OMNET++

OMNeT++ is an open-source object-oriented modular discrete event network simulation framework. It has a generic architecture. It can be used to model computer networks or just as well for queueing network simulations. OMNeT++ only provides the necessary framework for developing a certain simulation module, but these models are developed independently of OMNeT++, and follow their own release cycles. This means that several frameworks can be modeled in the same research area. OMNeT++ itself is not a simulator of anything concrete, but rather provides infrastructure and tools for writing simulations. One of the fundamental ingredients of this infrastructure is a component architecture for simulation models. Models are assembled from reusable components termed modules. OMNeT++ simulations can be run under various user interfaces. Graphical, animating user interfaces are highly useful for demonstration and debugging purposes, and command-line user interfaces are best for batch execution.

3.3 QualNet

QualNet simulator was proposed for large, heterogeneous networks. This type of simulator supports wired and wireless network protocol and device models which are useful for simulating diverse types of networks, speed optimization and scalability on a processor. QualNet executes your simulation multiples faster as you add processors. QualNet has been used to simulate high-fidelity models of wireless networks with as many as 50,000 mobile nodes.

3.4 VanetMobiSim

VanetMobiSim is an extension of simulator CanuMobiSim. It provides efficient, easily extensible mobility architecture, but due to its general purpose nature, suffers from a reduced level of detail in specific scenarios. VanetMobiSim is therefore aimed at extending the vehicular mobility support of CanuMobiSim to a higher degree of realism. VanetMobiSim adds two original microscopic mobility models in order to include the management of intersections regulated by traffic signs and of roads with multiple lanes, but it is to note that the complete tool integrates all of the CanuMobiSim features, providing a very wide set of possibilities in simulating vehicular mobility. VanetMobiSim are necessary to reach a level of realism sufficient to confidently simulate VANETs mobility.

3.5 VERGILIUS

VERGILIUS is a macroscopic-level vehicle motion generator. The output of this framework is then fed to a microscopic traffic simulator (currently SUMO or CORSIM), automating the process of map extraction and mobility trace creation. The user only needs to provide the total input flow rate and VERGILIUS builds a set of paths on top of the road topology. VERGILIUS enables more general and more reliable simulation studies for VANETs. VERGILIUS provides two innovative tools: a finely tunable mobility Scenario Generator to systematically explore the design space of protocols for VANETs and a Trace Analyzer to analyze and characterize urban mobility traces.

3.6 MOVE

MOBility model generator for VEhicular networks (MOVE)]: This tool is build on top of SUMO and it produces trace files that can be directly used in several network simulators. It facilitates the utilization of SUMO by the means of a very user-friendly, but complete, interface. MOVE allows the creation of a user-generated map and it also proposes some pre-defined topologies (grid, spider, random networks). TIGER maps are also supported and the mobility pattern can be generated automatically or manually through a Vehicle Movement Editor. MOVE (MOBility model generator for VEhicular networks) to facilitate users to rapidly generate realistic mobility models for VANET simulations. MOVE is built on top of an open source micro-traffic simulator SUMO . The output of MOVE is a mobility trace files which contains the information of vehicle movement, which can be immediately used by simulation tools such as ns-2 or QualNet.

3.7 Vehicles in Network Simulation (VEINS)

Veins incorporate all the benefits from state-of-the-art simulation techniques of both the network simulation and the road traffic micro simulation domains. A vehicle in Network Simulation (Veins) couples SUMO and the INET framework from OMNeT++ through a TCP connection. In Veins, the network simulator is directly extended and it is therefore able to send commands to vehicles from the network simulator, influencing their speed or path. its advantages and the need for bi-directionally coupled simulation based on the evaluation of two protocols for incident warning over VANETs.

3.8 Intelligent Traveler Assistant (ITA)

Intelligent Traveler Assistant (ITA) is a simulation platform that couples VISSIM and SWANS and it is developed at the University of Illinois at Chicago. As in other similar approaches, an external coordinator applications maintains a single simulation time step between the two environments.

4. CONCLUSION

VANET simulation requires that a traffic and network simulator should be jointly used with a powerful feedback between them to render the simulation results as accurate as real life. We first presented features of important traffic and network simulators and also certain VANET simulators. Vehicular communications are a major component of a future intelligent transportation system. Designed mainly for safety-related reasons, a vehicular network can also be used by applications with a different profile, like traffic management

or passenger entertainment. The complexity of analytical models and the financial cost of tests with real hardware have imposed computer simulations as the leading solution for V2X communications research. Software based

simulations are designed to provide an alternative to obtain the required results. VANET hits the protocol's strength due to its highly dynamic features, thus in testing a protocol suitable for VANET implementation the use of realistic mobility model should be considered. This paper tries to facilitate the first stage of a study on vehicular communications by providing researchers with meaningful information concerning the multitude of existing VANET simulators.

5. REFERENCES

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