

Vehicular Network Simulators for VANET: Review

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ABSTRACT: Vehicular networking is an emerging area of interest in the wireless networking community as well as in the transportation research community. The potential of vehicular networks to provide vital services, from real-time traffic information to advance collision warning makes this an important area of study. The Vehicular Ad-Hoc Network, or VANET is technology that uses moves cars as nodes in a network to create a mobile network. Because VANET nodes are vehicles rather than hand held devices, there is little concern with energy consumption, storage capacity or computation power. In order to evaluate VANET, simulation is required as the expense of deployment is too high. This paper will give a review of different simulators used for VANET.

KEYWORDS: VANET, Ad-Hoc network, simulators

I. INTRODUCTION

Wireless and mobile networks have greatly transformed our lives over the past twenty years. From Bluetooth and wireless LANs to satellite networks, wireless networks have benefited people around the world. We are experiencing a very speedy evolution of Vehicular Adhoc Networks as a part of future Intelligent Transport System (ITS). Vehicular networking can comprise Vehicle to Vehicle (V2V) communication, vehicle to infrastructure (V2I) communication, or a combination of both. VANETs have much in common with the mobile adhoc networks (MANETs). Both are adhoc networks of mobile nodes that are capable of wireless communication. Because VANET nodes are vehicles rather than handheld devices, there is a little concern with energy consumption, storage capacity or computation power. Additionally, because vehicles move much faster than humans, VANETs have the added complication of a quickly changing topology. In order to evaluate VANET simulation is the one which is required so that any modifications can be made in simulation rather than in deployment as the expense would be too high.

The use of simulation in evaluating MANETs has been well documented, but little attention has been paid to simulation used in VANETs. VANET simulations require both a networking component and a mobility component. In most cases, these components are provided by two separate simulators. The trace of the vehicle is provided by the mobility simulator, it is then fed to the networking simulator. Recently there has been work on developing integrated simulators that contain both networking and vehicular mobility components.

Vehicular network simulators can be classified into two types: Loosely integrated and tightly integrated. Loosely integrated simulators use separate mobility simulators and network simulators. The mobility simulator generates mobility of vehicles and records the vehicular movements into a trace files. The network simulators import these trace files whereas in tightly integrated they do not use trace files instead the mobility simulator is embedded into network simulator and provides a single vehicular network simulator. In this paper, few of the loosely integrated and tightly integrated simulators are discussed.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

II. LOOSELY INTEGRATED

II.I. Mobility simulators

Vehicular mobility simulators are used to generate travel path of vehicles. The movement traces can be saved and imported to a network simulator to study how VANET applications might perform.

TSIS-CORSIM

TSIS is an integrated development environment that enables users to conduct traffic operations analysis. Built using a component architecture, TSIS is a toolbox that contains tools that allow the user to define and manage traffic analysis projects, define traffic networks and create inputs for traffic simulation analysis, execute traffic simulation models, and interpret the results of those models. CORSIM is a microscopic simulation model that is especially designed to simulate highways and surface streets and thus includes traffic signals and stop signs. It consists of two main components, NETSIM for simulating surface streets and FREESIM for simulating freeways.

VISSIM

VISSIM is a commercial microscopic traffic simulator developed by PTV America. VISSIM allows users to simulate a large array of traffic scenario and complex traffic situations. It allows different types of objects in simulation like cars, trucks, buses and pedestrian.

PARAMICS

PARAMICS can simulate intersections, highways, urban areas, work zones etc. It also includes a 3D visualization tool. Paramics simulates the individual components of traffic flow and congestion, and presents its output as a real-time visual display for traffic management and road network design.

SmartAHS

SmartAHS is an automated highway system simulator developed as part of the California PATH project. It is based on the specialized programming language shift. SmartAHS simulations are first coded using shift language, and then translated to C, which is compiled into a Unix executable. The highway topology is built using this simulator.

CanuMobiSim and VanetMobiSim

CanuMobiSim is a Java based simulator designed for mobility simulation. It implements several mobility models and can generate mobility traces suitable for use in various network simulators.

VanetMobiSim is an extension to CanuMobiSim that implements the Intersection Management and Lane Changes mobility models

SUMO

SUMO (Simulation of Urban Mobility) is an open-source mobility simulator written in C++. The input files in SUMO are output files from two other programs, netconverter and duarouter. The user would employ this series of programs to generate the input files for SUMO.

II.II. Network Simulators

Because vehicular networks involve solely wireless communications, all of the networking simulators described here support performing simulations with mobile wireless nodes. A mobility simulator is generally used to produce node movement traces that are then fed to the network simulator. The network simulator then controls the communication between the mobile nodes.

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Vol. 6, Issue 5, May 2017

OPNET

OPNET is a commercial network simulator mainly used for simulations of wired and wireless communications networks. It supports a wide range of wireless technologies such as MANETs, IEEE802.11, Wireless LANs, WiMAX, Bluetooth and satellite networks. OPNET provides graphical editor interface to build models for various network entities from physical layer modulator to application processes and includes graphical packages and libraries from presenting simulation scenarios and results.

QualNet

The QualNet communications simulation platform (QualNet) is a planning, testing and training tool that "mimics" the behavior of a real communications network. Simulation is a cost-effective method for developing, deploying and managing network-centric systems throughout their entire lifecycle. Users can evaluate the basic behavior of a network, and test combinations of network features that are likely to work.

NS-2

NS-2 is an open-source discrete event network simulator that supports both wired and wireless networks. The core of NS-2 is written in C++, but users interact with NS-2 by writing TCL scripts. It includes many MANET routing protocols and an implementation of the IEEE 802.11 MAC layer.

J-sim

J-Sim is an open-source simulation environment, developed entirely in Java. J-sim provides two mobility models: trajectory-based and random waypoint. J-sim is presented as an alternative to ns-2. J-sim can take a TACL file as input and produce an even trace file and an animation file.

OMNeT++

OMNeT++ is an open-source simulation environment. The primary simulation applications are Internet simulations, mobility and adhoc simulations. OMNeT++ has a component-based design, meaning that new features and protocols can be supported through modules. OMNeT++ supports network mobility and models through the independently developed mobility Framework and INET Framework modules.

SWANS

SWANS (Scalable Wireless Adhoc Network Simulator) was developed as an alternative to ns-2 for simulating wireless networks. SWANS was determined to be the most scalable and the most efficient in memory usage with the fastest runtime. Along with better performance, SWANS delivered similar results as ns-2, atleast for the network components that were implemented in both.

III. TIGHTLY INTEGRATED SIMULATORS

Tightly integrated simulators consists of two subsimulators (network and mobility) that can communicate with each other.

SWANS++

SWANS++ extends the network simulator SWANS by adding GUI to visualize the scenario and a mobility model, STRAW (Street Random Waypoint), for the vehicles movement in street scenarios. STRAW consist of three main components: intrasegment mobility, intersegment mobility and route management and execution. In intrasegment mobility, the vehicles move according to a car-following model and change their speed only in certain situations.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

For intersegment mobility, according to the system design, there is either a traffic control sign or a stop sign at each intersection that forces the vehicle to alter its speed.

GrooveNet

Groove Net an open source hybrid simulator which integrate mobility simulator and network. It has the capability to load a real street map form Tiger / Line database. Multiple broadcast messages are supported to mention the vehicle position for neighbour, vehicle emergency and warning message based on priority. Various modes such as driver mode, simulation mode, playback mode, hybrid simulation mode and test generation mode are supported. It allow multiple network interface, GPS and event triggered are ensured.

TraNS

TraNS (Traffic and Network Simulation environment) can be called the first VANET simulator. It was the first work to combine a network simulator, ns-2, with a vehicular mobility simulator, SUMO, as to provide feedback from the network simulator to mobility simulator. TraNS can operate in two modes: network-centric mode and application-centric mode. In the network –centric mode, there is no feedback provided from ns-2 to SUMO, so the vehicles mobility trace file can be pregenerated and fed to the network simulator later. In the application-centric mode, the feedback between ns-2 and SUMO is provided through an interface called TraCI.

IV. CONCLUSION

There is no standard simulator for evaluating Vehicular networking research. ,Most often researchers have combined existing mobility simulators with existing network simulators. More recently tightly integrated simulators have been developed that combine both mobility and networking components into a single application. More advanced simulators allow for two-way communication between the mobility and networking components to allow for feedback between the network and vehicle movement. New developments in simulators providing feedback between realistic mobility models and realistic networking models will help researchers to better evaluate their emerging systems

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