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A Systematic Comparison analysis on Simulators in Vehicular Adhoc Network

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Abstract: ***VANET applications made it impact globally in all the area of research. Vehicular Ad hoc Network (VANET) is a merging technology of Intelligent Transport System (ITS). Vehicular Adhoc Network can use the various approach to choose the simulator for their research from the available operational data. The protocol design in VANETs is prime and vital issue for the smart ITS. We need simulators to design the protocol in the VANET. In this paper, various types of simulators are discussed and compared by using the various approach for choosing the simulators. For VANET, mobility generators are very important .It is also discussed various generators in this paper. This paper gives clear idea about implementation in the VANET and concludes the simulators***

I. INTRODUCTION

This section discusses the number of available VANET simulators currently used by researchers. Many Researches are done in the field of big data technology due to rapid development in the form of difficultly and volume of data in last few years. The terminology of Big Data is becoming ubiquitous today. Gathering and Combining data from the diverse services by the communication systems will be more useful in VANET.

The taxonomy of VANET simulation software is illustrated in figure 1.1. The three dissimilar grade of VANET simulation software are mention below,

- ✓ Network simulators
- ✓ VANET simulators
- ✓ Vehicular mobility generators

For the purpose of extending the realism level among VANET simulations, Vehicular mobility generators are mandated. The input of Network simulator is created realistic Vehicular mobility trace file.

The mobility generators the data embody the road model and the scenario specifications like speed of the vehicle, arrival rate, departure time, etc. The trace output gives a detailed overview of every vehicle's location that is prompt for the entire time for simulation and their mobility pattern generator. For example, SUMO , STRAW, FreeSim , Netstream , CityMob , and VanetMobiSim . An elaborate packet-level simulation is performed by the Network simulators in terms of route, channels, source destination, channels and data traffic transmission. For example, GTNetS , GloMoSim , JiST/SWANS , NS-2 and SNS. Due to the reason, MANETs simulators are only available, VANET extensions are needed (such as using the vehicular quality generators) prior to the simulation of vehicular networks.

II. RESULT AND DISCUSSION

2.1 VANET MOBILITY GENERATORS

When it comes to VANET simulations, for the realism amount to be expanded, the Vehicular mobility generators are necessary. In this section, various vehicular traffic models are presented along with present mobility generators followed by comparison among it.

VanetMobiSim: A CANU mobility Simulation surroundings extension (CanuMobiSim), according to the previous study ,concentrates on vehicle mobility which makes sure the realistic automotive motion models are happening at each macroscopic and microscopic level. While at the macroscopic level, the maps are imported by VanetMobiSim from the US Bureau of the Census TIGER database (Topologically Integrated Geographic Encryption and Referencing) or generated in a random manner by Voronoi tessellation. Various geographic operations are represented in the TIGER/Line with regards to legal boundaries, roads, railroads, lakes and rivers thus by covering the entire information.

SUMO : An open source simulation package is extensively microscopic road traffic-based package and easily portable specifically designed for handling large road networks. SUMO's features include multi-lane streets with lane changing, totally different vehicle varieties, collision-free vehicle movement, single-vehicle routing, junction-based right-of-way rules, dynamic routing, hierarchy of junction varieties and an openGL graphical user interface (GUI). It has the potential and capability to manage more than 10,000 streets in addition to importing several network forms such as XML descriptions, Vissim , ArcView and Visum. Based on the features, a combination of both SUMO and openstreetmap.org is used for the simulation of traffic across the global locations. In spite of this, being only a traffic generator, its generated traces can't be directly utilized by the accessible network simulators which remains a disadvantage for this simulation package.

MOVE: The realistic mobility models are generated in a quick manner by MOVE for VANET simulations. MOVE is constructed primary on the basis of SUMO.

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MOVE provides output in the form of a mobility trace file which encompasses the realistic vehicle movements' data. This data might be used by fashionable network simulation tools such as NS-2 or GloMoSim. In addition, a GUI is provided

by MOVE which enables the user generate the realistic simulation scenarios in a quick manner without taking efforts to write simulation scripts additionally since the simulator's inner details are already fixed inside it.

STRAW: It comes up with exact simulation results through a vehicular mobility model kept in place in original North American Countries supporting the operations of real vehicular traffic. The disadvantage of this method is that the model is able to define the node movements to only the streets which are predefined by the map knowledge as in the case of North American countries. This further makes sure that the mobility is limited for per vehicular congestion and simplified traffic management mechanisms.

FreeSim : It is a microscopic as well as a macroscopic which is further customized free-flow traffic simulator that enables easy representation of multiple freeway systems. In FreeSim, vehicles are given access for communication to the system that watches the freeway traffic. FreeSim is preferred by the above mentioned scenario for all Intelligent Transportation System (ITS) simulation. General Public License based FreeSim is made available for free download.

CityMob: Being a NS-2 compatibility mobility model generator, CityMob v.2 is planned to be employed in VANETs. There are three classes of mobility models implemented in CityMob such as,

- Manhattan
- Simple
- Realistic Downtown

DM model or otherwise the final model, is manhattan style grid-like standardized block sizes which are followed in the organization of streets across the simulation space. With two-way streets and lanes in place at each direction, lanes control the vehicle movements. Though vehicles are allowed to move at random speed, at the intervals, it needs to be in the value ranges which are defined by the user.

Table 1.1 Comparison of Mobility Generator

	Vanetmobisim	SUMO	MOVE	STRAW	Freesim	CityMobi
Freeware	Yes	Yes	Yes	Yes	Yes	Yes
Implement google map	Yes	Yes	Yes	No	No	No
Ns-3 trace support	No	Yes	No	No	No	No
Speed construction	No	Yes	No	No	No	No

As Shown in the table 3.1 SUMO exhibits good software characteristic, features and traffic model support compared to other mobility generators.

1.2 NETWORK SIMULATORS

Researchers would prefer to check the potential behavior of network simulators under various scenarios and different conditions. After this, the simulator is customized by the specific user in order to complete their objectives i.e., analysis. When compared to the time and effort to set up the entire test-bed in information links, multiple networked computers and routers, the cost and time are very efficient in case of network simulators. So researchers are encouraged to check the simulator situations being so challenging and of high cost-consuming to emulate with the utilization of real hardware, and to be particular, VANETs. The above-mentioned network simulators help in a much-needed time to check for the new networking protocols or changes that are newly supplied in the existing protocols in an exceedingly controlled and reproducible manner.

1.2.1 Network Simulators

In case of Inter-Vehicle Communication, multiple network simulators are used in order to simulate the communication between the vehicles. The next section would provide an overview about the characteristics of available promising network tools for simulating VANET scenarios.

NS-2: The VINT (Fall 2000) project analysis group at Berkeley, University of Golden State, developed a separate event simulator i.e., NS-2 which was extended by the Carnegie Andrew W. Mellon University's Monarch analysis group that resulted in

- ✓ Mobility of the node
- ✓ radio propagation model in the physical layer
- ✓ Radio network interfaces and
- ✓ Distributed Coordination Function in Medium access layer

In spite of this, there is a shortcoming prominently noted in NS-2 both within the overall design and also the modeling details of the IEEE 802.11 macintosh and PHY modules. The two modules were given a refined architecture and design by previous researchers (Fall 2000). The result of the above i.e., resulting PHY, could be a full-featured generic module that has the potential to support the communications which are primarily based on any single channel frame.

N3-3: NS-3 is a distinct network simulator which is chooses mainly for research and educational sectors. NS-3 is freely available software and licensed under the GNU GPLv2 license, and is publicly available for research, development, and use. The main objective of the NS-3 project is to create a favorable, open simulation environment for networking research: it should be aligned with the simulation needs of modern networking research such as VANET and should encourage community contribution, peer review, and validation of the software.

GloMosim: GloMoSim may be the simulation environment which can be scaled for both networks i.e., wireless as well as wired., GloMoSim has also been designed through layered approach like OSI Model. Between a number of simulation layers,

Standard API is used which enables the speedy integration of models which were developed by different people at completely different layers. The Business version of GloMoSim is QualNet simulator, a widely used simulator.

JiST/SWANS: Being an extraordinary performer in separate event simulation engine, it can operate over a customary Java virtual machine. This model comes as a replacement with an approach of putting together separate event simulators which coordinates with the normal systems and language-based simulator styles.

SNS :. SNS has a faster rate of quick simulation with an unremarkably used 1500 nodes for Adhoc simulation setup. It performs quicker than regular NS-2. In this scenario, half of the hour is spent only on the staging process followed by rest of engineering process. SNS is enabled by the above described performance level to simulate huge networks. However this implementation is predicated on NS-2 version 2.2, which doesn't mean to simulate VANET situations.

Table 1.2 Comparison of Network simulator

	NS-2	NS-3	GloMosim	JIST/SWANT	SNS
Freeware	Yes	Yes	Yes	Yes	Yes
Continuous development	Yes	yes	No	No	No
Resemble C++	No	yes	No	No	No
VANET Portable	No	yes	No	No	No

The NS-3 shows the better result and compatibility than the other simulator, which is clearly shown in Table 1.2.

1.3 VANET Simulators

In an IVC system where the simulation model is exceeds, the important side is about how the driver response to the IVC application. Based on the driver's reaction, in several things, value is added to the effect on traffic throughput . For instance, when a collision warning message is received by a driver from World Health Organization, the driver would do any one situation only such as hitting the brake or getting out of the route calculating the accident point by checking the exit availability. An integrated framework or a VANET simulator is the software which allows anyone to change the vehicular behavior (in the predefined context).

1.3.1 Existing VANET Simulators

A small number of integrated frameworks are available. Being enforced in two different simulation tools, both the Network models and node mobility in integrated frameworks require a transparent integrated mobility and network simulator for the assessment of IVC systems' performance whether effective or not. Following is the discussion about further simulators.

TraNS: TraNS (Traffic and Network Simulation Environment), is a simulation environment which consists of a node mobility generator followed by a network simulator which provides a tool for realistic VANET simulations. There provides feedback by TraNS between the vehicle behavior and the mobility model. For example, when a report is broadcasted by a vehicle with regards to the accident, the vehicles that are nearby reduce their speed. Being an open source project (developed by EPFL, Switzerland) that provides an application-centric analysis framework for VANETs, it was written in Java and C++, TraNS works in the operating systems such as Linux and Windows (trace-generation mode). Both grappling traffic simulator as well as NS-2 network simulator is used in the TraNS implementation. TraNS v1.2 has many options, including,

- ✓ Automated generation of road networks from TIGER and form file maps.
- ✓ Automated generation of random vehicle routes.
- ✓ Support for realistic 802.11p.
- ✓ Mobility trace generation for NS-2.
- ✓ sumo and NS-2 coupling through the TraCI interface.
- ✓ Risk to simulate road traffic events.

GrooveNet: GrooveNet (Mangharam et al. 2006) allows communication without obstacles between the simulated as well as the real vehicles. Using this peculiar approach, The inter vehicular Communication modeling is done at intervals by which a true street map primarily based on topography is created which eases the protocol style and in-vehicle deployment. The GrooveNet standard design combines the message broadcast models, trip and the mobility across the range of link and physical layer communication models.

These simulators support any number of vehicles in the region of North America. This is due to the inclusion of the latest models for vehicular interacts, applications, security and networking. It supports event-triggered (from the vehicles' on board computer) simulations, multiple network interfaces and GPS is permitted. There are three classes of simulated nodes supported which include

- ✓ Fixed infrastructure nodes.
- ✓ V2V and Vehicle-To-Infrastructure (V2NV) communication using Mobile gateways.
- ✓ hopping data over one or additional dedicated Short-Range Communications Channels by the vehicles

This features support multiple message varieties based on the scenarios in order to alert the nearby vehicles with the updated information of current position of the vehicle with priorities if vehicle faces any emergency. In order to analyze the printed storm downside, multiple transmit policies are enforced. This simulator support the hybrid simulations irrespective of the position of the simulated vehicle, its direction and the broadcasted messages over the cellular interface from one or additional infrastructure nodes.

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In this scenario, the communication will be only between the real vehicles and the simulated vehicles that are at intervals in its transmission range. The street-level maps are generated across the North American country through TIGER files being imported which are easily accessed from US Bureau census.

GrooveNet, is a predicated open-source roadmap, along with the important add-ons which also contains networking and simulation models, graph-based abstraction of streets, in addition to cross-platform user interface [trolltech.com,2008].

NCTUns: NCTUns (National Chiao tung University Network Simulator) was developed which is basically a high-fidelity & extensile network simulator and emulator that has the capability to simulate a number of protocols which are used in both wireless as well as in wired networks. The core techno-methodology of this simulator is completely specific and unique kind of kernel re-entering methodology. Because of this methodology, the simulator NCTUns, comes with bundled benefits which cannot able to achieve by other contemporary network simulators such as NS-2 and OPNET. In the simulator, NCTUns network simulator and emulator, there are plenty of useful options which enable it to be used only as an emulator as it supports flawless integration of both, emulation as well as simulation. Linux TCP/IP protocol stack is used in the NCTUns in order to get simulation results of high caliber.

MobiREAL: A replacement methodology (mobireal.net 2008) is provided MobiREAL, for the purpose of modeling and simulating the nodes' realistic mobility which can further lead to evaluation of MANET applications. Being a network simulator which simulates the human as well as vehicular realistic mobility, it can allow the dynamic of their behavior reckoning on a given application context. Its mechanism is simple, that it simply describes the quality of nodes which were mistreated by C++. It actually visualizes the node movement in a dynamic mode, which further states its properties and packet transmission. Through this, the simulation results can be understood intuitively. Mobility of nodes is simulated within the Behavior simulator. In addition to the above, there is a special rule which applies in the case of pedestrians to avoid collision. Using MobiREAL, the vehicles getting congested can be further modeled. It has the capacity to simulate a combination of assorted quality models simultaneously.

Table 1.3 Comparison of VANET Simulator

	Trans	Groovenet	NCTuns	Mobilereal
Freeware	No	No	No	No
Simulation type	Street Speed	Street Speed	Random	Street Speed
VANET Communication	V2NV and manually defined V2V	V2V and V2NV	V2V and V2NV	Manually defined
Trip Model	Random	Dijkstras	Manually defined	Manually defined
VANET Build in application	Detour and road warning	Vehicle warning and adaptive rebroadcast	No	No

The comparison of the well-known VANET Simulator is shown in Table 1.3. The unavailability of freeware is one of the main drawbacks.

III. CONCLUSION

The aim of research carried out in this paper is enhancing the knowledge the simulator in VANET.In this paper, we present main categories of simulator available in VANET, which may be challenging in Intelligent Transport System (ITS) for choosing simulators. Designing of VANET environment has many challenges like high cost for VANET simulators. Instead of using VANET simulators, we can use different network simulators and mobility generator in free of cost.

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