RESEARCH ARTICLE

Performance analysis of MOVE and VanSimFM mobility generator for VANET

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ABSTRACT

VANET (Vehicular ad-hoc network) is subgroup of MANET that has potential in improving road safety, security and provide intelligent transportation system. But VANET simulation is different from MANETs (mobile *ad hoc* networks) simulation because in VANET vehicular environment imposes new issues and requirements, such as constrained road topology, multi-path fading and roadside obstacles, traffic flow models, trip models, varying vehicular speed and mobility, traffic lights, traffic congestion and driver's behavior. We used different type of simulators for VANET. In this paper, we define two mobility generator such as MOVE and VanSimFM and analyse these result on network simulator (NS-2). We analyse that each mobility generator has different graphical user interface, its input characteristics and output visualization. Hence, each simulator work on different scenario differently and not each simulator work properly on each scenario. Hence study of different simulators is necessary.

Keywords—VANET , MANET , V2V, V2I, ITS , RSU.

I. INTRODUCTION

The most superior technology for Intelligent transportation system (ITS) is VANET which is subclass of MANET. By using wireless communication among vehicles and road side unit to send information to every user which are in the range of VANET area, it provide a best safety applications to passengers on road side area. VANETs are characterized by: (a) trajectory-based movements with prediction locations and time-varying topology, (b) varying number of vehicles with independent or correlated speeds, (c) fast time-varying channel (e.g., signal transmissions can be blocked by buildings), (d) lane constrained mobility patterns (e.g., frequent topology partitioning due to high mobility), and (e) reduced power consumption requirements [1]. Due to high-speed mobility, V2V and V2I communication links tend to be short lived. Thus, it is important to propagate traffic-related information toward a certain region of interest instead of sending to a particular vehicle; hence a particular region is to be set to transmit information to from wireless devices. Deploying and testing VANETs involves high cost and intensive labor. Hence, simulation is a useful alternative prior to actual implementation. Simulations of VANET often involve large and heterogeneous scenarios. Compared to MANETs, when we simulate VANETs, we must account for some specific characteristics found in a vehicular environment. Therefore, protocols developed for traditional MANETs is fail to provide reliable, high throughput, and low latency performance in VANETs [2]. Thus, there is a need for effective protocols that take the specific characteristics of vehicular ad-hoc network [3]. VANET simulation is a challenging task, since it involves network simulation and traffic simulation . Different type of simulator is to be used VANET. We

divide the simulators in three category when working in VANET. These are traffic simulator, network simulator and VANET simulator. Traffic simulator define the traffic information are e.g. Road topology, obstacles, environmental condition etc and network simulator is used for TCP ,routing information, multi-casting. VANET simulator is combination of both traffic simulator and network simulator. The output of traffic simulator is the input of network simulator while VANET simulator is integrated version of traffic and network simulator in a single simulator. When we work with traffic an network simulator it is very necessary both are compatible to each other otherwise not best result is find out for VANET simulation. Hence, compatibility of traffic and network simulator is very necessary.

II. Background

The main purpose of ITS is to reduce congestion and safety measures in road for this purpose a system is require to improve road safety. From the last few years a wealth of research has studied how to optimize the inter-networking of vehicles using short range radios (WiFi and other short range communications) to support a wide range of vehicles [4]. Hence, ITS define an idea of vehicular ad-hoc network in metropolitan area by enabling each vehicle to act as a traffic probe that measures and afterward spreads traffic related information. This information can then be used by other vehicles to efficiently select their routes to avoid congested areas. Hence, ITS use each vehicle as a crowd source traffic information. Each vehicle is send information to other vehicle by using wireless communication and each vehicle communicate to other vehicle bases on traffic knowledge and routing traffic information. System is not static it is highly dynamic because vehicles move not only on mobility pattern but also base on road side obstacles ,others vehicles and driver's interest. Hence, Simulating a VANET involve two different aspect. First aspect is related to communication among vehicles. Second aspect is related to mobility of VANET nodes. Network simulators are used for communication issues and traffic simulators are take into account of node movement [6]. 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) [7]. 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. 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 multilane 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 [8]. However, multi-lane roads are not taken into consideration. A more accurate model is VNSim (Gorgorin, 2006), which includes a complex model for vehicles mobility, a wireless network simulator, and an interface for the emulation of vehicular applications. The simulator can be used to analyze networks of several thousands of nodes in complex city scenarios as well as in highway scenarios, and can be used to improve both car-to-car communication protocols and traffic control applications (Gradinescu, 2007; Diaconescu, 2007).

III. Simulation theory

Research in Vehicular Networks (VNs) has found in simulation the most useful method to test new algorithms and techniques. When creating a vehicular simulation environment is to correctly model how vehicles move, providing an accurate and realistic vehicular mobility description at both macroscopic and microscopic levels such that real topologies, or the effect of radio signal absorption due to obstacles, they are rarely included, and, therefore, obtained results are far from being realistic. By improving the process of realistic mobility traces and accurate radio propagation

SHIFALI & YOGESH JUNEJA

models we developed a realistic simulation frame work.

Challenges of realistic VANET simulation: There are many challenges when simulating in vanet simulators. These are: Accurate and realistic topology of maps, obstacles, trip motion ,vehicle characteristics, path motion, smooth acceleration and deceleration, human driving pattern, intersection management, time pattern and external influences.

Mobility modelling: Different type of mobility model used in VANET which are used in simulation of protocols and applications. In random way point model, movement of nodes is random without any restriction which provide different results and not reach to steady state. By vehicle observations and GPS system some mobility traces are recorded and these predefined traces are used in real world mobility model which is very accurate than random way point. In real-world mobility there is restriction on trace data on what could be recorded from real-world vehicle movements. This limitation can be overcome by generating tracing file artificially. This type of mobility models are called Artificial Mobility Traces model. For any intensive cooperation like accident information, road block-age information, hazard condition warning require loop between traffic simulation and network simulation. So this type of simulator are called bi-directional simulator.

IV. Simulation set up and tools

The first step for simulation setup is to create Vehicular Ad Hoc Network. We designed a network for evaluation of simulator's performance. Network is created by writing tcl script meant for ns2 using MOVE and VanSimFM. In this simulation study we selected the following network parameters for vehicular nodes and communication among them:

Fig(1) GUI of MOVE simulator

Table 1: OVERVIEW OF MOBILITY MODELS, THEIR LEVEL OF SUPPORT IN SIMULATION FRAMEWORKS, AND THEIR PARTICULAR ADVANTAGES AND DRAWBACKS [9]

Mobility Model Class	Integrated Framework Support	Advantages	Drawbacks
Random Movement	Virtually All	Straightforward, intuitive and readily available	Imprecise and potentially unstable
Real-World Traces	GloMoSim, Qual-Net, OPNET, ns-2, Shawn, JiST/SWANS, OMNeT++/INET Framework	Most realistic node movement and Re-usable traces	Costly and time-consuming and No free parameterization
Artificial Mobility Traces	GloMoSim, Qual-Net, OPNET, ns-2, Shawn, JiST/SWANS, OMNeT++/INET Framework	Realistic node movement, Free parameterization and Re-usable traces	No Feedback on Driver Behavior
Bi-directional Coupled Simulations	ns-2, Shawn, JiST/SWANS, OMNeT++/INET Framework	Realistic node movement, Free parameterization, Feedback on driver behavior	No re-usable traces

1). TCP/IP network transmission mode.

2). IEEE 802.11b standard used for each vehicular node.

3). UDP packets used for communication.

4). 20, 100 and 150 nodes are selected for single scenario.

5). 15dbm Transmission power used for node operation.

Based on architecture, Kim et. al. has categorized the VANET simulators into four categories[10]. Mobility-trace-based VANET simulator (VanetMobiSim), Mobility implemented network simulator(ASH) Mobility-network integrated simulator (CQCL, TraCI) Tightly-coupled VANET simulator (NCTUns, GrooveNet).

Simulation setup for MOVE traffic simulator[11]

MOVE is an open source microscopic traffic model. MOVE is top on SUMO and run on JAVA. MOVE has two model one is mobility model and second is traffic model. Fig (2) define the GUI of MOVE simulator.

Mobility model provides a user friendly interface for generating mobility model for simulations using SUMO. It also allows the user to create customized topology or import maps. Mobility model define map editor and vehicle movement editor. Map editor create road topology in three ways: by manual, automatic and real road network . Vehicle

movement editor specify the trip and route of vehicle in three ways: manual, automatic and bus time table.Users inputs the information in the Map Editor and the Vehicle Movement Editor then this information is fed into SUMO to generate mobility trace which can be immediately used by NS-2 to simulate real world vehicle movements. Network traffic model generator takes the SUMO trace file as the input and generates the network traffic model as required by either NS-2 or QualNet [5]. MOVE provides a GUI that allows the user to quickly generate realistic simulation scenarios without the hassle of writing simulation scripts as well as learning about the internal details of the simulator. Drawback of MOVE is that it provide a room for TIGER map but TIGER map is no imported into MOVE [12]. Further research is move on to import TIGER map in MOVE. We can visualize the map in GUI of SUMO [13]. SUMO version 0.12.3 is used to visualize the road topology of MOVE.
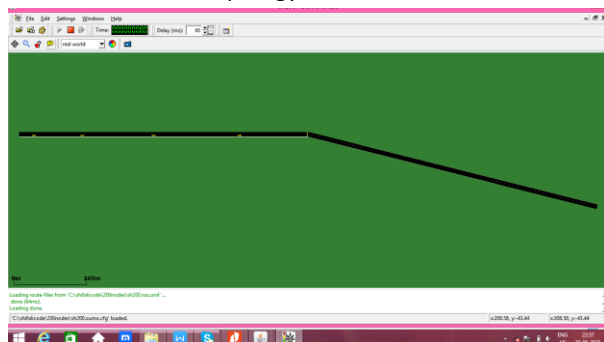

Fig 2:GUI of SUMO define road topology of highway scenario

The GUI define an example of scenario which define the 1000 X 1000 area for road topology .The vehicular movement are easily define by MOVE by using GUI of SUMO. For working with SUMO we have to define the binary path for SUMO in GUI of MOVE.

Simulation set up for VanSimFM traffic simulator:

VanSim FM is an open source microscopic traffic model which is work on linux not on windows.VanSimFM compatible with NS-2.To work on VanSimFM smoothly a number of software is required. They are NS-2, NAM, SUMO, JAVA, and Python[8]. Basically VanSimFM is an extension of citymob and run on JAVA. Fig (3) define the GUI of VanSimFM simulator[14].
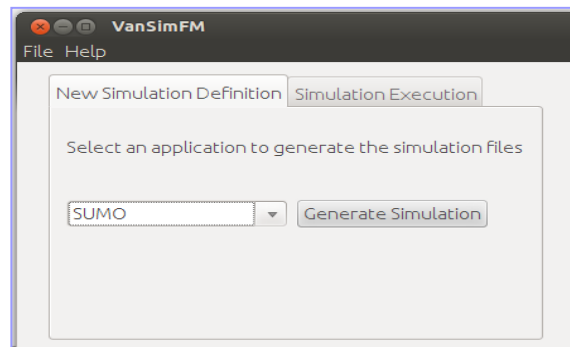

Fig 3: GUI of VanSimFM

VanSimFM is use the GUI of SUMO and citymob. In this paper we define the GUI of citymob.
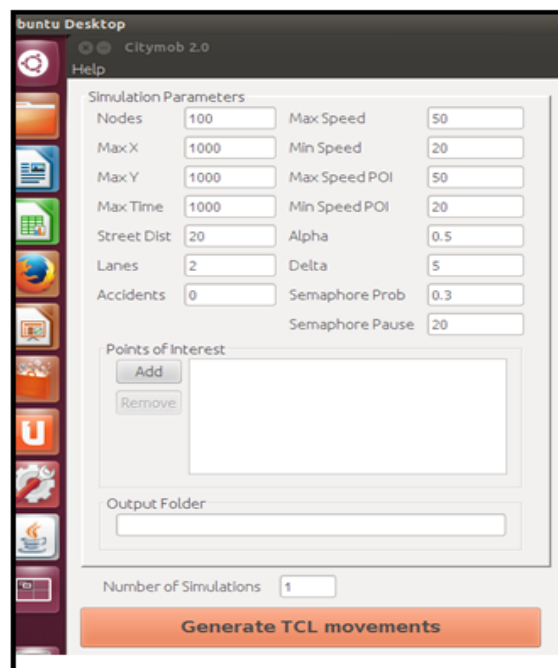

Fig 4: GUI of citymob

Citymob define the node position, X-Y dimension of random map configuration, no. of lanes, no. Of accident, maximum speed and minimum speed and some constant value (e.g. Alpha ,beta) [15]. The output of the citymob is the tcl file of mobility generator. That output is not compatible with the network simulator because it does not define the network topology application such that propagation method , mac layer protocol antenna type, network protocol. Hence, this output is act as input of the of the VanSimFM which define the network configuration. Now, complete tcl is formed which is compatible with NS-2.

Simulation set up for network simulator:NS2: The Network Simulator (ns2) [17] is a discrete event driven simulator developed at UC Berkeley. Several different NS-2 versions have been released over the last few years; the latest version of NS-2 is the NS-2.35.We are using Network Simulator NS2 for simulations of protocols. It provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. Users are feeding the name of a TCL simulation script as an input argument of NS-2 executable command ns. Ns- 2 code is written either in C++ and Object-oriented Tool Command Language (OTCL) and is kept in a separate file that is executed by OTCL interpreter, thus generating an output file for NAM (Network animator) [16].
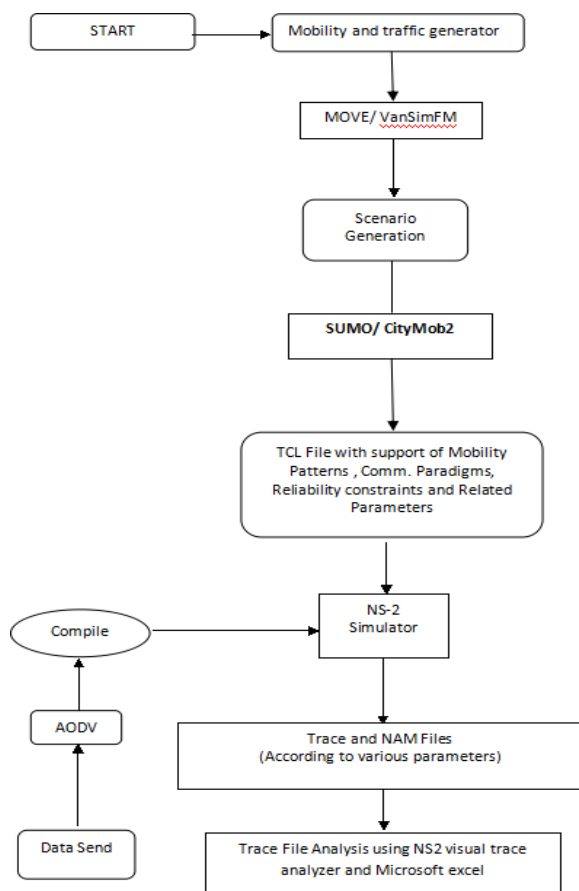

Fig 5: ns-2 architecture

In NS-2 C++ defines the internal mechanism (backend) of the simulation objects, and OTCL defines external simulation environment (i.e., a frontend) for assembling and configuring the objects. It then plots the nodes in a position defined by the code script and exhibits the output of the nodes communicating with each other. It consists of two simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator (NAM) is use to visualize the simulations. Fig(5) define the network architecture.

V. Performance matrices

Different performance matrices are used to determine the performance of simulators. We select average end to end delay throughput and packet delivery ratio to determine the performance of simulators in a single highway scenario.

Packet Delivery Ratio: It is the relation between the data packets delivered to destination and the generated by the CBR sources . It is calculated by the equation 1.

$$PDR = \frac{Pr}{Ps} \times 100$$

Where:

PDR = Packet Delivery Ratio

Pr = Received CBR Packets

Ps = Sent CBR Packets

Average End-2-End Delay: This metric gives the overall delay, from packet transmission by the application agent at the source node till packet reception by the application agent at the destination node. Lower delay shows higher protocol performance. The end to end delay is important metrics because VANET needs a small latency to deliver quick messages.

VI. Result and analysis

In this paper, we want to check the performance of single routing protocol using two different traffic simulators meant for VANET. For this purpose we built single network scenarios and varied the vehicular node density. We selected AODV routing protocol and MOVE and VanSimFM as simulators to evaluate the performance of VANET in terms of different performance metrics i.e. packet drop ratio and average end-to-end delay.Table 1 define the input parameter for network scenario.

Table 2: Parameter for network scenario

Parameter	Setting
Simulation Area	1000 m x 1000 m
Number of Nodes	20, 100 and 150

SHIFALI & YOGESH JUNEJA

Node Speed	50 m/s
Packet Type	UDP
Simulation Time	1000 sec
MAC Layer	802.11b
Routing Protocols	AODV
Mobility Model	Random Waypoint

Quantitative comparison of simulators: In this comparison same number of nodes outperform for both MOVE and VanSimFM traffic simulator. Table: 4,5,6 define the mathematical calculation of the PDR and E-2E Delay for different nodes.

Fig.6 shows the comparison between the two considered simulators MOVE and VanSimFM in terms of PDR. And in Fig. 7 In terms of E-2-E Delay.

Table 3: Analysis of different parameters for 20 nodes scenario

	MOVE	*VanSimFM*
Packets Send	144882	144882
Packets Received	127936	55572
Packets Dropped	16946	89310
PDR (%)	88.3	38.35
E-2-E Dela (m-sec)	0.01374249	0.37284329

Table 4: Analysis of different parameters for 100 nodes scenario

	MOVE	VanSimFM
Packets Send	144920	144882
Packets Received	143957	56888
Packets Dropped	963	87994
PDR (%)	99.33	39.26
E-2-E Delay (msec)	0.06959867	0.77991113

Table 5: Analysis of different parameters for 150 nodes scenario

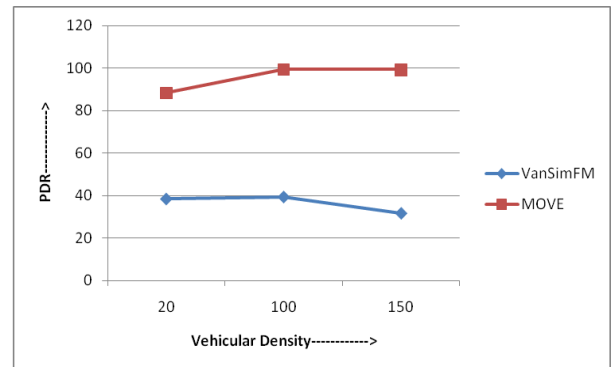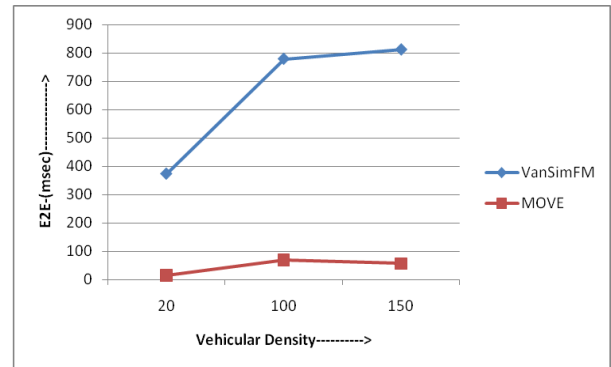|	MOVE	VanSimFM
Packets Send	144920	144882
Packets Received	143857	45961
Packets Dropped	1063	98921
PDR (%)	99.2	31.72
E-2-E Delay (msec)	0.05667466	0.81292273

Fig 6 PDR vs vehicular density

Fig7: E-2-E Delay vs vehicular density

In both the simulators performance is deteriorates as the number of nodes increases. We use a highway scenario and MOVE perform best in highway scenario as seen in Fig: performance of MOVE simulator in 100 node is highest as the nodes increase to 150 the performance is little bit deteriorates same in the case of VanSimFM. But VanSim FM is an extension of CityMob simulator and it work beeter in city scenario not in highway. Hence, the performance of VanSimFM is less for 20,100 , 150 nodes.

SHIFALI & YOGESH JUNEJA

Node density of different simulators: MOVE and VanSimFM perform different type of node density on network animator.
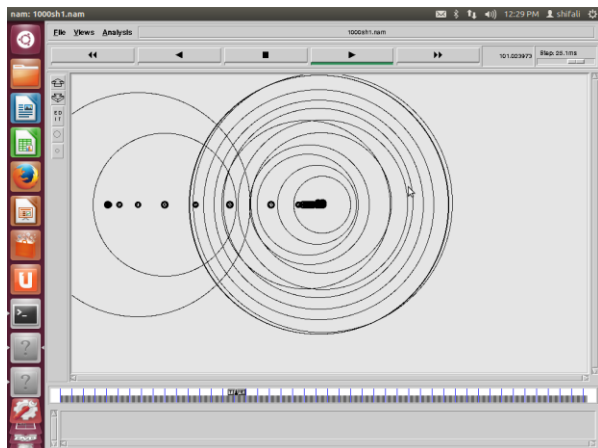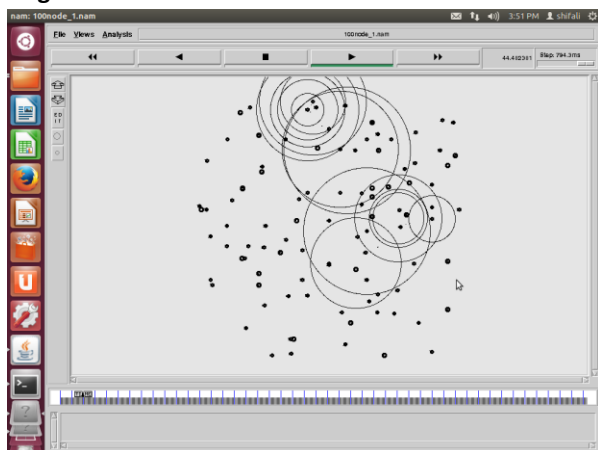

Fig 8: NAM trace file for MOVE simulator

Fig 9: NAM trace file for VanSimFM simulator

VII. Conclusion

The main goal of this thesis is to compare two different simualtors and to check the amount of variation in the outputs obtained. In this study we focused from traditional ad hoc routing protocols to recently proposed topology based routing protocols. We have examined how different simulators suffers from the highly mobile nature of VANET. In this study, by literature surveying we found that mobility generators are required for the movement of vehicles during network simulation for VANET. From the results of our study choice of simulators plays a pivotal role in performance in VANET. We examined reactive ad hoc routing protocol AODV for different vehicular density by taking MOVE and VanSimFM as two VANET simulators and found that the performance of MOVE outperforms VanSimFM.

Hence it can be predicted that the choice of simulators greatly affects the results. Hence it becomes quiet necessary that simulators should resemble the real world as close as possible.

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