Evaluating the Performance of VANET for Different Mobility Models using NS-2

Sumit Goyal, Dr. Rajesh Gargi

***Abstract*— A Vehicular Ad Hoc Network (VANET) is an instance of MANETs that establishes wireless connections between cars. VANET provides three major classes of applications possible in VANET are safety oriented, convenience oriented and commercial oriented. One key component of VANET simulations is the movement pattern of vehicles, also called the mobility model. Mobility models determine the location of nodes in the topology at any given instant, which strongly affects network connectivity and throughput. The Mobility Model governs the set of rules that define movement pattern of nodes in ad-hoc network. Network simulators can then, by using this information, create random topologies based on nodes position and perform some tasks between the nodes. VANET requires modification of the existing MANET protocols to adapt itself into VANET scenario .Several mobility models are developed in this regard. In this Paper Various mobility Models and Routing protocols are discussed and models are compared according to different routing protocols. Simulations results are shown for different mobility models over different protocols using VanetMobiSim and NS-2.**

***Index Terms*— VANET, MANET, VanetMobiSim, NS-2**

I. INTRODUCTION

VANET is a special class of MANET in which the nodes are the vehicles which communicate with other vehicles or with the base station which acts as a roadside infrastructure. VANET has emerged as a promising field of research, where advances in wireless communication Mobile Adhoc Network and sensors can be applied together to a wide range of application in ITS. The mobility of vehicles on road is restricted by factors like driving behavior of the driver as well as surrounding people, traffic jams, traffic signals, road-side mishap, and unseen obstacles, free passage of emergency vehicles etc., thus the mobility patterns in vehicular network is restricted and is frequently changing. VANETs provide a tremendous potential for low latencies which means communication delay for message or packet transmission is quite low and hence helps in increasing the performance of system by allowing the network connection to remain active even if vehicles are moving at fast speeds and in dynamic topologies. Driving means changing location constantly, this means a constant demand for information on the current location and specifically for data on the surrounding traffic, routes and much more. This information can be grouped together in several categories.

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II. PROBLEM FORMULATION

The main problem in VANET is the selection of mobility model and protocol which provides an accurate vehicular mobility description. Mobility models determine the location of nodes in the topology at any given instant, which strongly affects network connectivity and throughput. There are mainly two levels that is macroscopic and microscopic level. At macro-mobility level, all the macroscopic aspects which influence vehicular traffic: the road topology, constraining cars movement, the per-road characterization defining speed limits, number of lanes, overtaking and safety rules over each street of the aforementioned topology, or the traffic signs description establishing the intersections crossing rules. Micro-mobility level instead refers to the driver's behavior for example how one driver is interacting with other drivers or with the road infrastructure, traveling speed in different traffic conditions, acceleration, deceleration and overtaking criteria, behavior in presence of road intersections and traffic signs. In general driving attitude related to driver's age, sex or mood, etc.We propose a comparison between two mobility models over two protocols proposed for VANET. The performances will be compared on AODV(On-demand routing protocol) and DSDV (Table- driven routing protocol). In (AODV) routing, upon receipt of a broadcast query (RREQ), nodes record the address of the node sending the query in their routing table. This procedure of recording its previous hop is called backward learning. Upon arriving at the destination, a reply packet (RREP) is then sent through the complete path obtained from backward learning to the source. At each stop of the path, the node would record its previous hop, thus establishing the forward path from the source. The flooding of query and sending of reply establish a full duplex path. After the path has been established, it is maintained as long as the source uses it. A link failure will be reported recursively to the source and will in turn trigger another query-response procedure to find a new route. Previously AODV routing protocol develops on top of DSDV algorithm. DSDV **provides** proactive routing carries the distinct feature which is that the routing information such as the next forwarding hop is maintained in the background regardless of communication requests. Control packets are constantly broadcast and flooded among nodes to maintain the paths or the link states between any pair of nodes even though some of paths are never used. A table is then constructed within a node such that each entry in the table indicates the next hop node toward a certain destination. The advantage of the proactive routing protocols is that there is no route discovery since route to the destination is maintained in the background and is always available upon lookup. Despite its good property of providing low latency for real-time applications, the maintenance of unused paths occupies a significant part of the available bandwidth, especially in highly mobile VANETs.

III. Research Methodology

NS-2 (Network Simulator) is a discrete event simulator targeted at networking research. It provides substantial support for simulation of TCP, routing and multi cast protocols over wired and wireless networks. It consists of two simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator is use to visualize the simulations. NS-2 fully simulates a layered network from the physical radio transmission channel to high-level applications. Version 2 is the most recent version of ns (ns-2). The simulator was originally developed by the University of California at Berkeley and VINT project the simulator was recently extended to provide simulation support for ad-hoc network by Carnegie Mellon University (CMU Monarch Project homepage, 1999). NS-2 is an object-oriented simulator written in C++ and OT-cl [16]. The simulator supports a class hierarchy in C++ and a similar class hierarchy within the OT-cl interpreter. It also provides powerful trace. The full source code of ns-2 can be downloaded and compiled for multiple platforms such as UNIX, Windows and Cygwin.

VanetMobiSim is an extension to CanuMobiSim. Because of its limited scope of CanuMobiSim to be used in specific areas only, it was unable to produce high levels of details in specific scenarios. Therefore CanuMobiSim was expanded to achieve a high level of realism in the form of VentMobiSim. Modeling of VanetMobiSim includes car-to-car and car-to-infrastructure relationship. Thus it combines the stop signs, traffic lights and activity based macro-mobility with the support of human mobility dynamics. It can extract road topologies from TIGER, GDF, random and custom topologies. It allows users to generate trips based on their own assumptions or activity based and can configure the path between the start and end position on the basis of the Dijkstra algorithm, road-speed shortest or density-speed shortest. VanetMobiSim contains a parser to extract topologies from GDF, TIGER or cluster Voronoi graphs that will be used by network simulators.

IV. Results

Here compared some mobility models.

4.1 IDM_IM Mobility Model

It simulates node's motion using the Intelligent Driver Model with Intersection Management. It regulates vehicles speed based on movements of neighboring vehicles (e.g., if a car in front brakes, the succeeding vehicles also slow down).

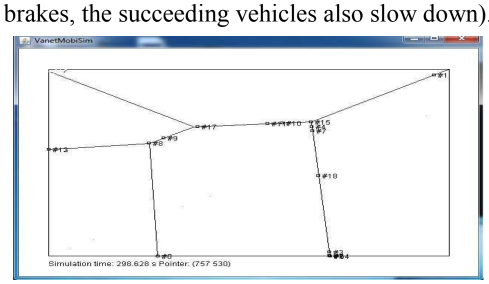

Figure4.1: IDM_IM MOBILITY MODEL

4.2 IDM_LC Mobility Model

It simulates node's motion using the Intelligent Driver Model with Lane Changing. Vehicles moving according to the IDM_LC model support smart intersection management: they slow down and stop at intersections, or act according to traffic lights, if present.

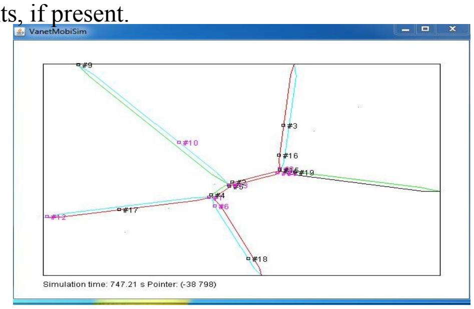

Figure4.2:IDM_LC Mobility Model

The output from VanetMobiSim simulation is a traffic generator trace file that corresponds to position coordinates of each vehicular node at every time steps. This traffic generated trace file is the mobility model that goes through network simulation (by NS-2 package in present study) and ultimately generates a communication trace file.

4.3 NAM File Output

NAM is a Tcl/TK based animation tool for viewing network simulation traces and real world packet traces. A network animator that provides packet-level animation and protocol-specific graphs to aid the design and debugging of new network protocols have been described. Taking data from network simulators (such as ns) or live networks, NAM was one of the first tools to provide general purpose, packet-level, and network animation, before starting to use NAM, a trace file needs to create and figure shows the running TCL script in ubuntu command shell.

V. Observations

Table 1: Parameters using AODV protocol

Model	Packets Generated	Packets Received	Packets Delivery Ratio	Packets Dropped	Avg. End-to-end delay (ms)
IDM_LC	4873	4428	90.868	8	98.0602
IDM_IM	14687	14199	96.6773	4	58.2429

Table 2: Parameters using DSDV protocol

Model	Packets Generated	Packets Received	Packets Delivery Ratio	Packets Dropped	Avg. End-to -end delay (ms)
IDM_LC	7819	7799	99.7442	8	121.462
IDM_IM	16114	16087	99.8324	13	53.4209

compared to existing routing protocols.This increases the efficiency of information distribution by reducing the dropped packets.The end-to-end delay is also

Figure 5.2: End to End delay for different mobility models

Analysis shows that IDM_IM mobility model under AODV protocol is better among all these models. PDR i.e. packet delivery ratio of AODV IDM_IM is highest. Average end to end delay is lowest in AODV IDM_IM.

CONCLUSION

The performance comparison of VANET for two mobility models using DSDV and AODV protocols concludes that AODV IDM_IM is better among various mobility models. IDM_IM (Intelligent Driver Model Intersection Management) gives better results using AODV protocol instead of DSDV protocol. The average packet delivery ratio is increased as reduced.in future the more vigorous simulation will perform so as to gain better understanding of such networks and subsequently helps in development of new mobility models or modification in existing protocols.

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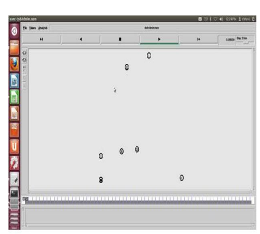

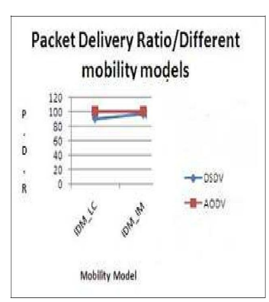

Figure 4.3: Nam file of IDM_IM using DSDV Protocol & Figure
5.1: Packet Delivery ratio For different mobility models