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Simulation and Analysis of Dropped Packets for DSR Protocol in VANETs

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Abstract— **VANET (Vehicular Adhoc Network) is a new concept in the field of wireless networks. The main objective of VANET is to build a powerful network between mobile vehicles so that the vehicles can talk to each other for the safety of the humans. The various protocols are being used in VANET environment. The aim of work is to simulate and analyze the DSR (Dynamic Source Routing) protocol in VANET. DSR protocol is simulated under realistic scenario with the help of mobility models. The work has been carried out with the help of open-source simulation tools on realistic scenario of traffic with the help of MOVE, SUMO and NS-2. The performance of DSR protocol is tested for the number of dropped packets during the simulation and results are also compared by varying the number of nodes used for simulation. The analysis indicate that there is increase in the number of dropped packets used as and the average throughput of dropped packets also increases the number of nodes are increased.**

***Index Terms*— VANET, DSR, NS-2, SUMO, MOVE**

I. Introduction

In the recent years, vehicular networking has gained a lot of popularity among the industry and academic research community and is seen to be the most valuable concept for improving efficiency and safety for future transportations. A Vehicular Ad-Hoc network is a form of Mobile ad-hoc Networks, to provide communication among nearby vehicles and between vehicles and nearby fixed equipment i.e. roadside equipment. The main goal of VANET is providing safety and comfort for passengers.

The important factors that would influence the adoption of VANET architecture for future vehicular applications would be -

- Low latency requirements for safety applications
- Extensive growth of interactive and multimedia applications
- Increasing concerns about privacy and security

A view of such a network is shown in Figure 1. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. Further, A novel type of wireless access called Wireless Access for Vehicular Environment (WAVE) is dedicated to vehicle-to-vehicle and vehicle-to-roadside communications. While the major objective has clearly been to improve the overall safety of vehicular traffic, promising traffic management solutions.

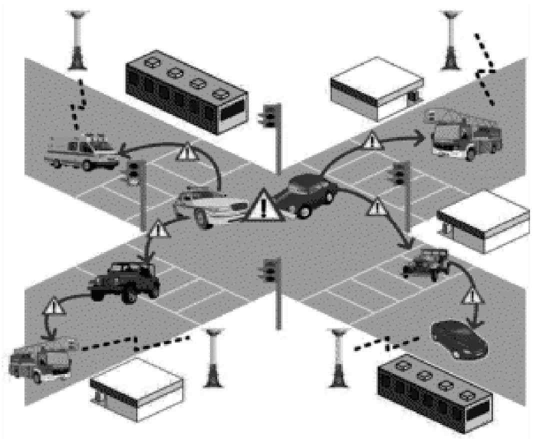

Figure 1. VANET Example

VANETs are characterized by[2]:

- high velocity of the vehicles
- environment factors: obstacles, traffic jams, etc.
- determined mobility patterns that depend on source to destination path and on traffic conditions
- intermittent communications (isolated networks of cars due to the fragmentation of the network)
- high congestion channels (e.g. due to high density of nodes).

In this paper, we have analyzed the performance of Adhoc Routing Protocol, DSR protocol by taking the different parameters such as cumulative sum of dropped packets, throughput and packet size.

II. Applications in VANETS

Transportation-related applications[3] are those applications that increase the safety of the driver and passengers. Transportation-related applications range from safety applications such as cooperative forward collision warning or extended electronic brake lights to traffic management applications such as road-condition warnings or alternative route warnings. Convenience and personalized applications increase the comfort of the driver and passengers.

Transportation-related applications and Convenience and personalized applications have a set of requirements that is common to almost all applications. The most interesting requirements are: coverage should be in the range of 10 to

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1000 meters with a car maximum relative speed of 500 Km/h. Latency ranges between 50 ms to 500 ms.
In general, safety applications should not wait more than 200 ms. A likely situation may arise in case there are traffic jams and redundant packets of multiple nodes consume the bandwidth.

A. *Safety Related Applications*

Typical safety applications are characterized as being applications in which the main objective is to disseminate certain event that have occurred in the vicinity of the sender. Some examples described are:

- Cooperative awareness: to extend non-cooperative driver assistance systems whose perception is limited to the operative range of on-board sensors (adverse weather, obstacles or dangerous road conditions).
- Cooperative assistance: distribution of data (e.g. warning of accidents).

B. *Convenience and Personalized Applications*

Typical Convenience and personalized applications[4] are:

- Car to Mobile devices: Those applications between the car and mobile devices (e.g. mobile phone, MP3, laptop, etc).
- Car to Home and Car to Office: Communications between the car and private networks either at home or at office.
- Car to Enterprise: Communications between the car and companies (e.g. restaurants, gas stations, parking areas, etc) that give road services.
- Car to infrastructure: Information received by a car from hot spots giving road and traffic information and car access to Internet.
- Car to Car: Exchange of information between car users (e.g. files, platoon traveling, etc).

III. ROUTING PROTOCOLS

In VANET, the routing protocols are classified into two categories: Topology based and Position based Routing Protocols. Topology based routing protocols use links information that exist in the network to perform packet forwarding. They are further divided into Proactive and Reactive.

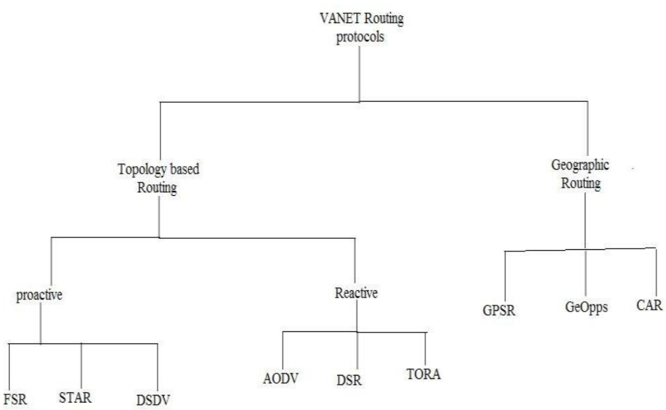

Figure 2. Classification of routing protocols[5]

The proactive routing means that the routing information like next forwarding hope is maintained in the background irrespective of communication requests. Reactive Routing Protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the burden on the network when only a subset of available routes is in use at any time . Position based routing Protocols share the property of using geographic positioning information in order to select the next forwarding hops.
In our simulation, we have used the Reactive Routing Protocols, namely DSR.

A. *DSR*

Dynamic source routing (DSR) [6] protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. The DSR network is totally self organizing and self configuring. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates.
The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: route discovery and route maintenance. The DSR regularly updates its route cache for the sake of new available easy routes. Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D. Route Maintenance is the mechanism by which node S is able to detect, with the help of a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. If a link failure is found between source and destination, the source node tries to find another route to the destination or invokes Route Discovery DSR has a unique advantage of source routing.
As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. The packet in DSR carries all information pertaining to route in its preamble (header) thus permitting the intermediate nodes to cache the routing information in their route tables for their future use.

IV. RESEARCH METHODOLOGY USED

To carry out the experiments in this paper, MOVE along with SUMO and NS2 is used.

A. *MOVE*

A tool MOVE (MObility model generator for Vehicular networks) [7] to facilitate users to rapidly generate realistic mobility models for VANET simulations. MOVE is currently implemented in java and is built on top of an open source micro-traffic simulator SUMO. By providing a set of Graphical User Interfaces that automate the simulation script generation, MOVE 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. The output of MOVE is a mobility trace file that contains information about realistic vehicle movements which can be immediately used by popular

simulation tools such as ns-2. The architecture of MOVE is shown in Figure 3.
The two main function of MOVE are:

- *MAP Editor*
- *Vehicle Movement Editor*

The Map Editor is used to create the road topology. Currently our implementation provides three different ways to create the road map – the map can be manually created by the user, generated automatically, or imported from existing real world maps such as publicly available TIGER. We have also integrated Google Earth into MOVE to facilitate the creation of nodes in a realistic setting. The Vehicle Movement Editor allows the user to specify the trips of vehicles and the route that each vehicle will take for one particular trip.

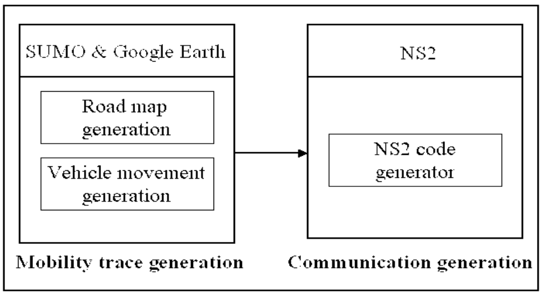

Figure 3. MOVE architecture

B. SUMO

"Simulation of Urban MObility" (SUMO) [8] is an open source, highly portable, microscopic road traffic simulation package designed to handle large road networks. It allows the user to build a customized road topology, in addition to the import of different readymade map formats of many cities and towns of the world. Figure 4. shows SUMO visualization.

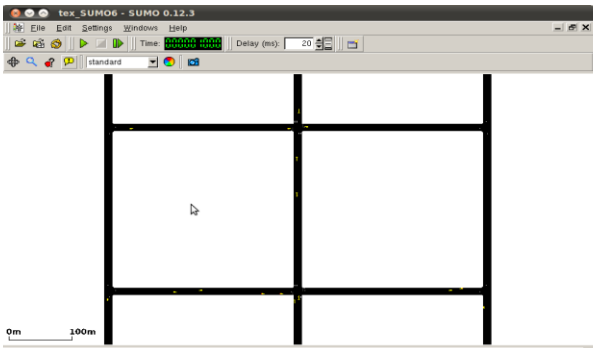

Figure 4. SUMO Visualization

C. NS-2

The Network Simulator (ns2) [9] is a discrete event driven simulator developed at UC Berkeley. 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. Ns-2 code is written either in C++ and OTCL and is kept in a separate file that is executed by OTCL interpreter, thus generating an output file for NAM (Network animator) [10]. 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.
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.

V. SIMULATION

The simulation parameters used and the simulation setup for this study are described in this section.

A. Simulation Setup

Simulation environment consists of 4,10 and 15 wireless vehicle nodes which are moving on the lanes of mobility model used and forming a Vehicular Ad-hoc Network, moving about over a 652meters X 752 meters area for 1000 seconds of simulated time.

The table below list the details of the simulation setup used in this simulation based analysis of DSR protocol.

Table 1: Simulation Setup

NS version	NS-2.33
MOVE version	2.64
SUMO version	0.12.3
Tracegraph version	2.0.2
DSR	NS-2 Default
No. Of nodes	4,10,15
Traffic type	TCP
Channel Type	Wireless Channel
Network Interface Type	Wireless physical
Antenna model	Omnidirectional
Radio Propagation Model	Two Ray Ground
Adhoc Routing Protocol	DSR
MAC type	IEEE 802.11
Simulation Time	1000 seconds
Data Type	CBR(Constant Bit Rate)
Data packet size	1000 bytes
Window Size	20
Scenario	Urban
Road Traffic Direction	Multidirectional
Queue Length	50

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B. Simulation Parameters

For this study three performance metrics are selected namely:-

1) Throughput: Throughput describes as the total number of received packets at the destination out of total transmitted packets. It is the average rate of successful message delivery over a communication channel. It is the number of received packets per TIL (Time Interval Length). This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time interval length(TIL).

$$T = \frac{\text{Total no. of received packets at destination * packet size}}{\text{Total simulation time}}$$

2) Packets drop: The number of packets dropped at a given instance of time in the simulation run determines the efficiency of the protocol. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc.

3) Simulation Time: It describes the total time taken by the simulator NS-2 to simulate the individual routing protocol.

VI. RESULTS AND ANALYSIS

The DSR protocol is being simulated over a realistic mobility model and the results are analyzed in different node densities of 4 nodes, 10 nodes and 15 nodes.

A. Cumulative sum of dropped packets vs event time

In this case, the number of dropped packets are analysed in three cases of 4 nodes, 10 nodes, and 15 nodes.

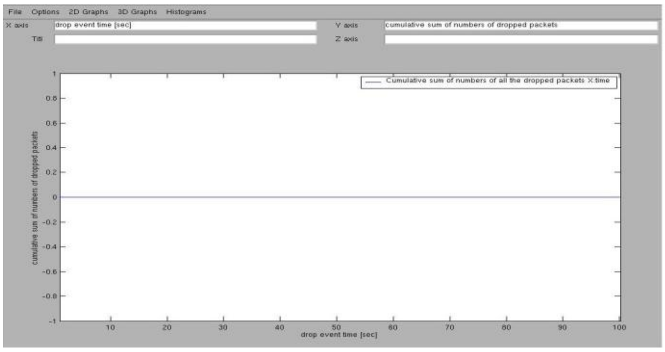

Figure 5. Cumulative sum of dropped packets vs event time for 4 nodes

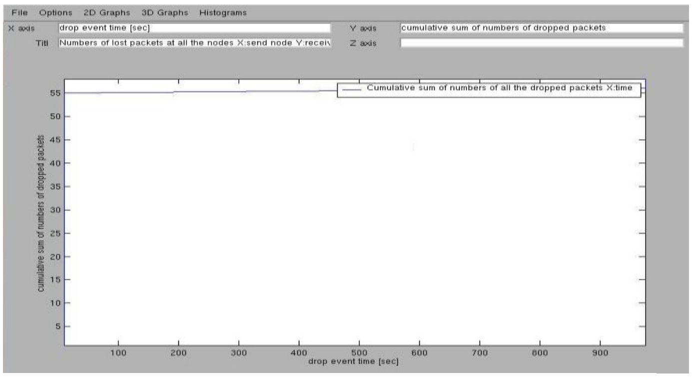

Figure 6. Cumulative sum of dropped packets vs event time for 10 nodes

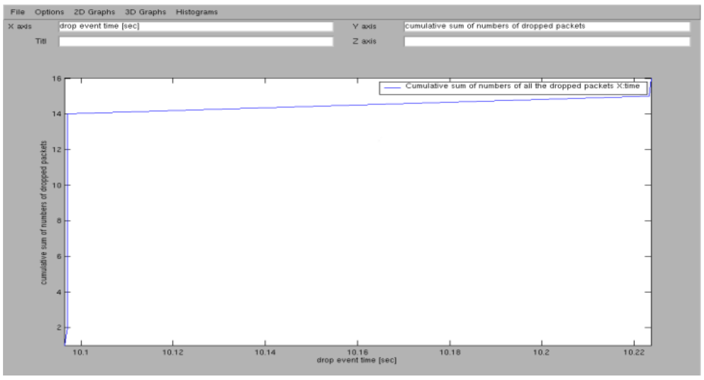

Figure 7. Cumulative sum of dropped packets vs event time for 15 nodes

INFERENCE: The number of dropped packets increases with the increase in number of nodes. The packet loss is always more at the initial stage and then increases slowly with the event time. The event time interval also decreases as the number of nodes increases due to the increase in dropped packets.

B. Throughput of dropping packets

Now, the throughput of dropped packets is analysed for 4, 10 and 15 nodes.

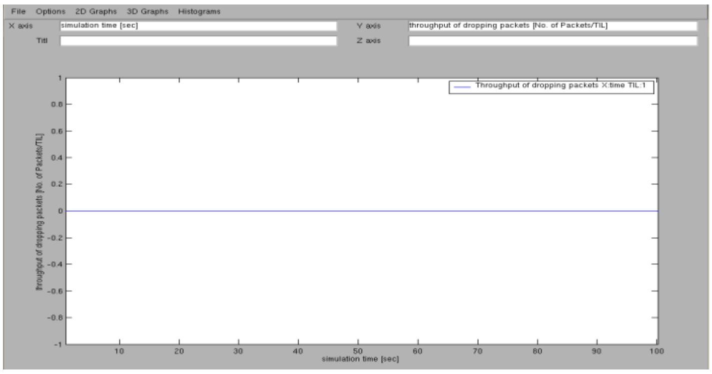

Figure 8. Throughput of dropping packets for 4 nodes

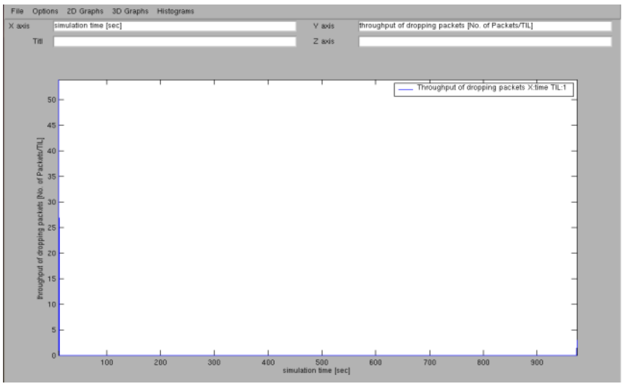

Figure 9. Throughput of dropping packets for 10 nodes

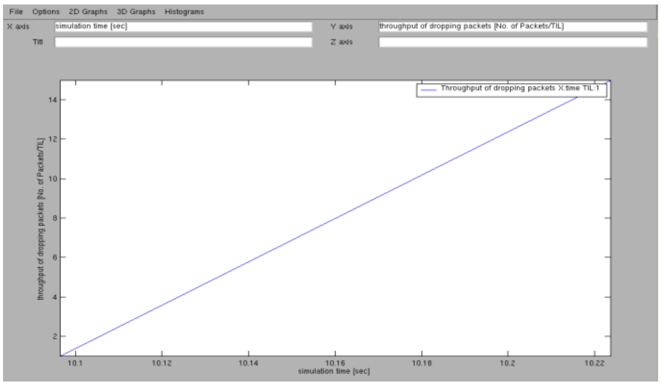

Figure 10. Throughput of dropping packets for 15 nodes

INFERENCE: As the number of nodes increases, the steepness of graph increases as the throughput of dropping packets increases with the number of nodes.

C. Packet size vs Average throughput of dropping packets

The packet sizes are analysed for which there are more number of packets dropped.

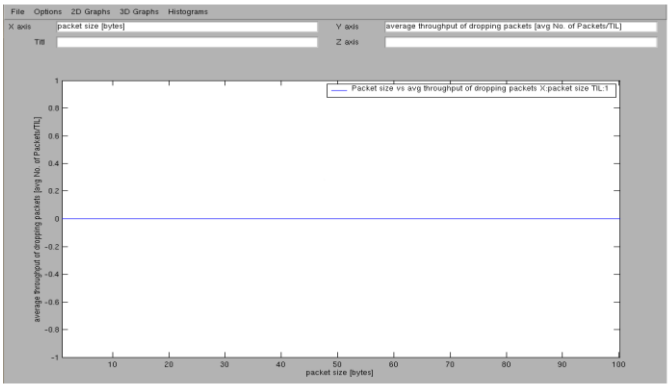

Figure 11. Packet size vs Average throughput of dropping packets for 4 nodes

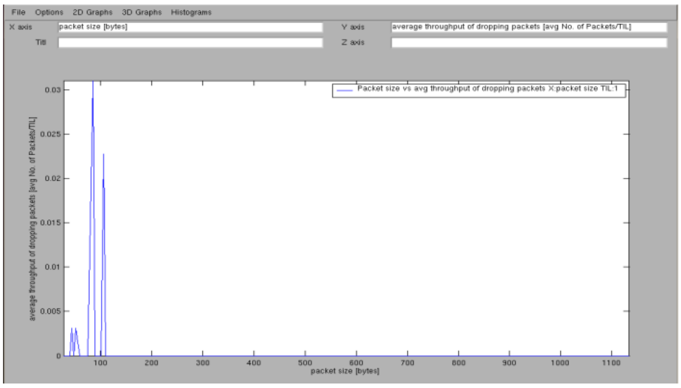

Figure 12. Packet size vs Average throughput of dropping packets for 10 nodes

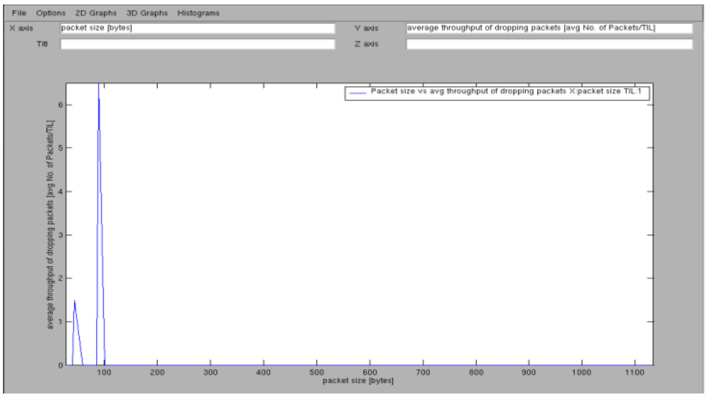

Figure 13. Packet size vs Average throughput of dropping packets for 15 nodes

INFERENCE: The highest ratio of dropped packets are of lower sizes around 100 bytes. The maximum number of dropped packets are of size below 110 bytes.

VII. CONCLUSION

VANETs are an important research field which is emerging nowdays. It defines the important technology required to support Intelligent Transportation Systems (ITS) applications. Instead of developing the all new protocols for VANET, an insight has been made to already existing MANET protocols such as DSR.

DSR is a reactive routing protocol and has been extended on VANET for simulations under MOVE and SUMO with mobility models taken from MOVE. The experiment has been conducted for 4 nodes, 10 nodes and 15 nodes to understand the behavior of dropped packets. The analysis against different parameters such as sum of dropped packets, throughput and packet size has been done and following observations has been made:

1) The number of dropped packets increases with increase in number of nodes.
2) The throughput of dropping packets increases with the increase in the number of nodes from 4 to 15, as the

number of dropped packets increases.

3) The more number of dropped packets are recorded for the packet sizes between 80 to 100 bytes for all the three scenarios of 4, 10 and 15 nodes.

The maximum nodes considered in the work are 15 due to hardware constraints of the computer. So, it would be interesting to see the behaviour of the DSR protocol for the higher number of nodes, for which the machine of higher configuration will be required.

ACKNOWLEDGMENT

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