Realistic Model of Mobility based on Location and Route for VANET

Shovita Verma, Rajeev Paulus, Aditi Agrawal, Manvendra

Abstract: In this research work, we propose two realistic mobility models named as location based realistic mobility model and route based realistic mobility model. In location based realistic mobility model speed and velocity is updating and route based realistic mobility model implies how many routes are available. With these models the targeted position is set and vehicles are moving according to the same position. Hence the problem of routing is resolved which is encountered in existing realistic mobility model. For implementation of our models, we use open source software named as network simulator NS-3 and traffic simulator MOVE with SUMO. We also compare our models with the existing realistic models in terms of performance matrices: packet loss, throughput and transmission delay. Since the vehicles are moving according to targeted position, so as application aspects we predict accidents and lots of traffic and with the help of prediction we will choose some optimal solutions.

Keywords: Dsrc, Ieee 802.11p, Location Based Realistic Mobility Models, Route Based Realistic Mobility Model, Ns-3, Vanet, Wave

I. INTRODUCTION

The application of wireless technology for moving vehicles, allows the establishment of a particular class of ad hoc mobile devices networks called ad hoc vehicular networks (VANET). Use from these networks establishment of a smart transport system, which offer enormous advantages for road safety, comfort and traffic efficiency [1]. To implement vehicular networks, numerous analyses have been conducted. In spite of, the adversity and the cost of substantial execution makes simulation extensively usage to certify the proposed explanation. Mobility models are able to extensively influence the outcome of simulation [2]. Simulation technology performs an imperative responsibility in VANET research. It is essential on the way to put together a realistic model of congestion in the simulation and finding explanation to figure out the problem [3]. Selecting a significant level of detail about the models of mobility for VANET simulation is a significant resolution. The result of simulation for unrealistic mobility model is misleading or incorrect. Diversely, the addition of details takes time to be implemented and perfected, it can increase the difficulty and also reduce the speed of the simulation and mislead the attention from the research difficulty [4].

An impose aspect in a VANET simulation study is the requirement for a mobility model that reflects, as closely as possible, the actual presence of vehicular traffic. Our research work proposed the two realistic models of mobility which are named as realistic model of mobility based on location and realistic model of mobility based on route, and these models are compared to the existing realistic mobility model. Our proposed models overcome the drawback of routing which is encountered in existing realistic mobility model.

II. DSRC/WAVE SET

DSRC (Dedicated Short Range Communications) standard uses the frequency 5.9 GHz [2] and assigned for applications related to smart transport systems. A. DSRC

DSRC is a set which is used for vehicular security messages. The rapid exchanges of security information, joint with ability of other roaming vehicles that might invisible to drivers in the proper approach pull out the concepts of security [5]. The DSRC set supports large bandwidth and rapid link method which is a fundamental constraint in automotive operations .This standard uses the IEEE 1609 workgroup standards which are shown in figure 1. DSRC supports the use of Internet protocols known for network layer and transport layers [6].

Fig.1. DSRC Standard suite [5]

B. Wave Standard And Mac Protocol

WAVE (wireless access in vehicular environments) is an improvement to IEEE 802.11 standard to support vehicular communications that work at speeds of 200 km / h. It varies up to 1000 meters. The WAVE standard usage a concept of multichannel that can be used both for security and only infotainment messages [7].

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MAC layer 802.11p collaborates with IEEE 1609.4 which provides multi-channel operations and route routing [8].

III. SIMULATION TOOLS FOR VANETS
Before implementing VANET in the real world, it is necessary to perform a series of analysis to assessment it. These analyses can be posh and very complicated to come into all kinds of situations. In VANET, simulations are categorized into two forms which are essential for good operation i.e., network simulation and traffic simulation [2].

A. Network Simulation
Network simulation is normally inured to model computer network configurations long before they are implemented in actual world. With simulation, it is possible to contrast the performance of diverse network configurations, which makes it feasible to identify and solve concert problems. Numbers of network simulators are available, including freely available software’s such as NS-2, NS-3 and commercial tools such as OPNET2 [9].

B. Traffic Simulation
Most of the practical simulation of roaming nodes and their mobility should be deduce from the tracking files accessed in actual-world measurements. Though, full manage over all facet of the circumstances can easily be achieved if traffic simulation tools generate traces of movement. [9]. The process that takes a long time, from the collection of traces, from the analysis of data to the generation and implementation of models can finally make some investigations obsolete before they end. In our research work, we use mobility model generator for vehicles i.e. MOVE via promptly generate realistic models of mobility for VANET simulations. It is built on SUMO (SUMO Simulation of Urban Mobility). The result of MOVE incorporate information on actual vehicular actions that can be used instantly through suitable simulation tools [10].

IV. RELATED WORK
Numerous works are realized to propose a mobility model, as close as conceivable to the realistic case. In [10] author introduced a VANET tool MOVE with which users immediately generate realistic models of mobility for simulations of VANET. They also evaluated and compared ad-hoc routing performance analysis for vehicular motes with MOVE. And simulation outcomes access when motes are moving in a manner of realistic model of mobility is extensively dissimilar from the generally used random waypoint model. In [11] author offered a novel path for determining a realistic flow of traffic for traffic simulators, known as Flow Generator Algorithm. In [12] author presented a realistic model of mobility for VANET, which is based on actual street map information and on modeling of vehicles roaming on streets. Their model is able to use through simulation tools for further kinds of wireless networks. In [2], the authors compared the random model of mobility with the realistic model of mobility to examine its impact on the exactness of the simulation outcome. Our proposed models are location based realistic model of mobility and route based realistic model of mobility and these two models compared with the realistic mobility model.

V. OUR PROPOSAL
In our research work we proposed two models named as Location Based Realistic Model of Mobility and Route Based Realistic Model of Mobility. These two models help to overcome the routing problem which is encountered in existing Realistic Model.

A. Location Based Realistic Model of Mobility
In this model we turned number of nodes and also the number of connection from source to destination based on the same environment but we have to modernize the location in a realistic not a random. Realistic means in a real time environment how the vehicles are moving, what is the initial point and what about the destination point and currently where about the vehicles are moving and in which direction, so thus the speed and velocity is updating i.e. location based.

B. Route Based Realistic Model of Mobility
In this model, updating the velocity and speed allocating the route so the route function should be adapted on speed and location. After updating that location, which considered the speed and velocity, it updating the sum of routes i.e. how much routes are available. Because after the mobility only we come to know how much routes are available between source vehicle to destination vehicle.

With the help of flowchart our proposed work is carried out smoothly. The flowchart is represented in figure 2.

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With the help of flowchart our proposed work is carried out smoothly. The flowchart is represented in figure 2.
Select source node S, destination node D and routing table from S to D. 
Set k=1,path[j]; k is the constant value
Set j=1,Neighbor=0; j is the number of id
WHILE (Src!=D) do Src is the source node
Send route request RREQ[i] from source node S to its neighbor node and wait for route reply RREP[i].
IF(E[i] > = L[i])then //Location based routing E[i] is the initial energy 
Neighbor++,Fid++; Fid is the forwarder id 
ELSE 
Discard the packet.
Add Energy from S to D in Route[j] and fid++;
END WHILE
Output: Packet transmission from source node S to destination vehicle D.

D. Performance Metrics

Throughput: Average number of successfully packets which is delivered on the communication network is defined as throughput [13]. It is calculated as [14]
Throughput = Total Number of delivered packets * packet size*8 bit / total duration of simulation. (1)

Delay Calculation: Time which is required for the messages to be passed among nodes in a network. It actually refers the time taken of a packet of data to go from one node to other node [15]. This comprises all possible delays. It is calculated as:
\[ \text{End-to-end delay} = \left( \frac{1}{N} \right) \sum_{n=1}^{N} (RPN - SPn) \]
where SPn = Time at which nth data packet is sent
RPN = Time at which nth data packet is received
N = Number of data packets received
Packet loss: Packet loss is calculated as percentage of lost packets corresponding to the packets sent. It is calculated as [14].
Packet Loss Ratio (%) = (1- received packet/sent packet) *100 (3)

V. SIMULATION RESULTS

Simulation is categorized in two scenarios. In scenario I performance matrices dealing with number of nodes, while in scenario II performance matrices dealing with number of connections. We mainly worked on the three performance matrices i.e. throughput, packet loss and transmission delay which I already discussed in above section. Table 1 shows the simulation parameters.

Table-1: Simulation Parameters

| PARAMETERS          | CONFIGURATION          |
|---------------------|------------------------|
| Simulation Tool     | NS-3                   |
| VANET Tool          | Move With Sumo         |
| Graph Evaluation    | Gnuplot                |
| Simulation Time     | 15 sec                 |
| Packet Size         | 1024Kb                 |
| Number Of Nodes     | 10,20,30,40,50,60      |
| Number Of Connections | 5,10,20,40,60        |
| Mac Protocol        | 802.11p               |
| Mobility Model      | Realistic Model/Location based realistic model/ Route based realistic model |
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In realistic model the transmission delay is high, but in case of location based and route based realistic model this parameter decreases and better result is achieved. The outcomes obtained from the realistic model of mobility based on location and route is a better strength for simulation in VANET.

### TABLE - II: Packet loss of Scenario I

| No. of nodes | Location based realistic packet loss | Route based realistic packet loss | Realistic packet loss |
|--------------|-------------------------------------|----------------------------------|-----------------------|
| 10           | 0.30255                             | 0.4214                           | 0.955                 |
| 20           | 1.1781                              | 1.1221                           | 2.8992                |
| 30           | 1.4772                              | 1.6964                           | 3.942                 |
| 40           | 2.8341                              | 2.4789                           | 5.153                 |
| 50           | 3.7241                              | 3.0446                           | 5.988                 |
| 60           | 3.934                               | 3.2492                           | 6.032                 |

### TABLE - III: Throughput of Scenario I

| No. of nodes | Location based realistic throughput | Route based realistic throughput | Realistic throughput |
|--------------|-------------------------------------|----------------------------------|-----------------------|
| 10           | 6.6978                              | 8.3633                           | 3.873                 |
| 20           | 5.9842                              | 7.9479                           | 2.819                 |
| 30           | 5.6742                              | 7.3169                           | 2.4987                |
| 40           | 4.3971                              | 6.7758                           | 2.2873                |
| 50           | 3.5889                              | 6.2748                           | 1.8993                |
| 60           | 2.9372                              | 5.7835                           | 1.2081                |

### TABLE – IV: Transmission delay of Scenario I

| No. of nodes | Location based realistic transmission delay | Route based realistic transmission delay | Realistic transmission delay |
|--------------|---------------------------------------------|----------------------------------------|-------------------------------|
| 10           | 0.7873                                      | 0.9061                                 | 0.9846                        |
| 20           | 1.6074                                      | 1.125                                  | 2.3628                        |
| 30           | 2.2868                                      | 1.2428                                 | 3.5875                        |
| 40           | 2.1221                                      | 2.6399                                 | 4.8734                        |
| 50           | 3.6598                                      | 2.9309                                 | 5.3958                        |
| 60           | 9.7082                                      | 3.1949                                 | 6.128                         |

The three performance matrices that depend on number of connection are modified by keeping a steady number of nodes. Figure.6. represents the performance of packet loss by way of number of connections. In realistic model the packet loss is more in comparison to the location based realistic model and route based realistic model.

**Fig.5. Transmission Delay for scenario I**

**Fig.6. Packet loss for scenario II**

Throughput and the number of connection has an inverse relationship with each other. In realistic model of mobility the throughput is less on comparison of location and route based realistic mobility model.

**Fig.7. Throughput for scenario II**

Figure.8.represents the transmission delay variation by way of number of connections. In realistic model, transmission delay is more in comparison to the location and route based realistic mobility model.

**Fig.8. Transmission delay for scenario II**

B. Scenario.II
The same consequence derives from the scenario I. So our proposed mobility model provides the enhanced result of realistic model of mobility with the higher throughput along with the minimum packet loss and transmission delay.

**TABLE - V: Packet loss of Scenario II**

| No. of connection | Location based realistic packet loss | Route based realistic packet loss | Realistic packet loss |
|-------------------|-------------------------------------|---------------------------------|----------------------|
| 5                 | 1.3852                              | 0.0180                          | 2.133                |
| 10                | 1.4798                              | 1.2511                          | 3.066                |
| 20                | 2.4241                              | 1.9987                          | 4.295                |
| 40                | 3.7293                              | 3.3361                          | 5.04                 |
| 60                | 4.0292                              | 3.8783                          | 5.24                 |

**TABLE - VI : Throughput of Scenario II**

| No. of connections | Location based realistic throughput | Route based realistic throughput | Realistic throughput |
|-------------------|------------------------------------|---------------------------------|----------------------|
| 5                 | 6.9843                             | 8.3633                          | 3.54                 |
| 10                | 5.8923                             | 7.9488                          | 2.984                |
| 20                | 5.1259                             | 7.8699                          | 2.653                |
| 40                | 4.9465                             | 6.8623                          | 2.198                |
| 60                | 4.0978                             | 5.5792                          | 1.948                |

**TABLE - VII: Transmission Delay of Scenario II**

| No. of connections | Location based realistic transmission delay | Route based realistic transmission delay | Realistic transmission delay |
|-------------------|---------------------------------------------|----------------------------------------|----------------------------|
| 5                 | 0.927                                       | 0.3632                                 | 0.534                      |
| 10                | 0.0385                                      | 0.5185                                 | 1.034                      |
| 20                | 1.2716                                      | 1.2353                                 | 2.3528                     |
| 40                | 2.8161                                      | 2.5048                                 | 4.477                      |
| 60                | 3.0166                                      | 2.9319                                 | 6.1374                     |

C. Simulation Setup for Vanet tool

In our work, we use MOVE with SUMO for representing the road in real time scenario. With the support of NS-3 we only deals with vehicles which is represented in form of nodes. But with the traffic simulator it is easy to create the real view as in this vehicles are present. Following figure.9 explains itself the traffic scenario. In the region where the green light is blow, the vehicles passes and where the red light blow, vehicles stopped.

We generate this scenario with the help of MOVE. In MOVE, we generate the mobility model and with the support of configuration we able to see the real view in the SUMO.

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