Performance Evaluation of Vehicular Ad Hoc Network Using SUMO and NS2

Prashant Panse, Tarun Shrimali and Meenu Dave

Abstract In current scenario each and every person is anxious about security and privacy. Vehicular correspondences frameworks have ways to deal with give well-being measures and solace to drivers. Vehicular communication is based on wireless short-range technology that enables impulsive information interchange among vehicles and with roadside stations. A new type of network called vehicular ad hoc network (VANET) is available for providing alerts to the vehicles on highways. VANET is vehicular ad hoc network, in which mobile nodes are replaced by vehicles. Vehicular network is used to alert a driver so that accidents can be reduced and also avoid congestion on highways. This can be used for postaccident investigation as well. Frequently changing environment of VANET leads to various challenges. In this paper, the performance of vehicular ad hoc network is evaluated by focusing several key factors and reactive routing strategy.

Keywords VANET · Ad hoc network · D2ITS · ITS · AODV · Ultrasonic sensor · Roadside unit · SUMO · NS2

1 Introduction

In current years, three revolutions have been seen in vehicle development. It includes stronger engines, safety features, and most important is accident prevention using new technologies. Nowadays accident avoidance and prevention systems are used which is active and also help vehicles itself and drivers to avoid accidents.

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There are some passive safety devices available with active devices such as airbags, head restraints to reduce the severity of an accident. In today's scenario accident preventions systems are available which are based on V2V, V2I communication. These system names include electronic brake force distribution, infrared night vision systems. Following is a detail of examples of prevention system for accidents.

1.1 Driver Fatigue Monitoring

Due to exhaustion and fatigue, it may be possible that driver falls asleep while driving which results in accidents. The system developed to help drivers is a driver monitoring system which activates the autonomous emergency breaking when the recorded eye movement is mismatched to the routine eye motion. To do so, a sensor is embedded in eye gear to monitor eye movement. A threshold level of mismatch is set, exceeding of which causes an alarm sound to alert the driver [1].

1.2 Blind Spot Accident Prevention System Based on Sensors

In this system, when the obstacle or bystander is detected by the blind spot detection device, the device triggers a first level alarm. A second level of visual and capable of being heard alert is activated if the vicinity of hindrance is distinguished even after a period deferral of first level caution. The second level caution alarms the system administrator (operator) of the unsafe circumstance and the vehicle will stop naturally [1].

2 Evaluation of Accident Prevention Systems

It is beneficial to road safety by reducing accident numbers and the severity of accidents using advanced accident prevention systems. Also, there are a number of advantages for transport operators such as less vehicle downtime and lower insurance premiums. It is observed against most of the systems, that the main cause of an accident involving heavy commercial vehicles is not effectively targeted. The main causes of accidents according to ETAC study are: not respecting intersection rules, use of improper maneuver when changing lanes and nonadapted speed [1]. There may be considerable impact on driver vehicle communication due to non-coordination in development of various system, is another area of concern. In fact, driver may start ignoring warning signals if it occurs regularly. Similarly, transport operator's choice should be taken into account so as the prevention system are acceptable to them, as experience shows that these systems are not appreciated. Advance accident prevention system may contribute to false sense of safety, by which irresponsible driving offsets the safety benefits of the system. At last, research on accident prevention and piloting of technology is often used as a backdoor to the influencing and development of technical legislation, meaning there is a clear lack of transparency in the drafting of legislation.

3 Architecture of VANET

Vehicular ad hoc network is used for communication and cooperative driving between cars [1]. Vehicle-to-Vehicle (V2V) correspondence permits sharing the remote channel for versatile applications to plan the routes, controlling movement clogging, or activity well-being change, e.g., maintaining a strategic distance from accident circumstances [2]. For providing so as to diminish the quantity of lethal roadway mishaps early notices rising remote advances for V2V and V2R correspondence, for example, dedicated short-range communication (DSRC), seems quite encouraging. [3]. Broadcast method is frequently used in inter-vehicular communication (IVC) system.

Remote access in vehicular situations, characterizes structural planning for Astute Transportation Frameworks has received 802.11p, which is an amendment in 802.11 standard of IEEE for vehicular interchanges [2–4]. Figure 1 depicts the communication between multiple vehicles.

The development in wireless technologies has permitted researchers to devise communication systems where vehicles take part in the communication. On the off chance that vehicles can specifically correspond with one another and with foundation, an altogether new worldview for vehicle well-being applications can be

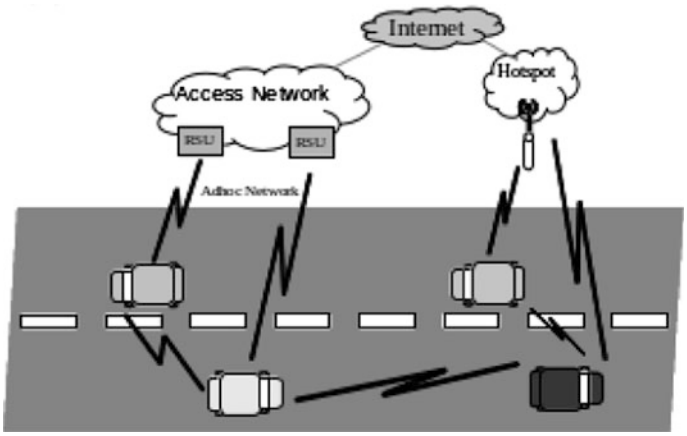

Fig. 1 Vehicle-to-vehicle reference architecture

made [5]. It also provides traffic alerts and information on time about jam; accidents on highway, increase road safety, and at the same time improve safe driving. Safety applications can be partitioned into active, passive, and proactive category [6]. Vehicular network permits correspondence among close-by vehicles and in the middle of vehicles and adjacent settled roadside equipment [7].

4 Simulation

Vehicular ad hoc network is simulated using SUMO and NS2 simulator. SUMO is an open-source traffic simulation tool. SUMO network consists of junction, edges, and nodes. SUMO network consists of node files (.nod.xml), edge file (.edg.xml), route file (.rou.xml), network file (.net.xml), and configuration file (.sumo.cfg.xml). In this paper road network is created using SUMO then we created traffic on this. Further, SUMO configuration is converted into tcl file and simulation is done in NS2. The sample file of implementation is shown below.

Sampleof new.nod.xml

```
<nodes>
<node id="node0" x="100.0" y="300" type="priority"/>
<node id="node1" x="500" y="300" type="traffic_light"/>
<node id="node2" x="100.0" y="600" type="priority"/>
</nodes>
```

Sample of new_EDGE.edg.xml

```
<edges>
<edge id="edgeS-0-1" fromnode="node0" tonode="node1"
priority="75"
nolanes="3" speed="40" />
</edges>
```

Sample of new12.net.xml

```
<routes>
<vehicle id="flow0_0" depart="0.00">
<route edges="edgeS-0-1 edgeS-1-0 edgeS-0-1 edgeL-1-4
edgeL-4-1 edgeS-1-0 edgeL-0-2 edgeL-2-0 edgeS-0-1 edgeL-
1-5 edgeL-5-7 edgeL-7-9 edgeL-9-7 edgeL-7-8 edgeL-8-7
edgeL-7-10 edgeL-10-7 edgeL-7-8 edgeL-8-7 edgeL-7-9
edgeL-9-7 edgeL-7-10 edgeL-10-7 edgeL-7-5 edgeL-5-6
edgeL-6-5 edgeL-5-6 edgeL-6-5 edgeL-5-1 edgeS-1-0 edgeL-
0-2 edgeL-2-0 edgeS-0-1 edgeL-1-3 edgeL-3-1 edgeL-1-3
edgeL-3-1 edgeL-1-5 edgeL-5-7 edgeL-7-9 edgeL-9-7"/>
</vehicle>
</routes>
```

Sample of SUMO configuration file new12.sumo.cfg

```
<configuration>
<input><net-
filevalue="/home/mitm/Desktop/PhD/new12.net.xml"/>
<route-files
value="/home/mitm/Desktop/PhD/new12.net.xml.rou.xml"/>
<additional-files value=""/>
<junction-files value=""/>
</input>
</configuration>
```

This configuration gives us result which shown Fig. 2.

4.1 Simulation Parameters

VANET is simulated considering various network parameters which are tabulated in Table 1.

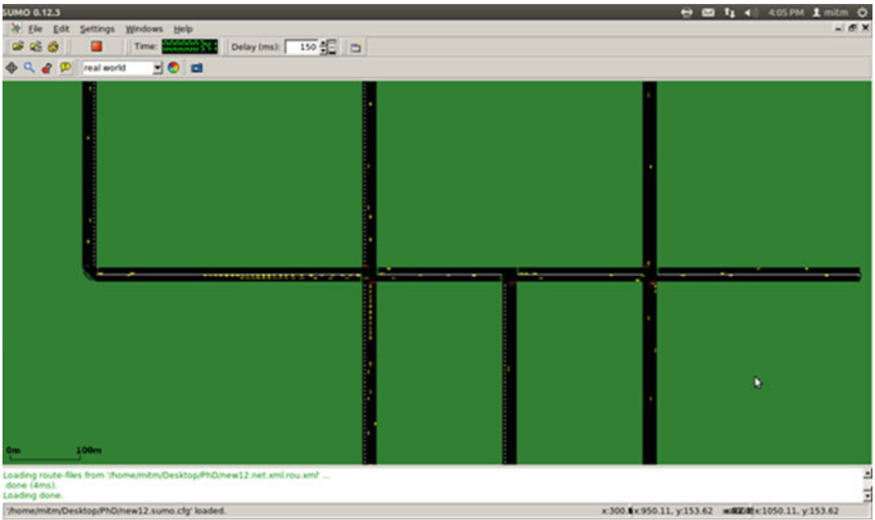

Fig. 2 SUMO scenario

Table 1 Simulation parameters

Parameters name	Parameter values
Number of nodes	20, 40, 60, 80, 100
Simulation time	985 s
Traffic type	CBR
Connection type	UDP
Routing protocol	AODV
Queue type	DropTail

4.2 Simulation Scenario

VANET is simulated considering different number of nodes such as 20, 40, 60, 80, and 100. VANET simulation scenario with 20 nodes is shown in Fig. 3.

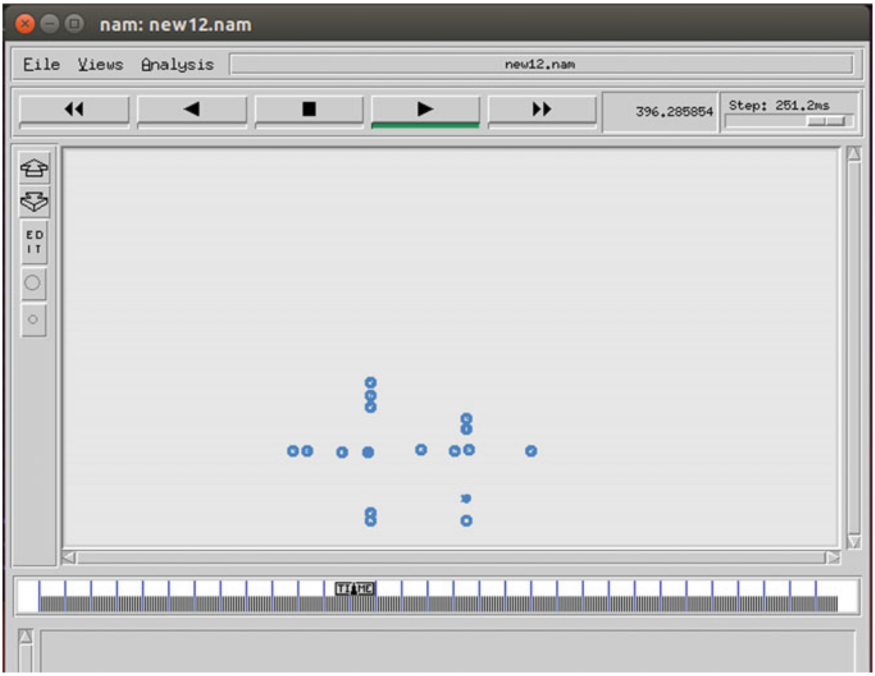

Fig. 3 Simulation scenario of 20 nodes in NAM

5 Result Analysis

The performance of vehicular ad hoc network is evaluated considering distinctive parameters, for example, data delivery rate, throughput, routing overhead, average end-to-end delay, and remaining energy, which are computed on the basis of simulation.

Throughput is defined as average number of bits, bytes, or packets per unit time (Fig. 4).

Data delivery rate is the ratio of received packet and sum of dropped and received packets in a network (Fig. 5).

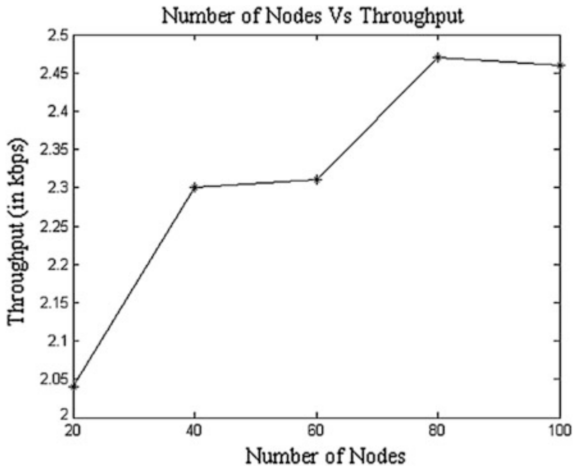

Fig. 4 Throughput versus number of nodes

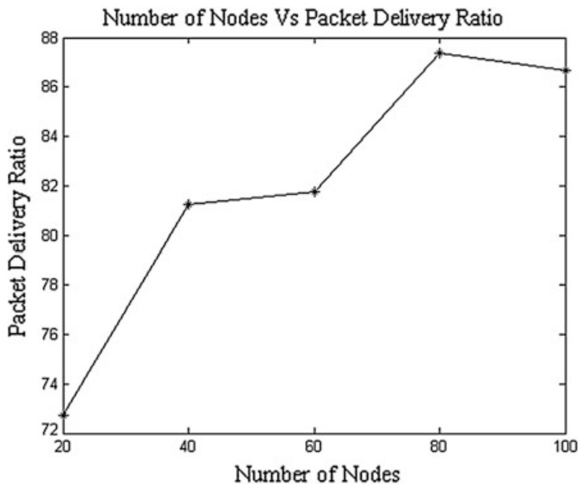

Fig. 5 PDR versus number of nodes

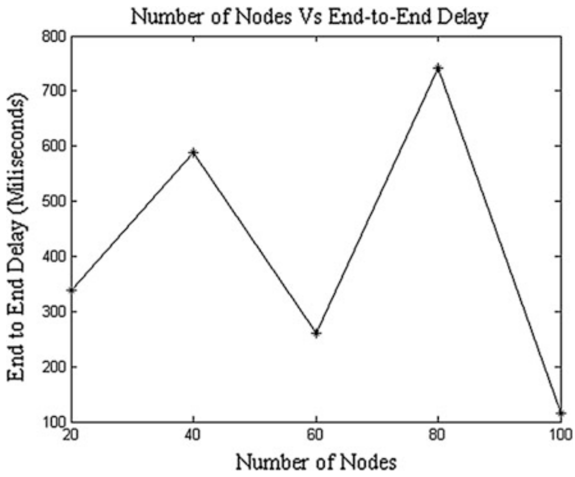

Fig. 6 End-to-end delay versus number of nodes

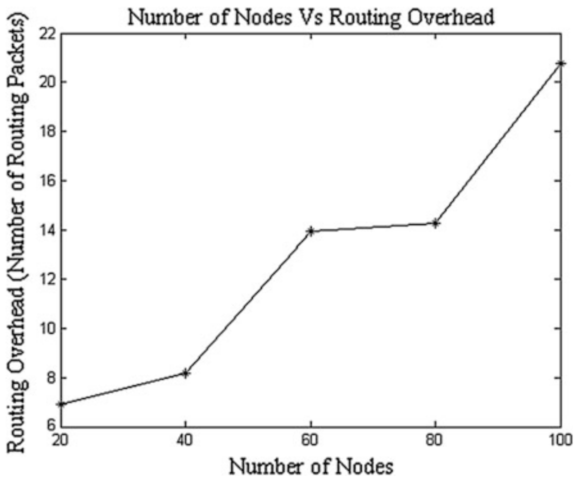

Fig. 7 Routing overheads versus number of nodes

End-to-end delay is the time required by a packet to reach its destination (Fig. 6).

Routing overhead is the total number of routing packets traversed in network over simulation time (Fig. 7).

Average remain energy is the average residual energy of network over simulation time (Fig. 8).

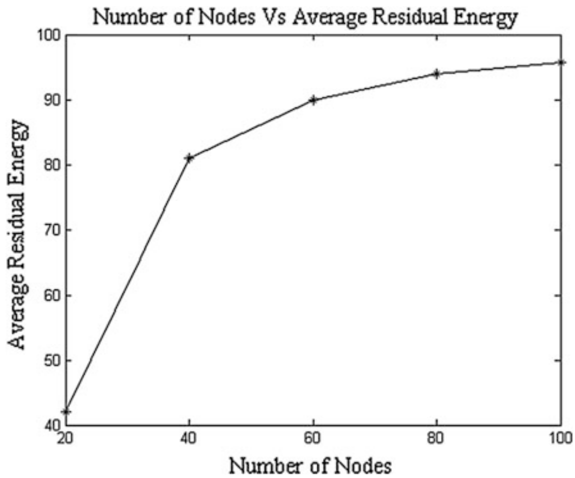

Fig. 8 Average remain energy versus number of nodes

6 Conclusion

Vehicular ad hoc network is simulated with different parameters. First, we created a SUMO network and a scenario for different number of vehicles, and then it is converted into tcl script using MOVE. We also evaluated performance of network based on throughput, end-to-end delay, average residual energy, packet delivery ratio, routing overhead using AODV protocol in NS2.

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