On Selection of Efficient Protocol for Mobile IP Enabled VANET through Realistic Channel

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Abstract

Vehicular Ad Hoc network is a versatile mobile wireless Ad-Hoc network targeted to support traffic monitoring, vehicular safety and many more applications. For the robust and reliable services in the VANET there is need for selection of efficient protocol to check the performance under frequent handovers in Mobile IP to prevent packet loss. Mobile IP is an interface that helps to track the mobile nodes and deliver messages even if vehicles are out of the coverage area of home node. In order to find the achievable performance bounds in terms of throughput, packet drop, collision rate and packet broadcast rate, extensive simulations have been done. A realistic city scenario has been proposed here by using the rician channel simulator, mobile IP enabled IEEE 802.11b OBUs and RSUs. The transmission speed levels of vehicles have been varied to obtain the optimum performance through realistic conditions. Simulations are performed using NCTUns6.0 (National Chiao Tung University Network Simulator) in mobile IP interface.

Keywords

VANET, Mobile IP, NCTUns6.0, 802.11b, Ricean Fading, Speed, AODV, DSDV.

I. Introduction

Vehicular networks are envisioned to provide cost effective and scalable solutions for applications like traffic safety, infrastructure based infotainment applications, dynamic route planning and using context aware advertisement for short range wireless communication. Considering the race between deployment of supporting infrastructure and continuous increasing access demand, user applications availability has been extended to multiple mobile IP communications through infrastructure to vehicle to vehicle (I2V2V) communication in VANET. Inter Vehicle to Vehicle (I2V2V) communication provides convenient solutions for continuous access to IP services in VANET through mobile IP channel. However in I2V2V communication many challenges arise in the provision of providing seamless communication. Firstly, due to frequent changing dynamics of vehicular network vehicles may transfer their active connections through different IP access networks like in mobile IP interface. This result in affecting the ongoing IP sessions by change in IP addresses which results to broken connections. Secondly due to link variability in the presence of asymmetric links results to complex seamless communication.

Routing and frequent handovers in signals are core problems in vehicular networks for sending data from one node to another. Handover occurs when one mobile node (MN) moves from one access point to another by changing its point of attachment. Mobile IP is an interface which incorporates handover process in six phases: triggering, discovery, authentication, association, IP address acquisition and finally home agent registration [9]. Yet for the reliable and robust services in VANET there is necessity to investigate the performance under frequent handovers which leads to packet loss.

Mobile IP addressing and routing solutions for vehicular environment have been studied from different perspectives. A number of evaluations have been incorporated in the last few years, yet very limited work have considered mobile IP framework for systematic performance evaluation. A multi hop authentication proxy mobile IP scheme has been proposed in [7]. This scheme is designed for enabling secure roaming of IP applications in Mobile IP vehicular environment. Both numerical and experimental simulations are performed on realistic highway scenario which shows the effectiveness of MA-PMIP to establish low packet loss. The idea of using Multi protocol label switching (MPLS) with mobile IP in [2] is used to gain better QoS in VANET. Due to unreliability in V2V communication, a method is proposed to send data to the nearest base station through MPLS domain which results to increase packet loss and throughput. Yet no positive change is noted in case of delay. Although performance investigation have been reported taking into account the mobile IP framework in the past [3][5] but the work is only limited to ideal channel conditions. Also no work has incorporated the selection of efficient protocol for mobile IP enabled 802.11b standard. In order to investigate the performance of VANET using mobile IP enabled nodes through realistic channel conditions work has been presented here. In doing so ricean channel simulator has been incorporated using selection of efficient protocol by varying the speed level. So this work intends to extends the work related to evaluating the QoS parameters through ricean fading channel for creating realistic situations unlike the previous reported work that was only limited to ideal channel moreover the speed is varied in both proactive and reactive routing environment to compute the QoS parameters.

The rest of the paper is structured as follows: In section II throws light on the background related to VANET framework. Section III presents brief overview of the simulation methodology used. Section IV shows the results obtained in with variable speeds for both protocols in ricean fading environment under results and discussion. At last section V concludes the paper.

II. Background

A. Routing Protocols

Traditional routing protocols for mobile ad- hoc network has been analyzed in VANET environment and demonstrated that the performance is very poor in VANET platform. Route instability is the core problems with these protocols in VANET environment which leads to packet drops, low packet delivery ratio, increase overheads, high transmission delays that makes efficient designing of routing protocols for VANET more challenging. The routing protocols in VANET are grouped into five classes such as position based, topology based, cluster based, geo cast based and broadcast based [16]. Yet these approaches have their own pros and cons and no single routing protocol is able to perform efficiently in all realistic scenarios. Proactive and reactive protocols AODV and DSDV have been incorporated in simulative investigation with varying speed in realistic scenario.

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1. Reactive Routing Protocol (AODV)

Ad-Hoc on Demand Distance Vector routing protocol belongs to reactive routing family in which it begins route discovery whenever a node wants to communicate with another node and route assurance is performed on demand basis. This reduces unnecessary flooding of RREQ, route redundancy and requirement of large memory. AODV is used to regulate the mobile traffic as it uses time to live (TTL) in IP header to regulate the search.

2. Proactive Routing Protocol (DSDV)

Destination Sequence Distance Vector protocol comes under proactive family. These protocols are mostly based on shortest path algorithm keeping information of all connected nodes in form of tables as their protocols are table based. DSDV protocols do not require route discovery and any change in the network is broadcast to every node of the network.

B. Fading

Fading means rapid fluctuations of the phases, amplitudes and multipath delays of a radio signal for either short duration or short travel distance. Speed of vehicles, multipath propagation, speed of surrounding objects, transmission bandwidth of the signal are the various factors influencing fading in the radio propagation channel. In NCTUns 6.0 three types of fading models are incorporated namely no fading (AWGN), rayleigh and rician fading. In this paper we focus on rician fading where there is both LOS and non-LOS path between transmitter and receiver. The resultant signal has both direct and scattered multipath waves. Later research focuses on incorporated AODV and DSDV protocol in ricean fading.

III. Simulation Methodology and Environment

In order to compute the desired performance bounds for the selection of efficient protocol for mobile IP enabled VANET through realistic channel conditions the following simulation scenario and methodology has been presented in this section. Simulator provides easy to use GUI based network tool to design and simulate network with SNMP, Telnet, FTP, Cisco IOS devices. In VANET simulators requires both traffic and network simulation capabilities. NCTUns 6.0 provides simulation platform in this research work.

A. Performance Parameters

The following QoS parameters are used to evaluate the performance bounds of VANET in mobile IP interface by varying speed.

- **Packet drop ratio** is the ratio of total number of packets unsuccessful to reach to destination to the number of packets send by the sender.

$$\text{PDR} = \frac{(\text{n Packet Sent} - \text{n Received Packet})}{(\text{n Packets sent}) * 100}$$

- **Collision rate** metric defines the number of packets collides to each other due to reasons like congestion, frequent fading, queue overloading and varying threshold total number of packets collide per second. High collision rate affects the performance directly on the bandwidth.
- **Throughput rate** defines the average number of successful packet delivery on a communication network. It defines as the total number of packets received at destination out of total packets transmitted. Throughput is calculated in data bytes per second (Bytes/sec). In NCTUns6.0 the simulation result for throughput is calculated from the mathematical formula:

$$\text{Throughput (KB/sec)} = \frac{\Sigma\,(\text{Number of successful packets reach at destination}) * \text{Packet size}}{\Sigma\ \text{Simulation Time}}$$

- **Broadcasting rate** highlights the broadcasting of incoming and outgoing packets on a particular network interface.

B. Simulation Scenario

Simulation scenario created using draw topology feature in the project workspace provided by NCTUns 6.0. Using mobile IP interface variable speed features are taken under consideration. Mobile nodes have been incorporated to provide vehicular connections in the network. Roads are designed according to real situation for the successful movement of vehicular nodes. Two ray ground propagation model is used for accurate prediction for even long distances than free space model. Using edit properties feature in workspace of NCTUns desired parameters are set. Different RSU have provided different values of provider service identifier. When mobile nodes (OBU) come in range of RSU then it takes just 1 second to register to that RSU. Dynamic path movement is incorporated to move vehicles to desired direction at any time. Following commands are used in application table of mobile nodes and PC to generate traffic.

Table 1: Passing Command Between MN (Mobile Node) and PC.

Identification	Command
Traffic generation command at sender side	Stcp –i stcp.conf 1.0.7.1 –p 2007
Traffic generation command at receiver side	Rtcp –u –w log1 –p 2007
Moving vehicle command	Car Agent

Stcp (Send transmission control protocol) and Rtcp (Receiver transmission control protocol) are used to generate greedy TCP traffic. They support real time conferencing of groups like traffic source identification, multicast to unicast translators and many more. Specifications of node information of scenario are listed in the table below.

Table 2: Node Information of the Scenario

Node ID	Node Identification	Node Description
Node 22,23,24,25,26	OBU (For moving nodes)	Car Agent moving command is used in application phase of IEEE 802.11b OBU to generate traffic and all nodes generate traffic at receiver using rtcp command.
Node 6,7,8	RSU (Road side units)	3 subnets are created, provider service information table is set with 1 second interval and home agent and foreign agent is set in mobile IP section.
Node 2,3,4,5	Router	All RSU's are connected with router.
Node 1	PC	It generates traffic at sender side by using stcp command.
Node 9	WLAN Infrastructure mobile node	It helps to connect mobile and infrastructure nodes to send information.

Various simulation parameters used in physical layer and channel model are deployed according to the channel requirement as shown in table below.

Table 3: Simulation Parameters

Parameters	Values
Frequency (MHz)	5860
Fading Variance	8.0
Fading	Ricean
Path loss model	Two Ray Ground
System Loss	1.0
Transmission Power (dbm)	17.0
Threshold (dbm)	-73
Antenna Gain (dbi)	1.0
MAC protocol	IEEE 802.11b
Traffic tool	Stcp, rtcp
Mobility Model	Manhatten Grid
Speed (Kmph)	35, 70
Simulation Time (sec)	100
Data Rates (Mbps)	8, 16
Communication	Full Duplex
Bit Error Rate	0.01

Using aforementioned simulation parameters simulations are performed using 'run' interface available in NCTUns 6.0 toolbar workplace.

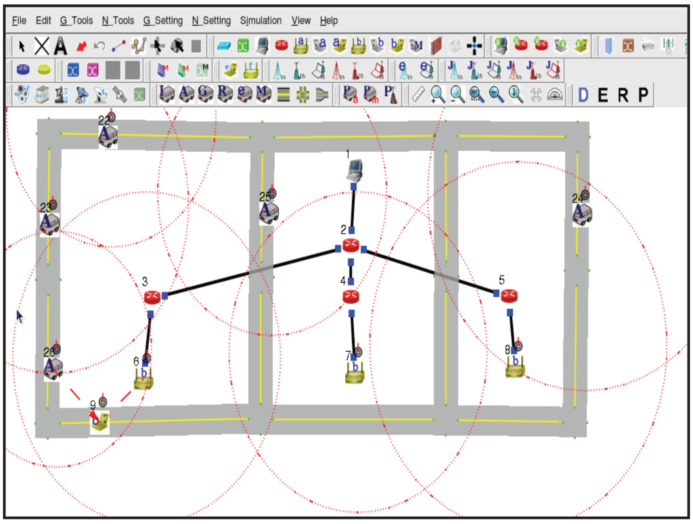

Fig. 1: Mobile IP Scenario with OBU at Home Network

IV. Result and Discussion

This section highlights the conducted numerical results obtained from the evaluation of QoS parameters in mobile IP interface for the selection of efficient protocol. Subsection A shows the effect of changing speed taking AODV routing protocol in mobile IP environment while subsection B shows Some light on effect of changing speed for DSDV protocol in realistic mobile IP environment. Ricean realistic fading is induced in both subsections.

A. Effect of Changing Speed for AODV Protocol

The performance is examined in mobile IP environment to check how variable vehicle speed affects the performance of AODV routing protocol. In this scenario two different situations where speed 35m/sec and 70m/sec are incorporated. Only values up to 30 seconds are taken in figure, yet table IV describes various average values up to 100 simulation time. Packet drop ratio of AODV for variable speed parameters are shown in fig 2(a). During simulation two values of speed 35m/sec and 70m/sec are incorporated. It has been examined that for speed of 70m/sec packet drops are slight higher by 12.81% than 12.11%. Packet delivery ratio is affected here due to greater packet drops. Fig 2(b) highlights the effect of collision rate on both speed values. As greater the collision rate greater will the packet drops this leads to downfall in performance. It has been examined that for speed of 70m/sec a sight higher rate of packets collision rate is calculated than for 35m/sec value. For speed of 70m/sec the collision rate has average value of 1.21% slight higher than 1.12%. Fig 2(c) shows some light on the throughput rate of incoming and outgoing packets for both speed values. This figure examined that for speed of 70m/sec the average value is 2.56% greater than 2.49% of 35m/sec. As higher the throughput rate greater will be the productivity. Fig 2(d) gives the view of broadcasting rate of incoming and outgoing packets of both speed values. Yet for speed of 35m/sec the broadcast rate is much higher by 18.09%. The main accent of these results is that for speed of 70m/sec the throughput is higher yet packet loss is slight higher.

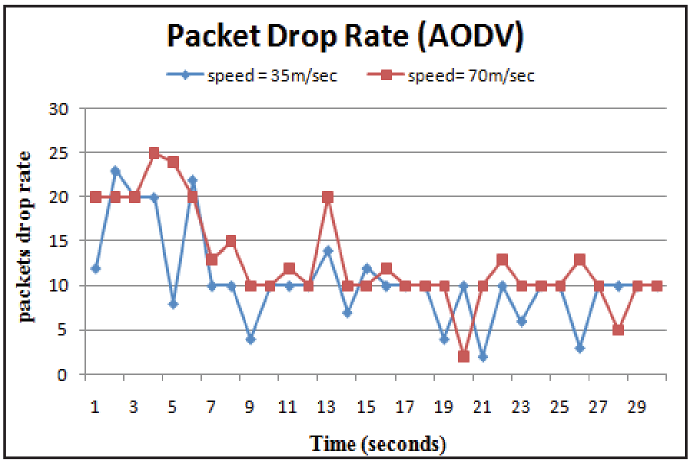

Fig. 2(a): PDR Ratio of AODV in Mobile IP Environment for Both Speed Values

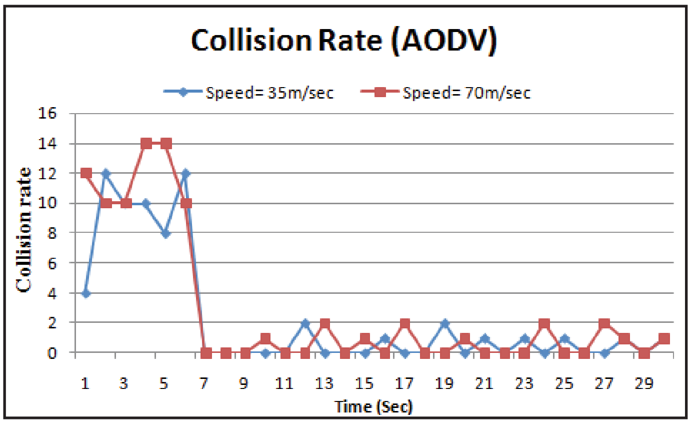

Fig. 2(b): Collision Rate of AODV in Mobile IP Environment for Both Speed Values

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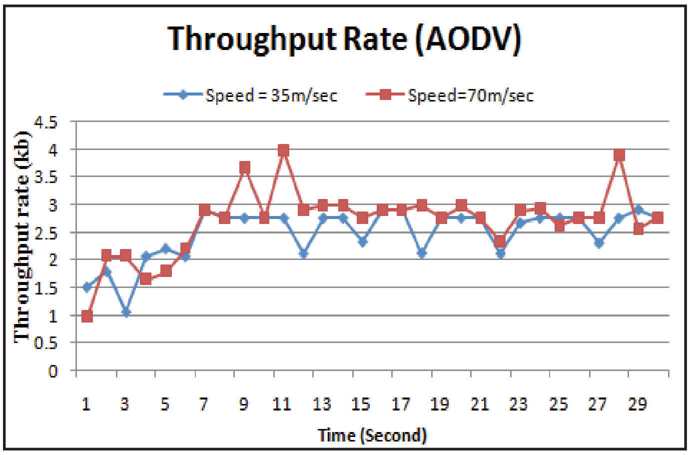

Fig. 2(c): Throughput rate of incoming and outgoing packets for AODV in mobile IP environment for both speed values

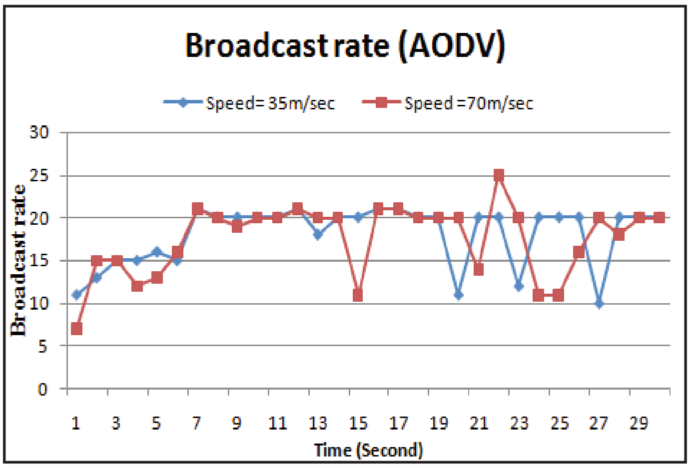

Fig. 2(d): Broadcast rate of incoming and outgoing packets for AODV in mobile IP environment for both speed values

B. Effect of Changing Speed for DSDV Protocol

This subsection shows the effect of changing speed of mobile nodes for DSDV routing protocol. The performance is examined in mobile IP environment to check how variable vehicle speed affects the performance of DSDV routing protocol. Vehicle speed with 35m/sec and 70m/sec are incorporated in these scenarios. Fig 3(a) shows packet drop ratio for both speed values and it is examined that for speed of 70m/sec the packet drops are much higher by 18.35% than 13.29%. As we know that packet drop increases then packet delivery ratio is affected and throughput decreases. Fig 3(b) throws some light on collision rate generated in the scenarios for both speed entities. The average values of both speed entities are taken and examined that for speed of 35m/sec the collision rate is higher by average value of 2.84% much higher than the other one. The impact of greater collision rate directly affects the throughput. Fig 3(c) presents the throughput rate of incoming and outgoing packets for both speeds. It has been evaluated that for speed of 70m/sec the throughput rate is higher by average value of 2.36%. Clearly it can be depicted that from the table IV that throughput rate is higher for vehicle speed of 70m/sec. The increase in throughput rate shows higher productivity and greater packet delivery ratio. The last QoS parameter throws some light on the broadcasting rate of incoming and outgoing packets. The average value for speed of 35m/sec has greater broadcasting rate by 19.03% than 18.28%. The accent of the results for DSDV protocol for variable speed depicts that for speed of 70m/sec the results are more preferable and yields in greater performance.

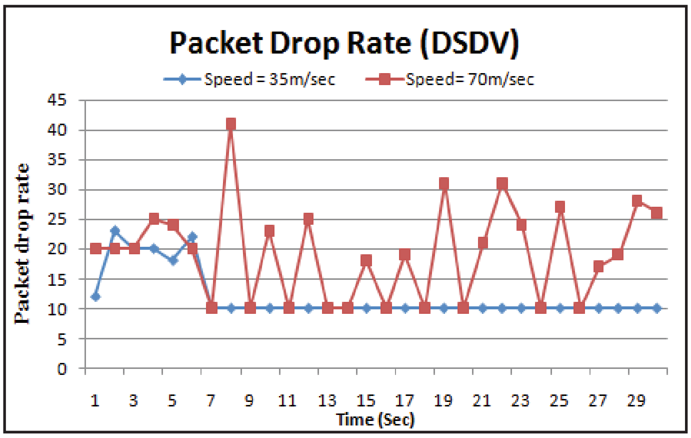

Fig. 3(a): PDR Ratio of DSDV in Mobile IP Environment For Both Speed Values

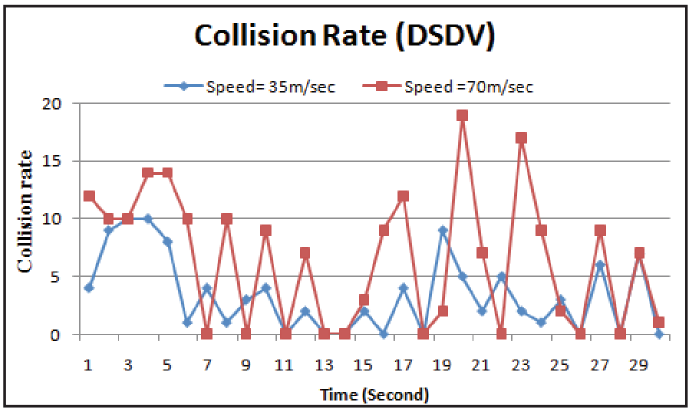

Fig. 3(b): Collision Rate of DSDV in Mobile IP Environment For Both Speed Values

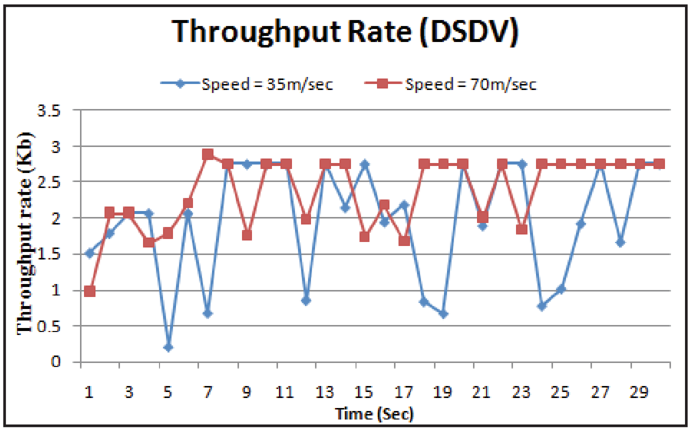

Fig. 3(c): Throughput Rate of Incoming and Outgoing Packets of DSDV in Mobile IP Environment for Both Speed Values

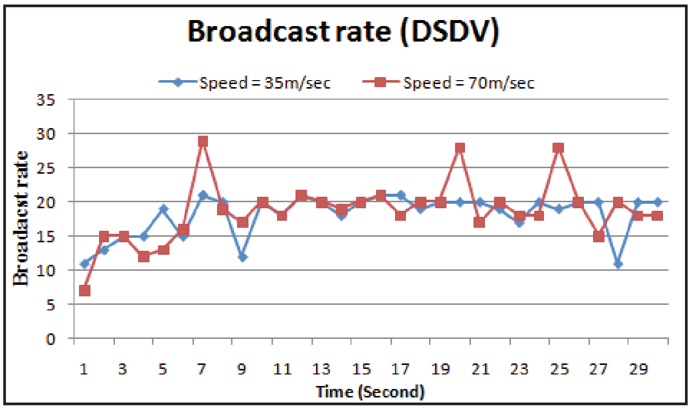

Fig. 3(d): Broadcast Rate of Incoming and Outgoing Packets of DSDV in Mobile IP Environment For Both Speed Values

Table 4: Simulation Results of Different Speeds in Mobile IP Environment

Different average values in mobile IP environment				
	AODV		DSDV	
	Speed= 35m/sec	Speed= 70m/sec	Speed= 35m/sec	Speed= 70m/sec
Packet drop ratio	12.11	12.81	13.29	18.35
Collision rate	1.12	1.21	2.84	2.57
Throughput rate (Kbps)	2.49	2.56	2.09	2.36
Broadcast rate	18.09	17.95	19.03	18.28

V. Conclusion

The main accent of this paper is to analyze the performance of QoS parameters for VANET in mobile IP environment using IEEE 802.11b MAC standard for both routing protocols using different speed values. This research work emphasis on selection of efficient routing protocol in Mobile IP environment even in realistic conditions. Using AODV routing protocol different speed values are evaluated and concluded that for 70m/sec speed the throughput rate is higher which helps to increase productivity and packet delivery ratio. Yet there is slight downfall in ratio of packet drops. Whereas the simulation results of DSDV routing protocol also shows acceptable improvement of performance for vehicle speed of 70m/sec. All the average values are calculated and evaluated that the throughput rate is higher for 70m/sec speed by 2.36%. Yet broadcast rate is greater for the other case. This concludes that even if we increase speed there are vibrantly good results for higher vehicular speed. Yet the efficient protocol for selection of routing protocol in mobile IP environment is AODV as throughput rates are vibrantly greater even we increase the speed. All the simulation results are incorporated using 100 simulation time and average values are calculated. These simulation results shows acceptable improve of QoS parameters in terms of throughput, packet drop and collision rate. VANET is a vast field and attracted much attention from research community, yet some issues need to be resolved like delay and improved path connectivity.

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