J. Basic. Appl. Sci. Res., 4(9)103-113, 2014
© 2014, TextRoad Publication

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Network-Congestion Based Traffic Investigation for Estimating QoS in Vehicular Ad Hoc Networks Using Diverse Routing Protocols

Ishtiaque Mahmood[1], Ahmad Khalil Khan[2], Samiuddin Mohammed[3], Shaik Azmath Ali[4], Zeshan Iqbal[5]

[1,2]University of Engineering and Technology Taxila, Pakistan
[3]College of Applied Sciences Ibri, Oman
[4]7th October University, Libya
[5]COMSATS Institute of Information Technology Attock, Pakistan

Received: June 5, 2014
Accepted: August 14, 2014

ABSTRACT

Vehicular Ad hoc Networks (VANETs) are the networks of next generation embedded in vehicles getting focus of researchers due to their wide applicability. VANETs are ad hoc but they are different from MANETs in many aspects like there is no power and computational constraints issue in VANETs. VANETs may be very large scale and nodes move in some organized fashion. In future VANETs communication capabilities will be available almost in all vehicles to make them part of existing network. So people are expecting and efforts are being made to provide all kind of services to VANETs users belonging to safety and comfort. As VANETs are different from MANETs in their nature, so existing communication and routing protocols of MANETs are not entirely suitable for this new kind of mobile networks and new communications and routing protocols are being optimized. In this paper we have made analysis of different existing routing protocols that in case of congestion, these protocols are how much reliable for safe data delivery in VANETs environment and what QoS can be achieved up to which extent.
KEYWORD*:* VANETs, Routing, Wireless Traffic, Vehicles speed, QoS

1. INTRODUCTION

VANETs are thought as subclass of MANETs, as nodes are mobile in both types of wireless networks. [1] But VANETs have many different features as compared with MANETs in terms of architecture, communication and network organization. VANETs are becoming hot topic for future research as use of cars at present is being increased day by day and to addresses issues of accidents, bad road conditions etc. Researcher and scientists are giving more attention to this new type of wireless communication. Also it provides many services related to comfort like searching of hotels, parks, watching multimedia contents and any other thing while on move. In VANETs, we have two types of communications i.e. communication between moving vehicles, also referred to V2V and communication between vehicles and road side unit (RSU) referred to vehicle to road side unit (V2R) or vehicle to infrastructure (V2I). When a moving vehicle comes within the wireless range of other vehicle, then an ad hoc network is formed between these two vehicles and they can exchange information like road maintenance, traffic congestion, suggestion about alternate route and information about any accident. VANETs are normally referred to large scale. Wireless network since there may be hundreds of Thousands of vehicles at any given Time, actively participating in network activity. [2] Every single vehicle not only transmits the information which it acquired but also it forwards the information obtained from the other vehicles, so every vehicle, sometimes known as node, works as a router as well. This routing should be done intelligently in order to get low end-to-end delay. Since links breakage occur very frequently in VANETs due to the fast movement of wireless nodes, hence robust and reliable routing is required in order to experience seamless connectivity. As there is no issue in vehicles regarding power, storage and processing, so complex algorithm can be run for routing to estimate the more proper links for communication purpose. [3] End-to-end delay is critical in moving nodes since it may take time for a node to search for another node to get its required information, in such scenarios RSU plays an important role and information collected from nodes passing by it, may be cached and provided to other nodes that

***Corresponding Author**: Ishtiaque Mahmood, Department of Computer Engineering, University of Engineering and Technology, Taxila, Pakistan.

needed. RSU may also be connected to gateway and using public network with other RSUs. RSU have many routing protocols running in parallel for calculation of best path to provide to vehicles

2. RELATED WORK

Hsieh and Wang discussed the issues of multicast for multimedia traffic [4]. As providing QoS (quality of service) is challenging task in VANETs, especially in case of live multimedia traffic, where end-to-end delay matters a lot, they device a technique known as 'dynamic overlay multicast' in which the non-group nodes also participate in disseminating the multimedia contents and as a result better QoS is achieved. In [5], overall delay is reduced with the help of MPLS (multiprotocol label switching). MPLS is used here for fast forwarding of packets having label between layer 2 and layer 3, since IP routing may take more time than usual while traversing the whole routing table but MPLS tags are small numbers and can be processed more fastly. MPLS in used in RSU backbone. But applying MPLS in wireless network having high mobility is difficult to use and good results cannot be obtained. [6] Uses intelligent RSUs to provide assistance in routing, there can be multiple routing protocols in operation in parallel for building and maintaining routing tables to assist the nodes passing by it and for sure, RSUs don't have any constraint in terms of storage, power or processing. At any given time, RSU can be in contact with many nodes to exchange the information, so it has broader view of network conditions as compared with other moving nodes, who may have limited view about network and available links. In [7], work is focused on configuring and tuning the parameters of FTP (file transfer protocol) for getting better results in downloading and uploading the data. They optimized the FTP for VANETs environment and showed good results, while minimizing the overall delay. They used different algorithms for optimization e.g. GAs (genetic algorithm) and PSO (particle swarm optimization). They conducted simulations for urban and rural areas and showed that these optimization techniques worked well. [8] Tried to solve the issues of multicast traffic using bee-life based optimization technique. They used this technique in the selection of best path and claimed that they optimized the transmission cost, delay, jitter and bandwidth and realistic metric values based on this algorithm. In [9], authors used cross-layer technique to control the QoS. They worked on MAC (medium access control) layer to get probability and estimation of link quality and also on Transport layer to control the flow. So information about the quality of link can be directly passed to transport layer and flow of data can be controlled accordingly. They showed that for multimedia traffic this method works well. [10] Works on a new application being introduced in VANETs, after conducting research on available bandwidth and other required features. This new application known as 'multi-player gaming' demands strict QoS parameters in order to work properly. Authors claim that they developed new paradigm according to which it is possible to run such kind of multipoint applications even in VANETs environment. In [11], work has been done to improve the handoff. As RSU are expensive to install, so here authors try to give responsibilities of RSU to the individual vehicles for calculating their preferences, time required for transmission and so on. So the work of RSUs is distributed among the moving vehicles and overall cost is reduced. [12] Proposes extension in existing 802.11p to provide more comfort related applications, as VANETs mostly caters for the safety related application. A user who is driving the vehicle will wish to have fast internet speed in the car, wish to have multimedia live streaming, and low delay, jitter and seamless connectivity. So authors try to address these and some extensions are proposed. [13] Proposes new routing protocol which studies the behavior of the vehicle and suggests the best routes based on this. Authors concluded that different vehicles have different moving behaviors depending upon the person who is driving that particular vehicle. In this way the route with longest life time can be suggested to any vehicle for further communication. In [14], authors propose a new technique to discover network topology. The available network is divided into clusters and then best path is selected for data routing. They claim that in large networks, it not only converges fastly even it reduces the consequences of vehicle mobility while controlling the packet, routing and other overhead. [15] Works on a scheme for selecting the best available gateway for data transmission. They worked on hybrid network i.e. ad hoc and LTE (long term evolution) cellular network. While a vehicle is moving towards its destination it may have many gateway to select for. Authors claim that this new technique helps in selecting the best gateway for transmission depending upon the network being used, amount of data being transmitted and speed of the vehicle. It also caters for the signal strength and cluster in which the vehicle is currently present then finally decision is taken. In [16], authors have tried to address the issues of comfort applications. They strained to provide internet services by proposing extension in existing 802.11 standard. They focused their work on medium access layer (MAC) to enhance QoS so that optimal path could be selected to satisfy needs of bandwidth hungry applications. Also they embedded prediction based routing in their work to get good prediction about future routes and situations. Their results they provided shows that overall bandwidth is managed properly and packet drop ratio is also reduced. [17] Uses hybrid wireless network for VANETs i.e. wireless ad hoc network and wireless mesh network. Moreover they used geographical routing technique to provide location based routing in which routing advertisement also have the locations of related vehicles. In this technique the VANET depends on both wireless mesh network and also wireless ad hoc network. They claimed that overall delay and packet received ratio is improved with this method. [18] Took into account different mobility patterns to analyze the QoS. For larger network like WiMax, they used different protocol and for small network, they used different protocols. Also they used different protocol for different number of users present at the moment in the network. They also tried to use and enhance adaptation modulation and coding techniques to address the issues of QoS. With the help of results they showed that their mobility models are more accurate and provide required Qos. In [19], authors focused their work on improving the load balancing technique for selection of better gateway in order to send the traffic without delay and loss. The vehicles will be able to request certain services from the gateways based on their QoS requirements and if required services are available from the gateways then they can send their data. They showed their experimental data and results and expressed that is better way to provide QoS in fast mobility setting.

3. PROPOSED WORK

From the related work, it is clear that there are no standard solutions for providing and managing QoS in VANETs to date and it would be better that if we could use existing MANETs routing protocols in VANETs environment according to situation and requirement. In this paper, we investigate the performance of diverse routing protocols and overall end-to-end delay in VANETs for congested network. Vehicle speed is also taken into account while considering the QoS, based on any particular routing protocol. We form a vehicular network by creating 40 mobile nodes in ad hoc fashion as shown in figure 1. Then data is collected from this network at the speed of 50km/s and with different routing protocols. Performance criteria is based on number of packets sent, number of packets received, number of packets dropped, end-to-end delay and variation in end-to-end delay i.e. jitter. We used ad hoc on demand distance vector (AODV), optimized link state routing (OLSR), dynamic source routing (DSR) and temporally-ordered routing algorithm (TORA) for estimation of QoS. Simulation time is thirty minutes for all protocol under test. Finally 03 random vehicles will be selected for traffic analysis.

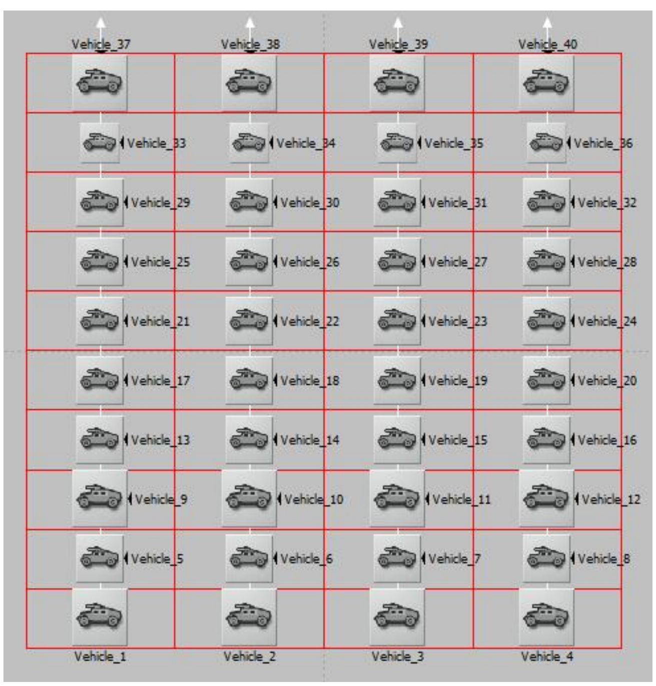

Fig. 1 formation of VANET

A. Traffic Analysis with AODV

Simulations were run with the speeds of 50km/s using AODV in order to acquire the best possible results. Random destination vehicles will be selected in order to send data and then required parameters will be calculated. End-to-end delay of randomly selected source and destination is shown in figure 2, it varies from .001 to .01 seconds but there are some surges when this delay is increased up to .055 seconds. Variation in end-to-end delay is shown in figure 3 and it is clear from the figure that variations in end-to-end delay is from .005 to .0055 seconds. But like end-to-end delay, here also there are spikes when this variation is increased up to .055 seconds. Packet drop ratio using AODV is shown in figure 4. And it shows that packet drop ratio is almost zero. Packets received and sent ratios using AODV shown in figure 5 and 6 respectively and it is clear from the figure that all the vehicles are getting fair chance for packets transmission and reception.

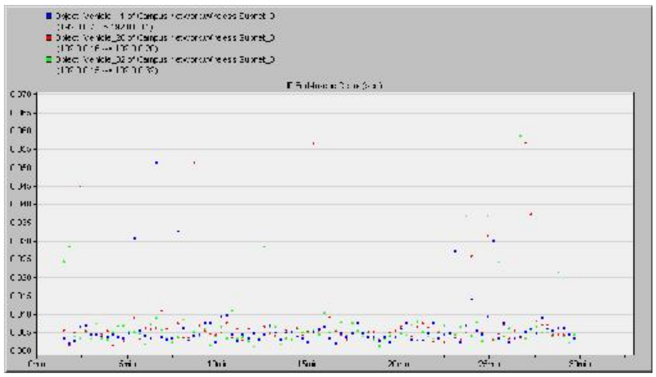

Fig. 2 end-to-end delay between randomly selected source and destination using AODV

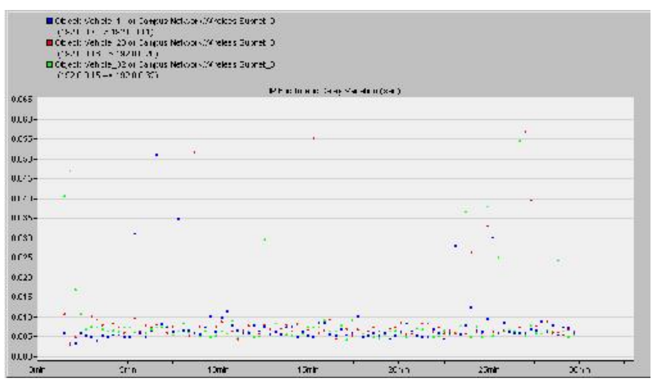

Fig. 3 variations in end-to-end delay between randomly selected source and destination using AODV

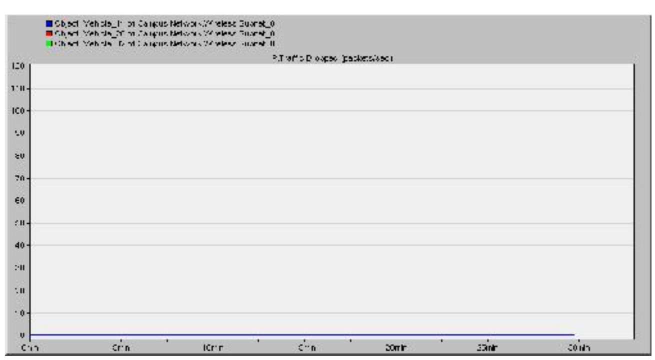

Fig. 4 packet drop ratio between randomly selected source and destination using AODV

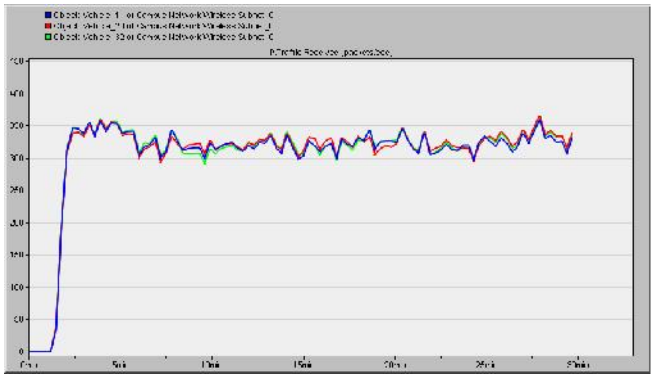

Fig. 5 packet received ratio between randomly selected source and destination using AODV

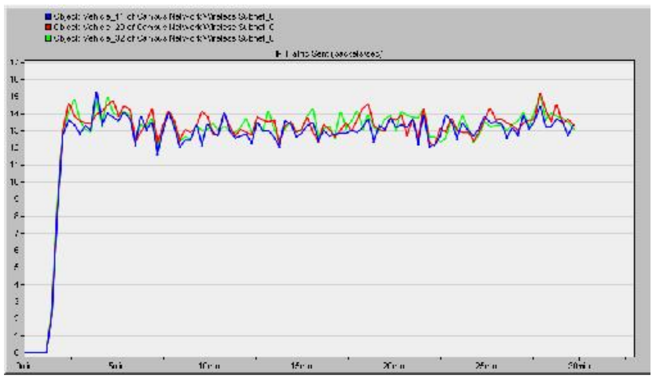

Fig. 6 packet sent ratio between randomly selected source and destination using AODV

B. Traffic Analysis with DSR

Simulations were run with the same speed i.e. 50km/s using DSR in order to acquire the best possible results. End-to-end delay in shown in figure 7 and it is clear that it's slightly above than zero but it is less than that of AODV and there are no spikes here like those in AODV. Variation in end-to-end delay is shown in figure 8, it was little high in the beginning but then it becomes constant and it is also better than that of AODV. In figure 9, packets drop ratio is shown and it is same like AODV i.e. packets drop ratio is almost approaches to zero. Packets received ratio is shown in figure 10. Unlike AODV, here receiving ratio increases abruptly then it becomes stable. Figure 11 shows packets sent ratio, it is almost the same situation like packets received ratio i.e. abrupt start and then it becomes nearly constant.

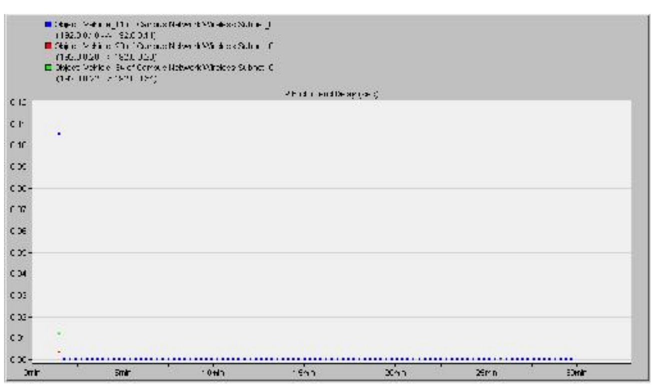

Fig. 7 end-to-end delay between randomly selected source and destination using DSR

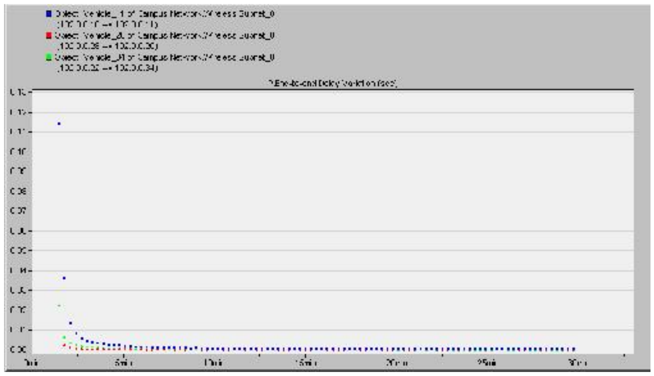

Fig. 8 variations in end-to-end delay between randomly selected source and destination using DSR

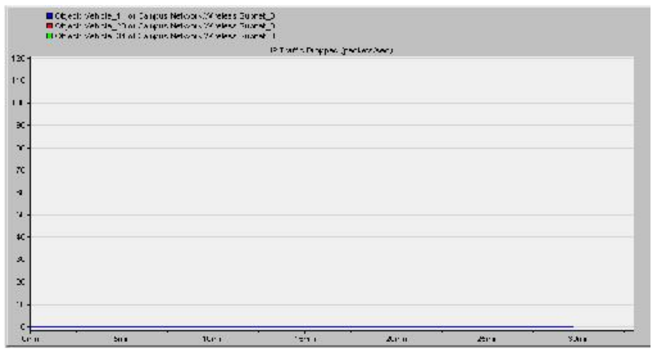

Fig. 9 packet drop ratio between randomly selected source and destination using DSR

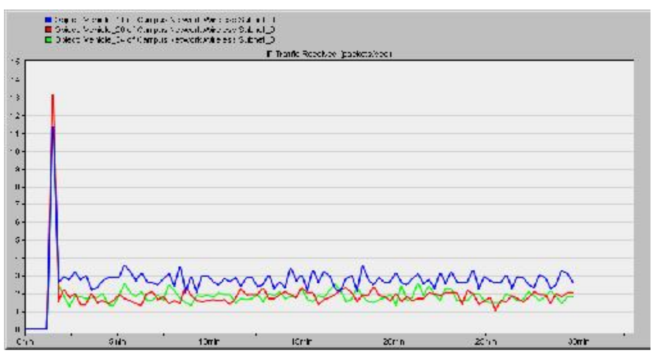

Fig. 10 packet received ratio between randomly selected source and destination using DSR

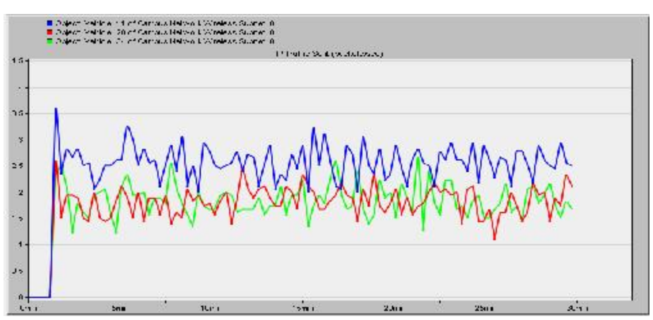

Fig. 11 packet sent ratio between randomly selected source and destination using DSR

C. Traffic Analysis with OLSR

Same 30 minutes simulation has been run for OLSR routing protocol. End-to-end delay is shown in figure 12 and it is very clear that this delay is more than that of DSR i.e. 0.004 second. Variation in end-to-end delay in available in figure 13, it shows that initially it was high but then it becomes low but still it is more than that of DSR. Figure 14 shows packets drop ratio and there no packets which have been lost. In figure 15, packets received ratio has been shown and it is obvious that once network is stable then it provides more packets received ratio as compared with AODV and DSR. In figure 16, ratio of sent packets is shown and it is almost the same graph as packets received.

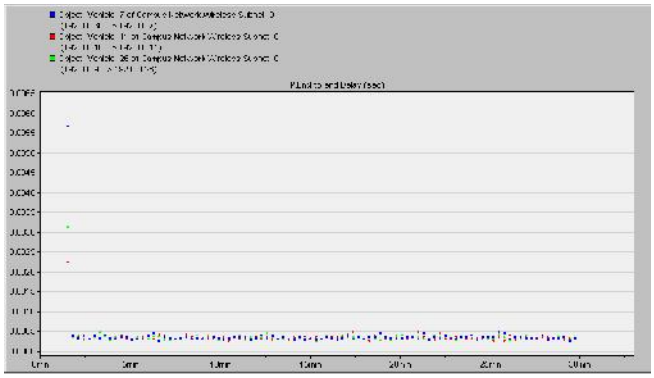

Fig. 12 end-to-end delay between randomly selected source and destination using OLSR

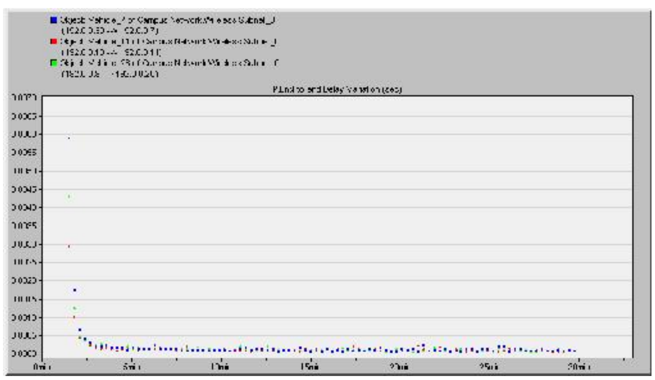

Fig. 13 variations in end-to-end delay between randomly selected source and destination using OLSR

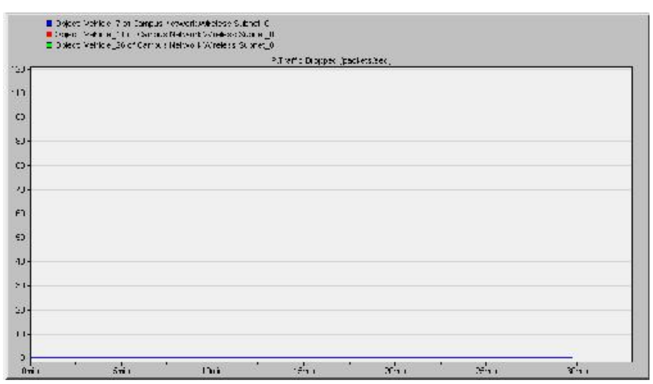

Fig. 14 packet drop ratio between randomly selected source and destination using OLSR

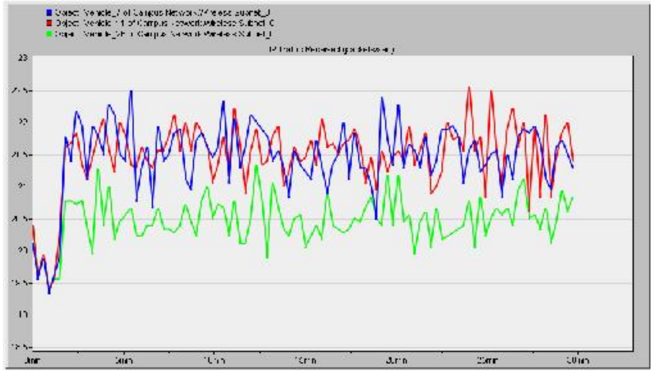

Fig. 15 packet received ratio between randomly selected source and destination using OLSR

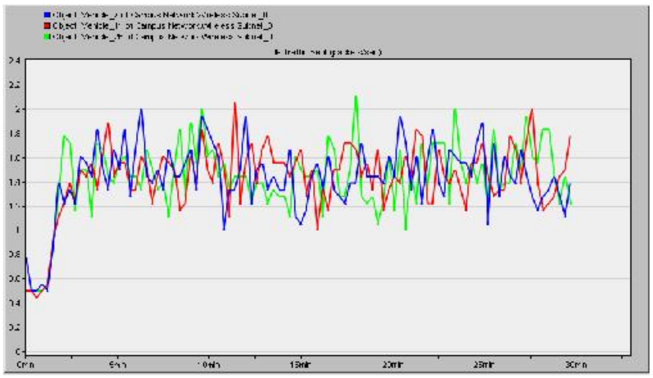

Fig. 16 packet sent ratio between randomly selected source and destination using OLSR

D. Traffic Analysis with TORA

Similar 30 minutes simulations has been executed for TORA. Figure 17 shows the end-to-end delay. It is clear that vehicles are facing delay up to about 8 seconds. This is the highest delay if we compare it with other routing protocols like AODV, DSR and OLSR. In figure 18, variation in end-to-end delay has been shown. Again variation in end-to-end delay is the highest i.e. up to about 7 seconds. Figure 19 provides the information about number of packets dropped. It is understandable that there are spikes when packets are dropped and these spikes are up to 0.168 packets. Figure 20 tells us that initially packet received ratio was low but then it increases. This is comparable with other protocols and can be accepted. In figure 21, we can see the ratio of the packets sent, like other routing protocols it was low in the beginning but then it increases.

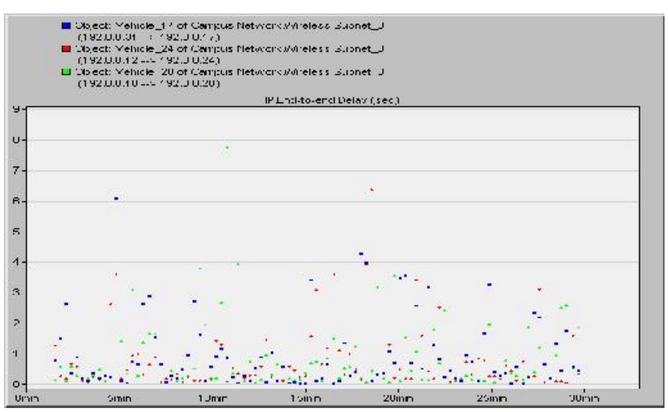

Fig. 17 end-to-end delay between randomly selected source and destination using TORA

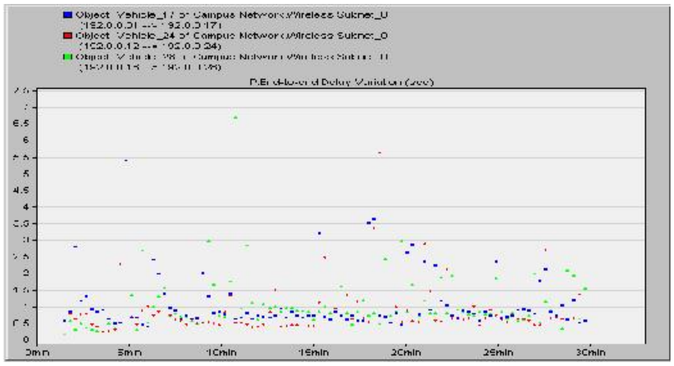

Fig. 18 variations in end-to-end delay between randomly selected source and destination using TORA

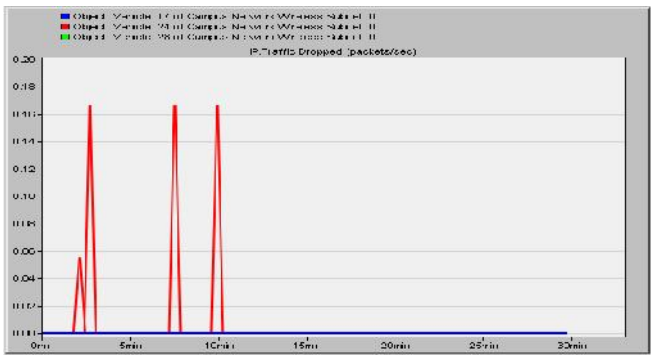

Fig. 19 packet drop ratio between randomly selected source and destination using TORA

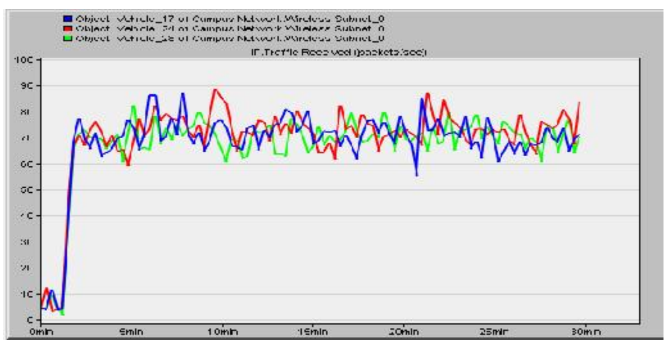

Fig. 20 packet received ratio between randomly selected source and destination using TORA

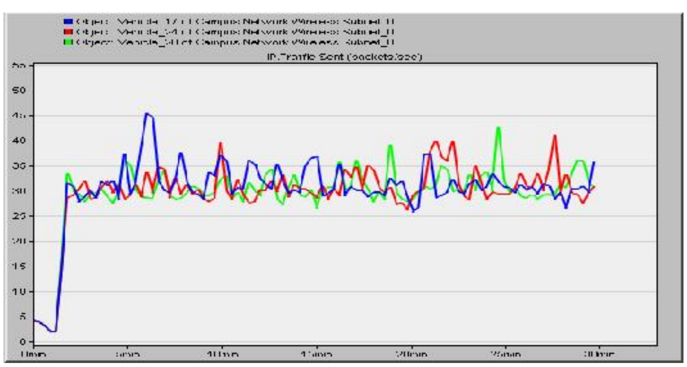

Fig. 21 packet sent ratio between randomly selected source and destination using TORA

4. RESULTS

Our simulations show that in case of congestion when vehicles are moving with moderate speed i.e. around 50km/s then DSR provides most better results in terms of QoS as DSR uses source routing technique and in case of congestion there is less chance of link breakage. Because it offers less delay as compared with AODV and OLSR in packets transmission and update reliable routing information is provided to the vehicles intending to send some. So DSR is the best available choice for congested VANETs environment chosen from MANETs routing protocols. Since there is congestion in network and there is no high link breakage where DSR has to be used, so DSR can provide optimal results as it uses source routing.

5. CONCLUSION

As VANETs are in development phase and new routing protocols and strategies are being devised but still there is lack of optimized standards and protocols for VANETs, if there is a need to use existing MANETs routing protocol for congested VANETs until finalization of standards for VANETs, network designers can trust DSR for getting reliable routing updates and ultimately they can achieve desired QoS within constrained situation.

6. FUTRUE WORK

Our work focuses congested VANETs environment and proposed routing protocol i.e. DSR was primarily developed for MANETs and caters for the needs of nodes moving in an unorganized manner, it meant for small or average size network, unlike VANETs which can very large scale, so modifications and extensions can be made to existing DSR protocol to use it in large scale VANETs or new routing algorithm can be developed to address the issues of high speed vehicles. Furthermore, some intelligent mechanism is needed to switch to DSR from other routing protocol whenever there is congestion in the vehicular network.

REFERENCES

1. Al-Sultan, S., et al. (2013). "A comprehensive survey on vehicular Ad Hoc network." Journal of Network and Computer Applications.
2. Li, J.-S., et al. (2013). "Intelligent Adjustment Forwarding: A compromise between end-to-end and hop-by-hop transmissions in VANET environments." Journal of Systems Architecture 59(10): 1319-1333.
3. Wahab, O. A., et al. (2013). "VANET QoS-OLSR: QoS-based clustering protocol for Vehicular Ad hoc Networks." Computer Communications 36(13): 1422-1435.
4. Hsieh, Y.-L. and K. Wang (2012). "Dynamic overlay multicast for live multimedia streaming in urban VANETs." Computer Networks.
5. Fathy, M., et al. (2012). "Improving QoS in VANET Using MPLS." Procedia Computer Science 1018-1025.
6. Huang, C.-J., et al. (2009). "QoS-aware roadside base station assisted routing in vehicular networks." Engineering Applications of Artificial Intelligence 22(8): 1292-1301.
7. García-Nieto, J., et al. (2010). "Automatic tuning of communication protocols for vehicular ad hoc networks using metaheuristics." Engineering Applications of Artificial Intelligence 23(5): 795-805.
8. Bitam, S. and A. Mellouk (2012). "Bee life-based multi constraints multicast routing optimization for vehicular ad hoc networks." Journal of Network and Computer Applications.

9. Zhou, L., et al. (2009). "Joint QoS control for video streaming over wireless multihop networks: a cross-layer approach." AEU-International Journal of Electronics and Communications 63(8): 638-647.
10. Tonguz, O. K. and M. Boban (2010). "Multiplayer games over vehicular ad hoc networks: A new application." Ad Hoc Networks 8(5): 531-543.
11. Wu, T.-Y., et al. (2012). "Improving RSU service time by distributed sorting mechanism." Ad Hoc Networks 10(2): 212-221.
12. Amadeo, M., et al. (2012). "Enhancing IEEE 802.11 p/WAVE to provide infotainment applications in VANETs." Ad Hoc Networks 10(2): 253-269.
13. Benslimane, A., et al. (2011). "An efficient routing protocol for connecting vehicular networks to the Internet." Pervasive and Mobile Computing 7(1): 98-113.
14. Zhang, L. and H. El-Sayed (2012). "A Novel Cluster-Based Protocol for Topology Discovery in Vehicular Ad Hoc Network." Procedia Computer Science 10: 525-534.
15. Elmouna Zhioua, G., et al. (2012). A multi-metric QoS-balancing scheme for gateway selection in a clustered hybrid VANET network. Wireless and Mobile Computing, Networking and Communications (WiMob), 2012 IEEE 8th International Conference on, IEEE.
16. Ksentini, A., et al. (2010). A proxy-based framework for QoS-enabled Internet access in VANETS. Communications and Networking (ComNet), 2010 Second International Conference on, IEEE.
17. Wu, D., et al. (2011). Geographic load balancing routing in hybrid vehicular ad hoc networks. Intelligent Transportation Systems (ITSC), 2011 14th International IEEE Conference on, IEEE.
18. Dorge, P. D., et al. (2012). Improvement of QoS in VANET with different mobility patterns. Radar, Communication and Computing (ICRCC), 2012 International Conference on, IEEE.
19. Aljeri, N., et al. (2013). A Performance evaluation of load balancing and QoS-aware gateway discovery protocol for VANETs. Advanced Information Networking and Applications Workshops (WAINA), 2013 27th International Conference on, IEEE.