

Multi Constraints Optimal Path based on Routing Protocols in VANETs



Vibha Oberoi, Praveena Chaturvedi

Abstract— Vehicular Ad-hoc network (VANETs) is a type of ad hoc network which has faced many challenges for its implementation such as Technical issues which include are Large Size area, Routing, Security, Congestion, High Mobility, Limited road topology, Intermitted connectivity, Continuous power transmission for significant computing communication & sensing of the network & On road issues include narrow road, unstructured road, all roads are not allowed for all vehicles, busy road, no defined speed on road, no road maintenance, high frequency of accidents, poor sign board, no road side amenities, multiple numbers of toll booths etc. In order to enhance the performance of the desired real time network link between the nodes must be stable and reliable so that information can be transmitted reliably to the desired destination. This paper has experimentally studied the optimal path for different routing protocols in VANETs. This paper clearly concludes which routing protocol is better under different parameters such as number of hops, average hop count, total packet send and received for the realistic environment.

Keywords— VANET, Optimal Path, Routing Protocol, Performance Metrics, Number of Hops.

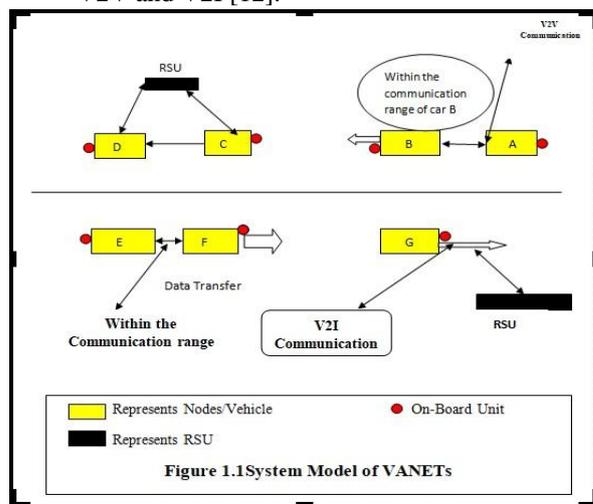
I. INTRODUCTION

VANET is a promising new technology which can provide a number of benefits to the transport system such as road safety to the travelers on road, can improve the efficiency of traffic, decrease the waiting time on traffic signals and most importantly decrease the number of accidents on road thereby giving comfort to the travelers and drivers on road. It is a type of ad-hoc network which uses vehicles as nodes in the network. Each vehicle/node communicate with each other by a device that is mounted on each vehicles in the network. The mounted devices help to receive and send the message in the wireless network. So, transmission of message from one vehicle to another needs to adopt the best shortest path available.

Several factors need to be considered by routing protocols in order to decide which will be the preferred or shortest path to a particular destination.

Data dissemination in VANETs depends upon three architectures (Figure 1.1.):

- **V2V:** In this architecture the network is formed between Vehicles to Vehicles.
- **V2I:** In this architecture the network is formed between Vehicles and Infrastructure/fixed gateways.
- **Hybrid:** This architecture is a combination of both V2V and V2I [12].



Although VANETs belong to a subclass of MANETs but still it holds two most characteristics that make it different from an ad hoc network. The most distinct characteristics of VANET are high speed and uncertain mobility of the nodes. The mobility and density of nodes change with time and location like the speed of the vehicle is more on highways as compared to city roads. Density of nodes is higher in daytime in comparison to nights which affects the topology and connectivity of the nodes [25].

The process of transferring information from one node/vehicle to another involves different characteristics of the routing protocols such as method of selection of the intermediate node, maintaining path and recovery of path. Routing protocols in VANETs can be categorized into different categories based upon the according to their position accusation and the route update method. Routing protocols can be classified into three main categories i.e. Table Driven/Proactive, On-Demand/Reactive and Hybrid protocols. Table driven or Proactive routing protocols are static in nature in which nodes exchange information among themselves periodically thereby updating the information of the neighboring nodes. In On-Demand or reactive protocol a connection between two nodes is made on demand or request. Hybrid routing protocol is a combination of both routing protocols i.e. Reactive and Proactive routing protocols [27].

Manuscript received on February 10, 2020.
Revised Manuscript received on February 20, 2020.
Manuscript published on March 30, 2020.

* Correspondence Author

Vibha Oberoi¹, Department of Computer Science, Gurukula Kangri Vishwavidyalaya, Haridwar, Uttarakhand, India
Email: vibha.oberoi85@gmail.com

Praveena Chaturvedi, Department of Computer Science, Gurukula Kangri Vishwavidyalaya, Haridwar, Uttarakhand, India

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Routing is the process which helps for the transfer of data or information from one node (vehicle) to another node (vehicle). As it's clear that during routing the route taken may be single hop or multi hop in nature.

There are many important metrics for evaluation of shortest path such as number of hops, path duration, node density , average hop count, total packet send, total packet forwarded , total packet received.

II. LITERATURE SURVEY

VANET s system design and implementation has come across many difficulties like routing, security, privacy, connectivity and most important the Quality of Service (QoS) parameters such as throughput, Jitter, End to End delay. The key area of concern in VANETs is **Routing**. Routing helps for transfer of data from one node (vehicle) to another node (vehicle). Routing protocol desires to be considered in rural region order to tackle challenges of VANETs such as high mobility of nodes, random topology, and heterogeneous network [21] [22].

Many different routing protocols are available in VANETs but each of the routing protocols have different advantages and disadvantages for a given scenario [24] has studied the different issues of Routing in VANET. It concluded that positional routing shows better results than traditional routing protocols in VANETs. VANET is a practical application of mobile ad hoc network (MANET) in transportation systems [20],[15] has assessed the performance of AODV & OLSR for VANET in urban environment. The study clearly reflected that OLSR is better for that scenario.

The author [1] has designed a real time traffic of Vishakhapatnam and has analyzed three protocols i.e. AODV, DSR, DSDV. Researchers in [2] and [3] has exported data from Google map and has tried to generate the mobility pattern but source and destination nodes are generated randomly. J. Harri [4] has generated the real time traffic scenario but did not took into consideration some important factors like Minimum and maximum speed of the vehicle, Traffic condition etc.

Author [5] has used VimSim with NS2. Performance Evaluation has been carried out in [16] on routing protocols AODV, DSR, DSDV. In this author showed that these protocols are not suitable for VANETs [17] has evaluated the performance of AODV and DSR using Swarm Intelligence Routing Protocol.

Jing Wu [18] has simulated single path and multipath protocols i.e. AODV and AOMDV. The study was analyzed under packet loss and end to end delay. Authors of [19] has compared the performance of AODV, DSR, and OLSR and has simulated the same scenario using ns2 and ns3.

Imran Khan [14] has evaluated the performance of AODV, DYMO, and OLSR Routing protocol. In [23] Performance Evaluation of routing protocol (AODV, DSDV and DSR) in terms of throughput, end to end delay and packet delivery ratio by using Network Simulator NS2 and SUMO under varying of number of vehicles.

III. PROBLEM DEFINATION

Aim of this paper is to identify which routing protocol performs better in the real time network of a region i.e. Ashley hall, Dehradun, Uttarakhand. The main idea is to analyze the shortest path in VANETs of a realistic scenario using Dijkstra's Algorithm by reducing the delay and most importantly to calculate the number of hops, average hop counts, total packet send and received for this particular real time scenario.

IV. PROPOSED WORK

In this proposed work, we have already exported a real time traffic map from Open Street Map of a region (Ashley hall, Dehradun, Uttarakhand). We have used topological based routing to route the packet from one vehicle/node to another i.e. from source vehicle to destination vehicle [26]. A mathematical model to estimate the path duration in VANETs is developed using the Poisson distribution method. This model attempts to evaluation the average path duration based on reduced number of hops principle [25]. Routing Protocol plays a vital role in transfer of information from one vehicle to another so in this work we have used AODV, AOMDV, DSR, and DSDV for our further analysis. Two simulators i.e. SUMO & NS2 have been used for the analysis and evaluation of the shortest path. In NS2, Dijkstra's algorithm is considered by default. Dijkstra's algorithm is greedy algorithm as it satisfies the condition i.e. makes the optimal choice at a particular moment.

V. PARAMETERS FOR ANALYSIS

The below described parameters are co related with one another ,so in order to find the optimal path in the desired area/network (Ashley hall) these parameters plays a vital role for shortest path evaluation.

A. *Optimal path/ shortest path:*

While finding the optimal path the next hop node is chosen which provides the least number of hops.

B. *Link distance:*

It can be defined as distance between two nodes which provide a link on a route.

C. *Node density:*

It can be defined as the number of nodes/vehicles per unit area of transmission range.

D. *Number of hops:*

Number of hops can be defined as the number of intermediate nodes in the desired route. Number of hops should be as least as possible which in order decreased the changes of breakage in link [25].

E. Average hop count:

It is the average distance covered by each hop present in the route. If there is less number of hops it means there is less number of links and less chances of link breakage [25].

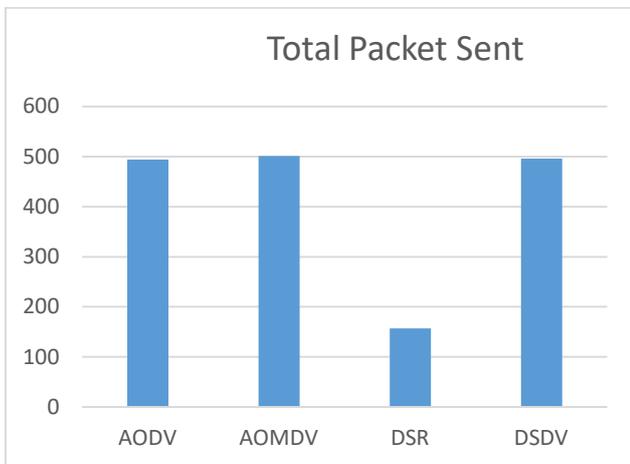
F. Path duration:

It is the amount of time the link is active and available for use for transmission of information.

VI. SIMULATION & RESULTS

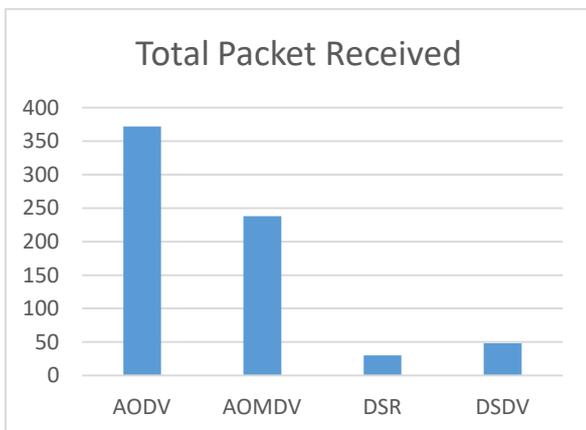
A. Total Packet Sent:

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that AOMDV sends maximum number of packets in this realistic environment.



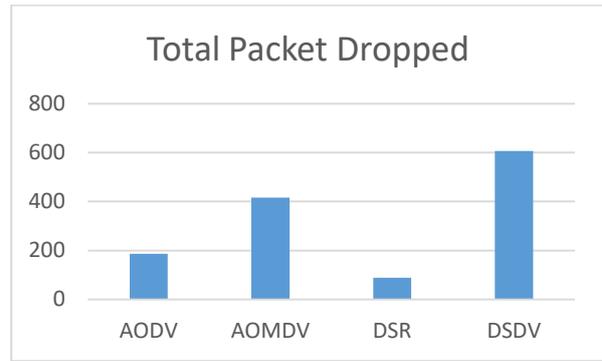
B. Total Packet Received:

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that AODV receives maximum number of packets in this realistic environment.



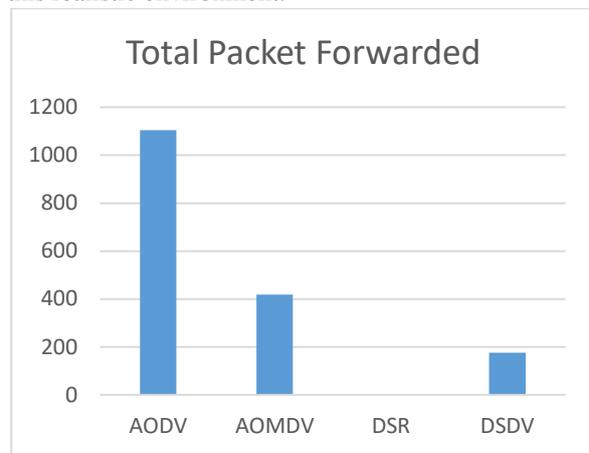
C. Total Packet Dropped:

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that DSDV drops maximum number of packets in this realistic environment.



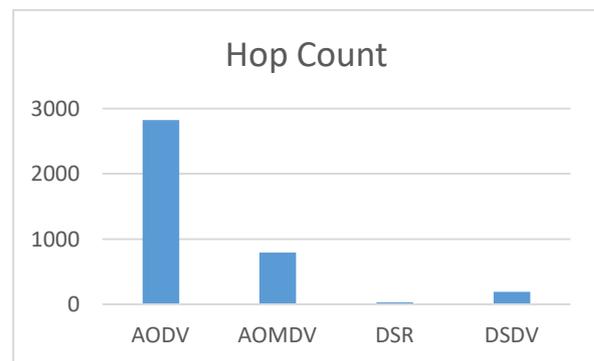
D. Total Packet forwarded:

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that AODV forwards maximum number of packets in this realistic environment.



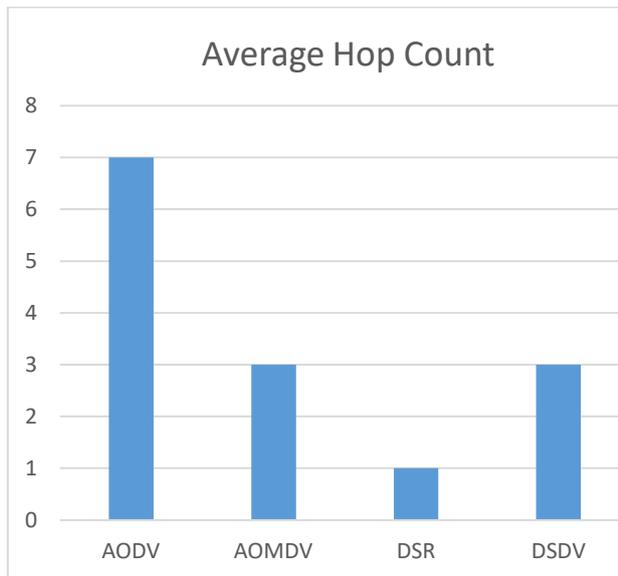
E. Total Hop Count:

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that AODV has maximum number of hop counts in this realistic environment.



F. Average Hop Count

In this scenario we have done simulation on four protocols i.e. AODV, AOMDV, DSR, DSDV. It clearly shows that AODV sends maximum number of average number of hop counts in this realistic environment.



VII. CONCLUSION

The shortest or optimal path of this desired route can be calculated by considered like node density, total number of hops, total packets send and received and average hop count.

This results of this paper clearly concludes that AODV has the maximum number of total hop counts and average hop counts. End to End delay of the network increases as the number of hops increases bit it decreases when the velocity of the vehicle/node decreases. Throughput of the network also affected by increasing arrival rate.

Due to multi path characteristic AOMDV sends the maximum number of packets but AODV protocol receives the maximum number of packets in that realistic network. DSR hold the least number of packets being dropped which makes it suitable for the area where there is more link breakage in the network. So, it clearly evident from the evaluation that no matter AODV has maximum hop counts but minimum drop of packets so for this realistic scenario either AODV((Single path) or AOMDV(Multi path) will be best routing protocol.

REFERENCES

1. Badugu Samatha, Dr. K. Raja Kumar, Nagarjuna Karyemsetty, "Design and Simulation of Vehicular Adhoc Network using SUMO & NS2," in *Advances in Wireless and Mobile Communications*, ISSN 0973-6972 vol. X, pp. 1207-1219.
2. F. Li La Wan and Y. Wang, "Routing Protocols in vehicular ad hoc networks(VANET): A survey," *IEEE Vehicular Technology Magazine*, vol. 2, no. 2, pp. 12-22, Jun. 2014.
3. D. F. Choffnes, F. Bustamante, "An integrated mobility and traffic model for vehicular wireless networks," *Proceedings of the 2nd ACM international workshop on Vehicular ad hoc networks*. ACM 2015.
4. J. Harri, M. Fiore, F. Fethi, "VanetMobiSim: generating realistic mobility patterns for VANETs," *Proceedings of the 3rd international workshop on Vehicular ad hoc net-works*. ACM, 2016.
5. K. Rama, K. Lakshmi, S. Manju Priya, K. Thilagam & A. Jeevarathnam "Comparison of Three Routing Algorithms based on Greedy for effective Packet Forwarding in VANET", *Int. J. Computer Technology & Applications*, Vol 3 (1), Jan-Feb 2013, pp-.146-151.
6. Martin Mauve, Dieter Vollmer, Michael Kasemann and Hannes Hartenstein, "A comparison of best routing protocol strategies in vehicular ad-hoc networks," *TechRep. 3/2002*, Universit"at Mannheim, Mar 2013.
7. IEEE, Abbas Jamalipour, Tarik Taleb, Member, IEEE, Ehssan Sakhaee, Student Member, Fellow, IEEE, Kazuo Hashimoto,

- Member, IEEE, Nei Kato, Senior Member, IEEE, and Yoshiaki Nemoto, Senior Member, IEEE, A Stable Routing Protocol to Support ITS Services in VANET Networks, *IEEE Transactions on Vehicular Technology*, Vol. 56, No. 6, November 2014, pp 3337-3347.
8. Mirko Stoffers, George Riley, "Comparing the ns-3 Propagation Models", *MASCOTS, 2012, 2012 IEEE 20th International Symposium on Modelling, Analysis & Simulation of Computer and Telecommunication Systems (MASCOTS)*, 2012 IEEE 20th International Symposium on Modelling, Analysis & Simulation of Computer and Telecommunication Systems (MASCOTS) 2012, pp. 61-67, doi:10.1109/MASCOTS.2012.17.
9. SUMO, Simulation of Urban Mobility, http://www.dlr.de/ts/en/desktopdefault.aspx/tabid-9883/16931_read-41000/
10. NS2, Network Simulator 2, <http://www.nsnam.org>.
11. OpenStreetMap, <https://www.openstreetmap.org/>
12. Er. Gaganpreet Kaur, Dr. Sandeep Singh Kang "Technique to control Data Dissemination and to support data accessibility in Meagerly Connected Vehicles in Vehicular Ad-Hoc Networks (VANETS)", *International Journal of Advanced Research in Computer Science*, Volume 7, No. 6(Special Issue), November 2016.
13. Mohammad Siraj, Soumen Kanrar, "Performance of Modeling wireless networks in realistic environment", *International Journal of Computer Networks (IJCN)*, Volume (2): Issue (1), pp: 62-79.
14. "Performance evaluation of Adhoc Routing Protocol for VANETS", Imran Khan, LAMBERT Academy Publishing.
15. Jerome Haerri, Fethi Filali, Christian Bonnet, "Performance Comparison of AODV and OLSR in VANETS Urban Environment under Realistic Mobilty Pattern", www.eurecom.fr.
16. Xiong Wei, Li Qing-Quan, "Performance evaluation of data dissemination for vehicular ad hoc network in highway scenarios".
17. Manvi, S.S., Kakkasageri, M.S., Mahapurush, C.V., "Performance Analysis of AODV, DSR and Swarm Intelligence Routing Protocol In vehicular Ad hoc Network Environment", *International Conference on future Computer and Communication*, April 2009, pp.-21-25.
18. Jing Wu, Yahao Wang. "Perforamnce Study of Multipath in VANET and their impact on routing Protocols, *Wireless Engineering and Technology*, July 2011, pp.-125-129.
19. Dipti Shastri, Ajay Lala, "Simulation Study of VANET Routing Protocols on NS-2 and NS-3", *Internal Journal of Science and Research*, Vol. 6 Issue 2, February 2017, pp.1407-1412.
20. Er. Vani Malagar, Mr. Manoj Kumar, "A Comparative Analysis of Routing Protocols in Vehicular Ad-Hoc Network", *International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)* Volume 6, Issue 5, May 2017, pp no.-378-389.
21. C. Jeremiah and A. J. Nneka, "Issues and possibilities in Vehicular Ad-hoc Networks (VANETs)," 2015 International Conference on Computing, Control, Networking, Electronics and Embedded Systems Engineering (ICCNEEE), Khartoum, 2015.
22. Carlos Jesus Bernardos et al, Elsevier, "Position-based routing in vehicular networks: A survey", Volume 36, Issue 2, March 2013.
23. Shima Suliman Mahmood, Dr. Mohamed Abaker Hussein, "Performance Analysis of AODV, DSR and DSDV Routing Protocols in VANET", *International Journal of Recent trends in Engineering & Research*, Volume 02, Issue 08; ISSN: 2455-1457, August - 2016, pp.:280-283.
24. Umar Waqas Raja, "Issues of Routing in VANET", ISBN:978-3-8433-8824-5
25. R. S. Raw, Vikas Toor, N. Singh "Estimation and Analysis of Path Duration in Vehicular Ad Hoc Networks using Position-based Routing Protocol", *Special Issue of International Journal of Computer Applications*, November 2012.
26. Vibha Oberoi, Praveena Chaturvedi, "Implementation of Real Time Traffic Network", *International Journal of Computer Science and Network*, Volume 8, Issue 6, December 2019, pg.no:-447-450.
27. Vibha Oberoi, Praveena Chaturvedi, "Challenges faced by Routing Protocols over VANETS", *International Journal of Engineering and Technology*, Volume 6, Issue-11, November 2019.

AUTHORS PROFILE



Ms. Vibha Oberoi completed her B.Sc. (H) Computer Science from Delhi University in the year 2009 and MCA in 2012. She has worked with many universities in India. Currently she is working as Research Scholar at Kanya Gurukul Campus, Dehradun (Second Campus to Gurukula Kangri Vishwavidyalaya, Haridwar). She has overall six years of teaching experience. Her research interests include Ad-hoc Networks, Vehicular Ad-hoc network (VANET), Mobile Ad-hoc Network (MANET). She is author of many books for graduate and under graduate courses. She has published a couple of research papers in national and international journals.



Dr. Praveena Chaturvedi has completed her MCA in 1994 and Ph.D in 2010. Currently she is working as "Associate Professor" at Kanya Gurukul Campus (Second Campus to Gurukula Kangri Vishwavidyalaya, Haridwar). She has overall 25 years of experience. Her area of interest is mobile agent Technology, Ad-hoc networks, MANET, VANET. She has authored around 23 research papers in reputed national and international journals. Apart from research she has been part of many workshop and refresher courses.