Comparative Analysis of Routing Protocol in VANET

N. Kaur, M. S. Devgan

Abstract: *VANET is a vehicle communication platform in which the vehicles can communicate with other vehicles either directly or through infrastructure unit named as RSU (road side unit). The density of the network depends upon several factors and condition of roads. In urban cities, the densities of vehicles are high whereas in rural area, the density can vary. Therefore, vehicle to vehicle communication faces problems in while communicating through VANET and the developer needs to design an infrastructure that can resolve this problem. In this paper, we are presenting a comparative analysis of various routing techniques used in VANET. The main issue that find in VANET communication is the selection of an appropriate routing protocol. Therefore, to know about the advantages, disadvantages and application of four different routing algorithms named as position based, geo based, cluster based and topology based a comparative analysis has been performed.*

Index Terms: *VANET, Routing Protocols, Position Based, Geo Based, Cluster Based and Topology Based.*

I. INTRODUCTION

VANET is one of the practical application of mobile ad hoc network (MANET) mostly used in transportation System and become an important part of an intellectual transportation system [1]. VANET is a subclass of MANET in which the vehicles are arranged on the road to form a multifunctional Mobile node. Different routing protocols are used to form route between nodes in an appropriate way so that the data can be transmitted successfully with minimum energy and high data rate [2].
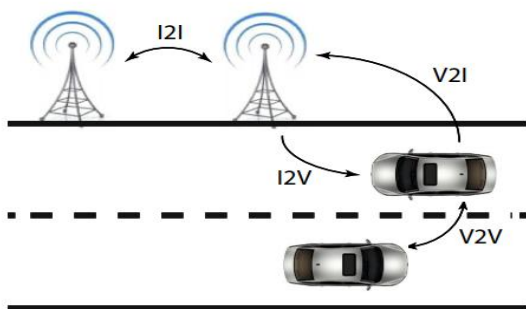

Fig. 1: Communication Paradigm in Intelligent Transportation System

VANET mainly included two different entries named as access points and vehicle points. Access point is used to linked with the internet. The communication between the vehicles and between the vehicles and infrastructure has been formed [3]. V2V (vehicle to vehicle) has two kinds of communication named as one hop communication and multi hop communication. The main objective of routing protocols is to offers an optimal route between network nodes by providing less overhead [4].

Figure 1 represents the communication links formed during the communication process in VANET. The communication link is created between V2V and V2I (vehicle to infrastructure) as shown in figure above [5]. In V2V the messages information is exchanges between vehicle to vehicle that are moving on road. In V2I, the information is exchanged between several vehicles around the infrastructure. The infrastructure is used to provide updated information such as traffic on road or empty road etc. with the help of internet connection. Also, the information is shared between infrastructure to infrastructure (I2I) so that the infrastructure must be updated as per the transmitted messages [6]. Generally, in urban areas, the density of cars is high, and V2V communication is possible. In such cases, this may be impossible, at night or because of strike in the urban area. The situation in rural areas is completely different, and the traffic density is relatively low, the spacing between vehicles can be quite large [7]. in order to overcoming these situations, a roadside unit (RSU) can be installed to provide V2I communication and hence fill the communication gap among vehicles. In VANET, vehicle speed is varied as in rural areas the speed is slow whereas on highway, the vehicle speed is high. As the speed of vehicle varies therefore the connectivity among the vehicles and between the RSU and vehicle changes [8]. This become a challenging research issues for example to route data packet and to decrease the packet drop during the communication process. on the highway. Due to the speed of the vehicle The connection between the RSU and the vehicle, many challenging research issues, such as Encountered the routing and throughput of data. To achieve best results, the developer must study and compared the VANET routing protocols [9].

A. Routing Protocols in VANET

Due to the dynamic nature of the mobile vehicles in the VANET, discovering and maintaining routes between source and destination vehicle is very challenging task. Routing in VANET (using pure ad hoc network) has been studied and several different protocols were proposed. The proposed protocols are mainly divided into five categories as shown in figure 2 [10].

- Position based routing protocol

The movement of vehicle in VANET is usually bidirectional in urban cities.

Revised Version Manuscript Received on October 28, 2018.

Narinder Kaur, Department of Information Technology, Punjab Technical University/ Chandigarh Engineering College, Mohali (Punjab), India. E-mail: n.bhatti537@gamil.com

Prof. Mandeep Singh Devgan, Information Technology, Punjab Technical University/ Chandigarh Engineering College, Mohali (Punjab), India. E-mail: Mandeepdevgan@gmail.com

Therefore, the routing strategies are formed on the basis of vehicle's geographical position. The message is forwarded to the next vehicle which is closest to the source vehicle, in this way the data is transmitted to the destination [11].

• Topology based

This scheme is used to communicate with the vehicles as per the topology of the network formed. By using this topology unicast as well as multicast data can be transmitted with less bandwidth consumption [12].

• Broadcast based

Using this type of routing algorithm, the entire data is forwarded at the same time in the network. This type of routing scheme is used in case when the destination node is far away from the source node. As the whole data is transmitted at the same time thus, this protocol required more bandwidth [13].
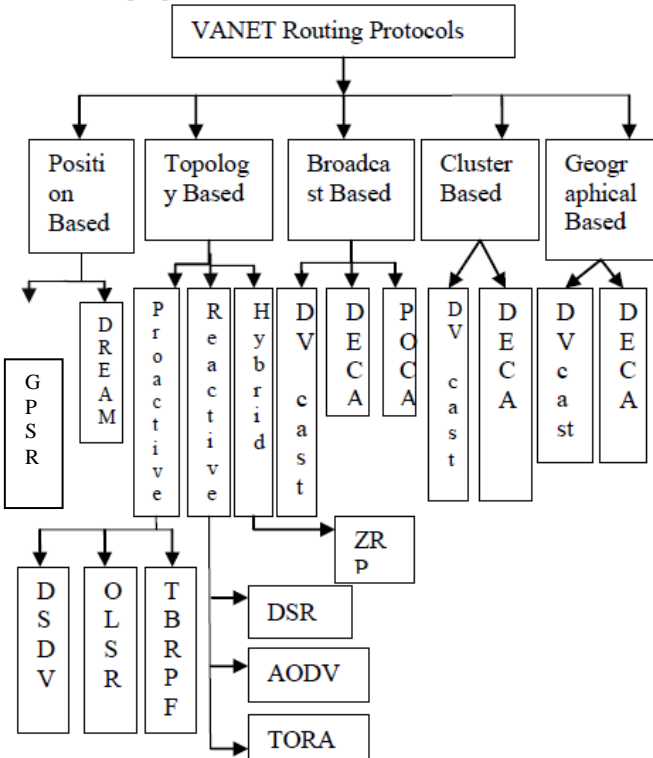

Fig. 2: Types of Routing Protocols in VANET

• Cluster based

In this type of routing technique, clusters are formed by the vehicles that consists same speed, direction etc. After forming clusters, a CH (cluster head) is selected among every cluster through which communication makes possible. If the source node and destination nodes are present in the same cluster, then the route is formed directed between source and destination vehicle. In case, when the destination node is present in another cluster then the route is formed by the CH.

• Geo cast

Geo-cast routing is a location based multicast routing. The main goal of a geo-cast routing is to provide data from source vehicle to all the vehicles present in a particular geographical region [14].

The communication or the route in VANET can be formed by using uni-cast routing, broadcast routing and geo-cast routing. These routing can be better understand by using the figure 3:
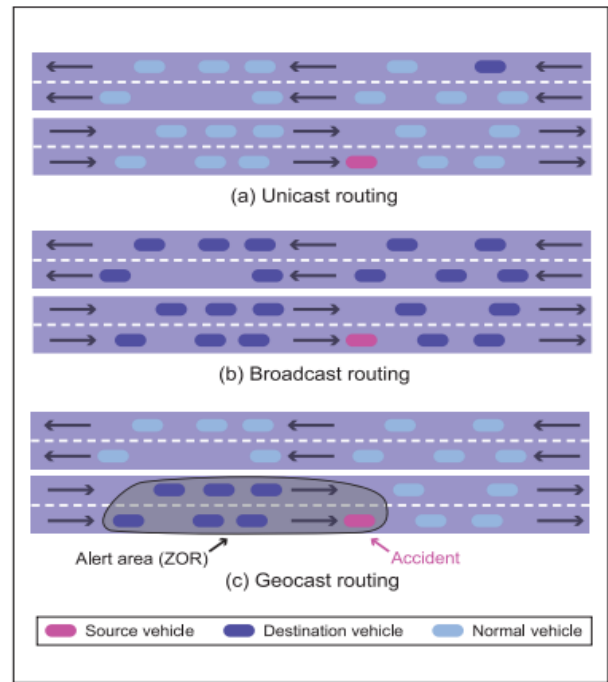

Fig. 3: Different Communication Scenarios in VANETs.

Table I: Comparison Between Different Routing Techniques [15]

Routing protocols	Location based	Broadcast based	Cluster based	Geo-cast based
Method to transmit data packet	Heuristic method	Wireless multihop	Wireless multihop	Wireless multihop
Need of Map	No	No	No	Yes
Need of virtual infrastructure	Not required	Not required	Not required	required
Realistic traffic flow	Yes	Yes	Yes	No
Recovery mechanism	Carry and forward	Carry and forward	Flooding	Carry and forward
Scenario	Urban	Highway	Highway	Urban

II. RELATED WORK

In this section, the work performed by various researchers in the domain of VANET by using different routing protocols and simulator along with the obtained outcomes are described in tabular form.

Table II: State-of –art of Existing Work

References	Proposed work	Techniques used	Parameters/simulator	Outcomes
[16]	Proposed reactive as well as proactive routing protocols to determined route between source and destination.	destination sequence distance vector (DSDV) and ad-hoc on demand distance vector (AODV) routing protocol	Throughput NS-2	It is concluded that AODV routing protocol perform better than DSDV protocol.
[17]	Presented an inter vehicle distance based routing protocol that forms routes on the basis of connectivity between vehicles	Localization methods such as: cooperative localization and Geometry based Localization methods have been used.	PDR (packet delivery ratio), hop count with respect to average speed of vehicles have been measured in NS-2 simulator.	It has been concluded that the proposed localization techniques makes the computation of IVD (Inter-vehicle distance) robust in case of GPS failure.
[18]	Proposed a technique to predict future position of vehicles on time basis.	Neural network, SVM has been used as a classification technique whereas Kalman filtering technique is used to reduce the transmitted information.	Prediction distance, MSE with respect to time.	It has been determined that how the localization technique has been used to determine an accuracy position of vehicle in case of incorrect sample position of vehicles.
[19]	Proposed two VAnet routing approaches named as AODV and GPRS used to control the message transmission in traffic scenario.	AODV and GPRS	PDR, delay and normalized routing load with respect to density of vehicles	It is concluded that AODV routing protocol reduced the broadcasting load and increase the performance of the VANET.
[20]	Proposed a technique to select shortest path by using intersection dynamic VANET routing protocol (idvr) along with Control overhead reduction algorithm (cora)	CBLTR (Cluster based life time routing),idvr and cora have been used in MATLAB simulator tool	Throughput, end to end delay and cluster overhead have been measured by using CBLTR, IDVR and CORA routing protocol respectively.	It has been concluded that the IDVR routing protocol perform better than other two techniques.
[21]	Proposed a traffic aware routing protocol to transmit message in traffic areas.	(TARCO) traffic aware routing protocol has been proposed using NS-2 simulator tool with network area of 1500m×2000m.	The performance metrics such as PDR along with communication overhead have been measured.	The performance of the network by using TARCO routing protocol has been increased.

III. CONCLUSION

One of the best routing protocols for VANET is the major issue that needs to be resolved during the daily life. The performance of VANET is mainly depends upon the movement of vehicles, density of vehicles, driving environment condition, etc. The routing solution for the VANET's application scenario might be impractical. Therefore, the researchers need to develop a routing protocol that meets the application requirement. The comparison between different routing protocols that are utilized in VANET has been presented. From the literature survey, it is concluded that AODV routing protocol perform well as compared to GPS, ZRP and DSDV routing protocol.

REFERENCES

1. Vijayakumar, P., Chang, V., Deborah, L. J., Balusamy, B., &Shynu, P. G., "Computationally efficient privacy preserving anonymous mutual and batch authentication schemes for vehicular ad hoc networks," Future generation computer systems, 78, pp. 943-955, 2018.
2. Shah, S. A. A., Ahmed, E., Xia, F., Karim, A., Shiraz, M., & Noor, R. M., "Adaptive beaconing approaches for vehicular ad hoc networks: A survey," IEEE Systems Journal, 12(2),pp. 1263-1277, 2018.
3. Al-Sultan, S., Al-Doori, M. M., Al-Bayatti, " A. H., &Zedan, H. A comprehensive survey on vehicular ad hoc network," Journal of network and computer applications, 37, pp. 380-392, 2014.
4. Liu, J., Wan, J., Wang, Q., Deng, P., Zhou, K., &Qiao, Y., " A survey on position-based routing for vehicular ad hoc networks," Telecommunication Systems, 62(1), pp. 15-30, 2016.
5. Liu, K., Ng, J. K., Lee, V., Son, S. H., &Stojmenovic, I, "Cooperative data scheduling in hybrid vehicular ad hoc networks: VANET as a software defined network. IEEE/ACM Transactions on Networking (TON), 24(3), pp. 1759-1773, 2016.
6. He, D., Zeadally, S., Xu, B., & Huang, X., "An efficient identity-based conditional privacy-preserving authentication scheme for vehicular ad hoc networks," IEEE Transactions on Information Forensics and Security, 10(12), pp. 2681-2691, 2016.

7. Li, G., Boukhatem, L., & Wu, J., "Adaptive quality-of-service-based routing for vehicular ad hoc networks with ant colony optimization," IEEE Transactions on Vehicular Technology, 66(4), pp. 3249-3264, 2017.

8. Xia, Y., Chen, W., Liu, X., Zhang, L., Li, X., & Xiang, Y., "Adaptive multimedia data forwarding for privacy preservation in vehicular ad-hoc networks," IEEE Transactions on Intelligent Transportation Systems, 18(10), pp. 2629-2641,2017.

9. Kapileswar, N., Santhi, P. V., Chenchela, V. K., & Prasad, C. V. S. (2017, August). A fast information dissemination system for emergency services over vehicular ad hoc networks. In 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS) (pp. 236-241). IEEE.

10. Logeshwari, K., &Lakshmanan, L. (2017, February). Authenticated anonymous secure on demand routing protocol in VANET (Vehicular adhoc network). In Information Communication and Embedded Systems (ICICES), 2017 International Conference on (pp. 1-7). IEEE.

11. Kumar, P., Sharma, S. K., &Singla, S. (2017). This paper proposes a geographical awareness routing protocol based on a hybrid routing protocol, the Zone Routing Protocol (ZRP), in Mobile Ad Hoc Networks (MANETs). ZRP is created from combining proactive routing protocol and on-demand routing protocol; therefore, it inherits the advantages of both these routing protocols. The long delay time of the on-demand routing protocol and the huge routing... Wireless Networks, 23(1), 103-116.

12. Li, F., & Wang, Y. (2007). Routing in vehicular ad hoc networks: A survey. IEEE Vehicular technology magazine, 2(2).

13. Lee, K. C., Lee, U., &Gerla, M. (2010). Survey of routing protocols in vehicular ad hoc networks. In Advances in vehicular ad-hoc networks: Developments and challenges (pp. 149-170). IGI Global.

14. Yousefi, S., Mousavi, M. S., &Fathy, M. (2006, June). Vehicular ad hoc networks (VANETs): challenges and perspectives. In ITS Telecommunications Proceedings, 2006 6th International Conference on (pp. 761-766). IEEE.

15. Rana, S., Rana, S., &Purohit, K. C. (2014). A review of various routing protocols in VANET. International Journal of Computer Applications, 96(18).

16. Ali, F., Shaikh, F. K., Ansari, A. Q., Mahoto, N. A., &Felemban, E. (2015). Comparative analysis of VANET routing protocols: On road side unit placement strategies. Wireless Personal Communications, 85(2), 393-406.

17. Hassan, A. N., Kaiwartya, O., Abdullah, A. H., Sheet, D. K., & Raw, R. S. (2018). Inter Vehicle Distance Based Connectivity Aware Routing in Vehicular Adhoc Networks. Wireless Personal Communications, 98(1), 33-54.

18. Balico, L. N., Loureiro, A. A., Nakamura, E. F., Barreto, R. S., Pazzi, R. W., & Oliveira, H. A. (2018). Localization Prediction in Vehicular Ad Hoc Networks. IEEE Communications Surveys & Tutorials.

19. Naumov, V., Baumann, R., & Gross, T. (2006, May). An evaluation of inter-vehicle ad hoc networks based on realistic vehicular traces. In Proceedings of the 7th ACM international symposium on Mobile ad hoc networking and computing (pp. 108-119). ACM.

20. Abuashour, A., &Kadoch, M. (2017). Performance improvement of cluster-based routing protocol in VANET. IEEE Access, 5, 15354-15371.

21. Lo, C. C., &Kuo, Y. H. (2017). Traffic-aware routing protocol with cooperative coverage-oriented information collection method for VANET. IET Communications, 11(3), 444-450.