Routing Protocol in VANET

Shreya Patel[1] Mr. Parimal Patel[2]
[1]M.E CSE [2]M.Tech. I.T
G.T.U, Gujarat

***Abstract*—** Vehicular Ad Hoc Network (VANET) is a sub class of mobile ad hoc networks. VANET provides wireless communication among vehicles and vehicle to road side equipments. The communication between vehicles is used for safety, comfort and for entertainment as well. The performance of communication depends on how better the routing takes place in the network. Routing of data depends on the routing protocols being used in network. Position-based routing protocols are considered best for high dynamic network like VANET. In this paper I am going to compare the position-based routing protocols which work even in high traffic density very accurately.

Keywords: .VANET, V2V

I. INTRODUCTION

The increasing demand of wireless communication and the needs of new wireless devices have tend to research on self-organizing, self-healing networks without the interference of centralized or pre-established infrastructure/authority. The networks with the absence of any centralized or pre-established infrastructure are called Ad hoc networks. Ad hoc Networks are collection of self-governing mobile nodes [1]. According to [2], in 1999 alone 450,000 road accidents were reported in Germany. During the same year, Europe reported three times this number of accidents with fatalities of 42,000. Similar situations exist in other parts of the world like United States[3]. To improve safety and traffic efficiency in vehicles, there has been significant research efforts [4] made by government, academia and industry to integrate computing and communication technologies into vehicles, which has resulted in the development of Intelligent Transportation Systems (ITS) [5]. Vehicular communication is a major part of ITS which forms a network called VANET. Vehicular ad hoc networks (VANETs) [6] are a special class of mobile ad hoc wireless networks (MANETs) where the nodes are vehicles and roadside units. It is currently attracting the extensive attention of research in the field of wireless networking as well as automotive industries. In VANETs each vehicle takes on the role of sender, receiver, and router [7] to broadcast information to the vehicular network or transportation agency, which then uses the information to ensure safe and free flow of traffic. For communication to occur between vehicles and Road Side Units (RSUs) vehicles must be equipped with some sort of radio interface or On Board Unit (OBU) that enables

short-range wireless ad hoc networks to be formed [3]. Vehicles must also be equipped with hardware that permits detailed position information such as Global Positioning System (GPS). VANETs [8] provide safer and well organized road by communicating information in timely manner to drivers and concerned authorities. The communication between nodes in a VANET faces many unique challenges [9].

II. POSITIONED BASED ROUTING PROTOCOLS

A. Greedy Perimeter Stateless Routing Protocol (GPSR)

GPSR [10] is the first position-based routing protocol. As a position-based routing protocol, it uses the geographic location of nodes to forward the packets. It works in two modes. First it requires that each node in the network is able to find its current position by using GPS receiver which provides current location, speed, current time and direction of the vehicles. By using all this information, source node or current forwarding node looks for the neighbor node which is closest to the destination and then forwards the packet to that node by considering it the next forwarding node. This operating mode is known as Greedy Forwarding in which the neighbor which is closest to the destination is selected as the next-hop node. Sometimes due to the transmission error of beacon messages or problem in GPS system in some situations like when node is in tunnel where GPS does not work or some other error, vehicles fail to find its neighboring nodes. Due to this lack of knowledge of neighbor nodes and due to the absence of neighbor node closest to destination than the forwarding node itself, a problem called local maxima may occur. In this situation GPSR uses its second mode called perimeter mode which is a most advance recovery strategy. It uses an algorithm of planer graph traversal to find a way out of the local maximum region. Although this advancement, considering only position information may lead packets to be forwarded in a wrong direction and loses good candidates that ensures its delivery.

B. Border-node based Most Forward within Radius Routing Protocol(BMFR)

Finding the next forwarding node to deliver the packet to the destination node using greedy approach does not support well in highly mobile ad hoc network such as VANET. Therefore, other position based protocols such as MFR, GEDIR,Compass routing, etc. have been used for VANET to improve its performance for high vehicular density environment. These protocols can be made better by utilizing farthest next-hop node in a dense and highly mobile network. Border-node base Most Forward within Radius (BMFR) [11] is a position based routing protocol that uses border-nodes with maximum progress towards destination node. This progress is observed by projecting the position of neighbor node on the line segment joining the source to estination. The BMFR utilizes the border-node to avoid the use of interior nodes within the transmission range for further transmitting the packet. This method selects the border-node as a next-hop node for forwarding packet from source to destination. Similarly that selected next-hop node follows the same procedure for selecting next forwarding node towards destination. The procedure continues till the

destination node is in the transmission range of the current forwarding node.

C. Adaptive Movement Aware Routing Protocol (AMAR)

In the greedy approach, the neighbor node of current forwarding node which is closest to the destination node is selected as the next forwarding node. In this method a sender node finds the position information of neighbor nodes and decides the next forwarding based on it. AMAR [12] is a Movement Aware Greedy Forwarding (MAGF) based on the greedy forwarding scheme to select next-hop node towards the destination. AMAR scheme makes use of additional information other than the position about vehicle movement to select an appropriate packet's next-hop that ensures the data delivery successfully. This scheme is suitable for highly mobile vehicular ad hoc network and it performs better even when pure greedy forwarding fails. In AMAR every vehicle calculates its position, speed and direction by using the GPS or any other navigation system. After this, its significant role is to assign priority based on calculated attributes between neighbors while selecting a next-hop node for forwarding a packet. The basic idea of this approach is to compute a weighted score Wi which depends on three factors: the position, the speed, and the direction of vehicle nodes. This weighted score *Wi* can be computed by current packet forwarder for neighbor node *i* as follows:

$$Wi = \alpha Pm + \beta Dm + \gamma Sm$$

where α, β, and γ are the weight of the three used metrics *Pm,Dm, and Sm* representing respectively the position, the direction and the speed factors.

D. Border-node based Movement Aware Routing Protocol (BMAR)

BMFR uses border node as the next hop node to reduce the hop count as border node is closest neighbor to the destination. But in city scenario or in situations where traffic density is very high, probability of two or more border nodes which are equidistant from the destination increases. BMAR [13] uses the features of AMAR to resolve the conflict between two border nodes. It calculates speed and direction parameters and determines the weighted score of candidate border nodes. Now the border node which is moving with high speed and in the direction of destination will be chosen as a next hop node. Since the traffic density is high, again a conflict may occur. BMAR resolves it using the probability factor. Probability of changing the direction at intersection is high so BMAR discards the nodes with intersection in their route. If it does not suit in the situation then the node with highest successful transmissions is selected as next hop node.

E. Edge node based greedy routing protocol(EGBR)

EBGR[14] is the position based routing protocol based on greedy forwarding strategy. EBGR protocol uses unicast for sending message from any node to any other node or broadcast for sending message from one node to all other nodes in highly dynamic networks. This method selects the edge node of the limited transmission range as a next hop node for sending message from source to destination.

F. Greedy Perimeter Coordinator Routing(GPCR) [15]

GPCR is based upon the fact that city street form a natural planner graph. GPCR does not require external static street map for its operation. GPCR consists of two components: A Restricted Greedy forwarding procedure, A repair strategy for routing algorithm. A GPCR follows a destination based greedy forwarding strategy, it routes messages to nodes at intersection. Since GPCR does not use any external static street map so nodes at intersection are difficult to find.

III. RESULT

We have considered the two scenarios: one in which number of nodes varies and other in which simulation time varies.

A. Simulation with variation of Nodes

First we consider the scenario in which number of vehicles varies from 24 to 120. In this scenario, we simulate the network for 100 seconds in 1652*1652 m2 area.

We simulate four routing protocols: GPSR, AMAR, BMFR and BMAR (proposed) using this scenario. We evaluate three metrics: Packet Delivery Ratio (PDR), Average End-to-End Delay and Throughput.we compared the average end-to-end delay of BMAR protocol with existing position based protocols. It can be clearly observed that the delay of BMAR is lowest as compare to existing protocols. Also we can analyze that as the number of nodes increase, delay of BMAR decreases. For AMAR and BMFR also, delay decreases with the increase in number of nodes but with small fraction. In case of GPSR, delay decreases initially but later on it starts increasing.

BMAR protocol outperforms other existing protocols in terms of throughput. GPSR has almost negligible throughput which increases with increase in number of nodes. AMAR and BMFR also perform well in terms of throughput.packet take less time to reach its destination in case of BMAR protocol as compare to other protocols. In case of GPSR, delay first decreases with increase in simulation time but after some time it starts increasing with time.

IV. CONCLUSION

We simulated routing protocols like GPSR, AMAR, BMFR and BMAR on NS2 and compared their performances. For comparison, we selected three metrics: packet delivery ratio, average end-to-end delay and throughput. We have considered

two parameters i.e. number of nodes and the simulation time for changing the simulation set up. For both set ups, we simulated and compared all the routing protocols and found that BMAR outperforms all the compared routing protocols. Its packet delivery ratio is highest and delay is lowest. It delivers the maximum packets accurately to the destination node within no time. Throughput of BMAR protocol is also highest in both the simulation scenarios which shows that maximum data is transmitted by BMAR in a given time period. We need to develop some more efficient routing protocol as VANET has main usage in safety related applications so message should reach the destination without any delay.

REFERENCES

[1] M. Mauve, A. Widmer, and H. Hartenstein, "A survey on position-based routing in mobile ad hoc networks," Network, IEEE, vol. 15, no. 6, pp. 30 - 39, Nov/Dec 2001.
[2] Andreas Festag, Holger Fubler, Hannes Hartenstein, Amardeo Sarma, and Ralf Schmitz FleetNet: Bringing Car-to-Car Communication into the Real World. In Proceedings of 11th World Congress on ITS, Nagoya, Japan, Oct 2004.
[3] A. Stampoulis, Z. Chai "Survey of Security in Vehicular Networks" Technical report, 2007 Project CPSC 534.
[4] Panos Papadimitratos and Jean-Pierre Hubaux Report on the "Secure Vehicular Communications: Results and Challenges Ahead" Workshop. ACM SIGMOBILE Mobile Computing and Communications Review (MC2R), 12(2):53–64, 2008.
[5] Y. Qian and N. Moayeri "Design of Secure and Application-Oriented VANETs" in Vehicular Technology Conference, VTC Spring 2008, IEEE, 2008
[6] H. Moustafa, Zhang Yan, "Vehicular networks: Techniques, Standards, and Applications," CRC Press, 2009.
[7] Jinyuan, S., Chi, Z., Yuguang, F., "An ID-based framework achieving privacy and non-repudiation", In Proceedings of IEEE vehicular ad hoc networks, military communications conference (MILCOM 2007) (pp. 1–7), October 2007.
[8] S. S. MANVI and M S KAKKASAGERI, "Issue in Mobile Ad hoc Networks for Vehicular Communication", IETE Technical Review, Vol. 25, No. 2, March-April 2008.
[9] Elmar Schoch, Frank Kargl, Michael Weber, Tim Leinmuller "Communication Patterns in VANETs", IEEE Communications Magazine, 46:119–125, Nov 2008.
[10] B. Karp and H. T. Kung, "GPSR: Greedy Perimeter Stateless Routing for Wireless Networks," Proc. Of ACM/IEEE International Conference on Mobile Computing and Networking 2000.
[11] Raw R.S., Lobiyal D.K., "B-MFR Routing Protocol for Vehicular Ad hoc Networks", IEEE, ICNIT 2010, Manila, Philippines 2010.
[12] Brahmi N., Boussedjra M., Mouzna J., Bayart M, "Adaptive Movement Aware Routing for Vehicular Ad Hoc Networks",Leipzig. Germany 2009.
[13] Monika, Sanjay Batish, Amardeep Singh, "Border-node based Movement Aware Routing Protocol", In Proceedings of International Conference on Computer Science and Engineering (ICCSE), page No. 164 -167, Feb. 2012.
[14] Ram Shringar Raw, Sanjoy Das, "Performance Comparison of Position-based Routing Protocols in Vehicle-to- Vehicle (V2V) Communication," in IJEST, Jan 2011.
[15] Kevin C. Lee," Survey of Routing Protocols in Vehicular Ad Hoc Networks".

