International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

Design and Performance Analysis of Multicast Routing Protocol for Vehicular Ad Hoc Network

Jyoti Thakur , Preeti Singh , Pardeep Kaur , Nidhi Garg ,Charu Madhu

ABSTRACT Development of dynamic routing protocol is most challenging task in (Vehicular Ad Hoc Networks) VANETs as topology keeps changing due to high speed moving vehicles. Due to the high mobility of vehicles the problem of link failure becomes frequent in vehicular ad hoc network , the most difficult task in VANET routing is the identification and maintenance of optimal paths for communication . The broadcasting technique has high bandwidth consumption and delay. Thus this paper presents the multicasting routing protocol so as to minimize the bandwidth .In this technique the cluster is formed on the basis similar parameters like speed and direction, after the formation of cluster the appropriate cluster head is selected and routing protocol is proposed for selection of best reliable path from source to destination. The nodes having maximum connectivity with nearest node is selected as cluster head . Simulation experiments are conducted and the results are compared that show better performance in terms of throughput and packet delivery ratio (PDR).

KEYWORDS Cluster , vehicular ad hoc nework , throughput , root node , multicast.

1 INTRODUCTION

In recent years, due to rapid urbanization the number of motorists has been increasing drastically. Critical traffic problem such as accident and traffic congestion require the development of new transportation system .The Intelligent transportation system (ITS) is an integration of telecommunication and information technologies in transport systems to improve safety [1].

VANETs comes under short range of Intelligent Transportation Systems .The vehicles are equipped with wireless sensors and on board units , that are that are interconnected for road safety ,driving improvement and comfort services [2]. interconnected for road safety ,driving improvement and comfort services [2]. Routing protocol is used for selection of the path having lowest delay.

- *Jyoti Thakur is currently pursuing masters degree program in Electronics and Communication Engineering in UIET Panjab University, India ,8219634592. jyotithakur1176@gmail.com*
- *Preeti Singh, Pardeep Kaur , Nidhi Garg, Charu Madhu are assistant professor in Department of Electronics and Communication in UIET Panjab University, India.*

Based on application requirement different routing [4] protocols can be used in networks based on specific parameters .. In cluster based routing, the network is divided into smaller groups based on specific parameters The advantage of grouping the vehicles in cluster is that the vehicles will remain inside the cluster for longer period and there will be less link failure . The cluster head is a vehicle that communicates with every node in the cluster and controls the cluster. There are many different techniques for cluster head election [3].

In this paper , a multicast routing is used and an appropriate and reliable cluster head is selected in VANETs. The cluster is formed on the basis of speed such that the vehicles moving with similar velocities are arranged in one cluster . The nodes having maximum connectivity with the adjacent nodes is selected as zonal head. The multicast routing is used to minimize the bandwidth consumption. In multicast , the packets go to a required set of devices on network so the traffic remains under control. Like broadcasting the messages are not flooded over the network .The path from source to destination is established. The rest of the paper is organized as follows: In section 2 the related work by different

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

authors is presented. The main idea of cluster head selection is described in section 3 , section 4 is about simulation environment and results , section 5 includes the conclusion of the paper.

2 RELATED WORK

Because of highly mobile vehicles the problem of link failure becomes frequent in VANETs [5] . When the vehicles having the similar characteristics are grouped into the clusters or zones they reside within the cluster for longer thus results in less link failure. A lot of work is reported about the routing and clustering techniques.

Eiza et. al. [6] present situation aware multiconstrained QoS routing algorithm (SAMQ) search that uses situational awareness (SA) and ant colony optimization (ACO). In [7] a novel Real Time Vehicular Communication(RTVC) is proposed , the clustering is done by using speed and direction matrices , the cluster head is selected by using cluster threshold value (CTV). The node having speed relative to CTV value is cluster head. In [8] , a cluster based on Demand delay tolerant routing algorithm (CODE) is used for vehicular ad hoc Networks. In CODE , the cluster are formed on the basis of speed. The nodes having similar relative speed are arranged with in the same cluster and the node that is having speed similar to the average speed of the cluster is selected as cluster head. In [9] ,the Affinity PROpagation for vehicular ad hoc network (APPROVE) uses vehicles position and mobility. This scheme takes extra delay time for clustering due to iterative loops. Zone based routing protocol (ZRP) is proposed [10]. ZRP is one of the protocol that is vulnerable to security. In comparison to greedy perimeter stateless routing (GPSR) it is having more packet delivery ratio in sparse and dense conditions. The [11] multicast routing selection for VANET using hybrid scatter search ABC algorithm is used for finding the best path between vehicle and reference vehicle. It is ant colony optimization that classify colony of bee as employed (carry information), onlookers(waits for information shared by employed bees) and scouts(carrying out random search) . A two level cluster based routing protocol is proposed in [12] for Vehicular ad hoc network. Two levels are used , at first level routing is performed between the cluster members .The metric used to select the best neighbor is quality of link (QoL) and distance. Firstly , it checks whether the link to the cluster head is strong or weak after that it decides how the packet need to be sent to the cluster head , in the second level . In [13] new multihop clustering algorithm for vehicular ad hoc network Passive Multihop Count (PMC) is proposed and cluster merging concept is introduced , enabled the strategy of priority based neighbor selection The greedy algorithm is used to find the path between two cluster heads. It is a simple and robust clustering scheme for large scale and dynamic VANETs. In [14] , a center based stable evolving clustering algorithm the concept of grid partitioning is used , that is dividing the road environment into grids. The cells collect information from road about the density of vehicle. A robust scheme [15] is proposed to select the efficient cluster head on the basis of location of vehicle. The vehicle at the middle is considered as cluster head .

The broadcasting technique used in most of the papers consume more bandwidth and power .To overcome the gaps we proceed with enhanced cluster head selection followed by multicasting routing protocol to get optimized results.

3 RESERCH METHODOLOGY

This section discusses the research methodology. The process starts with defining the source and destination node for establishing the path. After defining the nodes control messages are sent by road side units to vehicle nodes in the network. After receiving the message, the vehicle node calculates number of neighbor nodes in its direct range. The particular vehicle node that has maximum number of nodes in its direct range is considered as zonal head or cluster head.

After the cluster head is selected then the source node send route request packets to the cluster head. The message is transmitted from source to zonal head and it verifies whether it is zone or not. When the requesting node is in the zone then path will be directly formed from source to destination and if the requesting node is not in the zone ,then zonal head pass request to the next zonal head. Therefore, the best low delay path is established from source to destination. The flowchart of proposed methodology is shown in figure 1.

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

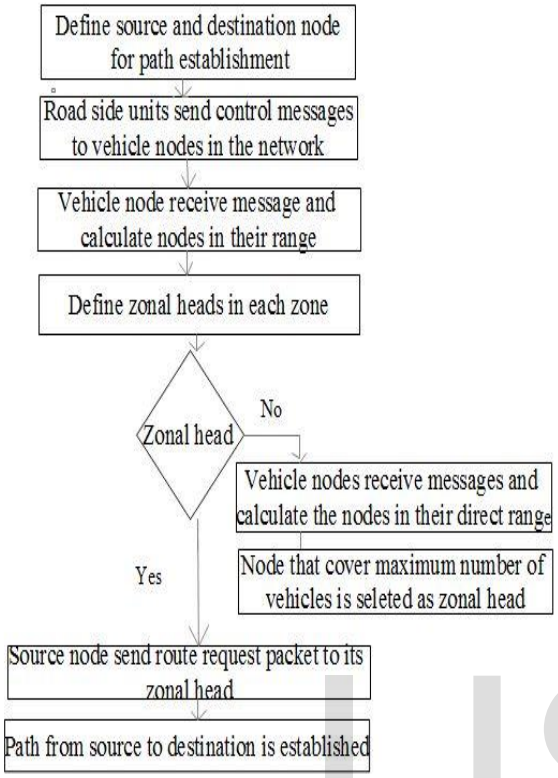

Fig. 1. flowchart of methodology used

A. CLUSTER FORMATION

The vehicles with almost similar speed are arranged in same cluster. Cluster speed limit (CSL) is the parameter used to arrange vehicles into clusters as follows.

Clusters of slow lane (CS): $CSL_S < 60$ km/h.

Clusters of medium lane (CM): $60 < CSL_M < 90$ km/h.

Clusters of fast lane (CF): $90 < CSL_F < 120$ km/h.

CSL_S is specified to be less than 60 km/h for constructing clusters, maximum speed limit specified is 120km/h.

B. CLUSTER HEAD

Vehicle node calculate the number of nods in their direct range, the node that cover maximum number of nodes is selected as cluster head.

C. DISTANCE CALCULATION

Let the v(x1,y1) is the position of node 1 and v(x2,y2) is the position of node 2 here x and y are the coordinates , the distance between these two nodes is calculated by using the formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad \textbf{(1)}$$

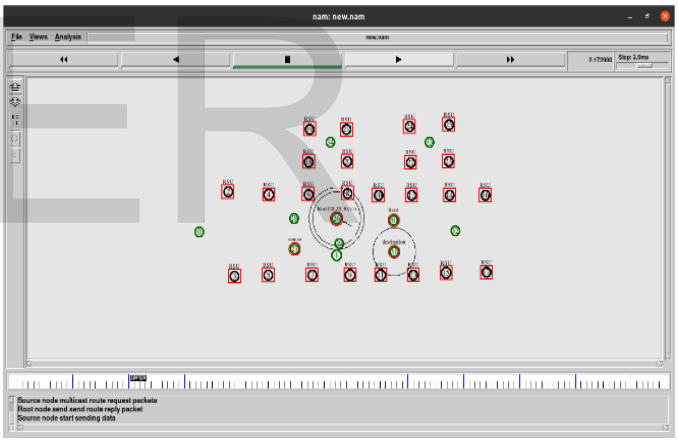

Fig. 2. network scenario is created by using ns2

Network is scenario is shown in figure 2 .The network consists of 34 nodes. The vehicles are mobile in nature. The network is initialized ,the root nodes are selected on basis of maximum correspondence with other nodes. As the network is highly mobile, if the vehicles reaches far away then the next node that is having maximum number of nodes in its direct range becomes cluster head. The source node

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

multicast route request the packets. Root node send route reply packet .Source node multicast route request packet ,after that source node start sending data to the destination.

Algorithm 1

1. For each vehicle v do

2. set initial position // *initial position of nodes*

3. if (cluster speed limit (CSL) value < 60) then

    2. lane= slow
    3. elsif (CSL value > 90) then
    4. lane = fast
    5. else
    6. lane= medium

4. end

5. calculate d // *distance from equation 1*

6. if d1==0 & d <180

7. process set neighbors

8. process calculate nodes in direct range

9. if nodes maximum then

10. set status= HEAD //*node is selected as cluster head*

11. process path formation

4 EXPERIMENTAL WORK AND RESULTS

This section presents analysis of throughput and comparison with previous work. Simulation has been performed by using network simulator ns 2.34 . The simulation has been conducted on 34 nodes for 8 seconds. Two lane highway scenario has been used. The performance of multicast clustering routing protocol is compared to the broadcast routing protocol . In broadcast routing, the source node floods the message to the every node in the network and requires more bandwidth and power consumption. The simulation parameters are given in table 1.

Table 1

The parameters of experimental work

Parameters	Values
Number of lanes for highway scenario	2
Maximum no. of vehicles	34
MAC protocol	IEEE802.11p
Application type	FTP
Radio propagation mode	Two ray ground
Maximum vehicle speed	120 km/h
Connection type	TCP
Application type	FTP

Throughput is defined as the ratio of number of packets received to the time. It tells about the efficiency of protocol in transmitting the data packets to the destination. In figure 3, the throughput is better in case of multicast than broadcast routing in broadcast routing.

After six seconds the number of packets in broadcast routing is fixed i.e 60000 packets in multicast routing the graph is still

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

increasing. At 5 second the value of throughput is 8000 packets per unit time, and in broadcast ,the value of throughput is 6000 packets per unit time.

This is because in broadcast routing the source node floods the packets to the every node in the network due to which there arise problem of traffic congestion and problem of collision occurs which leads to packet loss in the network

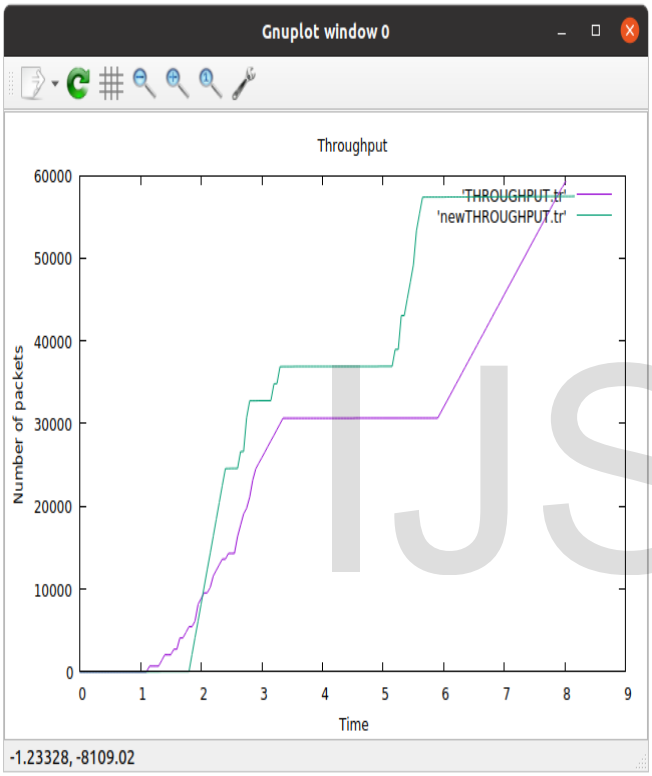

Fig. 3. Packets vs time for throughput analysis

After 6 seconds the graph rises exponentially .The concept of multicast routing overcomes the problem of traffic congestion and packets will reach safely to the destination node. The simulation results show throughput response is better in case of multicast routing protocol.

5 CONCLUSION

In VANET due to highly dynamic condition the topology keeps changing so there is need to develop a framework that can handle high speed vehicles efficiently. Thus multicast cluster based routing is useful , as vehicles with comparable speed are grouped in one cluster that overcomes the problem of frequent link breaks and multicast routing lessens the congestion in network and saves the bandwidth and power consumption , minimize collision and packet loss , packets arrives safely at the destination. This scheme provides better throughput.

REFERENCES

[1] Wiegel, Bernhard, Yvonne Gunter, and Hans Peter Großmann. "Cross-layer design for packet routing in vehicular ad hoc networks," *2007, IEEE 66th Vehicular Technology Conference*. IEEE.

[2] Panichpapiboon, Sooksan, and Wasan Pattara-Atikom. "A review of information dissemination protocols for vehicular ad hoc networks," *IEEE Communications Surveys & Tutorials* 14, no. 3 : 784-798.

[3] Sofra, Nikoletta, Athanasios Gkelias, and Kin K. Leung. "Link residual-time estimation for VANET cross-layer design," *2009, Second International Workshop on Cross Layer Design*, pp. 1-5. IEEE.

[4] Lai, Peiyuan, Xinhong Wang, Ning Lu, and Fuqiang Liu. "A reliable broadcast routing scheme based on mobility prediction for VANET." *2009, IEEE Intelligent Vehicles Symposium*, pp. 1083-1087. IEEE.

[5] Hartenstein, Hannes, and L. P. Laberteaux. "A tutorial survey on vehicular ad hoc networks," 2008 , *IEEE Communications magazine* 46, no. 6 : 164-171.

[6] Eiza, Mahmoud Hashem, Thomas Owens, Qiang Ni, and Qi Shi. "Situation-aware QoS routing algorithm for vehicular ad hoc networks,"2015, *IEEE Transactions on vehicular technology* 64, no. 12 : 5520-5535.

[7] Farooq, Waqar, Muazzam Ali Khan, and Saad Rehman. "A novel real time framework for cluster based multicast communication in vehicular ad hoc networks," 2016, *International Journal of Distributed Sensor Networks* 12, no. 4 : 8064908.

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518

[8] Zheng, Jun, Hui Tong, and Yuying Wu. "A cluster-based delay tolerant routing algorithm for vehicular ad hoc networks," *2017, IEEE 85th Vehicular Technology Conference (VTC Spring)*, pp. 1-5. .

[9] Hassanabadi, Behnam, Christine Shea, Le Zhang, and Shahrokh Valaee. "Clustering in vehicular ad hoc networks using affinity propagation,"2014 *Ad Hoc Networks* 13 : 535-548.

[10] Setiabudi, Aji, Amalia Ayu Pratiwi, Doan Perdana, and Riri Fitri Sari. "Performance comparison of GPSR and ZRP routing protocols in VANET environment," *2016 ,IEEE region 10 symposium (TENSYMP)*, pp. 42-47.

[11] Malathi, A., and N. Sreenath. "Multicast routing selection for VANET using hybrid scatter search ABC algorithm," *2017 ,IEEE international conference on power, control, signals and instrumentation engineering (ICPCSI)*, pp. 441-446.

[12] Hamedani, Parisa Saraj, and Arshin Rezazadeh. "A new two level cluster-based routing protocol for vehicular ad hoc network (VANET)," *2018, UKSim-AMSS 20th International Conference on Computer Modelling and Simulation (UKSim)*, pp. 121-126.

[13] Zhang, Weina, Ruijuan Zheng, Mingchuan Zhang, Junlong Zhu, and Qingtao Wu. "ECRA: an encounter-aware and clustering-based routing algorithm for information-centric VANETs," 2020,*Mobile Networks and Applications* 25, no. 2 : 632-642.

[14] Talib, Mohammed Saad, Aslinda Hassan, Thamer Alamery, Zuraida Abal Abas, Ali Abdul-Jabbar Mohammed, Ali Jalil Ibrahim, and Nihad Ibrahim Abdullah. "A Center-Based Stable Evolving Clustering Algorithm With Grid Partitioning and Extended Mobility Features for VANETs," 2020 ,*IEEE Access* 8 : 169908-169921.

[15] Banikhalaf, Mustafa, and Moaiad Ahmad Khder. "A simple and robust clustering scheme for large-scale and dynamic VANETs," 2020 ,*IEEE Access* 8: 103565-103575.

International Journal of Scientific & Engineering Research, Volume 13, Issue 5, May-2022

ISSN 2229-5518