Implementation of Multicasting Routing Techniques for Vehicular ad hoc Networks (VANETs)

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Abstract - The vehicular adhoc network is the decentralized type of network in which vehicles can move from one location to another. In the network two type of communication is possible which are vehicle to vehicle and vehicle to infrastructure. In the vehicle to vehicle type of path establishment is the major issue of the network. In this research work, multicasting routing technique is proposed for the path establishment from source to destination. The proposed technique is implemented in NS2 and simulation results shows improvement in network delay for path establishment.

Keywords - *LAR, Broadcasting, Multicasting, VANET, Path establishment*

I. INTRODUCTION

Within smart cites that consist of huge traffic, the mobility, quality, comfort as well as safety needs to be improved which can be done by utilizing Intelligent Transport Systems (ITS). For all the applications, in order to develop ITS, the most important part to be included is Vehicular Ad-Hoc Network (VANET) [1]. All across the globe, several researchers from industry as well as academia are attracted. In order to enhance the safety of vehicles on roads, the traffic efficiency as well as the level of comfort for commuters, VANETs are utilized. The vehicles are known as nodes within the VANETs and the edges within the network are considered to be the distance between these vehicles on roads. A wireless medium is used in order to accept and transfer the messages amongst vehicles. For connection and communication within the 100 to 500 meters of range, the vehicles that are participating are known as wireless nodes or routers which further generate a network. The vehicle will be dropped out of the network when it falls out of the signal range [2]. When any vehicle comes within the signal range of existing vehicles present in the network, it can possibly join the network. On Board Units (OBUs) are the advanced wireless communication devices through which these vehicles are furnished. There is no base station assigned towards such devices. Both V2V and V2I communications are possible for OBUs. A major application that supports vehicular ad-hoc networks is the Intelligent Transportation System (ITS). The development of dynamic routing protocol is one of the major challenges faced during the design of vehicular ad-hoc networks. The information from one node can be disseminated to another with the help of this protocol. Due to the highly dynamic and continuously changing topologies, there have been several changes made within the routing in VANET recently as comparison to other traditional approaches [3]. Within VANETs, few previously designed protocols for MANETs have been tested. The manner through which the delay related to passing information from one node to another can be minimized is the major challenge here. The real time applications for VANET scenario can be implemented by overcoming these challenges within MANET protocols. There is also a need to carefully examine other implications as well. The unpredicted and dynamic nature of vehicular network topology can be handled by routing protocol by examining the dynamic characteristics of VANETs. The identification and maintenance of optimal paths of communication within the required scenarios is the most difficult task to be performed within VANET routing [4]. As per the topology being used within network architecture, the routing protocols in VANET are linked. Further, whenever there is a change in network topology, the performance is modified. There are five major categorizations of routing in VANET. Due to the availability of efficiency and mobility in dynamic scenarios such as VANET, there most popular research areas are the multicast routing protocols. As they send multiple copies of messages to several vehicles simultaneously, the power consumption, transmission overhead and control overhead are minimized by multicasting. From a single sender to multiple destinations or group of interested nodes, the messages travel within the multicast routing protocols. The messages are transmitted to group of intended vehicles within the VANET multicast routing protocols [5]. Flooding, Tree-based, Mesh-based and Overlay-based approach, are the classifications of multicast routing methods. The messages are broadcasted through the network similar to a chain reaction through flooding. The messages are forwarded to all its neighbors except for the sender, by each node. Within the desired geographical region, the limitation to messages being broadcasted can be done. Thus, only when nodes lie within particular geographical region, the message is rebroadcasted by those nodes. It is very easy to implement the flooding algorithm. The reliable delivery of messages is possible with the help of this algorithm. For the redundant messages, there is huge bandwidth and power consumption by flooding. In order to transmit the messages, traditional

multicast protocols utilized the tree topologies. This is used to ensure that an efficient distribution topology is provided and it is not a major concern to ensure robustness here. The source-based and shared-tree-based are the two different types of tree protocols. For each multicast source, source-based protocol generates a tree which is mainly shortest-path tree. Since higher routing overhead is generated, this approach is less scalable even though its efficiency is high [6]. Only one tree is generated by each group for shared-tree-based protocol. For transmission, this tree is used by all the sources. Due to decrease in overhead and required routing state, this protocol is however less efficient. The robustness issue of tree-based protocols is solved with the help of mesh-based multicast protocols. For mitigating the effects of frequent topology changes, the alternative paths are utilized which provide redundancy through this approach. An example of such protocols is the On-Demand Multicast Routing Protocol (ODMRP) [7]. A forwarding group concept in which the scoped flooding is scope using subset of nodes is utilized by ODMRP. A JOIN QUERY message is broadcasted periodically by the node when it wishes to join a multicast group of requires to forward data. When there is increment in number of sources because of the high control overhead, the performance of tree-base and mesh-based protocols are minimized. The updating of routing structure needs to be maintained by these protocols thus resulting in higher number of collisions as well. The state information is stored only within the multicast group members by overlay-based protocols such that the overhead can be minimized.

II. LITERATURE REVIEW

Shaffy Singh, et.al (2017) presented the movement of vehicles is not dependent on the driver when they moves from one location to another within the network is known as the vehicular Ad hoc network. They implemented the root node selection technique in this paper in order to reduce chances of link failure. The selection of path done is done using the root node in case node wants to establish path to destination [8]. In this paper different optimal path algorithms was utilized by which path is established and traffic is controlled. They discussed the issues related to the routing in this paper and two type of communication is possible. V2V communication is the first type and V2I communication is the second. They proposed the multicasting technique in which route request packets are flooded by the source node by which establishment of the path to destination can be possible. There is reduction in packet loss, delay and increase in network throughput due to the proposed method. They performed various experiments on the proposed method in order to analyze the performance of the network within the network.

Anurag Shrivastava, et.al (2018) presented the main focused on the road side unit (RSU) for which it is required to improve the efficiency of energy and its throughput. They proposed an improved multicast based energy efficient opportunistic data scheduling algorithm in this paper [9]. They provided the service of the multicasting at optimal data rate to the selected group of users. On the basis of obtained results, it is concluded that proposed method efficient energy and optimal throughput is provided by it. This proposed method also estimates the maximum throughput accurately and with low search complexity. The flexibility of the algorithm was tested in this paper by performing simulation on two different cases. First case is no new user is entertained until all the initial users get served and second, in every time slot there is entry of new users.

Xiu Zhang, et.al (2016) presented that within the wireless communications, higher attention has been paid towards the vehicular ad hoc networks (VANETs). For transmitting information within VANETs, the major issue being faced is routing. For constraining multicast routing issue, the quality of service (QoS) is provided through this paper. A NP-complete issue is found here and it is seen that in comparison to classical algorithms, the swarm intelligence algorithms are better [10]. For a continuous optimization issue, multicast routing is abstracted. Further, with MABC, this approach is linked to achieve better performances. Using three instances, the numerical simulation is implemented on a traffic environment. An optimal route is achieved as per the results achieved using MABC algorithm. Even though there is less frequent change in the network structure, the routing framework is possibly applied in real time.

Sabri Allani, et.al (2016) presented the wireless communications technologies and low cost embedded sensors have been widely utilized in the VANET network due to which there is improvement in the road safety and transportation efficiency [11]. In this paper, analysis of literature was shown and the effective approaches were highlighted that was not able to fulfill the essential requirements due to which they are no more utilized. They proposed a new infrastructure-less Geocast protocol in this paper that eliminates all the previous limitations. Vehicles present in the Zone of Relevance only received message from this proposed method with a minimum overhead cost. On the basis of experiments, it is concluded that proposed method has minimum overhead cost while provide the high delivery ratio as well as a high Geocast precision. It is also demonstrates that as compared to other methods proposed method provide effective and efficient performance.

Jeongcheol Lee, et.al (2016) presented with the advent in the technology, one-to-many group communications has been provided by the Vehicular Ad Hoc Networks utilized for business and entertainment applications such as video conferences and file sharing. For VANETs they proposed a delay-sensitive and cost efficient multicast protocol in this paper. The shortest path connection and the farthest destination Selection strategy were utilized by the proposed

method in order to construct a multicast tree [12]. This method is based on the vehicle information like map information and location information and upcoming intersections. As per simulation results, it is demonstrated that better performance is shown by the proposed protocol using FSSC as compared to SPT and MST protocols. End-to-end delay, the transmission number, and the delay variation are the parameters for comparison.

Amel Ltifi, et.al (2015) presented for the road security various investigation has been done so that this major issue can be resolve. Most of the done investigation cost higher as it require expensive infrastructure [13]. They proposed a new scheme in this paper by which vehicles are warned for the upcoming obstacles due to which they are no more dependent on road foundation. They also proposed a model for trust management for VANET on the basis of cooperation between "Active vehicles" by which the security is enhanced and also false warnings through a vehicular network are cut down. As per the simulation results achieved, it is seen that with the help of tolerant delay constraint that is generated by DSRC, there is enhanced in end-to-end delay of the systems. For future work, the privacy issue will be of major focus.

III. RESEARCH METHODOLOGY

In order to enhance the performance of protocol, the lifetime of a route is to be increased for which the stability of route present in between source and destination is improved here. The nodes that participate within the route request and travel in the similar direction of movement are selected here. This is done due to the fact that the nodes that move in opposite directions generate the route that can break easily in comparison to the nodes moving in similar direction. Thus, the selection of direction of movement is an important factor to be considered.

1) *Direction of movement:*

The area where D is located can be estimated by S in case when a route request is required to be sent from node S to node D at t1 time. However, the direction of movement for the destination node is not known to S which must be known. The nodes that move in the similar direction D are no possible to be known. However, the direction of movement of S in time t1 is known here which means that the movements of nodes that go in same direction of S are known. A route request is proposed to be sent to the nodes that are moving in similar direction to that of a source in order to enhance the stability of path amongst source and destination on the highway scenario. The direction of motion in comparison to S is checked when a route request is received by a node. The route request is retransmitted in case it moves in the similar direction to that of S or the route request is eliminated otherwise. Upon the constraints of LAR scheme 1 (LAR1), this proposition is added.

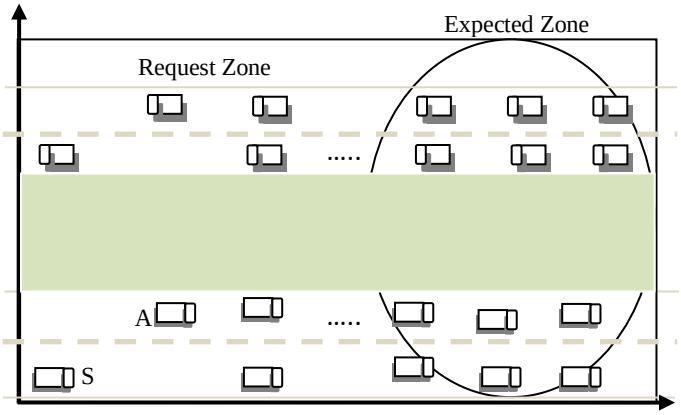

Fig. 1 Bi-directional highway model

Figure 1 represents an example scenario here. The route request node I is forwarded nu node A such that the route request can be forwarded due to the fact that its direction of movement is similar to that of S. The route request is deleted in case if 'I' does not have the similar direction to that of S.

2) *The neighbor to stay longest time:*

The transmission of route request message to the vehicle that has maximum time within the coverage area where the vehicle is transmitting is proposed here. The process of transmission of route request to all the vehicles that are traveling within the similar direction of motion of source S can be eliminated here. The time for which a vehicle has to remain in the coverage area such that the vehicle is in the half-circle of the communication range within the side that is near to destination (D), is computed, as shown in figure 2. The receiver vehicle of the route request message is chosen on the basis of the vehicle that has longest time. Till the message reaches the destination within the constraints of LAR1 protocol, the procedure keeps iterating. In order to compute the time of each neighbor, four different cases are presented here.

The transmission of each vehicle is assumed to be transmitted to the neighbors here. The position of vehicle A at time t0 is (X_A, Y_A) and V_A is its speed. The speed of neighboring vehicle I is V_I and it is located at position (X_I, Y_I). The coverage area of vehicle A is left by vehicle I at time t1. Thus, t0=t1-t0 is the time for which the vehicle stays within the coverage area. For instance, amongst A and I, d and h are the distances taken respectively. The distances are taken at time t0 on abscissa and ordinate axis. Then, at time t1, the distance between A

and I on abscissa axis is denoted as 'a'. The distance traveled by vehicle I at time t1 is denoted as 'x'. Further, during time t=t1-t0, the speed of vehicle is assumed to be constant. However, the speeds of each of the vehicles are different.

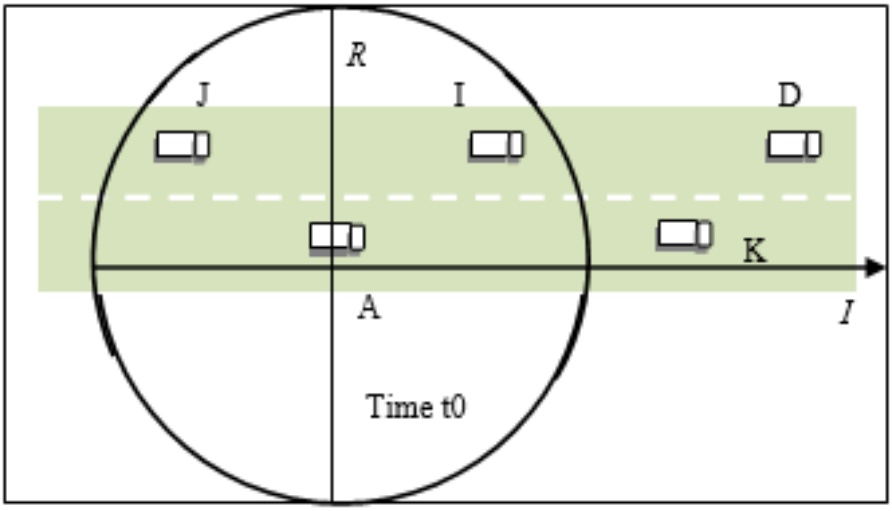

Fig. 2: half-circle of the communication range in the side closing to the destination

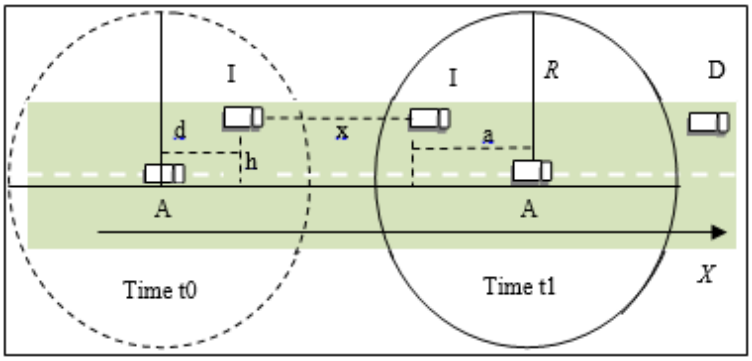

Fig. 3: D is in the direction of movement of S and VA > VI

First case: At time t0, in comparison to I, the speed of A is strictly higher and in the direction of S, the destination moves. As shown in figure 3, the distances travelled by A and I at time t1 can be calculated as:

$$d + x + a = t * V_A \quad \text{..... (1)}$$

$$x = t * V_1 \quad \text{..... (2)}$$

Thus,

$$x = \frac{V_1}{V_A - V_I} * (d + a) \quad \text{..... (3)}$$

$$d = |X_I - X_A| \quad \text{..... (4)}$$

$$a = \sqrt{R^2 - (Y_I - Y_A)^2} \quad \text{..... (5)}$$

Hence,

$$t = \frac{|X_I - X_A|}{V_A - V_I} + \frac{\sqrt{R^2 - (Y_I - Y_A)^2}}{V_A - V_I} \quad \ldots\ldots (6)$$

IV. EXPERIMENTAL RESULTS

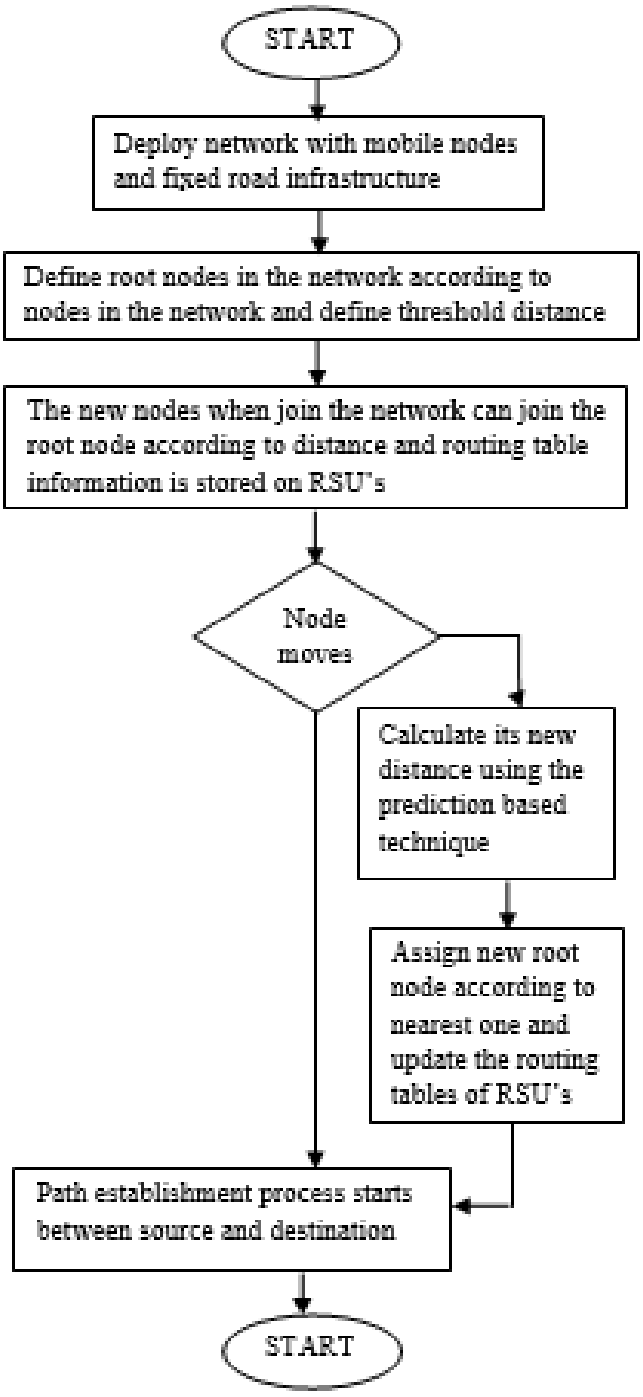

Fig 4: Proposed Flowchart

The proposed work is implemented in NS2 and the results are evaluated by performing a comparative analysis against proposed and existing techniques in terms of packet loss and throughput.

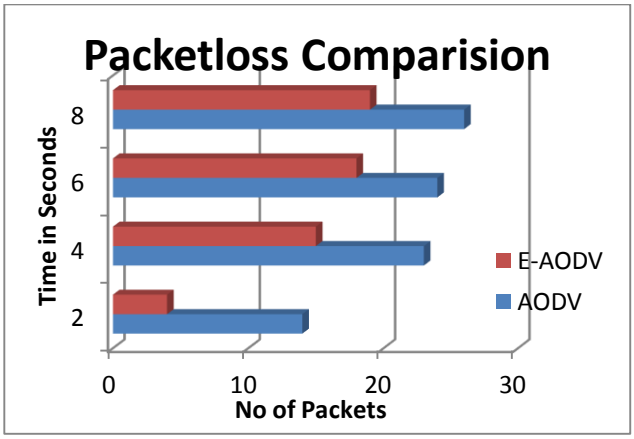

Fig 5: Packet loss Comparison

As shown in the figure 5, packetloss criteria are used to compare the old as well as the new proposed technique. The packetloss is found to be less in the new proposed technique than the already existing technique.

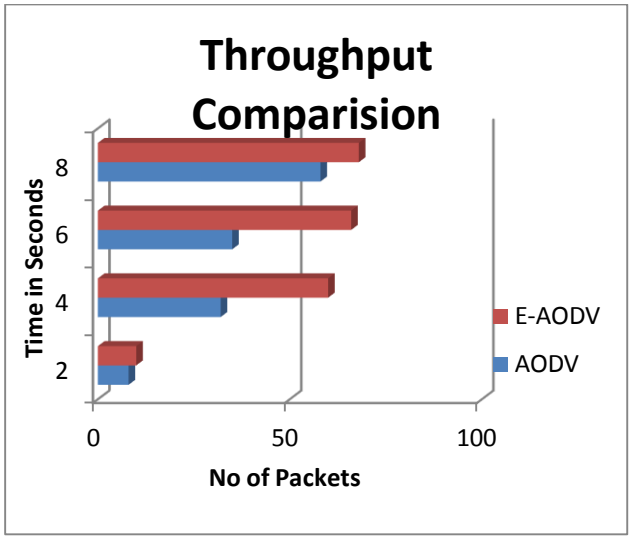

Fig 6: Throughput Comparison

As shown in figure 6, for the purpose of establishing a path the broadcasting technique is used. Also the multicasting

technique is applied by the proposed algorithm in the network. Due to this reason, the throughput of the network is increased.

V. CONCLUSION

VANET is one of the most challenging areas. Within the vehicular system, safety and security are ensured with the help of this network. As mentioned, it provides both Vehicle-to-vehicle and Vehicle-to-Infrastructure communications. In this work, it is conclude that path establishment is the major issue of vehicle adhoc network due to high mobility and dynamic nature of the network. In this research work, multicasting technique is proposed for the path establishment from source to destination. The proposed technique is based on zonal routing which is divided into expected and predicted zones. The simulation results show that proposed technique performs well in terms of packetloss and throughput.

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