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TRAJECTORY BASED MULTICASTING IN VEHICULAR AD HOC NETWORK

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Abstract

The tremendous growth in automobile industry is increasing the demand for car safety and the car to car connectivity. Vanets which is a super class of Manet are new promising and challenging technology that makes an improvisation in traffic safety and efficiency. It creates a path for intelligent transportation system (ITS).The information that is carried by the vehicles can enrol safety measures The group-oriented services are one of the primary application classes that are addressed by VANETs in recent years. To support such services, multicast routing is used. Thus, there is a need to design stable and reliable multicast routing protocols for VANETs to ensure better packet delivery ratio, lower delays and reduced control overheads. In this paper, we propose an efficient multicast protocol based on, clustering based trajectory technique to improve QOS in vehicular Adhoc network. The proposed scheme is simulated over a large number of VANET nodes with wide range of mobility and the performance is evaluated. It is observed that proposed scheme produces better packet delivery ratio, less control overheads and reduced packet delay.

Keywords: ITS, Multicast, Trajectory, Cluster, Reliable.

1.0 Introduction

With the rapid development of wireless communication systems, there will be a need for the network deployment of independent mobile users Significant examples such as establishing survival, proficient, active communication for emergency/rescue operations, disaster management efforts, and secured military networks Vehicular Ad-hoc Networks (VANETs) can be considered as a subclass of Mobile Ad hoc Networks (MANETs) with some unique characteristics [1]. Vehicles move on the roads sharing information among them. and they often move at high speed but their mobility is within regular constraints and predictable. An accurate estimate of the vehicle's position can be made available through GPS systems or on-board communication unit. VANETs are used for high-speed car to car communication [2] and between vehicles and roadside infrastructure units Most (if not all) of the high priority safety applications proposed for VANETs [3],[4] are based on one hop broadcast of information. A number of emerging network applications requires the delivery of packets from one or more senders to a group of receivers. These applications include bulk data transfer [5](for example, the transfer of a software upgrade from the software developer to users needing the upgrade), streaming continuous media (for example, the transfer of the audio, video, and text of a live lecture to a set of distributed lecture participants),shared data applications (for example, a whiteboard or teleconferencing application that is shared among many distributed participants), data feeds (for example, stock quotes),Web cache updating, and interactive gaming (for example, distributed interactive Virtual environments or multiplayer games such as Quake). For each of these applications, an extremely useful abstraction is the notion of a multicast: the sending of a packet from one sender to multiple receivers with a single send operation. in order to set up, maintain, and tear down connection state in the routers. Multicasting [6],[7] is message passing from a source to a group of destinations. Broadly two methods are employed. Using geographic addresses geocasting messages from a single source to group of destinations. Otherwise dividing the network into a group of clusters and assigning a cluster heads to each group which in turn takes care of communication between the clusters.

Strengths

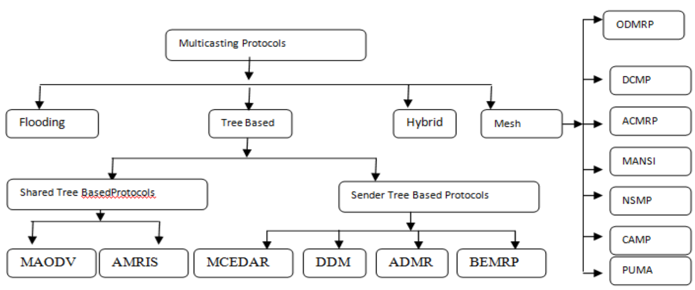
- Efficient routing by sending one copy to multiple nodes
- Minimum network consumption
- Minimum packet delivery delay
- Easy to implement
- Transparent to changeable addresses (no requirement to receiver's address)

Limitations

Consumes bandwidth

- More overhead in dividing network nodes into groups
- Routes loop

Scalability control for dynamic groups the cluster may not very efficient because frequent changing heads (like Mobile routers in network mobility but without a guarantee the network nodes will travel as one unit)



Geocast

The multi-cast of a message to nodes satisfying a geographical criterion is called geocast.

MULTICAST-BASED ROUTING PROTOCOLS

Multicast is defined by sending packets from a single source to specific group members by multi hop communication. Multicast routing in VANETs can be classified into two categories

Flooding

Tree-based

Mesh-based

Overlay-based

Backbone-based

Stateless

Flooding

Flooding is the simplest method to provide multicasting in vanets.If a node wants to send a message will flood the packets in the network. All the nodes in the network receives this message will in turn broadcast and thereby all the nodes in the network receives the message. More number of duplicate messages is created in this case which leads to increase in the routing overhead.

Tree-based

Tree-Based Multicast Routing creates a multicast routing tree and share among the group or one tree[8]for each group will be created. Basically tree based multicasting is of two types, source based and shared tree based multicast routing. This Protocol creates and maintains either a shared multicast routing tree or multiple source-based multicast routing trees (one for each group source) to deliver data packets from sources to receivers of a multicast group.

Mesh-based

Mesh-based multicast protocols try to solve the robustness problem of tree-based protocols [8]. They provide redundancy by using alternative paths in order to mitigate effects of frequent topology changes.

Overlay-based

Tree-based and mesh-based protocols performance [9]decreases when the number of sources increases due to the higher control overhead, they need to maintain updated the routing structure, and it results on higher collisions. In order to reduce overhead, overlay-based protocols keeps state information only in multicast group members, thanks to that the control overhead while the number of sources increases is more scalable. In overlay-based protocols, a virtual network is built over the VANET topology only among multicast group members and the links among the virtual network nodes are unicast tunnels in the VANET. The virtual topology remains static even if the underlying topology changes.In real time all the vehicles do not move with same speed and in same direction. Our proposed system reduces packet loss and also ensures less delay; initially vehicles will share its position and speed in travelling space to all the neighbouring vehicles which are moving in the same regional area. The vehicle with optimal speed and optimal location will trigger all the nodes and act as cluster head. Cluster Head will change dynamically based on the speed and the location. Route Selection will be done by Trajectory based routing, here the vehicle will check possible nodes and it selects the route that is available for a long time. Checking this kind of prediction, source will select the route. Vehicles will update its position and Speed in a certain time interval. Then it will share the information to its neighbour's continuously. This process will continue until the process completion. After collecting the information nodes will elect which node has optimal speed and suitable position for covering more number of nodes. In multicast Routing protocol source node can send a data to multiple destinations. Initially nodes will send a RREQ to all the nodes, if a destination node receive the RREQ, it will generates RREP otherwise it will forward to next neighbours. When source receive the RREP for all destinations which are the nodes participating in the routing all are updates the routing table. After collecting the routing information nodes will start to forward the data to given route. The route will change if a any link is failed between any nodes in network.

This paper proceeds as follows. The related works are introduced in Section II. In Section III, study related to the impact of trajectory in traffic messaging is discussed. Finally Section IV deals with the conclusion.

Section II

Existing work

Sebastian, Alvin, et al proposed a context-aware multicast protocol for ESM dissemination [10] which can reduce the accidents and crashes on roads. A different approach has been made in this protocol by considering estimated delay and the vehicle interaction graph for multicasting the message. In this protocol a routing tree is constructed based on delay and vehicle interaction graph and via the constructed tree the messages are forwarded to the receiver nodes. This protocol uses Dijkstra's shortest path algorithm which considers the transmission delay as the cost function to compute the multicast tree. The multicast tree which is constructed in this way is considered to be the minimum delay tree. Thus the number of messages being sent is reduced to reach the destination nodes thereby reduces the overhead .This protocol by using the least delay path improves the dissemination time thereby reducing the end to end delay. This protocol improves the reliability by incorporating the contention based forwarding technique.

ROVER, a new multicast routing protocol for vehicular ad hoc networks. [11] In this method the multicast routing tree is constructed using geographical addressing. It forms a multicast routing tree within a zone of relevance. A tree is created on demand and the same source can forward multiple data packets using the multicast tree. The protocol uses geographical addressing to form a multicast tree within a zone of relevance. The tree is formed on-demand and can be used to forward multiple data packets from the same source.

Section III

Instead of sending the message to all the vehicles in the network. If a vehicle knows the trajectory[12]-[14] of the following vehicles the vehicles which are in danger can be intimated about the collision. This decreases the unnecessary broadcasts and thereby the overhead in the network. Therefore a new approach in designing a multicast protocol in which a multicasting tree is computed based on the trajectory is proposed. Using the constructed multicast tree the messages are multicast to the receiver nodes. Consider the following scenario where there are four lanes(lane A,lane B,lane C,laneD) as shown in Fig1.The trajectory of lane C and lane A will be present in AP1(Access Point).If a blockage occurs in lane A, then the vehicle A1 has to intimate the vehicles which are going to travel towards lane A. Instead of broadcasting the message to all the vehicles which is usually done by the existing multicast protocols. By understanding the trajectory of each vehicle the messages are given to only those vehicles which will travel in lane A.In case of absent of AP in the network a clustering technique will be followed to forward the messages. All the nodes share the trajectory to nearest AP's.The expected delivery delay is calculated for each node in lane A.Out of that whichever is having the least Delay with optimal speed and suitable position will be selected as cluster head. Now to the cluster head the trajectories are shared. Now the cluster head will take the responsibility of forwarding the messages to the concerned vehicle in the network.

Expected delivery delay (EDD) The EDD is computed on the basis of a stochastic model as follows. Let $_{dxy}$ be the expected link delay for edge e_{xy} Let D_{xy} be the EDD at the intersection x when a packet is delivered over the edge e_{xy} . The EDD D_{xy} is formulated recursively as follows

$D_{xy}=d_{xy}$+E[delivery delay at y by forward or carry]

$=d_{xy}+\sum_{s\in N(y)} PysDys$

Where N(y) is the set of y's adjacent intersections. This recursive formation makes sense because the packet delivered over edge e_{xy} arrives at intersection y and it is forwarded to one of y's adjacent intersections (denoted as s) with the probability $_{Pys\ and}$ the EDD D_{ys}

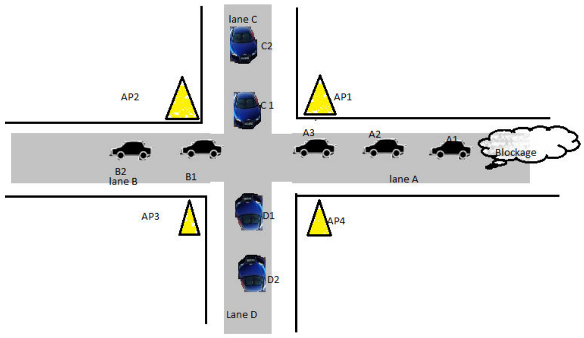


Fig 1. A Multicast scenario.

The message flow of the trajectory based multicast routing is shown in fig 2. As shown in fig the trajectories are collected and stored in a database about node position and the path it is going to follow. There are two ways to multicast the message firstly if the message transfer is via the Access point. The access point has the information of trajectory; therefore it sends the multicast message only to the concerned nodes thereby reducing the unnecessary rebroadcast. This approach unlike the other method reduces the overhead to a greater extent. Now in the absence of Access points the multicast messaging is done via the cluster heads. The expected delivery delay is calculated, the node with the least expected delivery delay and optimal speed is selected as cluster head. Now the cluster head will multicast the messages to the destined receivers.

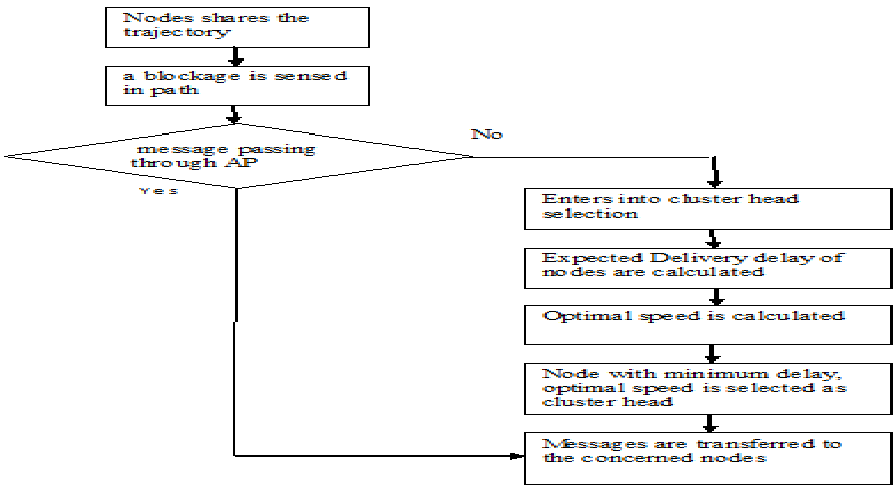


Fig 2: Message flow.

Simulation

Simulation is done via NS-2 simulator and the results are observed. The messages are not flooded to all the following vehicles. Messages are given only to the concerned vehicle therefore the unnecessary broadcast is saved which reduces the overhead of the proposed protocol. The expected delivery delay is calculated and then the messages are sent thereby decreasing the time delay which eventually increases the throughput. Fig 3 shows the throughput of existing Vs proposed .The messages are not overloaded in the network unnecessarily. The concerned receivers are identified and the messages are sent through the built multicast tree which increases the throughput in the network.

Throughput

No. of Nodes	existing	Proposed
20	70.45%	86.27%
40	74.73%	81.72%
60	72.34%	81.11%
80	68.65%	77.83%
100	65.13%	75.98%
120	62.98%	74.57%
140	60.23%	71.05%

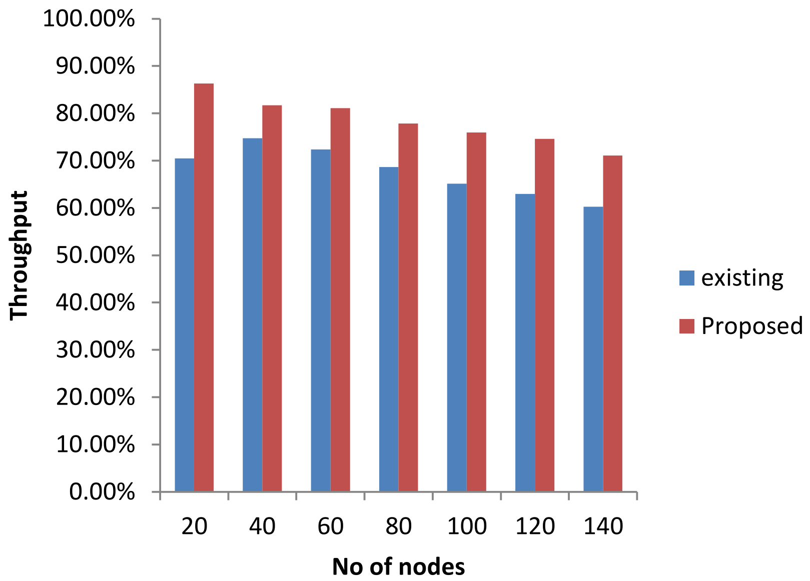


Fig-3. Throughput of Existing Vs Proposed.

Fig 4 shows the Packet delivery ratio of existing Vs Proposed. Either the access point or the cluster head knows the position of the receiver node which helps them in successfully delivering the packets with less delay thereby increasing the packet delivery ratio of the proposed one.

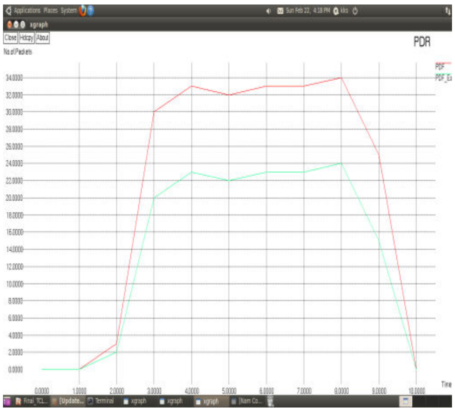


Fig-4.Packet delivery ratio of existing Vs Proposed.

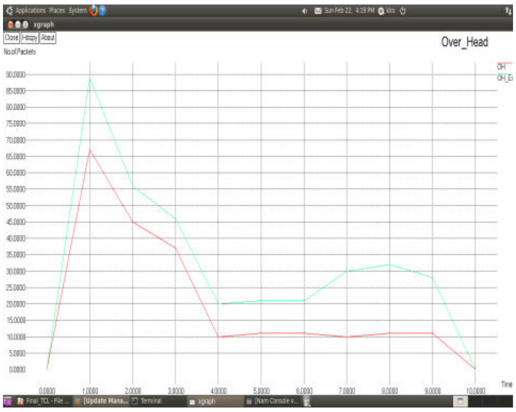


Fig-5.Overhead of existing Vs Proposed.

The comparison graph of existing and the proposed are shown in fig 5.Repeated message transfer to the unintended receivers are completely avoided thereby decreasing the overhead in the network.

Conclusion

Vehicular ad-hoc networks is a special kind of Ad hoc network which has become the recent attraction in the research industry as it constructs an Intelligent transportation system by providing safety and security as well as improve the comfort of the driver and passengers. There is a need for different types of routing protocol as there are different applications in the network. One such application is multicasting technique which sends message from a single source to a group of members. This paper has focussed some of the existing techniques in multicasting and come with a technique which uses the trajectory information .The protocol is simulated and the results proved it definitely an improvement in throughput, packet delivery ratio and in reducing the Overhead.

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