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Performance of Modified Edge Based Greedy Routing Algorithm in VANET Using Real City Scenario

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Abstract- In today's world, VANET (Vehicular Adhoc Network) plays a very important role and used for public safety communications and commercial applications. The most challenging task for VANET is Routing Algorithm due to rapidly changing topology and high speed mobility of vehicles. In this paper, we study the performance of modified Edge Based Greedy Routing Algorithm. In this algorithm, we set RSU's to provide better communication and improving performance of the movement of the vehicles and packet forwarding. The RSU at different Transmission Range are able to communicate with other RSUs and vehicles. The simulation results show that routing overhead and end-to-end delay is reduced compare to the Greedy Perimeter Stateless Routing (GPSR) and Predictive DirectionalGreedy Routing (PDGR) and EBGR in Vehicular Adhoc Network.

Keywords: Vehicular Ad hoc Networks, Routing Algorithms, modified EBGR.

1. Introduction

Vehicular Ad hoc Network (VANET) [5] is the most important form of mobile Ad Hoc Network (MANET) [23]. VANETs provide us the facility to develop new system to provide comfort and safety to the drivers and passengers. VANET also allow the nodes to move independently and established communication between them using wireless techniques. VANETs are distributed and self-organized network and provide the facility to move or communicate the vehicles or nodes with wireless communication devices. Vehicular adhoc network is a part of ITS (Intelligent Transportation Systems) to bring improvement of the traditional transport system performance and also improving the safety of the traditional transport system. ITS provide the techniques in which the vehicles can easily move on the roads without congestion [11] [13] [21] [22].

In the architecture of the VANET, there are number of vehicles, moving from one position to another on their lane and these vehicles can communicate from another vehicle called V2V communication. There are some Road side Unit (RSUs) which are connected through internet and having capabilities to communicate with Vehicles [9] [19] [24] [25].

2. Considered Routing Protocol in VANET

VANET consist of mobile node having dynamic topology; the mechanism of finding and maintaining and using routes for communication is difficult for fast moving vehicles. In this section, we study the considered routing protocols in vehicular adhoc networks [7] [8] [11] [17].

2.1 GPSR (Greedy Perimeter Stateless Routing)

GPSR is a routing protocol which is responsive and efficient for vehicles in wireless networks. It uses Greedy forwarding routing algorithm to forward packet between nodes [6].

2.2 PDGR (Predictive Directional Greedy Routing)

PDGR algorithm is used to forward packet to the most suitable next hop based on both current and predicable future situations of packet carrier. PDGR algorithm uses weighted score of immediate nodes. In the PDGR, the prediction is not always reliable at all situations. It doesn't guarantee the delivery of packet to the node present in the edge of the transmission range of forwarding node, which is considered as most suitable next hop, due to high dynamics of nodes. The problems occur is low packet delivery ratio, high end to end delay and increased routing overhead [2] [4] [26].

We have analyzed all the above routing algorithms [12] [18] and these algorithms have some drawbacks, which is given blow-

Table 1: Drawbacks of Routing Protocols in VANET [13][14]15][16].

Routing Protocols	Drawbacks
GPSR	Frequent network disconnection. Routing loops. Too many hops. Routing in wrong direction.
GSR	End to end connection is difficult in low traffic density.
GPCR	End to end connection is difficult in low traffic density.
A-STAR MDDV	Routing paths are not optimal and results in large delay of packet transmission
VADD	Large delay if the traffic density varies by time. Large delay due to varying topology and varying traffic density.
DGRP	Large Delay if the traffic density is high. Low Packet delivery ratio.
PDGR	Frequent network disconnection. Too many hops. Large Delay if the traffic density is high. Low Packet delivery ratio. Frequent network disconnection.

2.3 Potential Edge Node Based Greedy Routing Algorithm (EBGR)

Potential Edge Node Based Greedy Routing Algorithm (EBGR) is a unicast position based greedy routing algorithm designed for sending messages from any node to any other node in a vehicular ad hoc network [10]. The general design goal of the EBGR algorithm is to optimize the packet behavior for adhoc networks with high mobility and to deliver messages with high reliability [1][3].

2.4 Assumptions

In this mobility model and algorithm we assume thatall nodes are must equipped with on board GPS receivers and digital maps. GPS receivers provide the information of all mobile vehicles/nodes. The only communications paths available using the ad-hoc network and there is no other communication infrastructure provided. Node power is not the limiting factor for the design because continues power supply through the vehicle.

3. Proposed Model

In this paper we are considering city scenario to generate mobility model. The scenario shows the common urban settings found in the city traffic. The two lanes road is created. This model is considering the main road pattern, vehicle speed, lane change and fast vehicle can overtake the slow running vehicle and is simulated using NS-2 [20] taking the city of Bareilly, UP, INDIA as a region instance to generate the movement pattern of vehicles. The Google earth map of any region is available on the internet for public use. The proposed mobility model for vehicles communication i.e. one vehicle send packets to its destination. In the city scenario, we know that routing algorithm provide route from one location to another (i.e. from source to destination). Firstly we check the current location of the vehicle and we will enter the desired destination. With the help of modified EBGR algorithm we calculate the difference from source to destination. After calculating the distance, source node sends the information to RSU. The RSU broadcast the message to another RSU and all the vehicles in its range. Again the destination check by RSU, if the destination was same, the packet will send in proper manner and if the destination will change the RSU will broadcast this message to all other RSUs and Vehicles to its range and the current vehicle is now forward the packet to the destined vehicles.

3.1 Flowchart of the proposed Model

As shown in figure 1 flowchart, we proposed the model using this flowchart. Flowchart show how a node send a packet to the other nodes and it check destination every time and then send the packet to its intended destination. The process is shown step by step. At every step it has some information about nodes and RSU. The RSU sends the information to other RSU's and checks the destination. If the destination same then the process will continue and if the destination has changed then the packet will send to the new destination.

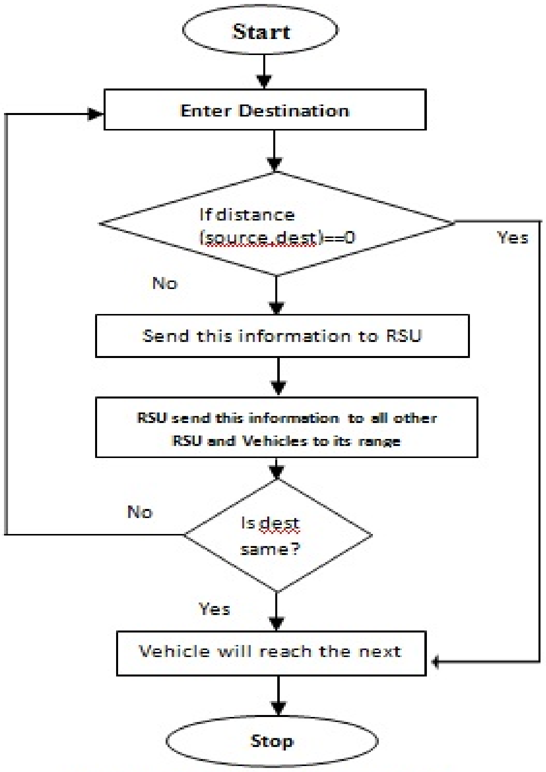

Figure 1- Flowchart of proposed system

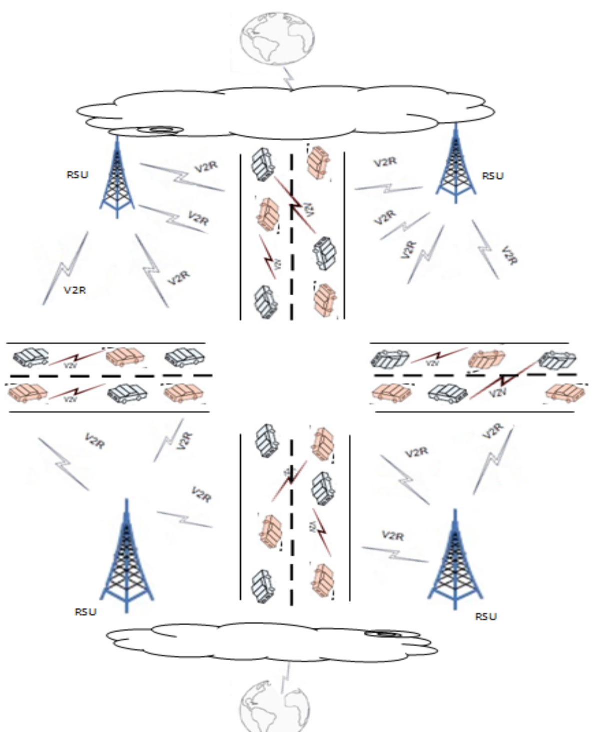

Figure 2-Proposed Mobility Model

As shown in the figure 2, there are four RSU's these RSU are communicating from vehicles with in their range and have all the information about the vehicles. There are two lane of road in which the vehicles/nodes are moving and carrying packets from source to destinations

3.2 Steps used in modified EBGR Algorithm

- We set RSU (Road side unit) for the convenience of the vehicles. These RSU communicate with each other and also communicate with vehicles.
- These RSU also transferring information to all the vehicles and other RSUs within their range.
- This algorithm is also used for sending packets from source to destination.
- The source node sends packets to the destination. Firstly it sends the packets information and information about destination to the Road side unit (RSU).
- RSU has track information and set the destination. If there are some problems to destine the packet or the destination has change due to any reason, the current node sends this information to the RSU. RSU then broadcast the message to all the nodes within their range and provide the information about changing the destination.
- Now the current node sends the packet to its new destined node.

4. Simulation Parameter

Figure 3- Screen shot of Simulation

4.1 Performance metrics to Evaluate Simulation

In order to evaluate the performance of VANET routing protocols, the following metric is considered.

4.2 End-To-End delay (EED)

The delay experienced by a packet from the time it was sent by a source till the time it was received at the destination.

In Table 2 the simulation perimeter for evaluating the performance of GPSR, PDGR, EBGR and modified EBGR (using EED and varied number of nodes).

Table 2- Simulation Parameters for EED Vs Number of Nodes

Parameter	Value
Simulator	NS-2.34
Simulation Area	1550m x 1550
Mobility of Vehicles	0-25(meter/second)
Number of packet Sender	15
Transmission Range	250m
Constant Bit Rate	2 (packets/second)
Packet Size	512 bytes
MAC Protocol	802.11
Simulation duration	30 Seconds
Performance Metrics	End to End Delay

Similarly the simulation perimeter for evaluating the performance of EED Vs Transmission Range of GPSR, PDGR, EBGR and modified EBGR shows in Table 3.
Table 4. shows the simulation parameter for evaluating the performance of GPSR, PDGR, EBGR and modified EBGR using EED Vs Mobility model.

Table 3- Simulation Parameter for EED Vs Transmission Range

Parameter	Value
Simulator	NS-2.34
Simulation Area	1550m x 1550
Number of vehicles	50
Mobility of Vehicles	15(meter/second)
Number of packet Sender	15
Constant Bit Rate	2 (packets/second)
Packet Size	512 bytes
MAC Protocol	802.11
Simulation duration	30 Seconds
Performance Metrics	End to End Delay

Table 4: Simulation Parameter for EED Vs Mobility

Parameter	Value
Simulator	NS-2.34
Simulation Area	1550m x 1550m
Number of vehicles	50
Mobility of Vehicles	15(meter/second)
Number of packet Sender	15
Transmission Range	250m
Constant Bit Rate	2 (packets/second)
Packet Size	512 bytes
MAC Protocol	802.11
Simulation duration	30 Seconds
Performance Metrics	End to End Delay

5. Results

In this part, the end-to-end delay from the source node to the destination is compared and shown in Figure 4. The end-to-end delay for GPSR increases much faster than the others. When no node is available, GPSR switches to perimeter mode and it increases the delay of packet transmission. PDGR has comparatively small end-to-end delay with GPSR when nodes become more. It is due to packet forwarding becoming easy when more nodes are present. But the next hop selection is done for future 2 hop neighbors on prediction and it is not reliable at all situations. The end-to-end delay of EBGR is comparatively small with PDGR and the end-to-end delay of modified EBGR is comparatively small with EBGR when the Vehicle density is high enough (n=100). More Nodes in the network will provide more opportunities to find some suitable node for efficient forwarding.

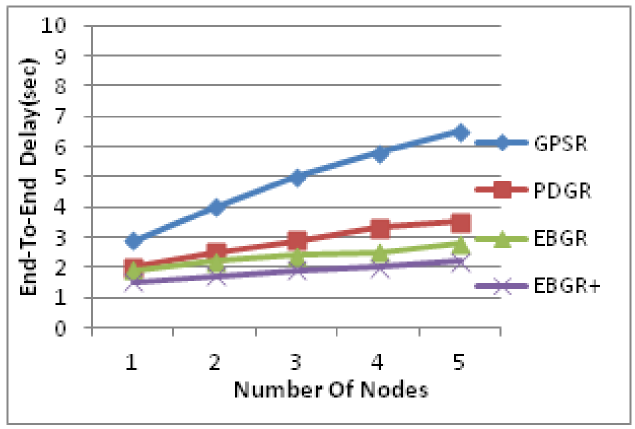

Figure 4- EED Vs. Number of Nodes

With high node density, the overall transmission delay is dramatically reduced in modified EBGR compared to EBGR.

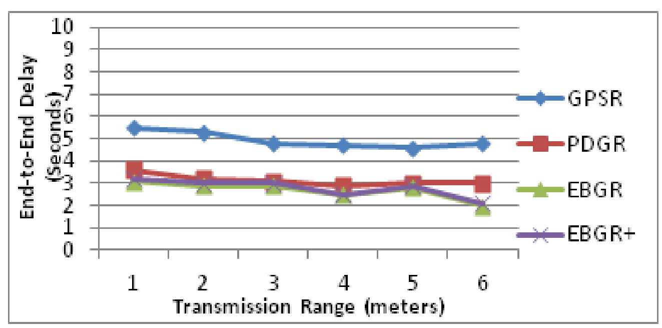

Figure 5- EED Vs Transmission Range

In this part the end to end delay with different level of transmission is compared. GPSR and PDGR always select the immediate neighbor node to forward the packet. This increases the average number of hops to transmit the packet to the destination, which leads to high end to end delay. In EBGR and modified EBGR the vehicle always select the edge node based on high potential score. As shown in the figure 5 end-to-end delay of EBGR & modified EBGR is comparatively small with GPSR and PDGR when the transmission rang in between 200m and 250m. Using modified EBGR the overall average decrease in delay compared to EBGR and PDGR.

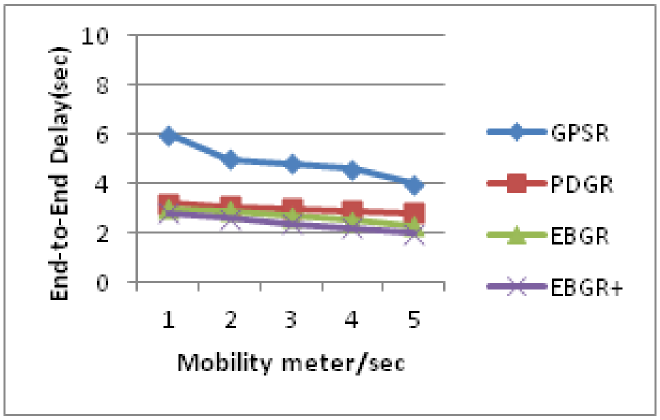

Figure6: EED vs. Mobility

In this part, the end-to-end delay is compared with varying mobility of vehicles, when the speed of the vehicle increases, the end-to-end delay of GPSR and PDGR decrease. High speed of vehicles may lead to link failure during packet transmission and result in loss of packets. Figure 6 shows that end to end delay for modified EBGR is comparatively reduced compared to PDGR and EBGR as the speeds of vehicles increase.

6. Conclusion

In this paper we have examined routing aspects of VANETs. We have also investigated and analyzed previous studies on different routing protocols in VANETs. We have commented on their contributions, and limitations of routing protocols. By using the uniqueness of VANETs, we have proposed Revival Mobility Model and a new position based greedy routing approach i.e. modified EBGR. Comparison of proposed modified EBGR approach with other existing approach shows that our routing algorithm is considerably better than other routing algorithms in VANET. Our simulation results show that modified EBGR outperform EBGR, GPSR and PDGR significantly in the terms of minimizing end to end delay.

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