An Improved GPSR Routing Protocol based on the Border Nodes and Angle of Orientation of the Neighboring Nodes

Tanisha Narang[1] Er.Vipin Gupta[2]
[1]M.Tech. Student [2]Assistant Professor & Head
[1,2]Department of Computer Engineering
[1,2]Doon Valley Group of Institutes, Karnal, Kurukshetra University

Abstract— In VANET, the communication between the vehicles takes place. As the vehicles are in motion the main aim is to provide efficient routing. The position based routing protocol are better than topology based routing protocol. Working on GPSR routing protocol main aim is to improve the performance of the GPSR as well as E-GPSR routing protocol. The proposed methodology considers the border node and angle of orientation of the neighboring nodes. Based on this the I-GPSR outperforms the GPSR and E-GPSR routing protocol in terms of throughput, average end-to-end delay, packet delivery ratio and network load. I-GPSR is methodology and algorithm is studied in detailed.

Key words: VANET, GPSR, E-GPSR, I-GPSR, GPS

I. INTRODUCTION

Vehicular Ad Hoc Network (VANET) is a type of Mobile Ad Hoc Network (MANET) in which communication takes place between two vehicles or a vehicle and roadside infrastructure. It combines the techniques of wireless and cellular technology and Ad Hoc technology to form a Intelligent Transport System. This is implemented because of Dedicated Short Range Communication (DSRC) standardization which help vehicles and road side unit to form VANET. VANET is used for the specific application which is ITS (Intelligent Transport System) for the smart and safe transportation. VANET not only provide safe transportation, but it also saves a lot of energy, fuel and time which is wasted in different traffic jam [1]. VANET is a form of MANET having some similarities and some differences. Some similarities are: self-organization, low bandwidth and short radio transmission range.

For communication to take place between the nodes the main task is to decide the route between source node and destination node. For the transfer of information the most difficult and challenging task is to find the route [2]. For Routing in VANET, there is a need of a technique which will allocate unique logical address to the vehicles but there is no available routing protocol based on this technique. The different routing protocol doesn't reject the assignment of duplicate logical address. In the VANET environment, there are various problems like mobility patterns, variation in the number of vehicles, frequent change in the incoming & outgoing network, etc this makes the ad hoc routing protocols inappropriate [3]. Classification of routing protocols for VANETs:

- Position based Routing Protocol
- Topology Based Routing Protocol

A. Position based Routing Protocol

In this type of routing protocol, the geographical positions of the nodes are taken into account. It uses the global positioning system (GPS) for considering the positions of the neighboring nodes [4]. Some examples are: greedy perimeter stateless routing (GPSR) and distance routing effect algorithm for mobility (DREAM).

1) Advantages

- It provides good performance in case of highway environment.
- There is no need to create and maintain global route between source & destination.
- As the mobility increases, stability also increases.
- Processing overhead is lowest.

2) Disadvantages

- There is a need of (GPS) global positioning system.
- Sometime location server goes into deadlock state.
- Satellite signal doesn't reaches in tunnel, so GPS device stop working there.

B. Topology based Routing Protocol

In this type of routing protocol, the information about the link between source node to destination node is available in the network [4]. Some examples are: Destination-sequenced Distance-Vector (DSDV), Optimized link state routing (OLSR), Ad hoc on-demand distance vector routing (AODV), dynamic supply routing (DSR), temporally ordered routing protocol (TORA) etc.

1) Advantages

- Few resources are consumed
- Consumption of less bandwidth
- It can send any type of messages i.e unicast, multicast and broadcast.
- Route will be surely provided between source and destination node.

2) Disadvantages

- Undesired flooding.
- Due to frequently moving vehicles, sometime it fails to find a complete path.
- Overhead is more as it require a route discovery mechanism & maintaining delay.

C. Introduction to GPSR

GPSR stands for greedy perimeter stateless routing. This routing protocol is suitable for VANET network, which is based upon geographical position. It is different from DSR, AODV, DSDV, it receives the neighbor vehicles node information with the help of GPS device instead of maintaining a large amount of information and then storing it in routing table [1].

The protocol is introduced by Brad Kard and H.T Kung in 2000. In this routing protocol greedy forwarding strategy is combined with the perimeter forwarding strategy. In this protocol every node broadcast its position information periodically. Neighbor table is used to store the information after receiving the neighbor information. Using location based services the ID of the destination node is obtained. The next forwarding hop is chosen with the help

of address of destination node. The information ready to send is attached with the obtained geographical information and forward to the destination node using greedy forwarding and perimeter forwarding method.

1) Limitations of GPSR

As in the GPSR routing protocol, broadcasting of message is done by flooding method and the nodes are moving and the data is process by the method of fast sending and fast receiving but its processing is slow. So, as the number of nodes increases in the network a large queue of data to be processed is formed. The increase in the number of data packets leads to network congestion which will cause increase in transmission delay and decreases the packet delivery ratio.

D. Introduction to E-GPSR

It overcomes the shortness of the GPSR routing protocol that is network congestion caused due to the multiple broadcasting of packets. E-GPSR not only considers the distance between the source and destination node, but also considers the probability of the intermediate nodes. The proposed routing strategy is applied to GPSR routing protocol so that to take not only the distance between the next-hop node and the destination node but also the available length of the next-hop node buffer into consideration. Thereby reducing the time delay of routing as well as the packet loss which caused by bigger waiting time than the retransmission delay [1], at the same time reducing the packet loss rate, and thus improving the performance of GPSR routing protocols.

1) Limitation of E-GPSR

The proposed E-GPSR protocol reduces the time delay of waiting to send due to considering the waiting time in nodes' buffer. The value of time delay may be slightly larger than GPRS protocol under the conditions of low node mobility according to increasing complexity on algorithm of E-GPSR. This implies the GPSR works better than the E-GPSR in low dense environment.

E. Introduction to I-GPSR

The proposed routing protocol Improved GPSR overcome both the limitations that is of GPSR as well as E-GPSR routing protocol. I-GPSR routing protocol is based upon the angle of orientation of the nodes and range of the nodes. It chooses the nodes which are at the border of the range of the sending node as the intermediate node. It improves result of both GPSR as well as E- GPSR.

In this paper section 2 discusses the network model and algorithm adopted in detail. Section 3 discusses the result and section 4 concludes the work done.

II. NETWORK MODEL

I-GPSR proposed routing protocol is based on the range and angle of orientation of the nodes. If the information is to be send from sending node to the destination node. Firstly, the range of the transmission node is calculated using the formula:

$$x^2 + y^2 = r^2 \qquad (2.1)$$

Where r is the range of the node and x, y are the abscissa and ordinate of the node. After taking out the range of the sending node, only those neighbor nodes are selected which lies in the range of the transmission node. The angle of orientation of these selected nodes and the sending node and destination node is calculated using the formula:

$$\theta = \tan^{-1}\frac{y}{x} \qquad (2.2)$$

Whereθ, is the angle of orientation and x, y are the abscissa and ordinate of the nodes. The nodes which are having angle of orientation towards the destination node are taken into consideration. Now, using the distance formula:

$$d = [(x_2 - x_1)^2 + (y_2 - y_1)^2]^{\frac{1}{2}} \quad (2.3)$$

From the equation, the distance between the sending node and neighboring nodes is calculated. Now, it will check:

$$r = d \qquad (2.4)$$

If the range of the node is equal to the distance between the sending node and any of the neighboring nodes, then the node lies on the border of the range of the sending node and are termed as border node. Then the border node is selected as the intermediate node. If there are two or more nodes at the border of the range then the one having angle of orientation more towards the destination is selected as the intermediate node. But if there does not lie any node on the border than it locate the node nearest to the border as the intermediate node and if it does not find any node than it will go back and call the algorithm again. The algorithm is shown in the figure 1 in the form of a flow chart.

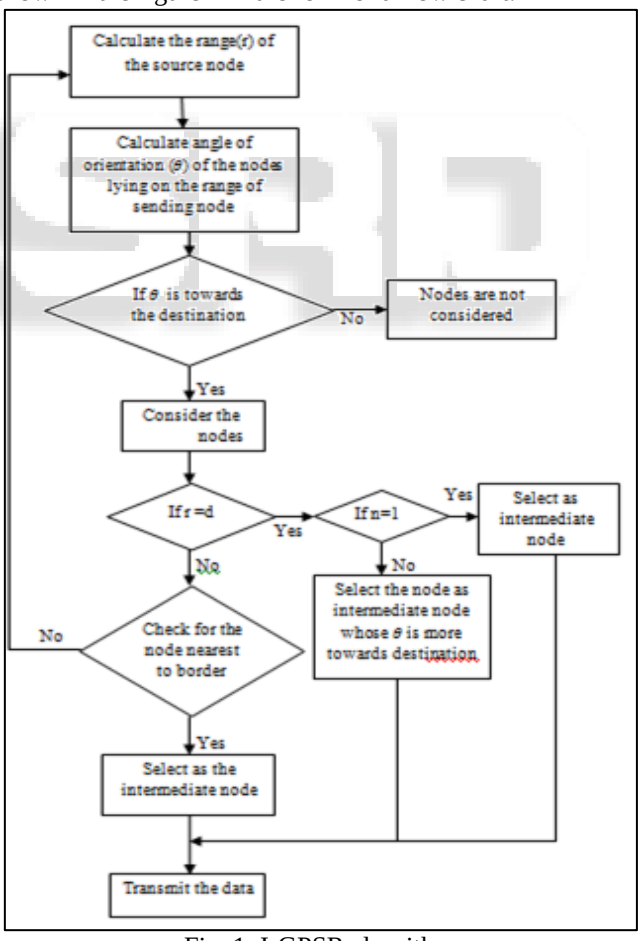

Fig. 1: I-GPSR algorithm

III. RESULTS

Results for the GPSR, E-GPSR and I-GPSR routing protocol are calculated at different speed i.e. 20, 40, 60, 80 and 100m/s. Firstly, GPSR is patch and all the results i.e. throughput, average end-to-end delay, packet delivery ratio

and network load at different speed are calculated. Then, E-GPSR and I-GPSR is patched and results are calculated.

Based on these results we will compare the three routing protocol i.e. GPSR, E-GPSR and I-GPSR on their performance. The bar graph below shows the comparison of the routing protocols on the basis of throughput.

The following parameters are initialized:

Parameter Name	Parameter Value
Simulation time	100s
MAC Protocol	802.11DCF
Application of the business layer	CBR
Size of data packet	512 bytes
Packet transmission rate	5 packets/s
Number of vehicle nodes	100
Maximum permissible speed of vehicle	20 40 60 80 100m/s
Network Bandwidth	2Mb/S

Table 1: Simulation Parameters in NS2

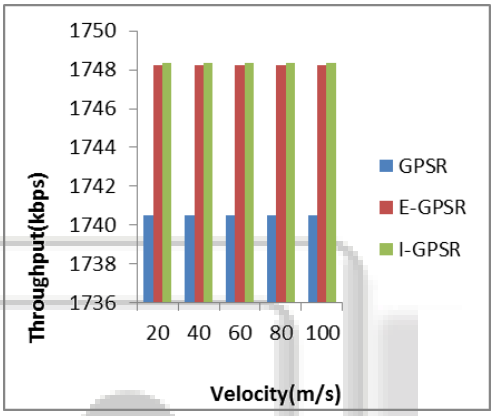

Fig. 2: Comparison of GPSR, E-GPSR and I-GPSR on the basis of Throughput

The result shows that, in terms of throughput I-GPSR performs better than E-GPSR and GPSR. I-GPSR routing protocol has higher throughput than the other two routing protocol this implies it is sending more data per unit time than other two routing protocol.

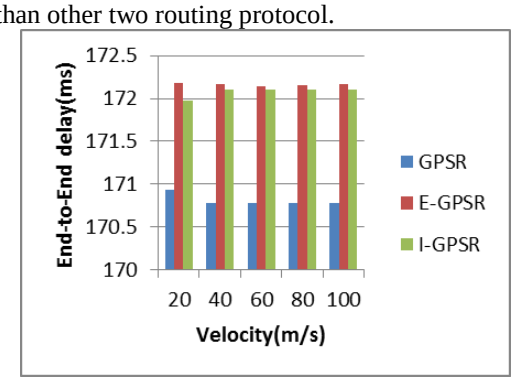

Fig. 3: Comparison of GPSR, E-GPSR and I-GPSR on the basis of end-to-end delay

The next bar graph in Figure 3 compares the three routing protocol performance on the basis of their average end-to-end delay.

The average end-to-end delay tells the delay in the transmission of the information. Comparing the three routing protocol, GPSR has less end-to-end delay as compare to E-GPSR and I-GPSR as routing in this protocol is simple as compared to the E-GPSR and I-GPSR. E-GPSR has more delay than the GPSR and I-GPSR as it is more complex routing. I-GPSR has more end-to-end delay than GPSR due to complex routing but less end-to-end delay than E-GPSR. So, the I-GPSR performs better than E-GPSR in terms of average end-to-end delay than GPSR.

The figure 4 bar graph represents the comparison of packet delivery ratio of the routing protocols at different speeds.

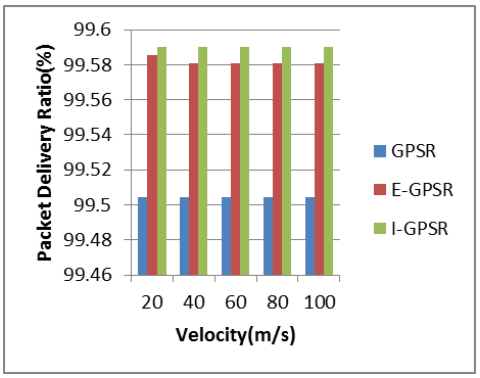

Figure 4: Comparison of GPSR, E-GPSR and I-GPSR on the basis of packet delivery ratio

Packet delivery ratio gives the ratio of the packets received to the packets transmitted. More the value of packet delivery ratio better the routing protocol is. In terms of packet delivery ratio I-GPSR outperform both the routing protocol GPSR as well as E-GPSR. I-GPSR has more packet delivery ratio than E-GPSR and GPSR.

In figure 5, the bar graph represents the comparison of the three routing protocol on the basis of the network load. Network load tells the load on the network while routing of the packets. I-GPSR puts lesser load on the network as compare to the GPSR and E-GPSR routing protocol. GPSR has very high network value E-GPSR has lower network load value than GPSR but higher than I-GPSR. So, I-GPSR is better routing protocol in terms of network load than other two.

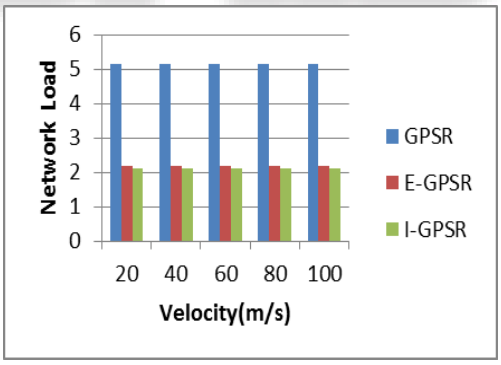

Fig. 5: Comparison of GPSR, E-GPSR and I-GPSR on the basis of network load

IV. Conclusion

I-GPSR is based on not only the distance between the sending node and destination node but it also considers the border nodes and angle of orientation of the nodes. It is observed that I-GPSR performs better than GPSR and E-GPSR in terms throughput, average end-to-end delay, packet delivery ratio and network load. I-GPSR performance is stable in all type of environment i.e. low dense and high dense environment. It overcomes the limitation of the E-GPSR which is it doesn't perform well in low dense environment as compare to GPSR routing protocol. I-GPSR is better routing protocol than GPSR and E-GPSR.

REFERENCES

[1] Tianli Hu, Minghui Liwang, Lianfen Huang, Yuliang Tang. An Enhanced GPSR Routing Protocol based on the buffer length of nodes for the Congestion Problem in VANETs. The 10th International Conference on Computer Science & Education (ICCSE 2015) July 22-24, 2015
[2] Zhang Ning, Yunho Jung, Yan Jin, Kee-Cheon Kim. Route Optimization for GPSR in VANET 2009 IEEE International Advance Computing Conference (IACC 2009) 6-7 March 2009
[3] Hongyu Tu, Lei Peng, Huiyun Li, Falin Liu. GSPR-MV: a Routing Protocol Based on Motion Vector for VANET. ICSP2014 Proceedings
[4] N.Brahmi, M.Boussedjra and J.Mouzna. Mobility Support and Improving GPSR Routing Approach in Vehicular Ad Hoc Networks[A]. New Technologies, Mobility and Security[C]. Morocco, 1-6, 2008.
[5] B.Karp and H. T. Kung. GPSR: Greedy PerimeterStateless Routing for Wireless Networks Proceedings of MOBICOMM'00. Boston, MA, USA, 243-254, 2000.
[6] M. Jerbi, S.-M. Senouci, R. Meraihi and Y. Ghamri doudane. An improved vehicular ad hoc routing protocol for city environments. ICC'07. IEEE International Conference on Communications, 3972-3979, June 2007.
[7] Y-B Wang, T-Y Wu, W-T Lee and C-H Ke, A Novel Geographic Routing Strategy over VANET, 2010 IEEE 24th International Conference on Advanced Information Networking and Applications Workshops. 873-879, 2010.
[8] Yunbin Hu, Weiwei Xie, Tiecheng Song, Lianfeng Shen. An improved GPSR routing protocol for VANET. Conference on the new development of communication theory and technology. 63-68,Sept 2009.

