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MATLAB Based Comparative Analysis of GPSR, E-GPSR and D-GPSR in VANET Based Network

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Abstract– Vehicular Ad-Hoc networks form an essential part of the intelligent transportation system. The routing protocol in VANET systems is the critical feature for efficient networking. Thus, various existing protocols are being used for routing in the VANET. The traffic condition in the VANET system is very challenging since they are prone to change very fast and are unstable sometimes. Also, the configuration changes rapidly. Therefore, we need to have a routing protocol that is quite adaptive. The various existing routing protocols like DGPSR, E-GPSR have already been in use. [3] Thus, as conditions change, the routing adapts itself for stable configuration and long lifetime and focuses on stable and lesser end to end with ensuring good packet delivery ratio. In this paper, we have presented a comparative study between all these protocols for analyzing the improvement and constraints analysis. The comparison has been made based on three main parameters, i.e., Average Throughput, Average Packet Delivery Ratio, and Average End to end Delay. It is an optimum adaptive routing protocol that can adapt itself for the optimum choice of the routing protocol. All the simulations and graphs are obtained by using MATLAB

Keywords: GPSR, D-GPSR, E-GPSR, Routing Protocols, End to End Delay, Comparative Study of Routing Protocols.

1. Introduction:

Wireless communication is the transmission of a data packet over a particular geographic area using a wireless channel. It provides mobility to the users & the information is transmitted faster to the destination than any wired communication. An ad hoc [9] network is a type of wireless network where wireless devices communicate without using any Wireless Access Point (WAP) device. There are two main categories of Ad Hoc network MANET [22] and VANET. [6] The Mobile Ad-hoc Network (MANET) is a continuously self-configuring, self-organizing, and infrastructure-less network of mobile devices connected without wires and also known as "on-the-fly" networks or "spontaneous network. The Vehicular Ad-hoc Network VANET provides wireless communication among vehicles and roadside infrastructure. [1] In this manner, the infrastructure requirement also increases to satisfy the demands and provide 'Quality of Services.' Since the nodes in VANET are constantly in motion and the traffic is changing very randomly. Therefore it is required to have effective and optimum routing protocols. The existing protocol like AODV is very primitive. It has many limitations and constraints like Energy efficiency, backhaul capacity, the distance between nodes, nodes distribution configuration, determination of the routing table, and position of the vehicles. [12]

GPSR Protocol is one of the routing protocols in VANET, which uses the GPS to position the nodes as the nodes randomly change their location. [2] The GPSR is distinguished between some of its types, such as D-GPSR, E-GPSR. The D-GPSR protocol determines the position based on the corner angle and orientation [4] and takes care of the energy efficiency of the nodes. The enhanced version of the GPSR, i.e., E-GPSR, proposed the improvisation in sending messages that deal with the node's speed and send the message that moves in the direction with the high speed. [19]

In this paper, we have compared the routing protocols like GPSR, D-GPSR, and E-GPSR. [18] The comparison is made considering the parameters like Average End to End delay, Average Packet Delivery ratio, and Average throughput analysis. All the simulations are done using MATLAB R2016a. All the comparison graphs were also obtained through it.

2. GPSR (Greedy Perimeter Stateless Routing) Protocol:

GPSR is a typical routing protocol based on a geographical position that is suitable for the VANET network. [10] It is different from AODV, DSDV, or DSR as GPSR obtains neighbor vehicle node information by GPS [7] positioning equipment, rather than getting a large number of routing information to maintain the information in the neighbor table. This protocol was put forward by Brad Kard and H.T Kung in 2000, in which the forwarding strategy combines greedy forwarding strategy with perimeter forwarding strategy.

In GPSR routing protocol, each node periodically broadcasts its location information to the neighbor node, and this information is stored in the neighbour table after neighbour information has been received. The forwarding node chooses the next-hop forwarding node according to both neighbour location information and destination location. Before sending data packets, the forwarding node requires the id of the destination node through location-based service information to gain the reallocation of the destination node. Then the data grouping ready for sending is attached with the above obtained geographic information and sent to the destination node

following the greedy forwarding method or perimeter forwarding method.

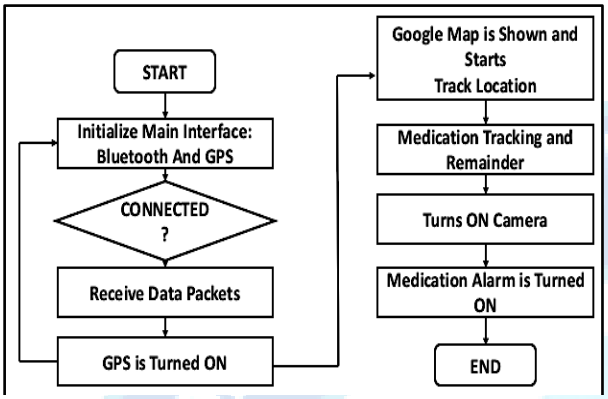

Fig.1 Algorithm of GPSR

Fig. 1 shows the algorithm of a scenario of road accident where the GPS location and the devices in a vehicle helps to turn ON the medication alarm for the vehicle in accident.

3. E-GPSR Routing Protocols:

In GPSR, they are routing protocol forwards in the way of flooding broadcast. The nodes process the data using fast sending, fast receiving, and slow processing. The number of data packets in the node's buffer will increase sharply when multiple broadcast nodes transmit data to the same forwarding node successively. Network congestion will happen while transmission delay of packets greatly increases when the speed of the packets processing is slower than the speed of packet receiving by nodes.

To solve the above-mentioned problem, the E-GPSR routing protocol is introduced based on the length of the buffer. [13] E-GPSR routing strategy is applied to GPSR routing protocol to take the distance between the next-hop node and destination node and the available length of the next-hop buffer into consideration. Therefore, it reduces the time delay of routing and the packet loss caused by a longer waiting time than the retransmission delay, thus improving the performance of GPSR routing protocols. [21]

4. D-GPSR Routing Protocol

The D-GPSR routing protocol is based upon the angle of orientation of the nodes and the range of the nodes. [11] It chooses the nodes at the border of the range of the sending node and termed as the intermediate node. It improves the result of both GPSR as well as E- GPSR.

D-GPSR proposed routing protocol which is based on the range and angle of orientation of the nodes. If the information is to be sent from sending node to the destination node.

1. Firstly, the range of the transmission node is calculated. After taking out the capacity of the sending node, only those neighbour nodes are selected, which lies in the range of the transmission node.

2. The orientation angle of these selected nodes and the sending node and destination node is calculated. The nodes which are having an angle of orientation towards the destination node are taken into consideration.

3. The distance between the sending node and neighbouring nodes is calculated.

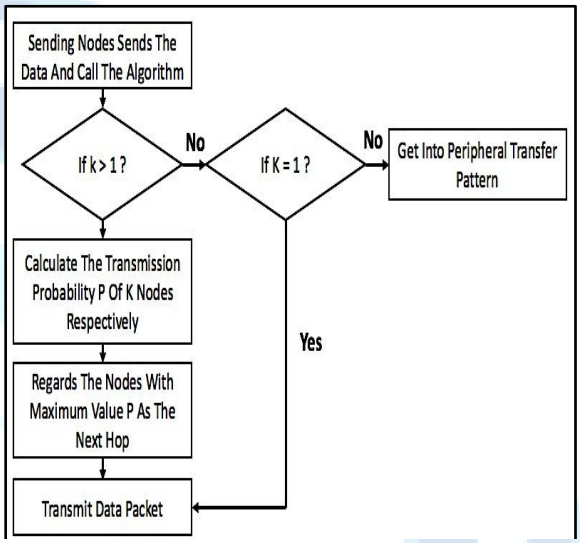

Fig.2 Algorithm of E-GPSR

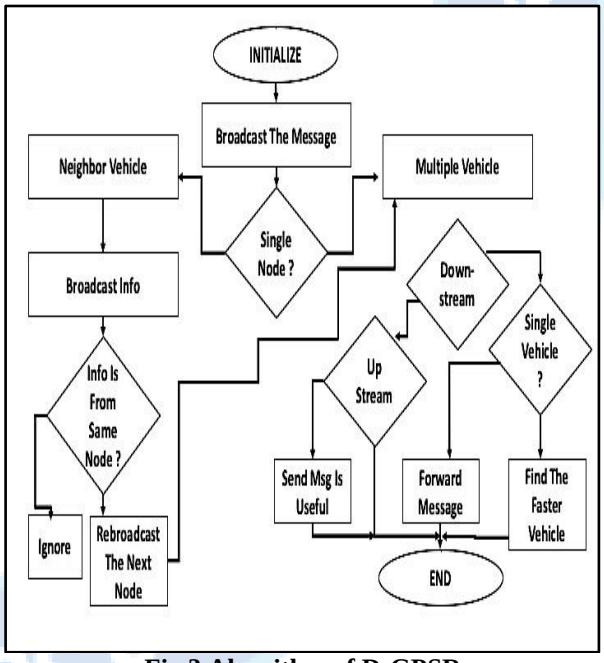

Fig.3 Algorithm of D-GPSR

If the range of the node is equal to the distance between the sending node and any of the neighbouring nodes, then the node lies on the border of the range of the sending node and is termed as a 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 an angle of orientation more towards the

destination is located as the intermediate node. But if there does not lie any node on the border, then it assigns the node nearest to the border as the intermediate node, and if it does not find any node, it will go back and call the algorithm again.

5. Simulation Parameters

The simulations are performed in MATLAB 2016a in an area of 1000x1000 km between 50 nodes. Among these nodes two nodes i.e. node 1 and node 50 are fixed, rest nodes are randomly arranged. The speed of the nodes varies from 20-60 km/hr and traffic follows FTP/TCP [8],CBR/UDP. [17] Each node is connected to its neighbour using wireless device, & its range is 250m. The size of the packets transmitted is 512 bytes and routing protocol used are GPSR, E-GPSR and D-GPSR.[23] The MATLAB 2016a uses high-performance language for technical computing and supports programming language including C, C++, C#, Java, Fortran and Python.In this project The WLAN system toolbox version 1.1 is used inMATLAB.

Table .1 Simulation parameters

Dimensions (m2)	1000x1000
No. of Nodes	50
Lane Configuration	Differentiate two flows
Node Speed Range (Km/h)	20/30/40/50/60
Driving Model	IDM_LC
Channel Type	Wireless
Simulation Time	200 s
Traffic Type	FTP/TCP, CBR/UDP
Propagation model	Two-Ray Ground
MAC/PHY	802.11, 802.11p
Radio Range	250 m
Visualization	NAM, Tracing
Packet Size	512 bytes
Routing Protocol	GPSR, D-GPSR, E-GPSR

6. Results & Discussions

In fig.4, the node distribution has been shown. The 50 nodes are distributed in the space. The space is of the urban scenarios of dimension 1000X 1000 Km. Thus; the graph obtained from the simulation in MATLAB distributes the map of all the nodes.

In figure 5, the comparison of the average throughput of all the mentioned protocol has been presented. The various protocols like GPSR, D-GPSR, and E-GPSR. The GPSR protocol is found to have larger throughput than others. Whereas, the D-GPSR presents the optimum solution. It provides the throughput of 330kbps.

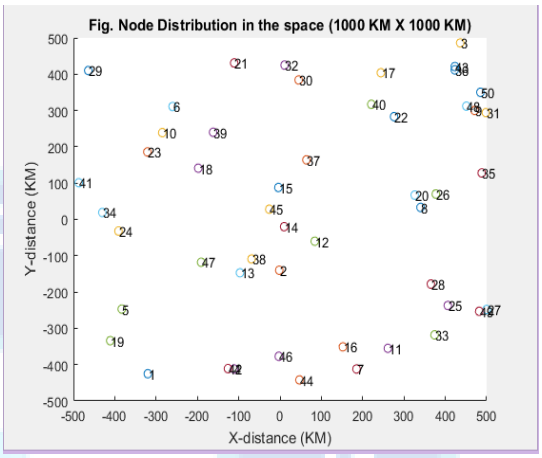

Fig. 4: Nodes distribution map of the scenario of 50 nodes

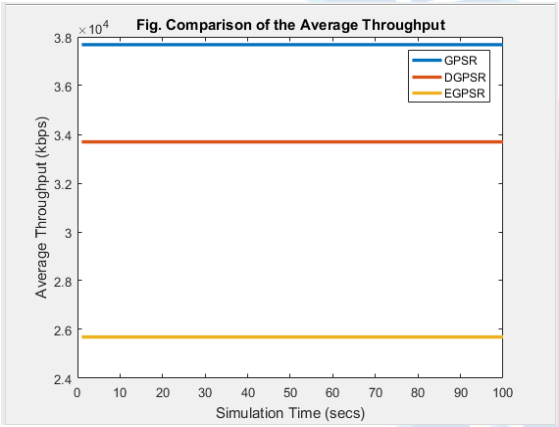

Fig. 5: Comparative analysis of the average throughput of all the protocols

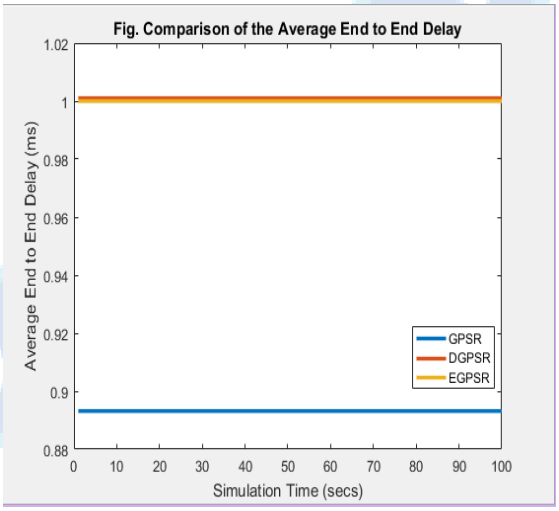

Fig.6 Average End to End Delay Analysis of all the protocols

In figure 6, the obtained graph presents the comparison of the average end to end delay of all the protocols. Here, the D-GPSR presents the highest end to end delay. Whereas the GPSR presents the minimum end to end delay. Here, the E-GPSR performs better than GPSR protocol.

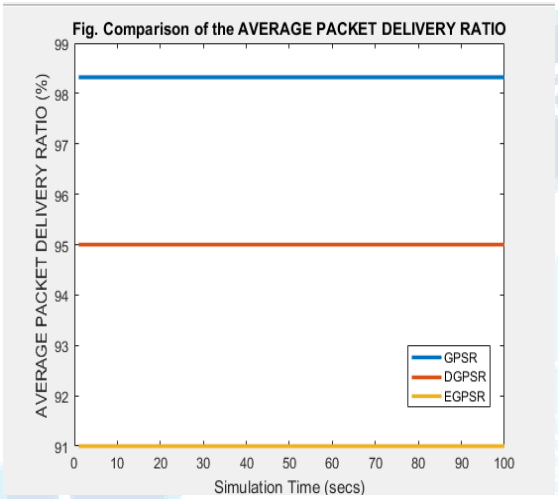

Fig.7 Average Packet Delivery Ratio Analysis of all the protocols

In figure 7, the Average Packet Delivery ratio analysis has been presented. All the routing protocols have been compared. Here, AODV outperforms the highest PDR in the mentioned simulation parameters as per table 1. The GPSR outperforms in terms to the packet delivery ratio than the other protocols.

7. Conclusion

Thus, the simulation results present the analysis of the various parameters like network throughput, packet delivery ratio, and end-to-end delay. Above table 1 presents the simulation parameters for the simulation. Thus, here the comparative analysis has been presented. The various protocols mentioned above have been compared. The GPSR is found to be optimum for the performance analysis. The GPSR is found to be optimum, thus presenting the optimum performance in all the conditions. Thus, the simulation results have been presented in the above section verifies the optimality of the performances.

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