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Comparison of Greedy Routing Algorithms and various techniques for Efficient Packet Forwarding in VANET: A Review

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Abstract: VANETs (Vehicular Ad hoc Networks) are highly mobile wireless ad hoc networks and will play an important role in public safety communications and commercial applications. In VANET nodes which are vehicles can move safety with high speed and must communicate quickly and reliably. When an accident occurs in a road or highway, alarm messages must be disseminated, instead of ad hoc routed, to inform all other vehicles. Vehicular ad hoc network architecture and cellular technology to achieve intelligent communication and improve road traffic safety and efficiency. VANET can perform effective communication by utilizing routing information. In this paper, we have discussed about three greedy routing algorithms, and have compared to show which one is efficient in delivering packets in terms of mobility, nodes and transmission range.

Keywords: VANET, MANET, Routing Protocol, GNGR, ENGR, PDGR**.**

I. INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) are special cases Mobile Ad Hoc Networks (MANETs). VANETs are distributed, self-organizing communication networks between moving vehicles. The Intelligent Transportation Systems (ITS) have been developed to improve safety, security and efficiency of transportation systems for traveling, which apply rapidly emerging information technologies in vehicles and transportation infrastructures. Inter-Vehicle Communication (IVC) is essential to the ITS, which aims at enhancing the public and private safety as well as increasing the efficiency of the transportation system. The Dedicated Short Range Communications (DSRC) system is developed based on IEEE 802.11 WLAN technologies for the purpose of exchanging information among vehicles. The field of Inter Vehicular Communications, including both vehicle-to-vehicle communications (V-V) and vehicle-to-roadside communications (V-R), also known as VANETs, is recognized as an important component of ITS. Its structure is shown in fig.1.

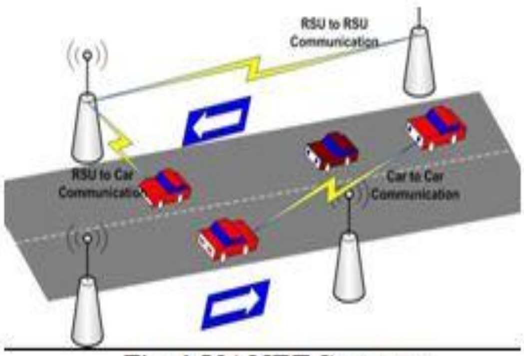

Fig. 1 VANET Structure

The main goal of VANET is providing safety and comfort for passengers helping drivers on the roads by anticipating hazardous. Each vehicle equipped with VANET device will be a node in the Ad-hoc network and can receive & relay other messages through the wireless network. Collision warning, Road signal arms and in place traffic view will give the driver essential tool to decide the best path along the way events or bad traffic areas. VANET has unique characteristics like high mobility with the constraint of road topology, initially low market penetration ratio, unbounded network size, infrastructure support that differentiate it from MANET. The routing Protocols in VANET are categorized into various types likes Topology based, Position based, Geocast based, Cluster based, broadcast Based and Infrastructure based.

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1.2 **Organization of the paper**

2. VANETS ROUTING PROTOCOLS

forwarding), along which a message that will be moved geographically closer to the destination (geographical forwarding). The selection of forwarding trajectory uses geographical knowledge and traffic density. MDDV assumes traffic density is static. Messages are forwarded along forwarding trajectory through intermediate nodes which store and forward messages opportunistically. This approach focuses on reliable routing. But trajectory based forwarding will lead to large delay if the traffic density varies by time.

2.1 GSR (Geographic Source Routing)

Lochert et al. in [2] proposed GSR, a position-based routing with topological information. This approach employs greedy forwarding along a pre-selected shortest path. The simulation results show that GSR outperforms topology based approaches (AODV and DSR) with respect to packet delivery ratio and latency by using realistic vehicular traffic. But this approach neglects the case that there are not enough nodes for forwarding packets when the traffic density is low. Low traffic density will make it difficult to find an end-to-end connection along the pre-selected path.

2.1.2 GPCR (Greedy Perimeter Coordinator Routing)

To deal with the challenges of city scenarios, Lochert et al. designed GPCR in [3]. This protocol employs a restricted greedy forwarding procedure along a preselected path. When choosing the next hop, a coordinator (the node on a junction) is preferred to a non coordinator node, even if it is not the geographical closest node to destination. Similar to GSR, GPCR neglects the case of low traffic density.

2.1.3 A-STAR (Anchor-based Street and Traffic Aware Routing)

To guarantee an end-to-end connection even in a vehicular network with low traffic density, Seet et al. proposed A-STAR [4]. A-STAR uses information on city bus routes to identify an anchor path with high connectivity for packet delivery. By using an anchor path, A-STAR guarantees to find an end-to-end connection even in the case of low traffic density. This position-based scheme also employs a route recovery strategy when the packets are routed to a local optimum by computing a new anchor path from local maximum to which the packet is routed. The simulation results show A-STAR achieves obvious network performance improvement compared with GSR and GPSR. But the routing path may not be optimal because it is along the anchor path. It results in large delay.

2.1.4 MDDV (Mobility-Centric Data Dissemination Algorithm for Vehicular Networks)

To achieve reliable and efficient routing, Wu et al. proposed MDDV [5] that combines opportunistic forwarding, geographical forwarding, and trajectory-based forwarding. MDDV takes into account the traffic density. A forwarding trajectory is specified extending from the source to the destination (trajectory-based

The rest of the paper is organized as follows. A qualitative comparison of the existing greedy routing protocols for VANETs are presented in Section 2. An overview of three greedy routing algorithms is described in Section 3. In Section 4, we present the simulation results and analysis with the Conclusion in Section 5.

2.1.5 VADD (Vehicle-Assisted Data Delivery)

To guarantee an end-to-end connection in a sparse network with tolerable delay, Zhao and Cao proposed VADD [6] based on the idea of carry and forward by using predicable mobility specific to sparse networks. Instead of routing along a preselected path, VADD chooses next hop based on highest pre-defined direction priority by selecting the closest one to destination. Their simulation results show VADD outperforms GPSR in terms of packet delivery ratio, data packet delay, and traffic overhead. This approach predicts the directions of vehicles movement. But it doesn't predict the environmental change in the future.

2.1.6 PDGR (Predictive Directional Greedy Routing)

Jiayu Gong et al. proposed PDGR [7], in which the weighted score is calculated from two strategies namely, position first forwarding and direction first forwarding. With these strategies, the current neighbors and possible future neighbors of packet carrier are found. The next two hops away are calculated from weighted scores of next hops using

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PDGR. Here next hop selection is done on prediction and it is not reliable, at all situations. The delivery of packet does not guarantee to the node present in the corner of transmission range of forwarding node, which is considered as most suitable next hop, due to high dynamics of vehicles. This will lead to low packet delivery ratio, high end to end delay and increased packet drops.

3.OVERVIEW OF THREE GREEDY ROUTING ALGORITHMS

The Greedy Routing Algorithms will route information using "long-range" connections that function as shortcuts connecting "distant" network nodes.

3.1 Gateway Node-Based Greedy Routing

Algorithm (GNGR):

GNGR is a greedy position based reliable routing algorithm and it is designed for sending messages from any node to any other node [8]. In this, the sending of message is from one node to another node (i.e., Unicast) or from one node to all other nodes (i.e., roadcast/Multicast) in a vehicular ad hoc network. The common design goals of GNGR algorithm are to deliver messages with high reliability and to optimize packet behavior for ad hoc networks with high mobility.

There are six basic functional operations of GNGR algorithm.

1. Identification of Neighbor Node (INN)
2. Calculation of Distance (CD) between nodes
3. Identification of Moving Direction (IMD) of the nodes
4. Link Stability Calculation (LSC) between nodes
5. Weighted Score Calculation (WSC) to identify the next hop which is closer to the destination
6. Gateway Node Selection (GNS).

At any point of time the INN takes the responsibility for collection of all neighbor nodes information, which is all present within the transmission range of source/forwarder node. The CD takes the responsibility for calculating the closeness of next hop using distance information from the GPS. The IMD takes the responsibility to identify the direction of motion of neighbor nodes and verifies that these nodes are moving towards the direction of destination. The LSC takes the responsibility for calculating the link stability between the source/forwarder node and its corresponding neighbor nodes. The WSC takes the responsibility for calculating the largest weighted score and also identify the largest weighted score neighbor node which is further forwarding of a particular packet to destination. The GNS takes the responsibility for selection of gateway node and this node will have high weighted score in different levels of transmission range.

3.2 Edge Node Based Greedy Routing
Algorithm (EBGR):

The EBGR (Edge Node based Greedy Routing) algorithm is designed for sending messages from any node to any other node (unicast) or from one node to all other nodes (broadcast) in a mobile ad hoc network[9]. The general design goals of the EBGR algorithm are to optimize the packet behavior for ad hoc networks with high mobility and to deliver messages with high reliability.

The EBGR algorithm has three basic functional units.

1. The Neighbor Node Identification (NNI) algorithm
2. The Node Direction Identification (NDI) algorithm
3. The Edge node Selection (ENS) algorithm. The NNI algorithm is responsible for collection of information of all nodes present within the transmission range of source/forwarder node at any time. NDI algorithm is responsible to identify the direction of motion of nodes which is moving towards the direction of destination. The ENS algorithm is

responsible for selection of the specific edge node within limited transmission range for further forwarding of a particular packet.

3.3 Predictive Directional Greedy Routing Algorithm (PDGR):

In PDGR, the weighted score is calculated not only for the packet carrier and its current neighbors but also for its possible future neighbors in very near future. To get the knowledge of possible future neighbors, the packet carrier requires the information about its 2-hop neighbors, which can also be achieved by beacon messages. According to all these weighted scores, next hop is then decided. The algorithm for ODGR has two parts. One is to calculate weighted score for current neighbors. The other is used for future neighbors in a short interval.

4. SIMULATION RESULTS & ANALYSIS

In this section, we evaluate the performance of routing protocols EBGR, PDGR and GNGR in an open environment. The simulation is performed using 5.0 [10], a novel vehicular network simulator and emulator tool. The movement of vehicles was controlled by setting vehicle movement and information related to this is stored in node movement scenario configuration file. Simulations for each of the routing protocols were carried out with varying number of nodes with specific parameters. Initially the nodes were placed at certain specific locations.

CONCLUSION

In this paper we have analyzed the various routing protocols of VANETs and descriptions on three greedy routing algorithms such as GNGR, EBGR and PDGR. All these three algorithms were compared in terms of packet delivery ratio. The simulation result shows GNGR significantly improves packet delivery ratio. In the future, our approach requires modifications to city environment characteristics and different mobility models with obstacles. So the GNGR routing algorithm approach when compared with other existing approach, gives an improvement of packet delivery ratio over other routing approach.

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