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Position Based Routing protocols in VANET for Better Link Quality: A Survey

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Abstract: ***Vehicular Ad-Hoc Networks, are a specified class of Mobile Ad-Hoc Network, in which vehicles are nodes VANET provides interaction between vehicles and road sides units. VANET now-a-days is affecting a large area of research due to its wide range of applications and special characteristics like movements constraints, On board sensors, Unlimited battery power, high node mobility etc . The main issue in VANET is routing. Routing of information is demanding task as considering rapid changing topology and node mobility of vehicles. In these networks, the link duration is often very short due to frequent changing topology which decreases the network efficiency leading to problem of link stability. In terms of high scalability and low overhead the most suitable solution for routing in VANET is Greedy routing approach. However various location based routing protocols have been proposed by researchers such as the GPSR, the GOAFR, A-STAR, GPCR etc. The main objective of this paper is to compare different routing protocols. The result of comparison identifies one of the efficient routing approaches in VANET.***

Keywords: Vehicular Ad-Hoc Networks, link stability, location based routing protocols.

1. Introduction

Over the last two eras, attentiveness to the applications of mobile as hoc network technology to be applicable to the Vehicular Ad Hoc Networks (VANET) has been given a lot. VANET provides two types of communication vehicle to vehicle (V2V) and vehicle to infrastructure or road side units (V2R), where vehicle to roadside units provides real-time information. VANET is a part of intelligent transportation system (ITS). It is a platform for application development to provide interactions between its moving components. Inter vehicle communication can be used to indicate the other vehicles approaching the site at the time of accidents. Network topology in VANET changes rapidly, due to which the link between two vehicles is maintained for a very short duration.

In vehicular ad-hoc network the communication is based on dedicated short range communication (DSRC), the two types of communicating devices deployed in VANET are the On Board Units, is a device that supports information exchange with RSUs and other OBUs and the Road Side Units (RSU), operates at a fixed position. The presence of navigation system on each vehicle makes it aware of its geographic location along with its neighbors. In VANETs the routing protocols can be divided into two major classes: topology based routing and position based routing. However, a particular type of routing method known as geographic routing in which packets are forwarded to a destination easily by choosing a neighbor who is next to the destination is adopted. In these methods, every node in a proper sequence broadcasts a hello message that contains its node identification number and the geographic location to its neighbors. Therefore every node can maintain the location information of its neighbors. On the basis of geographic location information, a node containing data packet selects the node among the neighbors whose physical distance is shortest to destination and forwards the information to that selected node. Due to node's moving nature and hello interval, the link between the nodes may break as the node may break as the node may have gone out of transmission range of the sender. However, by decreasing the hello interval this problem may be resolved, as by reducing the hello interval every node can maintain good motion information for its neighbors, but it results in increment of control overhead.

By adopting the above approaches it cannot be assumed that the link will be maintained throughout. Various natural factors are there which can easily bring variations and link between nodes can be broken due to path loss, shadowing and fading, therefore taking link quality into account is very necessary to avoid frequent link failure in the process of next hop selection, because as a result of that a sender node may have to select the next forwarding node multiple times. This will mortify the end-to-end communication and decrease the network throughput.

Therefore, as a solution of above mentioned two issues, the researchers have proposed a new link prediction metric for the selection of next hop and delivery of the packet to the destination successfully. And the metric considers the link quality both in terms of the future and past to more accurately evaluate the performance of link. The success rate of packets are responsible for obtaining the link quality assessment for past link quality, and prediction of node's future location is there for obtaining the future link assessment for future link quality evaluation. The above two are combined and the next hop selection is done on the basis of that combined link quality metrics. The past link quality is evaluated in the form of expected transmission count (ETX) in which there is evaluation of number of retransmission a forwarding node have to made before a sender node sends a packet to next hop successfully. Second is the future link quality evaluated as the predicted forwarding progress distance (PPD) that is known by position of sender node and next hop.

The mobility prediction mechanism is involved to predict the future location of a sender node's neighbors on the basis of motion information included in the last hello message. Then, the node having efficient link quality and predicted to stay in the transmission range of sender will be given higher priority being selected as the forwarding next hop.

2. Problem Definition

Due to rapid changing topology and frequent network disconnection, it is difficult to route packets among the vehicles, since the link between the vehicles may disappear at the time of transmitting information between the two nodes. An efficient routing protocol is required to improve the frequent network disconnection and provide improved approach for proper communication and to maintain link connection.

Therefore to improve the link quality, choosing routing protocol is important as the protocol is responsible for taking the steps in transmission of information, as it gives procedure for route establishment, to take forwarding decisions and to maintain the route till packets are transmitted and recover from failure.

Greedy forwarding is one of the suitable approaches for VANET.

3. Methodology

The following are various greedy routing protocols in VANET.

A. GSR (Geographic Source Routing)

To send packets to the destination the GSR utilizes a map and a location based address scheme. A source node calculates the shortest path to the destination using Dijikstra's algorithm which is based on distance metric. All the nodes on this shortest path are included to the header of the packet. Therefore, each node sends beacon with its own location and its node identification number. With the location information of beacon, every node builds a one-hop neighbor table. A neighbor is selected by receiving node according to whose progress is highest to the next hop. After arriving at the next hop, that hop is detected from the packet header and the location of the next hop is used as a new destination. In realistic vehicular environment GSR shows the advantages of map based approach. The packets are directly discarded when it faces a local maximum problem.

B. DSR (Dynamic Source Routing)

The dynamic source routing is an On-Demand routing strategy. DSR is an efficient routing protocol for mobile nodes designed especially for using in multi-hop wireless adhoc network. By using dynamic source routing, there is no requirement of existing network infrastructure on administration as the network is self-organizing and self-configuring.

The two main mechanisms are involved in the DSR protocol, both working together to allow the discovery and maintenance of routes in the adhoc network:-

1. Route Discovery.
2. Route Maintenance.

The process by which a source node obtains a source to the destination node is called route discovery. Route discovery is adopted when the destination node route is unknown and it attempts to send packets to destination. The mechanism in which the source node is able to detect any changes in the route, if the network topology has changes and the previous route can be followed further, is route maintenance. In this case, the route maintenance indicates the source node to again involve the route discovery mechanism and find another route to reach destination to transfer packets. The route discovery and route maintenance both are on demand services in DSR.

C. GPCR (Greedy Perimeter Coordinator Routing):-

GPCR is a location based routing protocol that utilizes the greedy algorithms to send packets which relay on pre-determined route which is formed to deal with obstacle of city scenarios. In greedy perimeter coordinator routing there is no requirement of any global or external information like map.

It contains two strategies:-

1. A Restricted Greedy Forwarding Strategy.
2. A Repair Strategy.

It do not face the planarization problem like unidirectional links, planner sub graphs and so on.

D. A-STAR (Anchor-Based Street and Traffic Aware routing)

A-STAR is a location based routing protocol designed especially for vehicle to vehicle communication system. It relay on the city bus information for end-to-end connection for packet delivery, in low traffic density. New location recovery strategy is used by A-STAR which is more suitable for city environment. Due to path selection A-STAR guarantees good connectivity.

E. GPSR (Greedy Perimeter Stateless Routing)

The greedy perimeter stateless routing is the best known location based routing protocol. The GPSR protocol is an efficient and scalable routing protocol.

Two forwarding strategies are used in GPSR protocol to route the data packet to the destination:-

1. Greedy Forwarding.
2. Perimeter Forwarding.

Greedy forwarding decision in GPSR uses the information about router's immediate neighbors in the network topology. In GPSR protocol, the sender node sends the packet to the neighbor node whose geographic position is closest to the destination node. When a packet enters a region where the greedy forwarding technique fails i.e. node fails to find a neighbor node closer to the destination than itself, then the perimeter forwarding strategy is used.

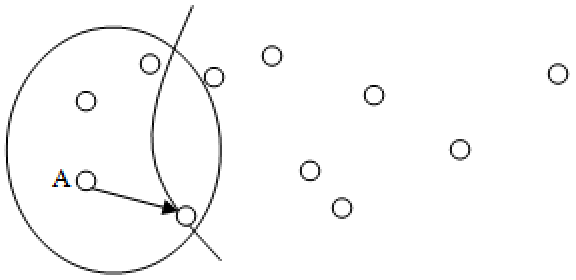

Figure 1: Greedy forwarding example.
x is A's closest neighbor to D.

Here A receives a packet to be delivered to D. The circle shows the A's radio range. A forward packet to x, because the distance between x and D is less than any of A is other neighbors. This greedy forwarding approach continuous, until the packet reaches destination D.

4. Result

The result shows the description of various greedy routing protocols. The link prediction metric was applied and comparison result is taken between the GPSR_LPD and GPSR_MP. The performances of the protocols are judged under various environmental factors by changing the value of zero mean Gaussian distributed random variable.

Table 1: Broken Link Ratio with varying X between GPSR_LPD and GPSR_MP

Random Variable X	Broken Link Ratio	
	GPSR_LPD	GPSR_MP
4	0.050	0.070
5	0.075	0.095
6	0.100	0.150
7	0.150	0.190
8	0.200	0.250

Table 2: Packet Delivery Ratio with varying X between GPSR_LPD and GPSR_MP

Random Variable X	Packet Delivery Ratio	
	GPSR_LPD	GPSR_MP
4	0.920	0.900
5	0.880	0.860
6	0.840	0.830
7	0.820	0.790
8	0.795	0.740

Table 3: Normalized Control Overhead with varying X between GPSR_LPD and GPSR_MP.

Random Variable X	Normalized Control Overhead	
	GPSR_LPD	GPSR_MP
4	34	35
5	38	40
6	44	48
7	53	57
8	62	64

Table 4: End-to-End Delay with varying X between GPSR_LPD and GPSR_MP

Random Variable X	End-to-End Delay	
	GPSR_LPD	GPSR_MP
4	0.5	1
5	1.2	1.8
6	2.8	5.8
7	5.9	8
8	7.9	11

5. Conclusion

Result Analysis: Figure 1, 2,3 and 4 show result of the broken link ratio, the normalized control overhead, the packet delivery ratio, and the end-to-end delay by changing the value of zero mean Gaussian distributed random variable X. With increment in value of X the broken link ratio of two protocols also increases due to which the transmitted signal suffers from are shadowing effects. The increase in broken link ratio leads to increment of normalized control overhead. The broken link ratio of GPSR_MP is more than GPSR_LPD. Due to increase in shadowing effect of GPSR_MP the GPSR_LPD achieves better packet delivery ration and end-to-end delay.

Therefore, with limited number of retransmission the GPSR_LPD achieves efficient end-to-end delay and packet delivery ratio than the GPSR with mobility prediction.

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