A Survey of Routing Protocols for Vehicular Ad-hoc Networks

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ABSTRACT
With number of moving vehicles, vehicular Ad Hoc Network (VANET) is formed. These are provided with the wireless connections. This network is one kind of class of Mobile Ad Hoc Network (MANET) where the communication occurs between various vehicles moving on the paths. VANETs have heterogeneous nature as they provide wireless communication in between various moving vehicles (V2V) together with vehicle to fixed Units present on the Road Side (RSU). This have been developed as an important research area as with this, the Intelligent Transport System (ITS) gets improved which targets for improvement in the safety of road, better traffic flow, reduction in congestion, etc. There are a lot of challenges in the VANET field, such as bandwidth limitation, scalability, security, privacy and also the routing issue. For obtaining effectual communication in between various vehicles, routing is an important element that requires to be examined. The routing protocols performance are based on the several internal factors such as movement of the nodes and external factors such as topology of the road and complications that inhibits the useful information. Basically, the routing protocols for Vanet has been divided into two categories as protocols based on topology of network and protocols based on position of vehicles. Greedy forwarding is one of the most suitable solutions for routing in the VANETs as it maintains only the location of adjacent vehicles in place of each destination entered for routing. It is also observed that carry-and-forward is the different and important consideration for designing all routing protocols in VANETs.

Keywords
Vehicular Ad-hoc Network (VANET), MANET, ITS, V2V, Greedy forwarding, carry-and-forward.

1. INTRODUCTION
VANET is a part of wireless connectivity field and it is raising field of MANETs. Here various vehicles are considered as the moving nodes inside the connectivity network. Its fundamental purpose is to improve road users safety and comfortably satisfaction of passengers. In this, communication is carried out by wirelessly along the paths connected to every vehicle. Every vehicle in VANET gets considered as the member and as the router. This is because all vehicles communicate with the help of another intermediary vehicle in their range of transmission. These are self-ruled network field. It is independent of any type of fixed network installation in the field. Some fixed network installations taking part in communication are used to provide information about the locational information or it can be act as a gateway for the internet connection. Very fast movement of vehicles, high speed of vehicles and very quickly changing movement of vehicles are the important features of ad hoc network of vehicles. Due to this the topology of network of vehicles in VANET are changes very fastly.

VANET, a notable class of Ad hoc network of Mobile elements, where vehicles are analogous to nodes in the network. To provide reliable services using VANET, various challenges in VANET are necessary to overcome. Fast & authentic data forwarding in the vehicular network is one of the critical things. That is why effective research is required for making VANET advantageously applicable.

1.1 Overview of Routing protocol
The data forwarding process in the ad hoc network of vehicles is important consideration to provide the services wirelessly. The performance of VANET depends on the data forwarding protocol which is used. In order to improve vehicular safety and to satisfy the need of traffic users, VANET routing should forward a data packet with constraints such as reduced end to end delay and few dropped packets. Various routing protocols had been proposed by various researchers but it is very difficult to design and implement an efficient routing protocol for all VANET applications. The data forwarding protocols are mainly grouped among two classes as-

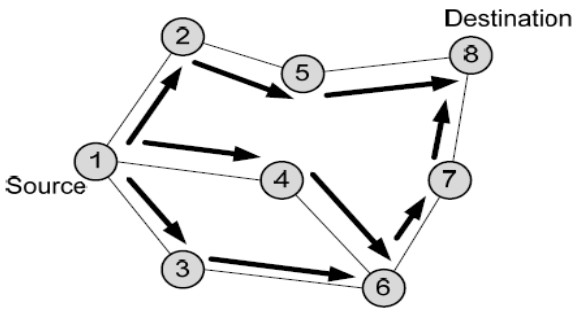
- Routing Protocols based on topology of the network
- Routing Protocol based on the positions of the vehicles in the network

2. TOPOLOGY BASED ROUTING PROTOCOL
Routing protocols based on the topology needs the information of the whole topology to make the decision for packet forwarding, while determining the routing path. They are further classified into proactive and reactive routing protocol.

In the Proactive Routing Protocol, the data forwarding information such as the next forwarding hop is stored even if there is no any communication request. Low latency is achieved using this but the bandwidth occupation is higher due to maintenance of unnecessary and non-used routes and also increases the overhead. Whereas, Reactive Routing protocol discover the route from source terminal to destination terminal only when the source node has the data to transmit to the destination node and maintains only that routes which are currently in use. It reduces the networks unnecessary burden or overhead.

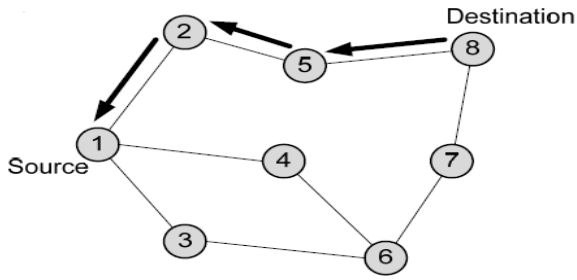
2.1 Ad Hoc on Demand Distance Vector Routing (AODV)
Ad Hoc On Demand Distance Vector Routing protocol was proposed by Perkins, in 1999. When the node receives

broadcast query RREQ message, the broadcast the query message sender address in recorded in their routing table (figure 1 a).



(a) Propagation of the RREQ

When the Destination node is found, reply message RREP is sent back t the source terminal which acknowledges that the path is discovered (figure 2 b).

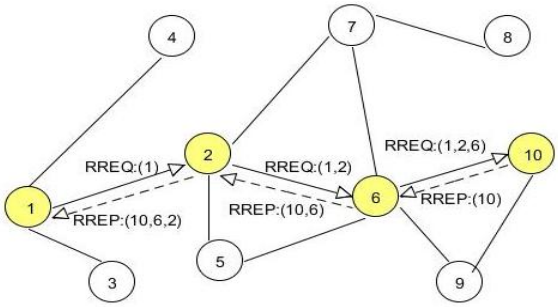


(b) Path of the RREP to the source

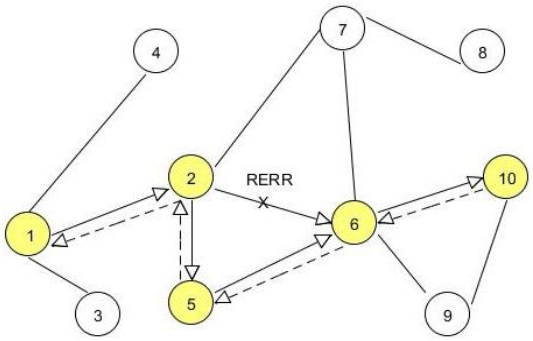
Each node of the path form source to destination, stores the address for the previous node from which it receives a packet. A full duplex path is established by sending the query and reply. After establishment of route, as long as the source uses that route, it is maintained. When the link failure occurs, it is recursively reported to the source node and then starts another query reply process is start in order to find new path to the destination.

2.2 Dynamic ManetOn Demand Routing Protocol (Dymo)

DYMO is a reactive data forwarding protocol that means the routes are computed and maintained only when it is required. DYMO routing protocol not used any unnecessary HELLO messages, unlike AODV routing protocol. The operation of DYMO based on sequence numbers which are assigned to all packets. Sequence numbers are employed to ensure loop freedom. Discovery of the route and the maintenance of that Route are two basic operations. The discoveries of the route in DYMO slightly different form that of AODV. The path accumulation process in DYMO aware each node about the route to the destination node.



Above figure 3 shows route discovery procedure for DYMO. In figure, the source node broadcast the RREQ packet that contains its own address, destination address, hop count, sequence number. Each intermediate node having the valid route to the destination keeps on adding their sequence number and address to the RREQ packet as shown nodes 2 and 6, until the destination is found. When the destination is reached, RREP message is send from destination to source which follows a similar path accumulation process in backward path.



When the route from packet generating terminal to target terminal breaks unexpectedly route maintenance is use in DYMO. In route maintenance node generates RERR message if and when link to the other node is breaks and multicasts the RERR message to the nodes which are in concern to the link failure. During route maintenance procedure, the entry with the broken link is deleted and routing table is updated continuously [12].

3. POSITION BASED ROUTING PROTOCOL

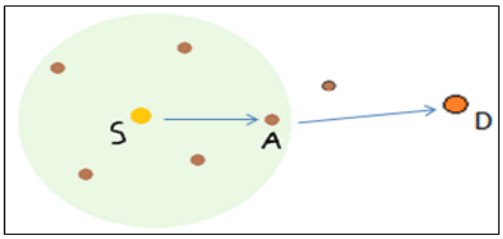
In this, the geographical positions are taken into account when the source wants to communicate with the destination besides of its network address. While considering any position based routing protocol the assumption is made that each node is aware of its position, the positions of its neighbor nodes and also the position of destination node. The geographical location of nodes which are taking part in the communication between the adjacent nodes is known by transmitting the beacon after fixed interval of time[4]. It mainly has three components: beaconing, location services and forwarding. In every Position based protocol, the position of various nodes is being found out with the help of global positioning system (GPS).

In this the data forwarding decision is dependent on the location of destinations included within the packet header, and also on the position of the source node's neighbor, without having any route discovery and route maintenance and without having any knowledge of network topologies.

Examples are DREAM and GPSR.

3.1 Greedy Perimeter Stateless Routing Protocol (GPSR)

In this Greedy Forwarding approach is used. In Greedy mechanism, intermediate nodes are used for data forwarding. They are selected on the basis of their distances to the target node. The progress of each intermediate node towards destination is made known from the Euclidian distance. While forwarding with greedy approach, sometimes the situation may occur where there is no any other node bringing progress towards destination rather than the packet forwarding node. Such situations are known as local maximum problems. Under such conditions GPSR uses Recovery Strategy. In recovery strategy, GPSR forwards the data packets using perimeter forwarding. In this the decision is taken with the help of right hand rule is. In this the node counterclockwise to the virtual line form in between source to destination is selected. The packet is forwarded in a backward direction in regard to the distance of the destination.



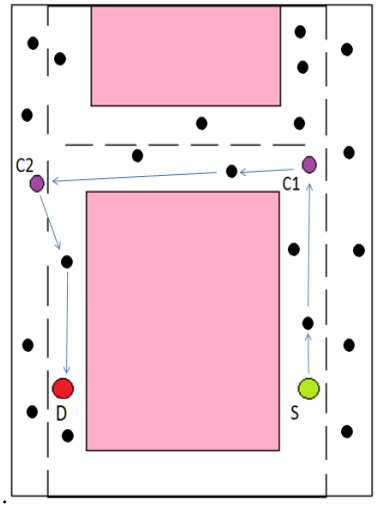
In the above figure 4, Using greedy forwarding technique the data is transmitted to the destination terminal through the intermediate node A .

3.2 Greedy Perimeter Coordinator Routing (GPCR)

It contains the concept of coordinator node and was proposed in order to improve Greedy Perimeter Stateless Routing Protocol. The junction nodes are considered as a coordinator node in GPCR.

GPCR forwards the data using of modes: 1. forwarding with the help of Restricted Greedy Forwarding & 2. In case of failure occurs then switch to the Repair Strategy.

In the Restricted Greedy Forwarding, the packets are always forwarded to the node which is present on the junction, since junction are the only places at which the correct routing decisions can be taken. If the packet forwarding node is present on the street, the packet is first forwarded to the next junction along the street. When the packet reaches the coordinator node, decision is taken about which street to follow next. This is done in Greedy fashion. Whenever a local maximum problem happens, Repair Strategy of GPCR is used. In this the packets are retrace to a coordinator node in a greedy fashion, and at each coordinator node, the decision is made about next road that the packet should move on and between the junctions, the data packet forwarding is done with the Greedy forwarding.



In above figure 5, a packet with destination D, suffers a local maximum at node S. So, it uses repair strategy. In this first the data packet is being forwarded to the first coordinator or junction node.

4. CONCLUSION

VANETs have various different properties than MANET. VANET have road pattern restriction and there is no restriction on the network sizes. VANET have very rapid0ly changing topology, it has infinite supply of energy and so on. Due to random movements of nodes, the nodes in the route from source terminal to target terminal, continuously dissociates. Therefore it is very necessary to implement efficient routing protocol. We have survey four routing protocols to provide efficient routing. Routing protocols are designed to deal with sparse or disconnected situation. Now a day, various advances is happening in VANET research and becoming mature therefore importance is given to the advantages of the various routing protocols.

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