

Routing Overheads in Vehicular Ad Hoc Networks(VANETs)

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Abstract

VANETs is a subclass of Mobile ad hoc networks which provides a distinguished approach for Intelligent Transport System .It should be capable to handle high rate, often interrupt in connection .The quality of received wireless signal level degraded due to path-loss from various obstacles in path as a result nodes use flooding mechanism that unconditionally scatters the data packets Which affects the network . In this paper we are throwing spotlight on routing overheads in VANETS.

Keywords: VANET, DSR, AODV, TORA

1. Introduction

Vehicular ad hoc network is an extended form of MANET which is a vehicle to vehicle & vehicle roadside equipment. It is autonomous & self-organizing wireless communication network, where nodes in VANET involve themselves as servers and/or clients for exchanging & sharing information. The main goal of VANET is providing safety and comfort for passengers. Collision warning, Road signal arms and in place traffic view will give the driver essential tool to decide the best path along the way. With the sharp increase of vehicles on roads in the recent years, driving becomes more challenging and dangerous. Roads are saturated; safety distance and reasonable speeds are hardly respected. The leading car manufacturer decided to jointly work with govt. agencies to develop solution aimed at helping drivers on the roads by anticipating hazardous events or bad traffic areas. there are several VANET applications such as Vehicle collision warning, Security distance warning, Driver assistance, Cooperative driving, Cooperative cruise control, Dissemination of road

information, Internet access, Map location, Automatic parking, Driverless vehicles.

2. Difference between MANET and VANET

mobile ad hoc networks (MANETs), nodes in VANETs self-organize and self-manage information in a distributed fashion without a centralized authority or a server dictating the communication. In this type of network, nodes engage themselves as servers and/or clients, thereby exchanging and sharing information like peers. Moreover, nodes are mobile, thus making data transmission less reliable and suboptimal. Apart from these characteristics, VANETs possess a few distinguishing characteristics , and hence presents itself as a particular class of MANETs:

2.1. Characteristics of MANET and VANET

2.1.1. Highly Dynamic Topology:

The topology formed by VANETs is always changing

frequently as vehicles are moving at high speed. On highways, vehicles are moving at the speed of 60-80 kmph and vary for different vehicles. If the radio range between two vehicles is 125 m then the link between the two vehicles would last at most 10 sec.

2.1.2. Frequently Disconnected Network:

The highly dynamic topology results in frequently disconnected network since the link between two vehicles can quickly vanish while the two nodes are transmitting information. The problem is further worsened by varying node density where there are different frequency of nodes for different roads and highways. A robust routing protocol is hence needed to recognize the frequent disconnectivity and to provide an alternate link rapidly to ensure uninterrupted communication node density during non rush hours results in disconnectivity of nodes

2.1.3. Patterned Mobility:

Vehicles follow a trail or certain mobility pattern which is a function of the underlying roads, the traffic lights, the speed limits, traffic condition and driving behaviors of drivers

2.1.4. Propagation Model:

The propagation model in VANETs is usually not assumed to be free space because of the presence of static objects such as buildings, trees and other obstacles. A VANET propagation model should well consider the effects of static objects and potential interference of wireless communication from other vehicles or widely deployed personal access points.

2.1.5. Unlimited Battery Power and Storage:

The nodes in VANETs are not subject to power and storage limitation as in sensor networks, another class of ad hoc networks where nodes are mostly static. Nodes are assumed to have a large amount of energy and computing power and hence the optimizing duty cycle is not as appropriate as it is in sensor networks.

2.1.6. On-board Sensors:

In VANETs the nodes are assumed to be equipped with sensors to provide information for routing purposes.

Many VANET routing protocols have assumed the availability of GPS unit from on-board Navigation system. Location information from GPS unit and speed from speedometer provides good examples for large amount of information that can possibly be obtained by sensors to be utilized to enhance routing decisions.

3. ROUTING PROTOCOLS IN MANET and VANET

The routing protocols in a MANET can be classified as follows: "Fig. 1,2 . (Continued)" below the last part.

3.1 Proactive protocols:

In this type of routing protocol, each node in a network maintains one or more routing tables which are updated regularly. If we made any changes in the network topology then each node will send a broadcast message to the entire network. However, it incurs additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may get affected but it provides the actual information to the availability of the network. Distance vector (DV) protocol, Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing protocol Fisheye State Routing (FSR) protocol are the examples of Proactive protocols.

3.2 Reactive Protocols:

In this type of routing protocol, each node in a network discovers or maintains a route based on-demand. It floods a control message by global broadcast during discovering a route and when route is discovered then bandwidth is used for data transmission. The main advantage is that this protocol needs less routing information but the disadvantages are that it produces huge control packets due to route discovery during topology changes which occurs frequently in MANETs and it incurs higher latency. The examples of this type of protocol are Dynamic Source Routing (DSR), Ad-hoc On Demand Routing (AODV) and Associativity Based Routing (ABR) protocols.

3.3 Hybrid Protocols:

It is a combination of best features of proactive and reactive protocols. An example of hybrid routing

protocol is ZRP (Zone Routing Protocol). Three basic routing protocols have been analyzed in this paper, namely; DSR, AODV and FSR.

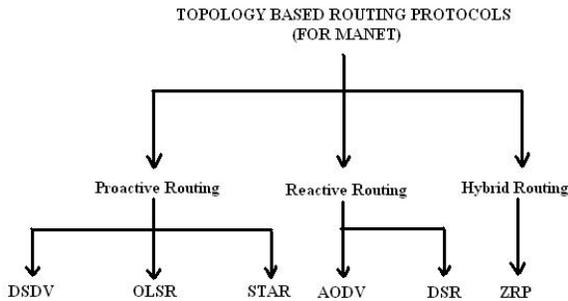


Fig. 1. Classification of Routing Protocols in MANET Ref(1)

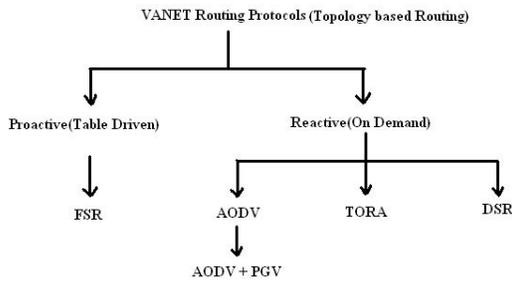


Fig. 2. Classification of Routing Protocols in VANET Ref(1)

4. Routing Overhead in VANET

4.1 AODV – Ad Hoc On Demand Distance Vector:

In this routing, upon receipt of a broadcast query (RREQ), nodes record the address of the node sending the query in their routing table (Figure 3(a)) or the previous hop and is called backward learning. Upon arriving at the destination, a reply packet (RREP) is then sent through the complete path obtained from backward learning to the source (Figure 3(b)). At each step of the path, the node records its previous hop and establishes the forward path from the source. The AODV has the advantage of establishing on-demand route in between source and destination node with the lower delay in

connection setup and does not require much memory for communication but there are several disadvantage with this protocol like if the source node sequence number is very old than the intermediate nodes can lead to route inconsistency. Heavy control overhead if there has multiple route reply packets for a single route request packet. It consumes extra bandwidth because of periodic beaconing.

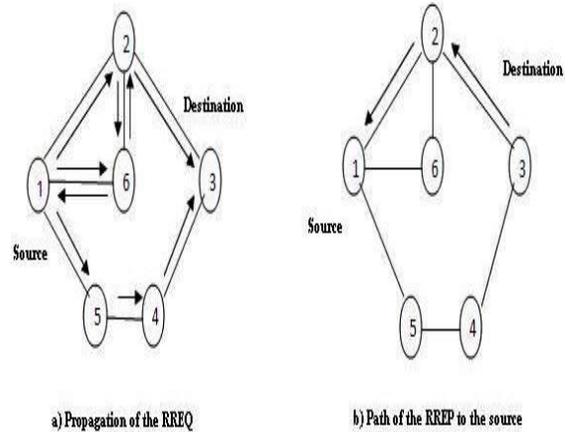


Fig. 3. Propagation of Packets Ref(1)

4.2 DSR – Dynamic Source Routing (DSR):

It uses the concept of source routing, as the sequence of intermediate nodes on the routing path is maintained in a data packet of the source. In DSR, the IDs of the intermediate nodes that it has traversed are copied in the query packet. The destination then can access the entire path from the query packet, and uses it to respond to the source. As a result, the source establishes a path to the destination. If the destination is allowed to send multiple route replies then the probability of source node of receiving and storing multiple routes from the destination get increases. When some link in the current route disconnect then an alternate route is used. In a network with low mobility, this is an advantage over routing protocols such as AODV as the alternative route can be tried before the DSR initiates another flood for route discovery. AODV, in comparison with DSR is that in AODV data packets carry the destination address, whereas in DSR, data packets carry the full routing information. Hence DSR has potentially more routing overheads. Moreover as we increases the network diameter, the amount of overhead in the data packet continues to increase. Also in AODV, route reply packets carry the destination address and the sequence number, while in DSR, the route reply packets carry the

address of each node along the route. The advantage of this protocol is that it provide on-demand routing path and does not require periodic packet that are used by a node to inform its presence to its adjacents. The control overhead is reduced by using the information efficiently from route cache by node to access the route for packet transmission that are already discovered but In this protocol path length effect the routing overhead and broken links in network does not repair locally at route maintenance process. This is the main limitation of this protocol that makes it unsuitable for large high mobility network see Refs(3).

4.3 TORA – Temporally Ordered Routing Algorithm (TORA):

This routing belongs to a family of link reversal routing algorithms where the height of the tree rooted at the source is used to build a directed acyclic graph (DAG) toward the destination which directs the flow of packets and ensures their reachability to all the nodes. The node broadcasts the packet when it has a packet to send. Its neighbor then broadcasts the packet if it is the sending node's downward link based on the DAG. A node constructs the directed graph by broadcasting a query packet. Upon receiving a query packet it will broadcast a reply packet, if it has a downward link to the destination; otherwise, it simply drops the packet. A node, upon receiving a reply packet, updates its height only if the height from the reply packet gives the minimum of all the heights from reply packets it has received so far. It then rebroadcasts the reply packet. The advantages of TORA are that the execution of the algorithm gives a route to all the nodes in the network and it reduces far-reaching control messages to a set of neighboring nodes. However, since it provides a route to all the nodes in the network, maintenance of these routes is a cumbersome task, especially in highly dynamic VANETs see Refs(4).

5. Conclusion

The study of the various routing protocols considered under MANET and VANET on the basis of their routing efficiency protocols which are feasible for a MANET will not surely feasible in the VANET too and their performance varies with varying traffic conditions and densities. If we look for the best out of the existing protocols then we find that the Reactive protocols will be the best if we want to use the same set of rules in

both the VANET and MANET. Moreover AODV results to be the best among the various reactive protocols for both MANET and VANET based on previous research work and study and can be used for both the VANET and MANET if we consider a common set of rules to be applied to both types of the ad hoc networks. From the analysis we find that DSR AND TORA both are quite cumbersome for highly dynamic VANETs. TORA can suffer from unbounded worst-case convergence time for very stressful scenarios .There are very few routing protocols that can be applied to both the VANET and MANET.

6. References

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