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Routing Protocols for Vehicular Ad-Hoc Network: A Survey

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Abstract-Vehicular Ad-Hoc Network (VANET) has been developed to provide a communication service among vehicles to support the Intelligent Transport System (ITS). In this paper, we provide survey of routing protocols in vehicular ad hoc networks. Routing Protocol are used for the routing the information among vehicles. The routing protocols are such as topology based routing, position based routing, and multicast based routing, clustered based routing and broadcast routing protocol. This paper provides a comprehensive study of these routing protocols by representing the advantages / disadvantages and application. Many scholar came with the flying color in this aspect but I came with the study of these protocol in a single paper. In addition, we provide the brief discussion of the OLSR, DSR and ZRP routing protocol in the Vehicular Ad hoc Network.

Keywords: - VANET, ITS, OLSR, DSR, ZRP.

I.INTRODUCTION

VANET stands for vehicular ad hoc network. In the VANET vehicles are taken as nodes that are connected to each other in the form of a wireless network called "vehicular ad hoc network". For transferring the between vehicles the CBR and TCP are the traffic agent is used. Vehicular ad hoc network is the major part of the intelligent transport system. VANET have two types of communication 1) Vehicle to Vehicle (V2V) 2) Vehicle to Infrastructure (V2I) that is road side unit. Vehicle to Vehicle communication uses multi-hop or multi cast technique and it use two type of broadcasting first is naive broadcasting in which vehicle send broadcast message periodically and at regular interval upon receipt of the message, the vehicle ignores e the message if it has come from a vehicle behind. If the message comes from a vehicle in front, the receiving vehicles send it own broadcast message to vehicle behind it. Limitation of this broadcasting is that large numbers of broadcast message are generated. So message collision risk. Second, Intelligent broadcasting remove this message collision risk. By taking an example we can easily understand, if a car spot a dangerous road situation such as black ice, it transmit the information to car behind it, that might be heading in the direction of danger. Routing protocols are used to provide the communication by routing the data among vehicles. In the VANET vehicles (nodes) itself taken as router. Firstly systems that will integrate this technology are police and fire vehicles to communicate with each other.

Characteristic of VANET are: - nodes are highly moveable, topology are dynamically changes, unlimited network size, real time and time sensitive data are exchange and unlimited battery power and storage capacity.

Applications of VANET are: - VANET applications are such 1) safety applications 2) user applications. User applications are internet access, weather information, map location, entertainment etc[1]. Safety applications, security is provided on roads. These provide the dissemination of road information, vehicle collision warning. Numbers of vehicle are increases on the road so that many accidents are happen and other hazardous conditions are coming in human life. To provide security to human life vehicular ad hoc network is designed. By using this, traffic can be easily managed. VANET provide internet connectivity to vehicles (nodes) while on the movement so that the passenger to communicate with other vehicles and with internet host which improve passenger comfort.

VANET is a subgroup of the MANET (Mobile ad hoc network). Being a subgroup of MANET VANET has some characteristics like MANET. Nodes of both the network are moveable so that both are mobile network , both does not have any infrastructure and both use the nodes as a network router for routing the data among nodes or for providing communication among vehicles by forwarding the data packet. But there are some characteristics which differentiate VANET from MANET. 1) VANET, topology is very dynamically changed as compare to MANET because vehicles speeds are high so they change the location very frequently.2) MANET nodes can be moved randomly but the VANET nodes can move on a desired fashion such as roads and highway. 3) MANET use the GPS (Global Positioning System) to determine the position of node but the VANET use the AGPS (Assisted Global Positioning System) or DGPS (Differential Global Positioning System). In MANET, low storage space, low battery and processing power but these are not in VANET.

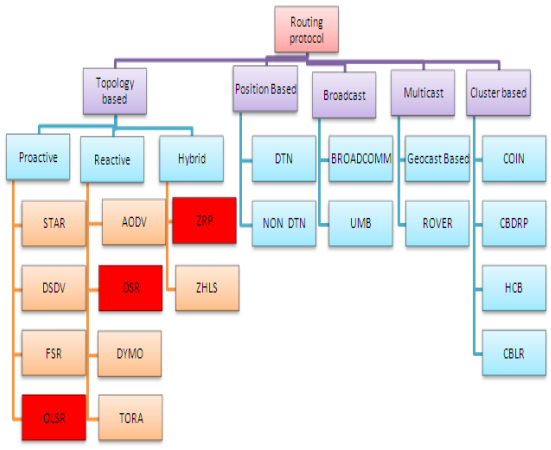

Fig 1. Routing Protocol In VANET

Routing Protocol: - In the VANET, there are some protocol are used for routing the information among the vehicles. A routing protocol governs the way that two communication entities (vehicles that are taken as a node) exchange information; it includes the procedure in establishing a route,

decision in forwarding, and action in maintaining the route or recovering from routing failure .

Topology Based Routing Protocol:-

Topology based routing protocols discover the route before the sender starts transmitting data and store the information . They are divided into Proactive, Reactive and hybrid protocols.

Proactive protocols:-

The proactive protocol is also known as table driven routing protocol. This protocol discover the path, in advance, for all source-pair destinations periodically exchange routing information to maintain paths.

Advantages: -

- There is no need to route discovery since route to the destination is maintained in the background and is always available upon lookup.
- It also provides low latency for real-time application.

II.TYPES OF PROACTIVE ROUTING PROTOCOLS

Reactive (On Demand:-

Reactive routing protocol is called on demand routing because it starts route discovery when a node needs to communicate (sent data) with another node thus it reduces network traffic. Discover a path when a packet needs to be transmitted and no known path exists**.** Attempt to alter the path when a routing failure occurs

Advantage:-

- To update routing table not require periodic flooding the network. Flooding requires when it is demanded.
- Beaconless so it saves the bandwidth.

Hybrid Routing Protocol Hybrid protocols have the property of both the protocol proactive and reactive protocols. They use the technique of proactive protocols just for the neighbours discovery phase. For the rest of the nodes they act as reactive protocols

Positions based routing protocol:-

Position based routing consists of class of routing Algorithm. Which is sharing the property of geographic positioning information in order to select the next forwarding hops? The packet is send without any map knowledge to the one hop neighbour which is closest to destination.

Advantage:-

- Position based routing better performance because that is no need to be created and maintained global route from source node to destination node.

Broadcast based protocols:-

Broadcast is based on hierarchal structure for highway network. In broadcast the highway is divided into virtual cells which move like vehicles. The nodes in the highway are organized into two level of hierarchy: the first Level hierarchy includes all the nodes in a cell, the second level hierarchy is represented by cell reflectors, which are few nodes located closed to geographical centre of cell. Some Cell reflected behaves for certain interval of time as cluster head and handles the emergency messages coming from same members of the cell or nearby neighbour. This protocol performs similar to flooding base routing protocols for message broadcasting and routing overhead.

Cluster Based Routing Protocols:-

Clustering in vehicular ad hoc network can be defined as the virtual partitioning of the dynamic nodes (vehicles) into various groups. A group of nodes identify themselves to be part of a cluster. A special node, designated as cluster-head is responsible for routing, relaying of intercluster traffic, scheduling of intra-cluster traffic and channel assignment for cluster members. The cluster members do not participate in routing.

Advantage:-

- Good scalability can be provided for large networks but network delays and overhead are incurred when forming clusters in highly mobile VANET. In cluster based routing virtual network infrastructure must be created through the clustering of nodes in order to provide scalability.

AODV:-

AODV stands for ad-hoc on demand distance vector routing protocol. It is a reactive protocol. In this protocol route is discover only when the sender want to sent data to the destination. In this process, the source node broadcasts a Route Request (RREQ) packet. Neighbour nodes which do not know an active route for the requested destination node forward the packet to their neighbours until an active route is found or the maximum number of hops is reached. When an intermediate node knows an active route to the requested destination node, it sends a Route Reply (RREP) packet back to source node in uncast mode. Eventually, the source node receives the RREP packet and opens the route.

DYMO:-

The DYMO routing protocol is successor to the popular Ad hoc On-Demand Distance Vector (AODV) Routing protocol and shares many of its benefits. It is, however, slightly easier to implement and designed with future enhancements in mind.

TORA:-

Temporally Ordered Routing Algorithm (TORA) (Park, 2007) routing belongs to a family of link reversal routing algorithms where a directed acyclic graph (DAG) toward the destination is built based on the height of the tree rooted at the source. The directed acyclic graph directs the flow of packets and ensures reach ability to all nodes. When a node has a packet to send, it broadcasts the packet. Its neighbour only broadcasts the packet if it is the sending node's downward link based on the DAG. A node would construct the directed graph by broadcasting a query packet. Upon receiving a query packet, if a node has a downward link to the destination, it will broadcast a reply packet; otherwise, it simply drops the packet. A node, upon receiving a reply packet, will update 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.

Advantage:-

- The advantages of TORA are that the execution of the algorithm gives a route to *all* the nodes in the network and that it has reduced far-reaching control messages to a set

- of neighbouring nodes. However, because it provides a route to all the nodes in the network, maintenance of these routes can be overwhelmingly heavy, especially in highly dynamic VANETs.

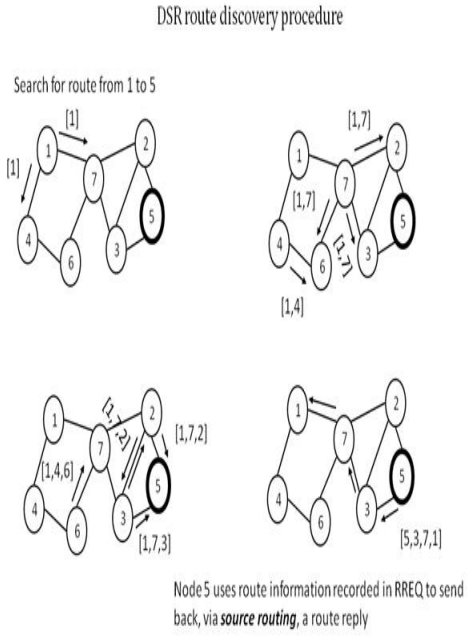

Fig 2 DSR Routing Protocol

DSR:- DSR stands for the dynamic source routing.

- It perform two operation route discovery and route maintenance .
- DSR is suitable for routing in multi-hop networks.
- Route Discovery : A node S wishing to send a packet to node D obtains a route to D
- Route Maintenance : When S is using a discovered route to D, S may detect that the route is broken. In such cases, S may use an alternate route to D (if it is known), or start another route discovery phase to D

OLSR:-

OLSR is a proactive (table driven) Protocol. It is developed by INRIA (France). In this type of protocol each node is a network maintains one or more routing table which are updated regularly. OLSR is a proactive link stage routing protocol. Link state routing protocol is used in packet switching network for computer communication. OLSR uses HELLO and Topology Control massage to discover and the disseminate link state information. OLSR require a reasonably large amount of bandwidth and CPU power to compute optimal path in the network. OLSR make use of "HELLO" massage to find its one hope neighbours and it to hope neighbours though their response.

The sender can then selects its Multipoint Relay (MPR) based on the one hope node that offers the best route to the two hope nodes.

OLSR use Topology Control massage along with (MPR) forwarding to disseminate neighbours information throughout the network.

Advantage:-

- It reduce the size of control packet instead of all links; it declare only a subset of links with its neighbors who are its multipoint relay sector.
- It minimize the flooding of control traffic by using only the selected nodes only multipoint relay, to diffuse massage in the network.
- Being a proactive routing protocol routes to all the destination nodes within the network are known and maintained before use. So the no route discovery delay.
- In this whenever any change in the topology occur, MPR (Multipoint Relay) are responsible to generate and forward the topology information to selected nodes.
- Reduce the number of retransmission of packets in broadcast scenario.

ZRP:-

ZRP stands for zone routing protocol. In the ZRP the network is divided into the zone. The zone radius is always fixed.

The routing in ZRP is divided into two parts:

Intra zone routing:- If the source node and the destination node are on same zone then intrazone routing. First the packet is sent within the routing zone of the source node to reach the peripheral nodes.

Inter zone routing:- If the source node and the destination node are on same zone then interzone routing. First the packet is sent within the routing zone of the source node to reach the peripheral nodes. Then the packet is sent from the peripheral nodes towards the destination node.

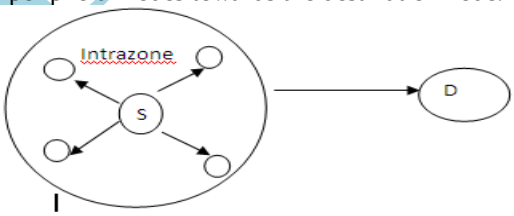

Fig 3 ZRP

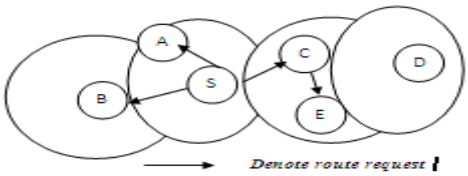

Fig 3.1 ZRP Route Discovery

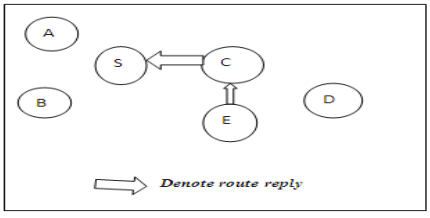

Fig 3.2 ZRP Route Reply

In Intrazone Routing:- Each node collects information about

all the nodes in its routing zone proactively this strategy similar to the proactive protocol like DSDV. Each node maintains a routing table for its routing zone, so that it can find a route to any node in the routing zone from this table.
Each node periodically broadcasts a usage similar hello massage known as a zone notification massage.

FSR:-

FSR stands for Fisheye State Routing. It is a proactive or table driven routing protocol where the information of every node collects from the neighboring nodes [6]. Then calculate the routing table. It is based on the link state routing & an improvement of Global State Routing.

Advantage:

- FSR reduces significantly the consumed bandwidth as it exchanges partial routing update information with neighbors only.
- Reduce routing overhead.
- Changing in the routing table will not occur even if there is any link failure because it doesn't trigger any control message for link failure.

STAR [1]:-

It stands for source tree adaptive routing . In this no need to send update messages to whole network whenever any change in the network topology. Update message is send when any event occurs in network.

Advantage:

- It is suitable for large scale area.
- It reduces the overhead of messages on the network by eliminating the unnecessary updates.

DSDV:-

It stands for destination sequenced distance vector . DSDV solves major problems associated with Distance Vector routing of wired networks as per author. Each entry in the routing table contains sequence numbers. Initially routing tables are broadcasted by every vehicle to its adjacent vehicles. The neighbour vehicles update the routing table with the help of two types of packets namely Full Dump packets and Incremental Normally Full Dump packets which contain information about every participating vehicle in the VANET. It forward two type packets: full dump and incremental. All the routing information is send in full dump packet and all the updates information is send in incremental packet.

Advantage:

- It provides loop free routing protocol.
- No route discovery is required because it is already stored in background.

ZHLS-GF:-

ZHLS-GF stands for Zone-Based Hierarchical Link State Routing Protocol with Gateway Flooding. It is a hybrid routing protocol based on ZHLS (Joa-Ng and Lu, 1999). In ZHLS, all network nodes construct two routing tables, an intra-zone routing table and an inter-zone routing table, by flooding NodeLSPs within the zone and ZoneLSPs throughout the network. However, this incurs a large communication overhead in the network. In ZHLS-GF, the flooding scheme floods ZoneLSPs only to the gateway nodes of zones thus reduces the communication overhead significantly. Furthermore in ZHLS-GF, only the gateway nodes store ZoneLSPs and construct inter-zone routing tables therefore the total storage capacity required in the network is less than ZHLS.

Delay Tolerant Network (DTN):-

Delay Tolerant Network is an approach to networking, which addresses the technical issues related to heterogeneous network that lack continuous network connectivity. They are characterized by limitations of latency, bandwidth, error probability and/or path stability. DTN uses carry and forward strategy to overcome frequent disconnection of nodes in the network. When a node cannot contact other nodes it stores the packet information and forwards the same when an opportunity arises.

Non-DTN – Overlay:-

The fundamental principle in the greedy approach is that a node forwards its packet to its neighbor that is closest to the destination. The forwarding strategy can fail if no neighbor is closer to the destination than the node itself. In this case, we say that the packet has reached the *local maximum* at the node since it has made the *maximum* local progress at the current node. The routing protocols in this category have their own recovery strategy to deal with such a failure.

Urban Multihop Broadcast protocol (UMB):-

UMB is designed to overcome the interference, packet collision and hidden node problems during message distribution in multi hop broadcast. In UMB the sender node tries to select the farthest node in the broadcast direction for forwarding and acknowledging the packet without any prior topology information. UMB protocol performs with much success at higher packet loads and vehicle traffic densities. This protocol assigns the duty of forwarding and acknowledging broadcast packet to only one vehicle by dividing the road portion inside the transmission range into segments and choosing the vehicle in the furthest non-empty segment without apriori topology information. When there is an intersection in the path of the message dissemination, new directional broadcasts are initiated by the repeaters located at the intersections. We have shown through simulations that our protocol has a very high success rate and efficient channel utilization when compared with other flooding based protocols.

BROADCOMM Routing Protocol:-

BROADCOMM is based on hierarchical structure for highway network.[5] In BRAODCOMM the highway divided into virtual cells which move like vehicles. The nodes in the highway are organized into two level hierarchy: the first Level includes all the nodes in a cell, the second level is represented by cell reflectors, which are few nodes located closed to geographical centre of cell. Cell reflected behaves for certain interval of time as cluster head and handles the emergency messages coming from same members of the cell or nearby neighbor.

Geo Cast Routing :-

Geo cast routing is basically a location based multicast routing. Its objective is to deliver the packet from source node to all other nodes within a specified geographical region (Zone of Relevance ZOR). In Geo cast routing vehicles

outside the ZOR are not alerted to avoid unnecessary hasty reaction. Geo cast is considered as a multicast service within a specific geographic region. It normally defines a forwarding zone where it directs the flooding of packets in order to reduce message overhead and network congestion caused by simply flooding packets everywhere. In the destination zone, unicast routing can be used to forward the packet. One pitfall of Geo cast is network partitioning and also unfavourable neighbours, which may hinder the proper forwarding of messages.

ROVER*:* -

ROVER stands for the Robust Vehicular Routing. [9]It is a reliable geographical multicast protocol where only control packets are broadcasted in the network and the data packets are unicasted. The objective of the protocol is to send a message to all other vehicles within a specified Zone of Relevance (ZOR).The ZOR is defined as a rectangle specified by its corner coordinates. It is a reliable geographical multicast protocol where only control packets are broadcasted in the network and the data packets are unicasted. The main objective of the protocol is to send a message to all other vehicles within a specified Zone of Relevance (ZOR).

***HCB* :-**

HCB stands for Hierarchical Cluster Based routing .

Hierarchical Cluster routing protocol designed for highly mobility ad hoc networks. HCB is two-layer communication architecture. In layer-1 mostly nodes have single radio interface and they communicate with each other via multi-hop path. Among these nodes some also have another interface with long radio communication range called super nodes which exist both on layer-1and 2. Super nodes are able to communicate with each other via the base station in layer-2. During the cluster formation, each node will attach to the nearest cluster header and super nodes will become cluster headers in layer-1. In HCB, intra-cluster routing is performed independently in each cluster. Cluster heads exchange membership information periodically to enable inter-cluster routing

CBDRP:-

CBDRP stands for Cluster-Based Directional Routing Protocol Cluster are the small units .It divides the vehicles into clusters and vehicles which are moving in same direction form a cluster. The source sends the message to its cluster header and then it forwards the message to header which is in the same cluster with the destination. At last the destination header sends the message to the destination. The cluster header selection and maintenance is same like CBR but it considers velocity and direction of a vehicle.

Clustering for open IVC network (COIN):-

COIN selects clusters according to three parameters: mobility of nodes, nodes positions and behavior of nodes. The protocol provides each cluster specific time which is a time to live; in order to decrease control overhead. Inter vehicles communication system (IVC) deals with the unstable distances of inter vehicles. To enable a head of cluster node and the cluster member node stay continue communicate, their mobility should be low and related to the mobility of each, in this case they can reside in radio contact for a longer time.

CBLR [8]:

CBLR stands for Cluster Based Location Routing.

It is a reactive or on demand routing protocol and cluster based routing protocol. Each cluster header maintains a routing table contains the addresses and geographic locations of the cluster members and gateways nodes, and it also maintains a Cluster Neighbour Table that contains information about all neighbouring clusters. When a source wants to send data to a destination, it first checks whether the destination is in the same cluster or not. If it is in same cluster, it sends the packet to the closest neighbour to the destination. Otherwise, the source stores the data packet in its buffer, starts a timer and broadcasts Location Request (LREQ) packets. CBLR is suitable for high mobility networks because it updates the location of the source and destination every time before data transmission starts.

III.CONCLUSION

Routing is an essential component of communication protocols in vehicular ad hoc networks for proving the communication in vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V).In this paper, we study the routing protocols in Vehicular Ad-hoc networks and classify them into many categories .

IV.FUTURE WORK

In future, the performances evaluation of reactive, proactive and hybrid protocols like DSR, OLSR and ZRP under different attacks can be evaluated by using different type of parameters and different security mechanism is developed to prevent routing protocols from the different type of attacks.

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