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An Overview and Evolution of the Intelligent Transportation System as VANETs

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***Abstract*- Vehicular Ad-hoc Network (VANET) in the recent years have emerged as a most attractive topic for researchers and automotive industries due to their tremendous potential to improve traffic safety, efficiency and other added services.The routing in VANET is the most challenging part of research. In this paper we have discussed the various routing protocols and also discussed the advantages as well as the disadvantages of these routing protocols.**

***Keywords*- Vehicular Ad Hoc Network (VANET), Road Side Units (RSUs),Dedicated Short Range Communication (DSRC), Wireless Access in Vehicular Environment (WAVE), Intelligent Transport System (ITS).**

I. INTRODUCTION

A vehicular Ad-hoc network created by applying the principles of Mobile Ad-hoc network .It is a network of devices denoted as nodes which can sense the environment and share the information gathered from monitored field through various wireless links, the data is forwarded to a sink that can use it locally or with others networks via gateway. It uses moving cars as nodes to create a mobile network.[1] Vehicles are equipped with wireless products or communication devices (OBUs). VANET turns every participating vehicle into a router or node. They convey and interchange messages with the alternative vehicles within the network to improve the road safety.[2] Vehicles can communicate either with other vehicles' on-Board Units (OBUs) in an infrastructure less network or with Road Side Units (RSUs) in an infrastructure network.

II. PURPOSE OF VANET

The major purpose of VANET is to provide (1) Ubiquitous connectivity while on the road to mobile users, who are otherwise connected to the outside world through other networks at home or at the work place. (2) Efficient vehicle-to-vehicle interactions that enable the Intelligent Transportation System.[3]

III. STANDARDS AND SPECIFICATIONS

1) Dedicated Short Range Communication (DSRC)
2) Wireless Access in Vehicular Environment (WAVE)

It works on Dedicated Short Range Communication (DSRC). Dedicated short range is engaged as a communication medium and it operates on 4.9GHz frequency band provided with a bandwidth of 74 MHz DSRC is predicated on IEEE 802.11a standard and IEEE 1609 WAVE (Wireless Access in vehicular environment) protocol stack builds on IEEE 802.11p WLAN operating on 7 reserved channel with a frequency band of 5.9 GHz [4].WAVE protocol is a light weight application layer protocol which is designed to provide multi channel operations even for vehicles equipped with only a single radio.

VANET applications focus on the safety of the users and various user requirements. VANETs is used to increase safety on the roads by running

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several safety applications, e.g., cooperative collision warning, VANETs can also provide several non-safety applications, from notifications of traffic conditions to file sharing. Unfortunately, it has been shown that using WAVE VANETs cannot support both safety and non-safety applications with high reliability at high traffic densities. These are bandwidth exigent and require network capability to supply continuous access to the web with a controlled Quality of Service.[5]

It provides web surfing, file downloads, email, movie download and gaming. Over the last few years, we have witnessed many research efforts that have investigated various issues related to V2I, V2V, and VRC areas because of the crucial role they are expected to play in Intelligent Transportation Systems (ITSs).[6]

Vehicle-to-Vehicle communications resting on infrastructure less networks where vehicles can stay connected and interact with other while moving. Vehicles are equipped with on-Board Units (OBUs). Figure1 shows the scenario of V2V communication.

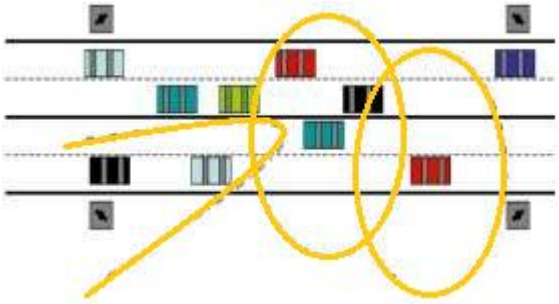

Figure 1 Vehicle-to-Vehicle Communication

Vehicle-to-Infrastructure communication resting on infrastructure networks where vehicles interact with the Road-Side Units (RSUs).which are the Access points located at the roadside. RSUs provide information such as roadside recognition, parking a vehicle, cruise control, lane keeping assistance etc. Figure 2 shows the scenario of V2I communication.

The routing-based communication configuration is a multi-hop unicast where a message is propagated in a multi-hop fashion

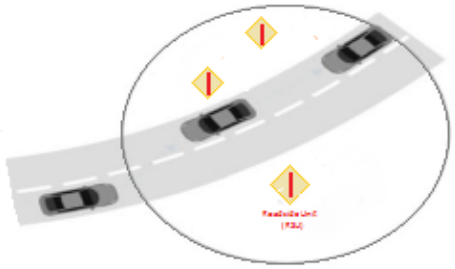

Figure 2 Vehicle-to-Infrastructure Communication

until the vehicle carrying the desired data is reached.

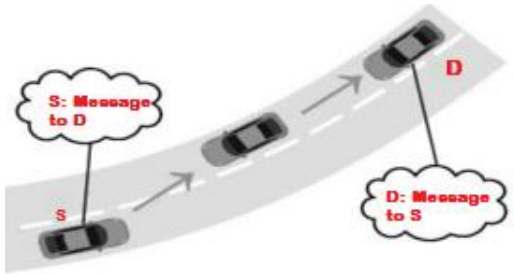

Figure 3 Routing Based Communication.

When the query is received by a vehicle owning the desired piece of information, the application at that vehicle immediately sends a unicast message containing the information to the vehicle it received the request from, which is then charged with the task of forwarding it towards the query source.

IV. ROUTING PROTOCOLS

Various Routing protocols are enforced in vehicular environment to provide timely and correct data to the drivers and to enhance its performance. Routing Protocols to be employed in the VANET must be robust, can handle network load, have low latency, reduce collisions, duplicate message dissemination, increase stability and provide efficient data dissemination. Ad-hoc routing protocols can be classified into two categories.

1. Reactive(On- demand)
2. Proactive

A. Ad hoc On Demand Distance Vector Routing (AODV)

It is reactive routing protocol that establishes route from source to destination node on demand and there is no requirement of maintaining routes to the node that are not communicating. It has the ability of unicast & multicast routing [7].AODV defines three types of control messages for route maintenance:

RREQ

A route request message is transmitted by a node requiring a route to a node. As an optimization AODV uses an expanding ring technique when flooding these messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be forwarded.[8] During first transmission this value is set to a predefined value. Retransmissions occur if no replies are received and Data packets waiting to be transmitted (i.e. the packets that initiated the RREQ).TTL value increase during retransmissions.

RREP

If the receiver is either the node using the requested address, or it has a valid route to the requested address a route reply message is unicasted back to the originator of a RREQ.

RERR

When a link breakage in an active route is detected, a RERR message is used to notify other nodes of the loss of the link.[9]

Advantages:

The main advantage of AODV protocol is that routes from source to destinations are established on demand. The connection setup delay is less. It doesn't require much memory for communication.

Disadvantages:

There are several disadvantages with this protocol like the intermediate nodes can lead to route inconsistency if the source node sequence number is very old [10].Multiple route reply packets for a single route request packet can lead to Heavy control overhead. It consumes extra bandwidth because of periodic beaconing.

B. Greedy Perimeter Stateless Routing Protocol

(GPSRP)

Position-based routing protocols for VANETs Uses greedy forwarding to forward packets to nodes that are consistently more closer to the destination. It utilizes the distance between their geographic positions in wireless network by exploiting the nodes position to form packet forwarding choices. This info is updated intermittently via hi or beacon messages. In GPSR [Karp (2002), Raw (2010a)] [11] (see figure 4) a node finds the situation of its neighbors by means that of their HELLO messages and also the position of the destination with the help of location service. GPSR needs that every node within the network is in a position to search out its current position by exploitation of GPS receiver that provides current location, speed, current time and direction of the vehicles. With of these info, a node forwards incoming packets to a neighboring node highest to the estimation, set in an exceedingly realm. This operational mode is thought as Greedy Forwarding (in that within which) the neighbor which is highest to the destination is chosen because the next-hop node.

In some cases, once salutation messages wander off because of temporary transmission errors, some vehicles become unaware of subsistence of its neighbors. But in some regions of the network, an area most might occur once a forwarding node has no neighbor that is nearer to the destination than itself. During this scenario GPSR uses a most advance recovery strategy known as perimeter routing that uses associate algorithmic rule of plane graph traversal to look for how to out of the native most region. Though this advancement, considering solely position info direction and loses thus, smart candidates that guarantee its delivery. Since the topology of a transport network in urban or town setting is probably going to satisfy native most, we've turned recovery strategy of perimeter routing on throughout our experiments.

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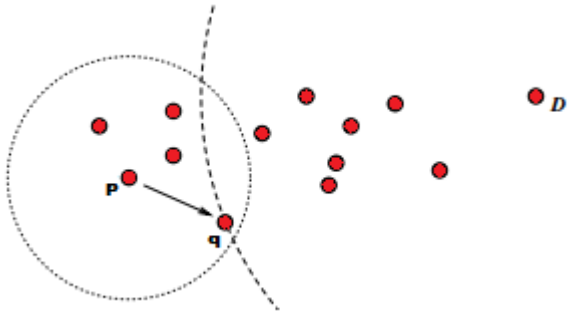

Figure 4 Greedy Forwarding (p is q's neighbor closest to D)

Advantages:

The main advantage of GPSR protocol is that to forward the packet a node must bear in mind only one hop neighbor location. Forwarding packet selections are created dynamically.

Disadvantages:

For high quality characteristics of node, stale data of neighbor's position are typically contained within the causing node's neighbor table. Though the destination node is moving its data within the packet header of intermediate node is seldom updated.

C. Greedy Perimeter Coordinator Routing Protocol (GPCR)

Lochert *et al*. [12] proposed GPCR (greedy perimeter coordinator routing) which is a position-based minimum delay routing protocol. GPCR protocol is very well suited for highly dynamic environments such as inter-vehicle communication on the highway or city. GPCR traverses the junctions by a restricted greedy forwarding procedure, and adjusts the routing path by the repair strategy which is based on the topology of streets and junctions. Fig. 5 shows that vehicle V_S tries to send packets to vehicle V_D. Vehicle 1*a* is selected as the next hop of V_S if greedy forwarding scheme is used. After vehicle 1*a* received the packets, vehicle 1*a* detects destination V_D is not located at north. Vehicle 1*a* then moves packets backward vehicle 2*a*, then the packet is forwarded to V_D.

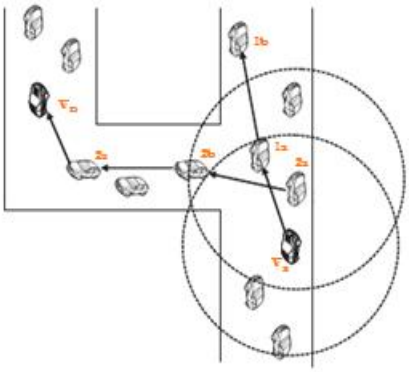

Figure 5 Geographic Routing Protocol

Advantages:

GPCR does not require any global or external information. Though it is based on the GPSR it uses underlying roads for representing the planar graph .[13] There is no polarization problem as there is no unidirectional links, planar sub-graphs & so on.

Disadvantages:

It depends on junction nodes. There has been a problem in the Junction detection approach in which first approach fails on curve road & second approach fails on a sparse road.

D. Cluster Based Routing Protocol (CBRP)

In cluster based routing a group of nodes identifies themselves to be a part of cluster and a node is designated as cluster head will broadcast the packet to cluster. This protocol is proposed for a highway scenario in which vehicles are divided into clusters and a vehicle node is selected as a head of cluster. The cluster-based routing protocol (CBRP) was introduced by Jiang [14]. In CBRP the nodes of a wireless network are divided into several disjoint or overlapping clusters. Each cluster elects one node as the so-called cluster head [15]. These special nodes are responsible for the routing process. Neighbors of cluster heads cannot be cluster heads as well. But cluster heads are able to communicate with each other by using gateway nodes. A gateway is a node that has two or more cluster head as its neighbors or when the clusters are disjoint at least one cluster head and another gateway node. The routing process itself is performed as source

routing by flooding the network with a route request message.

Advantages:

Due to the clustered structure there will be less traffic, because route requests will only be passed between cluster head.

Disadvantages:

Good scalability can be provided for large networks but network delays and overhead are incurred when forming clusters in highly mobile VANET. Some low speed vehicles in cluster with high speed vehicle make reason of high end to end delay and losses of data packets.

VI.CONCLUSION

In this paper we have mentioned various routing protocols used in VANET and advantages and disadvantages of various routing protocols used in VANET for inter vehicle communications is investigated .We considered 4 protocols AODV, GPSR, GPCR and CBRP. We have seen that further performance evaluation is required to verify the performance of various routing protocols.

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