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VANET: Application And Routing Protocol

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Abstract*—Vehicular Ad Hoc Networks (VANET) is sub class of the ad hoc networks. VANET allow vehicles to form a self-organized network and not having permanent infrastructure. In Advance required for communication, an efficient route between network nodes must be established, and it must adapt to the rapidly changing topology of vehicles in motion. Geographic routing schemes have been widely adapted to routing in VANET. In geographic routing uses the greedy routing mode, but due to the non-uniform distribution of nodes (cars) and particular urban topology it often fails and we need the recovery strategy. In this paper, we present a survey on geo graphical routing protocol that are used in the VANET and also the existing real-world implementations of that protocol and VANET application survey. We report on the technology used for the implementations as well as on key findings from experiments conducted with these implementations.*

Keywords: *VANET, Greedy forwarding, GPSR, GPCR*

I. NTRODUCTION

Day by day increase of personal and sport utility vehicles in the recent years and driving is more challenging and dangerous. Roads are saturated, safety distance and reasonable speeds are hardly respected, and driver soften lack enough attention. Without a clear signal of improvement in the near future, leading car manufacturers' decided to jointly work with national government agencies in order to develop solutions aimed at helping drivers on the roads by anticipating hazardous events or avoiding bad traffic areas. One of the outcomes has been a novel type of wireless access called Wireless Access for Vehicular Environment (WAVE)[1].The WAVE standards define architecture and a complementary, standardized set of services and interfaces that collectively enable secure vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications. Together these standards provide the foundation for a broad range of applications in the transportation environment, including vehicle safety, automated tolling, enhanced navigation, traffic management and many others.

With the support of WAVE communication device cars and roadside unit form a highly dynamic network called VANET, which are mainly focus on transfer cars or vehicle into intelligent machine that communicate each other and road side units or devise for safety and comfort purpose. From the intelligent transport system (ITS) expected the some safety scenarios, which is required for the point-to-point connectivity. The survey of Govt. India in India 2011 had 4.28 accident, 1.28 death, more than 5 lacks injuries and the drivers waste 3.5 billion hours, 5.7 billion gallons of fuel because of the traffic conjugation[2]. Due the new

technology it has taken huge attention of government, academy & industry. There are many research projects around the world which are related with VANET such as COMCAR[3], DRIVE[4], FleetNet[5] and NoW(Network on Wheels)[6], CarTALK2000[7], CarNet[8].

discusses the routing protocol, specially the geographical routing protocol in VANET. We conclude in section IV and section V for reference.

II. Application of VANET

In the recent years, vehicular networking has gained lot of popularity among the industry and academic research community and is seen to be the most valuable concept for improving efficiency and safety for future transportations. The Mobile communication standards have emerged from first generation to the third generation and the fourth generation (4G) mobile communication standards are actively being researched. Wi-Fi has the highest data rate (around 10Mbps) but GSM (2.5G) has the best mobility support but can only sustain data rates of up to 180kbps. With the wireless technology becoming pervasive and cheap, several innovative vehicular applications are being discussed. We classify these applications into two main categories first is Safety related, it consist the safety of human as well as

This paper is summarizes the application and routing protocol in VANET. The rest of this paper is organized as follows: Section II describes the VANET applications. In Section III,

infrastructure and communication, and second is Connectivity related application is for user/client to access the internet for different purpose. The application of these categories is follows:

- **Safety Related** [9]**:** Applications like collision alert, road conditions warning, merge assistance, deceleration warning, etc. will be classified under safety related applications where the main emphasis is on timely dissemination of safety critical alerts to nearby vehicles.

- **Internet Connectivity Related [9]:** Accessing emails, web browsing, audio and video streaming are some of the connectivity related applications where the emphasis is on the availability of high bandwidth stable internet connectivity.

The following figure 1 show the vehicular ad hoc network and their application & the vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) AND vehicle-to-road side unit (RSU) communication

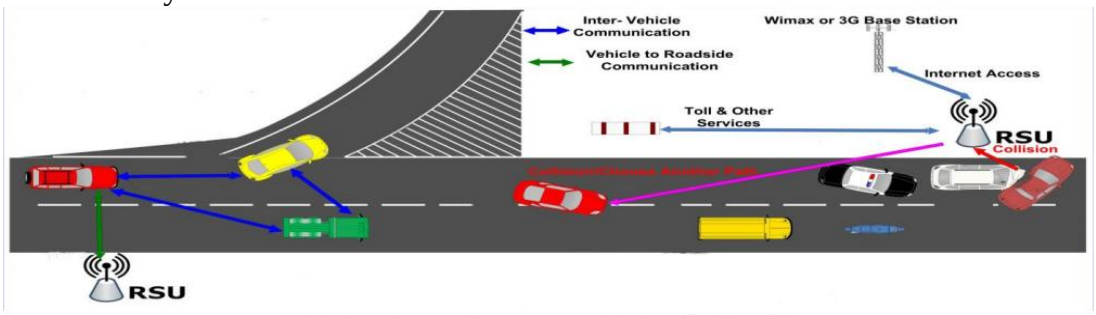

Fig 1: Vehicular adhoc networks and some possible applications.

III. Routing protocol in VANET[10]

For VANET design the efficient routing protocol is challenging task because of the highly dynamic topology. The routing protocol of VANET can be classified into the five main categories [12] such as Topology based routing protocol, Position based routing protocol, Cluster based routing protocol, Geo cast routing protocol and Broadcast routing protocol. In this section we focused on some the Geographical /Position based routing protocol. In VANET mostly used the Geographical based routing protocol because of the Geographical based routing protocol is very well suited for highly dynamic environments such as inter-vehicle communication and vehicle-to-RSU communication on highways. The radio obstacles[11] found in city/urban environments, have an impact on the performance of the Geographical based routing protocol. Geographical based routing protocol‘s algorithm needs the global knowledge of the city topology as it is provided by a static street map. Geographical based routing protocol routing schema generally required the additional node at the time of routing decision process for the physical-position information. Generally, the obtaining the position information of any node using the GPS or the other location service schema. Given this information the sender determines the junctions that have to be traversed by the packet. In this section we discussed the some Geographical routing protocol such as Greedy Perimeter Stateless Routing (GPSR), Greedy Perimeter Coordinator Routing (GPCR), and short GpsrJ+.

1) GPSR[12]

The Greedy Perimeter Stateless Routing (GPSR) algorithm belongs to the category of position-based routing, where an intermediate node forwards a packet to an immediate neighbor which is geographically closer to the destination node. This approach is called greedy forwarding. For that, each node needs to be aware of its own position, the position of its neighbors as well as the position of the destination node. The GPSR is in positions based routing and sub-category of GPCR is Non-DTN (Delay Tolerant Network). It is under the Non-DTN because, it is not uses the carry & forward strategy to overcome frequent disconnection of nodes in the network. It stores the packet & forwarding is done based on some metric of nodes neighbors. In Non-DTN, GPCR comes under the Beacon. Beacon means transmitting short hello message periodically. In GPSR node sending the beacon message contain its own position for exchange the own position it with neighboring nodes by sending beacon messages and obtain the position of the destination. If any node fails to receive the beacon after certain period of it neighbors then an entry will be removed from routing table of corresponding node. The bellow figure shows the difference between the Traversing a planar graph versus greedy routing. In Traversing a planar graph the packet forwarded to each next node but in the greedy routing forward the packet to the geographical closet to the destination.

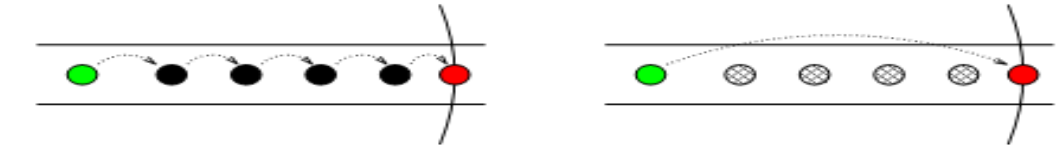

Figure 2: Traversing a planar graph versus greedy routing

As geographical routing or position routing schemes based on the neighbor's information or location and destination location, but in VANET non-uniform distributions of nodes / car or to the existence of radio obstacles the greedy method fails and the packet reaches to local maximum i.e. A node cannot find a potential forwarder that is closer to the destination than itself. In order to escape from this local maximum, the GPSR is used the anther method to forward packets toward the destination i.e. a recovery mode is used to forward a packet to a node that is closer to the destination than the node where the packet encountered the local maximum. The packet will be forwarded backward with respect to its distance to the destination until it reaches a node whose distance to the destination is closer and greedy mode may be resumed. This mode called in GPSR is perimeter packet forwarding method.The GPSR is simply combination of greedy packet forwarding method and perimeter mode, when greedy method is fail forward packets to closest to destination at that time perimeter mode start until the greedy method resumes. Note that if the graph is not planar, that is, there are cross edges in the graph, routing loops may occur. Given that perimeter mode must operate on planar graphs to avoid routing loops, GPSR provided two distributed algorithms that produce Relative Neighborhood Graph (RNG)[13]and Gabriel Graph (GG)[13] which are known to be planar.

2) **GPCR**[14]

Greedy Perimeter Coordinator Routing (GPCR) is a position-based routing protocol. It is come under category Non-DTN and under Beacon. Unlike GPSR, GPCR is comes under the overlay i.e. a network that every node is connected by virtual or logical links which is built on top of an existing network. The main idea of GPCR is to take advantage of the fact that streets and junctions form a natural planar graph, without using any global or external information such as a static street map. As the GPSR is based on the greedy packet forwarding method and perimeter mode same as GPSR, GPCR consists of two parts: a restricted greedy forwarding procedure and a repair strategy. A GPCR follows a destination based greedy forwarding strategy, it routes messages to nodes at intersection. GPCR is based on the topology of real-world streets and junctions and hence does not require a graph planarization algorithm. GPCR does not use any external static street map so nodes at intersection are difficult to find.

As name suggests that coordinator routing, important point is that, since junctions are the only places where routing decisions are made. In GPCR packet must always be sent to a node that is at a junction. To forward a packet across the junction it may risky because if packet is forward beyond or across the junction then it leads to the local

maximum. At junctions, a greedy decision is also made, and the neighboring node which brings the maximum progress towards the destination is chosen. After that is the recovery mode is used. When GPCR is in recovery mode, packets are backtracked in a greedy fashion to a junction node in order to find an alternate solution to return to the greedy mode. At the junction node, the right-hand [14][15] rule is used to find the next road segment to forward the packets.

3) **GpsrJ+[20]**

GpsrJ+ is a position-based routing protocol. It is come under category Non-DTN and under Beacon. Like GPCR and unlike GPSR, the GpsrJ+ is come under the overlay. In the GpsrJ+ all nodes virtually connect nodes. As like the GPSR and GPCR ,the GpsrJ+ using two mode for packet forwarding i.e. first is greedy mode and GpsrJ+'s recovery mode. The greedy forwarding using in GpsrJ+ is a special form of greedy forwarding. As obstacles block radio signals, packets may only be greedily forwarded along road segments as close to the destination as possible The GpsrJ+ is the advance version of GPCR, in GpsrJ+ like GPCR the major decisions are made at the junction node. In the GPSR and GPCR the only one hope beacon information but in GpsrJ+ it takes the two hope beacon information, to predict which road segment its neighboring junction node will take. If the prediction indicates that its neighboring junction will forward the packet onto a road with a different direction, it forwards to the junction node; otherwise, it bypasses the junction and forwards the packet to its furthest neighboring node. When packets reach a local maximum, a point at which GPCR is reached to local maximum the recovery mode is used. When GPCR'S greedy method fails to forward the packets then there is no node closer to the destination, the node switches to GpsrJ+'s recovery mode. In the recovery mode, packets are greedily backtracked along the perimeter of roads. It is not necessary to backforward in small steps through planarized links. Unlike GPCR, where packets must be sent to a junction node since junction nodes coordinate the next forwarding direction, GpsrJ+ lets nodes that have junction nodes as their neighbors predict on which road segment its junction nodes would forward packets onto, and thus may safely overpass them if not needed. The prediction is based on the fact that the forwarding node knows all road segments on which its junction neighbors have neighbors. The GpsrJ+ uses the modified beacon[16]. GpsrJ+ further enhances GPCR by taking fewer hops to the destination, while keeping the same route traversal and the same high delivery ratio as GPCR over GPSR. Main disadvantage of GpsrJ+ is not appropriate for the delay sensitive applications.

IV. CONCLUSION

Routing is an important component in VANET for vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V) communication. This paper discusses application ad some geographical routing protocols of VANET. Designing an efficient routing protocol for all VANET applications is very difficult. Hence a survey of different VANET geographical routing protocols, and also study the VANET application is absolutely essential to come up with new proposals for VANET. The performance of VANET routing protocols depend on various parameters like mobility model, driving environment and many more. Thus this

paper has come up with an exhaustive survey geographical routing protocol and different applications of VANET routing protocols. From the survey it is clear that position based protocols are more reliable for most of the applications in VANET.

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