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A Review: Position based Routing Protocols in VANET

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Abstract: ***VANET is a type of mobile ad hoc networks (MANETs). The main difference between VANET and MANET is the mobility, and changing topology. However, it is not effective to apply the existing routing protocols of MANETs into VANETs. Vehicular Adhoc Network (VANET) uses vehicle to vehicle (V2V and V2I) communication to inform about the location of other vehicles and the traffic density. There are many routing protocols described in VANET. Research study shows that Position-based protocols are best suited in highly dynamic topology environment. In this study, we are mainly focusing on significant features, summarizing the advancements of the VANET position-based routing protocols and discussing the advantages and disadvantages of these routing protocols and compare them with other well known position based protocols.***

Keywords: Adhoc Network, Vehicular Adhoc Network, VANET, position-based routing protocols.

I. INTRODUCTION

To overcome the road safety problem and accidents of a particular area, computer networkers purpose a new networking concepts i.e. Vehicular Ad hoc Network (VANET). VANET is subset of mobile Ad hoc network in which vehicle operate as a node [1]. It has own distinct characteristics such as dynamic network topology, undefined network size, frequent disconnection, amount of battery power and storage and road pattern restrictions [2]. Some characteristics impose challenges such as network management, environmental impact, MAC design etc. It provides recent information of traffic, node to node communication or node to road side infrastructure communication through wireless network. The real time traffic never has a fixed pattern, so the topology of VANET keeps on changing which makes it a highly dynamic network.

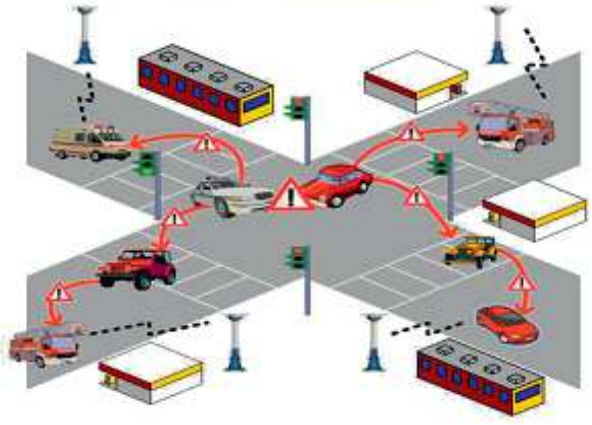

Figure-1 The facilities of VANETs technology

The transmissions strategy may be of three types: unicasting, broadcasting, multicasting. Unicast strategy takes less network space to deliver the massage and due to less packet delay, it is more secure. But there are chances of packet loss which makes it less reliable. Broadcasting is comparatively more reliable but it consumes high bandwidth, having very low throughput. There are chances of packet collision and routes loop. Multicasting is having the advantage of both unicasting and broadcasting. In view of some of the researches broadcasting is better because the information in VANET should go to everyone in the network. If the problem of bandwidth arises we have to switch to multicasting. Still if the users in the network are very large so we have to select unicasting. Routing protocols are used to provide best possible route between nodes with less overhead. For communication, vehicle exchange message with another vehicles using radio range signals with bandwidth of 5.850-5.925 GHz [3].

VANET Routing Network

The VANET routing network gives a highly secure network which helps in reducing the road accidents and deals with the emergency situation. VANET routing is possible by two means: Vehicle to Vehicle/inter-node transmission (INT/V2V) and vehicle to infrastructure/node to road side infrastructure transmission (NRT/V2I) [4]. In V2V routing is between vehicles only, this systems doesn't require any external infrastructure for communication. In V2I systems the communication is between vehicle to vehicle and vehicle to road side infrastructure. It is more reliable but require extra infrastructure.

Routing Protocols in VANET

Routing protocols provide route between two nodes via minimum overhead and without delay. As shown in below figure, routing protocols are categories into topology-based and position-based routing.

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Figure-2 Types of VANET Routing Protocols

Topology-based Routing Protocol [5/6]

Topology-based routing protocol uses link knowledge of each node present in routing table, and this knowledge is used to send packets. It requires the IP addresses of the source and the destination. It mainly categorized into three categories.

Proactive (table-driven)

Routing information is always maintained regardless of communication requests. It is time dependent i.e. the information is delivered after a certain period of time.

Reactive (On Demand)

It establishes a route only when a node in network requires exchanging message with different node. It stores only the currently used paths and all other routes are standby routes which acts as active nodes as and when demanded.

Hybrid

It is the combination of both reactive and proactive. The routes which are having more weight are updated along with the active routes after a certain period of time or on request.

Position or Geographic Routing protocol [5/6]

Position based routing protocols requires the moving nodes knowledge through the GPS system, which is based on location services. Geographic routing protocols consider the position of the nodes in routing process. They require the information of the neighbor's location and the location of the target node to send packets successfully. When the source has the data to send it identifies its neighbor nodes within its communication range. The packet header releases from source node contains the position of the target node, speed of the moving vehicle, direction and current time. In these types of protocol there is no need of route detection and route repair, and knowledge of associated topology. Thus geographic based routing protocols are more suitable in highly mobile environments and thus more reliable for VANETs.

These are categories into three types:

Delay tolerant network (DTN) protocols

In DTN all nodes are connected in sequence and provide detail to each other to forward packets. Data transmission between these nodes has large delay due to limited transmission range.

Non delay tolerant network (NON DTN) protocols

In NON DTN node deliver its packet to the node which is closest to targeted node. It does not take a disconnectivity problem. It presumes that there are sufficient number of nodes to get the unbeaten transmission. NON DTN is always used in dense network area.

Hybrid position based routing protocol

It is a combination of both protocols.

Position-based Routing Protocols

Position-based protocols do not maintain routing table, do not require link state information, they are suitable to the highly changing environments like VANETs. In position-based protocols, packet forwarding is based on geographic position of vehicles and they require position services to find the location of the target node. There are many location services available like Global Position System (GPS)[6]. Every node frequently sends Hello or beacon packets with their location knowledge and other node recognition parameters as shown in Figure-3.

ID	Location	Speed	Current time	Direction

Figure-3 HELLO packet format

When wireless network become congested Beacon packets introduce overhead for managing the list of neighbors and reduce the overall performance of the network. To overcome this problem, alternate approach is used called as beaconless dispersed receiver-based selection of next node . This technique uses modified version of request-to-send and clear-to-send method. In this process, request frames contain the position of the sender and destination node. Each node wait for a given time in request frame,

after completion of this time, it will forward a clear frame back to the sender node. There are some of examples of position-based routing protocols.

Greedy Perimeter Stateless Routing (GPSR) protocol

It only retains location information of all of its one-node neighbors, since it is almost stateless. This protocol follows firstly greedy forwarding and then perimeter forwarding [7].

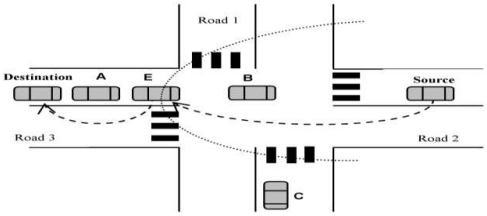
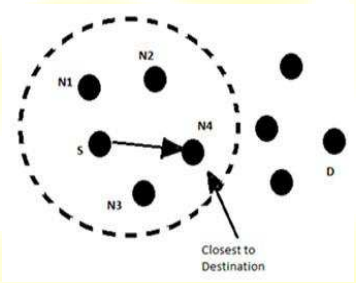


Figure-4 Illustration of the GPSR

In greedy mode each node deliver packets to next hop node that is always nearer to destination node as shown in Figure-5(a), until the packet reaches its final destination. When neighboring nodes are not towards to the destination (Figure-5(b)), local maxima occurs. GPSR uses perimeter forwarding technique to recover from a local maximum. In this process, deliver a packet to a nearby node to the destination. Packet restarts forwarding in greedy mode when it recovers from local maximum.



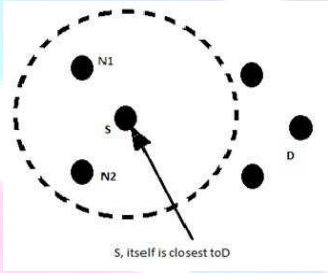


Figure-5 GPSR protocol (a) Greedy forwarding working, (b) Greedy forwarding fails.

Geographic Source Routing (GSR) protocol

It overcomes the limitation of GPSR in urban environment. It uses location information about each node and static street map to compute route to destination. to locate the shortest path from source to destination node Dijkstra's shortest route method is used. The node send packet to its next junction node. Junction IDs are used to compute shortest path, along which packets should be moved to reach the destination. Packet header sent by source contains list of junctions. This protocol does not work efficiently in sparse network and accessibility of street map is mandatory [8].

Greedy Perimeter Coordinator Routing (GPCR) protocol

It makes routing decision by considering only street and junctions rather than individual node. In GPCR, natural planar graph is formed by junctions and streets. Nodes located at the junction are called as coordinators. Source node will deliver packet to one-hop neighbor, then current forwarding node send packet on the junction (see Figure-6). If no node is found at the junction, the packet is delivered beside the street for the next junction. When a packet reaches a coordinator, it decides about route of the packet. Therefore, this protocol uses greedy mechanism similar to GPSR. This protocol depends on connectivity of destination node and node density. If node density is low, it could not connect destination, then transmission delay increases.

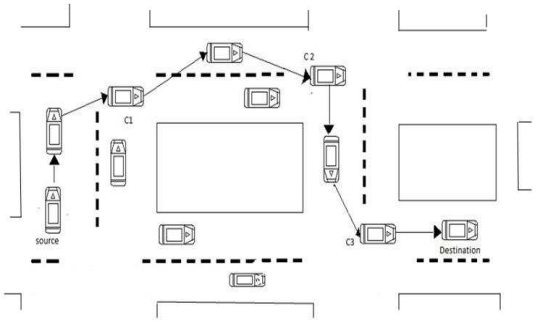


Figure-6 GPCR routing mechanism- In this scenario c1, c2, c3 are coordinators. Node1 sends packet to one-hop-neighbor, then current forwarding node send packet at junction i.e. c1. This process will continue until packet reach at destination.

Border-node based Most Forward within Radius (B-MFR) Protocol

It uses the idea of border node. Border nodes present at the edge of the radio transmission range (e.g. DSRC- Dedicated short-range communications) of a node. This method uses border node avoiding use of interior node for utilization of bandwidth. This protocol consists of two steps: neighbor innovation and border node selection method. In the neighbor innovation process, each node collects current one-hop neighbor information by periodic beaconing of Hello packets. Under border node selection method, select the one which is maximum towards the destination by taking the projection of border node on a straight line between sender and destination (see Figure-7(a)). In this protocol, confliction arises (see Figure-7(b)) if two or more border nodes project on a straight line between sender and destination node. It does not support real -time communication traffic.

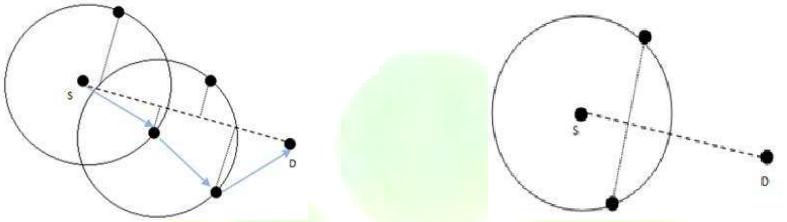


Figure-7 (a) B-MFR working (b) B-MFR limitation

Intersection-based Geographical Routing Protocol (IGRP):

This protocol is suitable for dense traffic environments. It considers efficient selection of road joints along which a packet travels to arrive at the gateway. Vehicles have access to a digital map to find the location of its neighboring road intersections. Internet gateway gives information to source node to pass on a packet to gateway. Each moving node gives its present information to the gateway when it goes out of its communication range. Internet gateway builds different set of paths between itself and each node. To raise intermediate node's constancy, IGRP makes paths by considering adjacent road joints toward the gateway. These paths are called as backbone paths as shown in Figure-8, which are located as succession of joints. Based on these backbone routes, the Internet gateway will choose the most linked route. Source node receive selected path and store it in packet headers. Intermediate nodes forward packet to next node by using information located in packet header. IGRP achieves better performance, selects routes that are highly connected and assures less end-to-end delay.

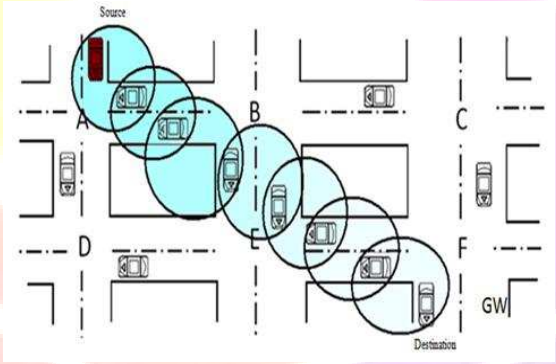


Figure-8 VANET routing with IGRP- There are three backbone routes to reach the destination, i.e., A-B-C-F, A-D-E-F or A-B-E-F. In this network, internet gateway selects the A-B-E-F path since it is containing dense traffic.

Road-based using Vehicular Traffic (RBVT) Routing protocol

It uses real-time communication traffic. Geographic forwarding as mention in above protocols does not perform well in city scenario. This protocol adapts itself to network situations by associating actual vehicular traffic information and route constancy. There are the two types of RBVT protocols: RBVT-R (RBVT-reactive protocol) and RBVT-P (RBVT-proactive protocol). In RBVT-R, source node send route demand packet to each node, whose header includes all necessary information related to source and destination node. On receiving the route demand packet, destination node will generate route reply packet for source node by coping route demand header into route reply header. For route maintenance, node will convey the route update (RU) packet. RBVT-P store the graph formed by generated packets in periodic way along the road [13]. This graph is then dispersed to all vehicles in the network and further used to find the shortest paths to destination node.

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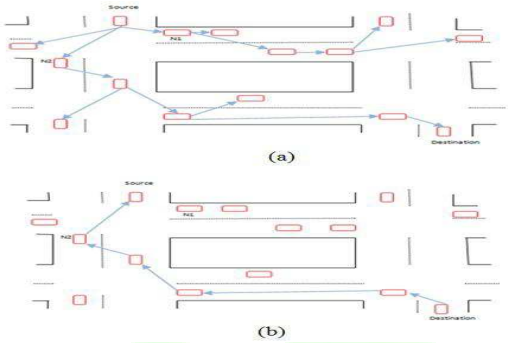

Figure-9. RBVT-R working- (a) Source node broadcast route demand packet with improved flooding mechanism. Packet will store the traversed intersections in its header when it moves along the street. (b) The destination node unicast a route reply packet back to the source. Route reply packet takes the route along the intersections stored in packet's header during the route demand process.

Geo DTN+Nav

Geo DTN+Nav is a combination of non-DTN and DTN routing protocols which incorporate the greedy mode, the perimeter mode, and the DTN mode [11] It swaps from non-DTN mode to DTN mode by calculating the connectivity of the network depending on the number of hops a packet has journeyed, the neighbor's delivery quality, and the neighbor's behavior in terms of the targeted location. The DTN mode can deliver packets although the network is disconnected or partitioned by taking lead of the movement of vehicles in VANET. Means packets are dispatched first in greedy mode and next in recovery mode when a packet faces a local maximum. If the recovery mode is unsuccessful, it finally swaps to the DTN mode and depends on mobility to distribute the packets. Figure10 shows the changeover among these three modes.

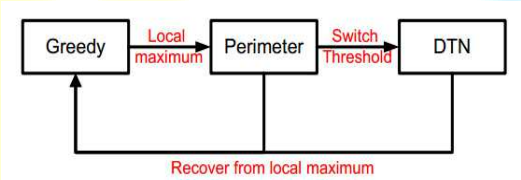

Figure-10 Transition between greedy, perimeter, and DTN modes

The simulation results in show that Geo DTN+Nav outperforms GPSR because it can evaluate network partitions and subsequently improve the partitions' reachability via a store-carry-forward technique when needed.

Routing Protocol	Forwarding Strategy	Street Map Required	Simulation Scenario	Delivery Rate Performance
GPSR	Greedy and Perimeter	No	Highway	Low
GSR	Greedy	Yes	City	Low
GPCR	Greedy	No	City	Better
B-MFR	Greedy on border Nodes	No	Highway	Better
IGRP	Greedy towards gateway	No	City	High
RBVT	Next-hop self-election mechanism	No	City	High
Geo DTN+Nay	Greedy, Perimeter and the DTN node	No	Highway	Better

Table-1 Comparison of VANET routing protocols Discussed

II. CONCLUSIONS

Various routing protocols such as GPSR, GSR, GPCR, B-MFR, IGPR, RBVT and Geo DTN+Nav have been compared (Table-1). Protocols like GSR requires extra agency like street map. For highway traffic we have GPSR, B-MFR and Geo DTN+Nav as routing protocols, out of these B-MFR and Geo DTN+Nav are best suited because of high delivery rate but it require

street map for communication while no street map not required in Geo DTN+Nav. For city traffic GSR, GPCR, IGRP, RBVT routing protocols can be used. IGPR and RBVT both have high delivery rate but RBVT is preferred over IGPR as it uses the real time communication between the traffic.

REFERENCES

1. Bilstrup Katrin. A survey regarding wireless communication standards intended for a high-speed vehicle environment, Halmstad University (Technical Report; IDE0712), Sweden; Feb 2007.
2. C. Siva Ram Murthy, B.S. Manoj. Ad Hoc Network. "Ad Hoc Wireless Networks: Architectures and Protocols". June 3, 2004. ISBN: 978-0131470231
3. H. Hartenstein, K. Laberteaux. VANETs. "VANET Vehicular Applications and Inter-Networking Technologies Intelligent Transportation Systems)". Wiley: s.n., March 2010. ISBN: 978-0470740569.
4. A. Mahajan, N. Potnis, K. Gopalan, A. I. A. Wang. Proceedings of the 2nd IEEE International Workshop on Next Generation Wireless Networks. "Urban mobility models for vanets". December 2006
5. Marwa Altayeb and Imad Mahgoub. 2013. A Survey of Vehicular Ad hoc Networks Routing Protocols:IJIAS,Vol-3.
6. Venkatesh A. Indra and R. Murali. 2014. Routing Protocols for Vehicular Adhoc Networks (VANETs): A Review, Journal of Emerging Trends in Computing and Information Sciences Vol. 5.
7. B.Karp and H. T. Kung. 2000. GPSR: Greedy Perimeter Stateless Routing for Wireless Networks: ACM/IEEE MobiCom, USA.
8. Sardar MuhammadBilal, CarlosJesusBernardos and CarmenGuerrero, 2012, "Position-based routing in vehicular networks: A survey", Journal of Network and Computer Applications, Elsevier.
9. Baraa T. Sharef, Raed A. Alsaqour and Mahamod Ismail. 2013. Comparative Study of Variant Position-Based VANET Routing Protocols: ICEEI.
10. Mingliu Zhang and Richard S. Wolff. 2008. Routing Protocols for Vehicular Ad Hoc Networks in Rural Areas: IEEE Communications Magazine.
11. Cheng, P. C. Weng, J. T. Tung, L. C. Lee, K. C. Gerla, M. Haerri, J. GeoDTN+ Nav: A hybrid geographic and DTN routing with navigation assistance in urban vehicular networks. MobiQuitous/ISVCS, 2008.
12. Tajinder Kaur, A. K. Verma, "Comparative study of Position based Routing Protocols in VANET", ARPN Journal of Engineering and Applied Sciences, ISSN 1819-6608, VOL. 10, NO. 15, AUGUST 2015
13. J. Nzouonta, N. Rajgure, G. Wang and C. Borcea. 2009. VANET Routing on City Roads Using Real-Time Vehicular Traffic Informationm: IEEE Transactions on Vehicular Technology, Vol. 58.

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