Position based Routing in Vehicular Adhoc Networks - A Survey

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Abstract

A Vehicular Ad hoc Network or VANET is a novel approach of intelligent transportation system technology which has received significant attention recently. Routing in VANETs is a challenging task due to network partitioning, high vehicular speed, and city environment characteristics. These characteristics results in degraded performance in traditional routing protocols. Traditional routing protocols, addressing the issues of mobile ad hoc network (MANETs), are applicable for MANET applications. Position-based routing protocols, which are mostly based on greedy routing, are more suited to highly dynamic and mobile networks. The key distinction between VANET and MANET is the high mobility pattern, swift changing topology and capability of mobility prediction. However, it is not effective to apply the prevailing routing protocols of MANETs into VANETs. In this study, we are mainly focusing on significant features, summarizing the advancements of the VANET position-based routing protocols besides discussing the advantages and disadvantages of these routing protocols.
Keywords: Vehicular Ad hoc Network, Intelligent Transportation System, DTNs, Position-based Routing Protocols

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I. INTRODUCTION

VANET is receiving a lot of attention from academicians, research & development (R&D) and industrial community as it plays a vital role in traffic safety besides ensuring a pleasant driving experience. VANET provides a wide range of services to users such as information on vehicle safety and planning a trip by using communication devices. Furthermore, in order to safe guard the drivers and regulate the stream of vehicles the drivers have to be alerted about the road conditions, traffic congestion and other related aspects. The accurate information and time is very vital to achieve this aim. The VANET will be able to address this issue. Moreover, unwanted incidents can be evaded by utilizing beneficial facilities provided by VANET technology. VANET is an innovative technology that incorporates the capabilities of new generation wireless technology into vehicles. It provide continuous connectivity to mobile consumers whilst they are on the road but linked with others who are at their homes or offices and using different networks. This type of VANET architecture is known as Vehicle-to-Infrastructure (V2I) communication and can be effectively integrated into heterogeneous wireless technologies such as 3G cellular systems, Long term evolution (LTE), LTE advance, IEEE 802.11, and IEEE 802.16e [4][5]. It also provide effective wireless connection among vehicles without logging on to any fixed sub structured technologies which is called Vehicle-to-Vehicle (V2V) communication.

Many routing protocols have been devised for MANETs and a few of them can be integrated into VANETs. Nevertheless, the results of this integration showed that the performance is not overwhelming because of the high speed of vehicles which caused high topology changes are dissimilar to MANETs. Therefore, to identify and administer routes is a thought-provoking chore in VANETs which requires researchers to develop a suitable ad hoc routing protocol.

In this paper, our main focus is on a major issue of networking that is position-based routing protocol for VANETs. The principal prerequisite for routing protocols is to attain negligible communication time with least usage of network resources. Position-based routing which required supplementary information was found to be more appropriate for VANET environment. In this instance, the extra knowledge needed to perform data routing is the physical position of the said mobile modes or vehicles. This can be acquired through Global Positioning System (GPS) with the supposition that in future most of the vehicles will be fitting with one, or by using other techniques that determines position. One of the main benefits of using position-based routing is no maintenance of routes is required and apt for high mobile networks that exist in the VANET settings.

II. POSITION-BASED ROUTING PROTOCOLS

In position-based routing, all nodes recognize their own locations and their neighbour node geographic locations through position-pointing devices such as GPS. It does not manage any routing table or exchange any information related to the link state with the neighbour nodes. The information from the GPS device is used in making routing decisions. This type of routing performs better as it is not obligatory to construct and sustain a global route from the source node to the destination node.

A. GpsrJ+

GpsrJ+[6] is an intuitive predictive plan that clears the impediments at an intersection while maintaining the plans of the geographical maps. It practises two-hop neighbour beaconing to visualize roads which might be occupied by the neighbouring junction node. If its prediction shows that its neighbouring junction intends to send the packet against a road with a dissimilar direction, it sends to the junction node; otherwise, it diverges from the junction and sends the packet to its farthest neighbouring node. This means each node will send a beacon message about its coordinates and the road segments on which its neighbours are located.

B. Junction-based Adaptive Reactive Routing (JARR)

The network topology of VANET in a metropolitan setting is made up of numerous probable paths and junctions which form the routing paths. The shortest path routing is not practical as every path must be inhabited by vehicles. A scalable multi-hop routing protocol that is perfectly suitable for a city setting with swiftly changing network topologies and plenty of detached and intense network setting is therefore required. JARR[7] aims to deal with the inadequacies of the present protocols by assessing the density of paths in question. The density of a path can be assessed by determining the beaconing rate, which depends on information obtained from one-hop neighbours. This information helps to assess the density of a path since the beaconing rate is dependent on density, and density is dependent on velocity. By obtaining the reports on the velocity of nodes, the density of a path can be assessed. Nevertheless, vehicles may move at a slow speed even in a sparse condition. Thus, both the beaconing rate and the velocity of vehicles are utilised to assess the density on a particular path. The beaconing rate begins with an initial rate. Then, the beacon rate of a node is controlled by the surrounding node densities. This denotes that by acquiring the information on the beaconing rate of a node, the data about the density around that node can also be acquired.

C. Greedy Traffic-aware Routing (GyTAR)

GyTAR[8] is a junction-based routing protocol which meticulously searches for the junctions to find potential routes through the city. In order to recover from the local maximum it engages a carry-and-forward technique. GyTAR utilizes a digital map to detect the positioning of the neighbouring junctions and selecting the connection based on the two main parameters: traffic density and curvemetric distance to the destination. A score is set to all neighbouring junctions based on the traffic density Tj and the curve-metric distance Dj to the targeted location. The junction j with the maximum score is chosen as the next intersection. The chosen junction is the one nearest to the target and encompasses the maximum traffic density. In GyTAR, the greedy routing strategy is utilized to deliver the packet through the road that connected between two junctions. Hereby, applying GyTAR moves a packet closer sequentially to the destination along the routes whereby an adequate number of vehicles will offer connectivity.

D. Geographic Source Routing (GSR)

The GSR [9] protocol merges the position-based routing with topological information and is meant for routing in city settings To obtain information regarding the targeted node's location, the protocol utilizes the reactive location service (RLS) [10], a direct translation of the route discovery process utilized in reactive non-position-based ad hoc routing protocols to the position discovery of position-based routing. Basically, the querying node gluts the network with a "position request" for a specific node identifier. When the node which matches to the requested identifier obtains the enquiry for location, it signals a "position reply" backward to the querying node.

By using digital maps, the source S identifies the location of all the junctions from the source to the targeted location D. It employs the Dijkstra shortest path algorithm to determine the shortest route from source to endpoint. Junctions known as GSR anchors are encompassed in the shortest path through which the packets have to go through to get to the targeted location. Furthermore, all data packets in GSR are tagged with the location of the S, D, and GSR anchors. Hereby, the GSR might not require an adequate number of vehicles on the roads to offer connectivity. In fact, the GSR is not dependable on the traffic intensity on the lanes when choosing the route from the source to the targeted location. The packet delivery ratio of the GSR protocol's simulation is superior than that of the AODV and DSR protocols in [8]. The drawback of this routing protocol is that it ignores situations such as a sparse network where the numbers of nodes for advancing packets are insufficient. This routing protocol also experiences a high routing overhead since HELLO messages are frequently used as control messages.

E. Scalable Knowledge-based Vehicular Routing (SKVR)

SKVR [11] divides the network between inter domain and intra domain. In inter domain routing, the source and targeted location belong to different routes, whereas in intra domain routing, the source and targeted location belong to the same route. In the inter domain algorithm, the message is forwarded to a vehicle journeying in the targeted location domain. Once the destination domain is reached, the intra domain message delivery procedure is followed. In intra domain routing, the messages are sent in forward or reverse directions depending on the entries of the contact list. If the sending vehicle‘s contact list does not include any vehicle in the targeted domain, next the messages will be delivered to the other vehicles in the contact list. Once vehicles travelling along the same road meet one another, a node that carries a message must choose whether to continue buffering the message or to advance it based on the direction of the vehicle.

F. Vehicle-assisted Data Delivery (VADD)

VADD[12] is a vehicular positioning routing protocol proposed to enhance routing in disconnected vehicular networks based on the carry-and-forward strategy which is reliant on the usage of ordinary vehicle mobility. In VADD a vehicle makes a choice at an intersection and chooses the next forwarding path with a negligible delay in packet delivery. A path is detected only a split road from an intersection. VADD has three packet modes namely: Intersection, Straight Way and Destination. The optimal path for forwarding the packet is selected by swapping among these modes.

G. Geographical Opportunistic (GeOpps)

GeOpps[13] protocols adapt a vehicles' navigation system to select a vehicle that may be travelling nearest to the ultimate target of a packet by get benefit from its recommended routes. GeOpps calculates the straight distance from the destination of packets to the nearest point (NP) of the vehicles' path and estimates the arrival time of a packet at the target node.

H. GeoDTN+Nav

GeoDTN+Nav [14] is a combination of non-Delay Tolerant Networks(DTN) and DTN routing protocols which incorporate the greedy mode, the perimeter mode, and the DTN mode. 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 neighbour's delivery quality, and the neighbour's bearing 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. In other words, 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. The delivery quality of neighbours is acquired through the virtual navigation interface (VNI) which access data from underlying hardware for example the navigation system and event data recorder (EDR). Besides it also delivers necessary data for GeoDTN+Nav to establish its routing mode and forwarder. Besides, its hybrid approach, VNI provides the consumers with the option to protect private data and simultaneously provide the besteffort routing decision. The simulation results in [14] show that GeoDTN+Nav outperforms GPSR because it can evaluate network partitions and subsequently improve the partitions' reachability via a store-carry-forward technique when needed.

III. CONCLUSION

Routing mechanism plays a major rule in both V2V and V2I communication. Designing and developing competent routing protocol forl VANET applications is a very challenging task. Thus, a review of various position-based VANET protocols has been done. The performance of VANET positioning routing protocols is depending on variant parameters such as mobility traffic conditions and the driving environment. Different VANET position-based routing protocols which are applied in different communicative environments have been compared in this study. Position-routing protocols are most forceful in the highly dynamic environments like VANETs whereas the geographic location of neighbouring nodes is the main factor in determining the optimal route as the packets are forwarded. In this kind of routing protocols neither link state exchange nor route setup is required unlike other kinds of routing protocols.

Even though recently VANETs has captured an extensive attention in the wireless network research but there are still some essential issues that remained unsolved. In safety applications, the rate of high packet delivery and marginal latency required ensures that all data packets are dispatched at an appropriate time, such a current position-based routing protocols still suffering from large end-to-end delay and low packet delivery rate which make it not suitable in this kind of applications. Moreover, security is one more critical issue in routing whereas the characteristics of VANETs makes the secured routing protocol more difficult and challenging than any other communication networks.

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