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A Survey on Routing Protocols and Issues in VANET

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Abstract— VANET (Vehicular Ad Hoc Network) is a new emergent technology with some special characteristics that makes it distinct from other ad hoc networks. Due to frequent disconnection and rapid changing topology it is difficult to design adequate routing protocol for routing information among nodes or vehicles called vehicle to vehicle or vehicle to road side infrastructure communication. Because of daily occurrences of road side accidents VANET is one of the efficient area for the betterment of intelligent transport system (ITS) which gives traffic information and increase road safety etc. So, in this paper we aims at classifying the VANET routing protocols on the basis of routing information and also discuss merits and future perspective which help in improvement of existing routing protocol in near future..

Keywords— IGRP, APU, RBVT, VANET, GPS

I. Introduction

A vehicular ad hoc network (VANET) is a special case of Mobile ad hoc network (MANET) where vehicle act a node in the network. A VANET turns every participating car in to a wireless router or node, allowing cars approximately 100 to 300 meters to each other to connect and create a automatic network while moving along roads. Direct wireless communication in vehicles make it possible to exchange data even where there is no communication framework.
A VANET play an important role in future car to car communication. By using VANET vehicles are capable to connect with themselves which help to obviate any critical circumstances such as road side accidents, traffic jams, speed control, free passage of emergency vehicles and unseen obstacles etc. VANET is nothing but a wireless sensor network that uses different sensors (e g., road and weather conditions, state of vehicle radar and others), cameras, computing and communication capabilities, vehicles can gather and decode the information which helps the driver to make the decision, particularly in driver assistance system..

1.1 ROUTING ARCHITECTURE FOR VANET

The architecture of routing in VANET is same as in other connectionless networks. There is no fixed architecture in VANET. VANET is basically the combination of application units (AUs) and On Board units (OBUs). A device Known as OBUs with communication capabilities is placed inside the vehicles. An AU is a device executing applications by OBUs communication capabilities. The VANET units are usually attached with wireless or wired connection. The vehicle equipped with stationary units and On Board units placed along the roads.
Stationary Road side device and OBUs can be seen as nodes of an ad hoc network. RSU can be attached to an infrastructure network, which in turn can be connected to the Internet. Road side stationary can also

communicate to each other via multi-hop or directly. Their basic role is the improvement of road safety, by executing special applications and by sending, receiving, or forwarding data in the ad-hoc domain. Fig. 1 shows overview of VANET architecture.

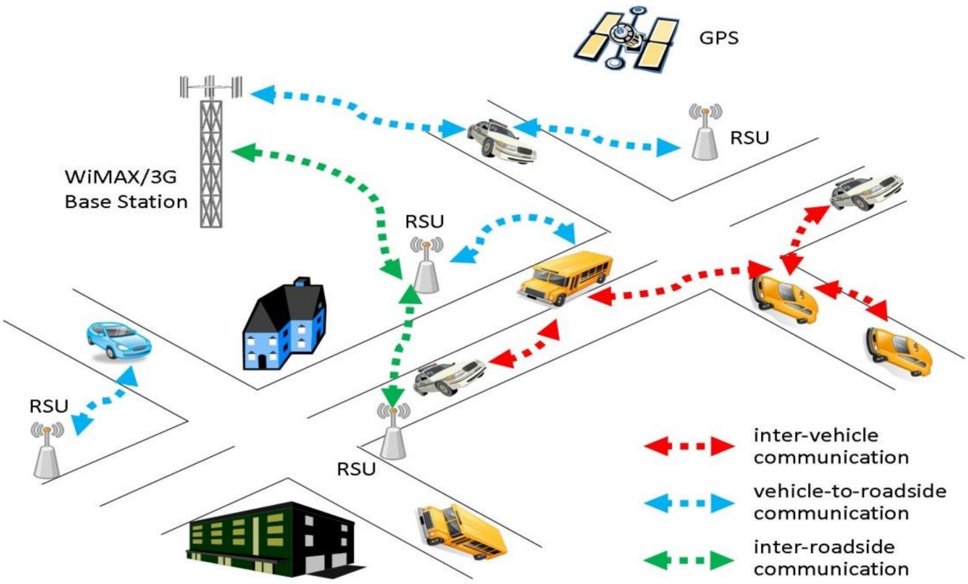

Fig.1 : VANET Architecture

1.2 ROUTING TECHNIQUES FOR VANET

1.2.1 Geographical Source Routing (GSR)

GSR is a position based routing with topological knowledge. Geographical routing states that each node knows its own position using the Global Positioning System (GPS), or some other indirect, localization technique. When a source wants to deliver a packet to a destination, it uses the destination's location to find a neighbor that has closest distance to the destination then itself, and forwards the packet to that neighbor. The neighbor after receiving repeats the same procedure and until the packet reaches the destination. The location of potential destination node is assumed to be available via a location service. This approach is suitable for sensor and automotive network.

1.2.2 Data Dissemination Routing

In this technique, we transport the information to intended receivers with design objective such as high delivery ratio and low delay. For the data dissemination in vehicle to vehicle communication a mobility centric data dissemination algorithm has been designed for partitioned and highly vehicle network. This algorithm combine the idea of opportunistic, geographical, trajectory based forwarding. Message is stored and forward opportunistically along a pre-defined geographical path.

1.2.3 Greedy Perimeter Stateless Routing (GPSR)

GPSR data forwarding algorithm consist the two components i.e. greedy forwarding and perimeter routing. GPSR uses the default forwarding mechanism to forward the packet. But when the greedy forwarding is not possible then the perimeter packet routing is used. The greedy forwarding is not possible when the packet reaches a node which does not have any neighbor closer to destination then itself. i.e. packet reaches dead end or void.

1.2.4 On-Demand Routing Protocol

Reactive routing protocol starts route discovery when node needs to communicate with another node thus reduces network traffic. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving an RREQ rebroadcasts the request unless it is the destination or it has a route to the destination in its route cache. Such a node sends a route reply packet to the route request that is routed to the source. The RREQ builds up the path traversed across the network.

1.2.5 Fish Eye State Routing

FSR is implicit hierarchical and proactive routing protocol in which node maintains a topology table (TT) based upon the latest information received from neighbors and frequently exchange it with its local neighbors. For large networks to reduce the message size the FSR uses the different exchange period for different entries in routing tables. Node periodically broadcast update messages to its neighbor and updates correspond to closer nodes propagate more frequently. The problem in FSR is that as the network size increases the routing table also increases Route to remote destination become less accurate with the increase in mobility. If the target node lies out of scope of source node then route discovery fails.

1.2.6 Geo-Cast Routing

Geo-cast routing is a location based routing. Its main objective is to deliver the information to a group of destination within a specified geographical area (Zone of Relevance (ZOR)). In Geo-cast routing vehicles outside the ZOR are not alerted to obviate unnecessary quick reaction. Within a specific geographic region geo-cast is considered as a multicast service. In order to reduce message overhead and network congestion caused by simply flooding packets everywhere forwarding zone is normally defined where it directs the flooding of packets. In the destination zone, unicast routing can be used to forward the packet.

1.2.7 Position Based Routing Protocol

In Position based routing each node knows its own geographical position and geographical
position of the neighbor's node by position determining services like GPS. In order to select the next forwarding hops they share the property of using geographic positioning information. It does not exchange any link state information and does not maintain any routing table. Since no global route from source node to destination node need to be created and maintained that is why Position based routing is beneficial.

1.2.8 Dynamic Source Routing

The Dynamic Source Routing (DSR) protocol is beacon less presented in which utilize source routing & maintain active routes. Route discovery & route maintenance are the two phases of DSR. It has small overload on the network to obtain the routes between the nodes and to reduce the load on the network for future route discovery it uses the cache. In DSR on periodical update is required.

1.3 APPLICATIONS FOR VANET

We arrange the VANETs application in following classes :

1.3.1 Safety application

In safety application we monitor the surrounding road, road curve, surface of the road and approaching vehicles etc. we can classify the road safety applications as: real time traffic, traffic vigilance, cooperative collision warning and post crash notification.

1.3.2 Commercial application

In commercial application the driver is provide with the entertainment and services as streaming audio and video and web access. We can classify the commercial application as: remote vehicle diagnostics, internet access, digital map downloading, real time video delay and value-added advertisement.

1.3.3 Convenience application

This application mainly deals with the management of traffic with a goal to enhance the traffic efficiency. We can classify the convenience application as: route diversion, electronic toll collection, parking availability and active prediction.

1.3.4 Productive application

As this application is additional with the above application so we will intentionally calling it as productive. We can classify the productive application as: environmental benefits, time utilization and fuel saving.

1.4 ISSUES IN VANET

Based on the survey on routing protocols of VANET its is found that few challenges and research issues exist in the routing of VANET which is the most important area of research today. These challenges and issues in VANET such as loss of signal, interference caused by tunnels, driver's behavior and high buildings have been discussed in this section.

1.4.1 Fault Tolerance : Since VANET is having fast changing topology. During the data exchange a node could enter or exit the network. To manage the network new route is created by the routing protocols. We can overcome from this problem if we know the route failure in advance which requires a lot of update information exchange.

1.4.2 Dynamic Topology And High Mobility : Vehicles acts as a mobile nodes in VANET and proceed in accordance with road pathways which restricts movement of the node, This causes changing in topology and disruption in communication. For routing protocols advancements we should disturb the dynamic topology. A solution is to give efficient information distribution not protesting fast varying topology may be broadcast based communication.

1.4.3 Flexibility and Scalability : Number of vehicles is depend upon the area for e.g. the number of vehicles is low in rural area without road side units (RSUs), to maintain network connectivity becomes difficult. For advancement of RSUs large assets are needed, therefore less power necessities can be used by growing communication. On the other hand urban areas are crowded and large and having a large number of vehicles running. The routing protocols want to lower the control of data packets and overhead as huge range of vehicles want to communicate. It should present safe communication instead of control overhead.

1.4.4 Security: Security and privacy are the most challenging and important issue in safety application. If there is no security in routing protocol malicious node go into the network and cause damage. The misleading of information can be used by hijacker to tarp the person as dead and underpass.

1.4.5 Delay Constraint and Real Time Transmission : To deal with frequent happening situations, drivers do not have adequate time to acknowledge as the knowledge is disperse in the real time. If knowledge is acquired on time accidents cane be escaped. Hence the routers are sustained and created for real time applications.

II. Literature Review

Chih-Hsun Chou et. al. (2008), In this paper the author presents the scheme to decrease the risk of data packet encountering the dead end situation as it is moved to its destination. Under this to exchange neighboring node information to detect dead ends along their calculated transmission paths the mobile nodes periodically broadcast beacon messages. Using the ns2 simulator the two baseline algorithms and dead-end reduction (DR) scheme were evaluated. The simulation and analytical results show the dead end occurrences is significantly reduced by the DR scheme. As a result the average path length and packet delivery ratio were improved a compared with the conventional greedy perimeter stateless routing (GPSR). Control overhead causeed by the DR scheme is less then 10% as compared to GPSR. To further reduce control overhead coarse quantization is presented.

Josiane Nzouonta et. al. (2009), In this author presents a class of protocols called road-based using vehicular traffic (RBVT) routing, which performs actual routing in city-based vehicular ad hoc networks (VANETs). To create road-based paths consisting of road intersections having, high probability and network connectivity among them RBVT protocols influence real-time vehicular traffic information. To transfer packets between intersections on the path geographical forwarding is used, reducing the path's sensitivity to distinct node movements. For dense networks with high contention, the author optimize the forwarding using a distributed receiver-based election of next hops based on a multi criterion prioritization function. A reactive protocol RBVT-R and a proactive protocol RBVT-P is designed and implemented by the author and compared them with protocols characteristics of mobile ad hoc networks and VANETs. RBVTs performs best with, up to a 40% increase in average delivery rate and 85% decrease in average delay rate compared with some existing protocols.

Hanan Saleet et. al. (2011), This paper presents the routing protocols VANET called the intersection based geographical routing protocols (IGRP). IGRP is based on an efficient selection of road intersections through which a packet should move to reach the gateway to the Internet. While satisfying quality-of-service (QoS) constraints on tolerable delay, with high probability and error rate the selection is made that guarantee, network connectivity among the road intersections and band width usage,. To achieve this, QoS routing problem is mathematically formulated by the author as a constrained optimization problem. Specifically, hop count end-to-end delay, analytical expressions for the connectivity probability, and bit error rate (BER) of a route in a two-way road scenario are derived. To solve the optimization problem, a genetic algorithm is proposed. Simulation and numerical concluded that the proposed approach gives optimal or near-optimal solutions which improves VANET performance when compared to other routing protocols such as optimized link-state routing (OLSR), greedy perimeter coordinator routing(GPCR), and greedy perimeter stateless routing (GPSR),.

Quanjun Chen et. al. (2013), Presents the Adaptive Position Update (APU) strategy for geographic routing dynamically adjust the frequency of position update based on the forwarding patterns and mobility dynamics of the nodes in the network. APU is based on two simple principles: 1) movements of those nodes that are harder to predict will update their positions anytime (and vice versa), and (ii) nodes which are closer to forwarding paths update their positions anytime (and vice versa). GPSR shows that APU can improve the routing performance and reduce the update cost and in terms of average end-to-end delay and packet delivery ratio and in comparison with other recently proposed updating schemes and periodic beaconing.

Siddhant Jaiswal et. al. (2013), Vehicular Ad Hoc Network are extremely unstable wireless networks that is designed to support traffic monitoring, vehicular safety and other commercial applications. Although, adequate routing in VANETs remains conflicting for many reasons, e.g., the size of VANETs, wireless channel fading due to high movement and natural obstructions in urban environments and the varying vehicle density over time, (e.g., buildings, trees, and other vehicles). Within VANETs, vehicle movement will cause the transmission links between vehicles to be broken. Routing becomes an important issue in VANET. It becomes more difficult to transmit a packet from source to destination if the network has very less vehicle. In such schemes efficient routing method plays an important role. With efficient routing method he can provide communication in network even if the denseness of vehicles in the network is degraded. The author suggest a routing algorithm which perform on a hybrid scenario, i.e. it will have both dynamic and static framework. The technique applied is Cluster based routing which will help in sending the packets even in a network with degraded vehicle density.

TABLE I. COMPARATIVE ANALYSIS OF ROUTING PROTOCOLS

YEAR	AUTHOR	FEATURES	MERITS	CONCLUSION	FUTURE SCOPE
2008	Chih-Hsun Chou	Geographical Forwarding with dead-end reduction	Reduce the number of dead end occurrences	Reduce dead ends, packet deliver ratio and average path length also improved	
2009	Josiane Nzouonta	Discuss RBVT protocols, forwarding optimization and performance evaluation	Takes advantage of the road layout to upgrade execution of routing in VANETs		
2011	Hanan Saleet	Presents intersection based routing protocol, analytical framework, formulation message routing as an optimization problem, numerical and simulation result	Significantly upgrade VANET performance when contrast with several prominent routing protocols	IGRP tends to satisfy QoS constraints on four performance metrics: 1)BER; 2) bandwidth usage; 3) connectivity probability; and 4) tolerable end-to-end delay.	
2013	Quanjun Chen	Adaptive Position Update (APU) strategy for geographic routing	Reduce the update cost and upgrade the performance of the routing in terms of average end-to-end delay and packet delivery ratio .	APU strategy generates similar or less amount of beacon overhead as other beaconing schemes but achieve better packet delivery ratio, average end-to-end delay and energy consumption	How the proposed scheme can be used to achieve load balance and calculating the performance of the proposed scheme on TCP connections in Mobile Ad hoc Networks.

YEAR	AUTHOR	FEATURES	MERITS	CONCLUSION	FUTURE SCOPE
2013	Siddhant Jaiswal	Hybrid Approach for Routing in Vehicular Ad-hoc Network (VANET) Using Clustering Approach	Provide a routing algorithm which works on a hybrid scenario, i.e. it will have both static and dynamic infrastructure.	Increase in number of cars and Road Side Units probability of message reaching the destination increases, reduces average time required for successful message transmission	Different technique for selection of cluster head can be used and network can be expanded with respect to area, number of cars, and number of Road Side Units

III. Conclusions

In this paper, we have analyzed the different VANETs routing protocols and issues that are appropriate for the vehicular communication for the advancement. In literature we investigated the different routing protocols such as greedy forwarding with dead end reduction that reduce the number of dead end occurrences and packet delivery ratio and also improves path length. We also studied about RBVT protocol that improves the performance of routing in VANET. Adaptive position update strategy for geographical routing is also discussed that enhance the routing performance in packet delivery ratio and end-to-end delay and also reduce update cost but this strategy will not tell us that how we can achieve the load balance and evaluate the performance on TCP connection. By analyzing these distinct types of routing protocols we have observed that further implementation analysis is necessary to validate the performance of routing protocols.

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