

A Brief Review of Geographical Routing Protocols of VANET

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ABSTRACT: The Vehicular Ad-hoc network (VANET), is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless node, allowing cars just about 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. However, in situations where nodes are movable or when nodes often switch on and off, the local topology rarely remains fixed. Hence, it is necessary that each node broadcasts its updated location information to all of its neighbours. These location update packets are usually referred to as beacons. Beacons are broadcast periodically for maintaining an accurate neighbour list. This paper focusing on various Geographical routing protocols and various beaconing schemes and study of Distance-based and Speed-based Beaconing schemes.

KEYWORDS: Vehicular Ad-Hoc network (VANET), routing protocol, GPSR, GPCR, IGRP, Beacons, geographical forwarding, efficient algorithm

I. INTRODUCTION

Vehicular Ad-Hoc Network (VANET), is a technology that use moving cars as nodes in a network to form a mobile network. VANET turns every participating car into a wireless node, allowing cars just about 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. VANET distinguishes MANET in terms of the following features: - mobility topology, high level mobility, distributed communication, oneself organized architecture, path reduction and elements network size. [1]

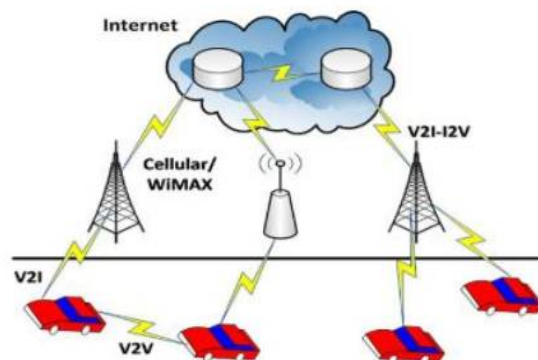


Fig 1: Vanet[2]



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Vehicular Ad Hoc Network (VANET) is a capable approach and receiving a lot of interest due to the broad range of services they can provide. Their applications range from infotainment dissemination, road safety and traffic management for drivers and passengers.[2][3] VANET system designed and is implemented under the following rigidity: connectivity and trait of services ,security and solitude.[2] Recently, car manufacturers and telecommunication companies have been gearing up to provide each car with technology that allows passengers and drivers to communicate with each other as well as with the roadside infrastructure that may be situated in some critical sections of the road, such as at every traffic light or any intersection in order to improve the driving experience and make driving safer.[2] Today, a vehicle is not just a thermo mechanical machine with few electronic devices. Rather, latest advancement in wireless communication technology has brought a foremost transition of vehicles from a simple moving engine to an intelligent system carrier.[3]

Nodes One of the ultimate goals in the design of such network is to attain vehicle-to-vehicle and vehicle-to-roadside unit wireless communication. VANETs are capable to gather real-time data on road conditions and make them useful for a wide range of applications, including traffic routing ,drivers assistance and safety warning systems. Traffic routing, for instance, could be used to build vehicle routes according to carbon emission levels, avoiding to route certain types of vehicles to polluted areas. Furthermore, these data can be used to create intelligent traffic management systems, which can automatically indicate probable urban tolling zones ,update traffic light cycles, study the daily population of vehicles in the road, etc. Vanet unique features are such as the high-speed mobility of the network entity (or vehicles), extremely large amount of network entities, highly dynamic topology of the network, large scale networks, random movement pattern of vehicles, hybrid communication pattern, self-organizing nature of the network .[2]

Though, in situations where nodes are mobile or when nodes often switch on and off, the topology hardly remains static. Hence, it is necessary that each node broadcasts its updated location information to every neighbor. These location update packets are typically referred to as beacons. Beacons are transmitted periodically for maintaining an accurate neighbour list at each node. Position updates are expensive in many ways. Each update consumes node energy, wireless bandwidth, and increases the danger of packet collision at the medium access control (MAC) layer. Packet collisions cause packet loss which in turn affect the routing performance due to decreased accuracy in determining the correct local topology (a missing beacon broadcast is not retransmitted). [4] Security in vanet: There are several different aspects involved in security. Security problems mainly include message authentication, integrity, confidentiality and non-repudiation, message privacy, false positions by some of the users, false velocity, false direction, network latency problem etc.[2] Falsified position information can be generated by inaccurate Geographical Position System (GPS) or deliberately by an attacker to disturb the entire safety system. A malicious node creates multiple virtual identities and associates forged positions with them.[5] The promising applications and the cost effectiveness of VANETs constitute key motivations behind increasing interest in such networks. The success of VANETs revolves around a number of key elements such as message routing between the gateway to the Internet ,the mobile nodes (MNs). Without an efficient routing strategy, the success of VANETs will continue to be limited. VANET-based applications classified into two categories: a) those that are delicate to delay, e.g., downloading a multimedia application from the nearby Internet gateway, connecting to a virtual personal network (VPN) for video or voice conferencing, and video streaming; b) those that are delay tolerant, e.g., sending simple text messages or sending an advertisement. [6]

II. ROUTING PROTOCOLS

VANET is a particular class of MANET. Routing in ad-hoc networks is a critical issue .Routing is a process of sending data packets from source node to destination node. VANET routing is broadly classified into the following categories: Topology based and Position based routing protocols.[2] In topology-based protocols, it is believed that each node has information about the whole network topology before the node begins forwarding messages. In position-based protocols, messages are routed based on information of the geographical location of the source, intermediate nodes, and final target. One benefit of geographical routing protocols is that they can discover a suboptimal route from source to destination without the use of routing tables hence, there is no need to flood the network and store routing information at each node. [3]

1. GPSR assumes that each node in the network has a local table in which all neighbouring nodes are scheduled by name and position. GPSR also assumes that every source node knows the location of the destination with

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- the aid of a location service. However, in situations where nodes are movable or when nodes often switch on and off, the local topology rarely remains fixed. Hence, it is necessary that each node broadcast its updated location information to every neighbour. These location update packets are typically referred as beacons. Beacons are transmitted periodically for maintaining an accurate neighbour list at each node. GPSR has two working mode: a greedy forwarding mode and a perimeter mode. Greedy forwarding is the default approach, where the packet is forwarded to the node that is geographically closer to the destination. Greedy forwarding works well if there are no holes, meaning voids, in the network. Because GPSR lacks information about the network topology, it can potentially go through loops. This occurs in the case of perimeter routing when the protocol routes the message in the incorrect direction, resulting in performance degradation.[4][8]
2. GPCR assigns the routing decision to the nodes located at the street intersections, and at the same time, it uses the greedy forwarding strategy to route the message among the street intersections. Like GPSR, GPCR does not make use of road maps for routing the messages, which may result in loops and bring in many hops in the route. In addition, GPCR does not take into concern the quality of the routes nor does it have a method to select the best path.[4]
 3. The Multi-hop Routing protocol for Urban VANETs (MURU) assumes that every node has a stable street map and that there is a location service that gives the source node information about the location of destinations. To find a route, therefore, the source node calculate the shortest path to the destination based on a static street map and the location of both the source and the destination. MURU provides routes that minimize the hop count. At the same time, it proposes the “expected disconnection degree (EDD)” to estimate the quality of the routes. The EDD of a given route represents the probability that this route will fail during a given time period. MURU uses the EDD to construct an optimal path based on predicted speed, location, and road geometry. Each node broadcasts route request packets, which are routed on paths that are constrained by node movement trajectory (A trajectory is the path that a moving object follows through space as a function of time). However, since MURU uses the local information available to the forwarding node, it is susceptible to local optimum, which would significantly decrease the scalability of the routing protocol.[4]
 4. IGRP (Intersection based geographical routing) chooses the routes based on fixed points, which are the road intersections (i.e., junctions). This increases the stability of the constructed routes. Specifically, IGRP choose the path that maximize connectivity possibility while satisfying the QoS constraints regarding hop count, BER, and end-to-end delay. Between any two intersections on the particular path, geographical forwarding is used to transfer packets, thus reducing the path’s sensitivity to individual node movements. To do so, IGRP makes use of a central control unit, which is the gateway. This latter node has indeed detailed information about the MNs in its vicinity using a location-aware service and uses a GA to choose the optimal routes.[6] Fig 2 shows message routing in vanet using IGRP.[6]

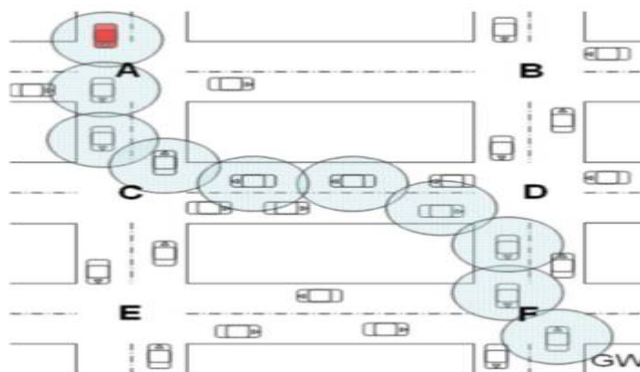


Fig 2. Message routing in vanet using IGRP[6]



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5. Delay Tolerant Network (DTN) Routing Protocol This protocol is a appropriate protocol for networks with features, such as rapid disconnectivity during communication, massive/giants calability, large crucial delays, high fault tolerance rates, restricted bandwidth and power restriction. DTN uses a store, carry and forward action map within the network where all the nodes help each other in forwarding the data packets. The packet transmission takes long delay because of restricted transmission range. In DTN protocol, when the data packets are accessed with midway nodes and if there is any disconnectivity, it cannot be maintained .[1]

III.RELATED WORK

In [3] Siddhant Jaiswal and Dr D. S. Adane Presented a routing algorithm which works on a hybrid scenario, i.e. it will have both dynamic and static infrastructure. The approach used is Cluster based routing which will assist in transmitting packets even in a network with low vehicle density. In [4] Quanjun Chen, Salil S. Kanhere and Mahbub Hassan demonstrated that periodic beaconing in spite of the node mobility and traffic patterns in the network is not attractive from equally update cost and routing performance points of view. Author proposed the Adaptive Position Update (APU) plan for geographic routig, which dynamically adjust the frequency of position updates based on the mobility of the nodes and the forwarding patterns in the network. APU is based on two straightforward principles: 1) nodes closer to forwarding paths update their positions more frequently (and vice versa) and (2) nodes whose movements are difficult to predict update their positions more frequently (and vice versa).

In [5] Jyoti Grover ,Manoj Singh Gaur and Vijay Laxmi introduces new variants of (a) Position forging attacks and (b) Combination of position and ID forging attacks.Also proposed an execution of these attacks, their impact on the performance of VANET and description of detection methodology.Inaposition forging attack, an attacker broadcasts timely coordinated wrong traffic warning messages with forged positions, producing an illusion of a traffic jam ,car accident or an emergency braking. This reduce the performance of VANET in terms of channel utilization.It also has a severe impact on the performance of security algorithms and examine the impact of forged position information on average vehicle speed, proportion of delivered packets and number of collisions.

In [6] Hanan Saleet, Rami Langar , Kshirasagar Naik, Raouf Boutaba, Amiya Nayak and Nishith Goel Presented a class of routing protocols for vehicular ad hoc networks (VANETs) called Intersection based Geographical Routing Protocol (IGRP), which surpass existing routing schemes in city environments. IGRP is based on an successful selection of road intersections through which a packet must go by to reach the gateway to the Internet. The selection is made in a way that guarantees, high probability, network connectivity among the road intersection while fulfilling quality-of-service (QoS) constraints on bandwidth usage, error rateand tolerable delay. Geographical forwarding used to transmit packets between any two intersections on the path, reducing the path's sensitivity to individual node movements. To achieve this, author mathematically formulate the QoS routing problem as a constrained optimization problem.In particular, analytical expressions for the hop count ,connectivity probability, end-to-end delay,and bit error rate (BER) of a route in a two-way road scenario are derived. Then, proposed a genetic algorithm to solve the optimization problem. Simulation and Numerical results show that the anticipated approach gives optimal or near-optimal solutions and drastically improves VANET performance when compared with several prominent routing protocols, such as optimized link-state routing (OLSR), greedy perimeter stateless routing (GPSR) and greedy perimeter coordinator routing (GPCR). In [7] Josiane Nzouonta, Neeraj Rajgure, Guiling (Grace) Wang and Cristian Borcea presented a routing protocols called road-based using vehicular traffic (RBVT) routing protocol, which outperforms existing routing protocols in city-based vehicular ad hoc networks (VANETs). RBVT protocols uses real time vehicular traffic information to build road based paths consisting of successions of road intersections that have network connectivity and high probability among them. Geographical forwarding is used to move packets between intersections on the path, dropping the path's sensitivity to individual node movements. For dense networks with high contention, author optimize the forwarding using a circulated receiver-based election of next hops based on a multi criterion prioritization function that takes non uniform radio propagation into account.



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IV.SUMMARY OF THE TECHNOLOGIES AND DIFFICULTIES FACED

The given table contains some of methods used along with their authors and conclusions given by them.

AUTHOR	METHOD/APPROACH	YEAR	FINDINGS
Hanan Saleet	Intersection-based Geographical Routing Protocol (IGRP).	2011	IGRP achieves better performance. Satisfies thresholds on the end-to-end delay, hop count, and BER
Quanjun Chen	Adaptive Position Update (APU) strategy for geographic routing	2013	Reduces update cost and improve the routing performance in terms of packet delivery ratio.
Siddhant Jaiswal	Cluster based routing in hybrid scenario	2013	Cluster based routing used for transmitting packets even in a network with low vehicle density.
Qiong WU	support vector machine(SVM) for early car accident detection in VANET.	2015	Used real data to evaluate SVM scheme and simulate more complicated road conditions, such as multiple-line roads.
Prashant Panse	Implemented a vehicle 2 vehicle communication scenario with weighted cluster algorithm (WCA).	2016	Evaluated the performance of VANET with parameters i.e. routing overhead, packet delivery ratio, end-to-end delay and throughput.

TABLE 1

V. CONCLUSION AND FUTURE WORK

In this paper we have looked at different types of routing protocol.we have reviewed and provided a detailed explanation of the Protocols. IGRP achieves better performance and satisfies thresholds on the end-to-end delay, hop count, and BER. Adaptive Position Update (APU) strategy for geographic routing reduces update cost and improve the routing performance in terms of packet delivery ratio.Support vector machine use real data to evaluate SVM scheme and simulate more complicated road conditions, such as multiple-line roads. Cluster based routing used for transmitting packets even in a network with low vehicle density. Implementation of vehicle 2 vehicle communication scenario with weighted cluster algorithm (WCA) evaluated the performance of VANET with parameters i.e. routing overhead, packet delivery ratio, end-to-end delay and throughput.

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