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Survey Paper on Routing Protocols in VANET

Abhikarsh Singh[1], Arpit Jain[2], Sumit Singh Chhonkar[3*] and Manish Kumar[4]
[1]Department of Computer Science and Engineering, Galgotias College of Engineering and Technology Greater Noida, Uttar Pradesh, India. Email: abhikarshsinghh@gmail.com
[2]Department of Computer Science and Engineering, Galgotias College of Engineering and Technology Greater Noida, Uttar Pradesh, India. Email: arpitj490@gmail.com
[3]Department of Computer Science and Engineering, Galgotias College of Engineering and Technology Greater Noida, Uttar Pradesh, India. Email: chhonkarsumit@gmail.com
[4]Assistant Professor, Department of Computer Science and Engineering, Galgotias College of Engineering and Technology, Greater Noida, Uttar Pradesh, India. Email: manish.kumar2@galgotiacollege.edu
*Corresponding Author

Abstract: Vehicular ad hoc networks (VANETs) are the specific class of Mobile ad hoc networks (MANETs). The vehicles displaces at a large speed because of which the network topology is continuously changed. It is a promising base work for the Intelligent Transport System (ITS). There are many challenges to be addressed when employing VANET. The dynamic topology and the complex mobility scheme make the MANET protocol futile for VANET implementation. The aim of this paper is to compare the various concepts used in field of VANET and provide an efficient solution.

Keywords: Dynamic, Efficiency, Reliable connection, Routing, VANET.

I. Introduction

A vehicular ad hoc network (VANET), a type of wireless network, is able to provide many communication services via the collaboration of the vehicles in the network. It has only been less than a century since the first automobile came to the world. Vast innovations in safety, comfort, and convenience have already made today's vehicle a very different machine than it was in the past century. Now a new technology characterized by proliferation of low-cost wireless connectivity and distributed peer-to-peer cooperative systems, is changing the way in which next generation vehicle will evolve. All the aforementioned applications rely on the metropolitan wide VANETs which involve moving vehicles and fixed roadside units. The roadside units can come in many forms and provide many different functions, such as information broadcast station to announce roadside services, data collection hub to collect real-time traffic information, Wi-Fi access point and metro mesh node to provide internet access. Data are disseminated in the network by employing all possible connectivity including vehicle to vehicle communication, vehicle to roadside communication and roadside to roadside communication.

II. Technologies in VANET

Vanet is a broad concept which comprises of basically three important areas governing the layout and type of communication to be established in the network. These are: -

A. In-Vehicle Communication

Communication within a vehicle allows the exchange of information between various components within a vehicle and is widely used in any modern car. In general, 2 application areas for in-vehicle communication will be distinguished: the primary is that the in-vehicle network of sensors, actuators and controllers, and also the second is high rate multi-media communication for comfort applications [3]. Since in most cases the amount of human activity entities won't change over the period of time of the vehicle, in-vehicle communication networks have a stable topology, a clearly outlined restricted set of possible communication partners and think about wire line communication [3]. Typical are bus and ring topologies. Particularly controller networks have rigorous needs on delay and integrity, whereas just in case of comfort applications consequences of violations of the utmost allowed delay or information corruption square measure less serious however higher information rates square measure needed.

Examples:

With the increasing range of electronic elements integrated in vehicles, standardized communication systems for in-vehicle communication became important.

B. Vehicle to Roadside Connection

The term Vehicle-to-Roadside Communication (VRC), additionally referred to as vehicle to infrastructure communication, is employed for any quite communication from the vehicle to a set infrastructure or contrariwise [2]. This communication can be uni or bidirectional. Broadcast systems support unidirectional transfer of data from a broadcast station to the vehicle. In distinction, in systems permitting bifacial communication, the vehicle communicates purpose-to-point with a base station or access point. In this case, the bottom station is sometimes liable for coordinative the communication, e.g. physical layer synchronization and medium access [2] [3]. Furthermore, the bottom station will give access management and avoid excessive load. Bi-directional VRC technologies are often divided more into cellular portable systems and short range/WLAN-like systems. The former employs the existing cellular infrastructure; the latter cowl solely a tiny low native space however will give high information rates at a coffee price.

Examples:

Public Radio Stations.

C. Inter Vehicle Communication

Direct communication between vehicles, alleged Inter-Vehicle Communication (IVC), permits info exchange while not requiring any mounted infrastructure [7]. While an analogous kind of communication has recently been deployed on an outsized scale in maritime traffic with the automated Identification System and in natural philosophy with the automated Dependant police work - Broadcast (ADS-B) system, it's not nevertheless in wide use within the automotive sector. A basic demand for associate reasonably IVC is an air interface capable of unplanned communication: In distinction to VRC, synchronization and medium access cannot be coordinated by a base station. The network needs to be self-organized and permit spontaneous peer-to-peer communication between any 2 vehicles that square measure at intervals mutual transmission varies. Thus, medium access and synchronization have to be solved in a decentralized way [4]. Two varieties of IVC will be distinguished supported the relative positions of knowledge supply and destination:

Single-hop: In single-hop IVC info supply and destination area unit at intervals transmission vary of every alternative and communicate directly. Multi-hop: Information exchange over distances larger than the transmission range of a single vehicle can be achieved using multi-hop IVC.

Information source and destination are connected by one or more intermediate vehicles which forward the information. IVC is that the foundation for conveyance unintended networks, which permit a large vary of applications within the areas comfort and safety.

III. Routing Protocols

VANET includes a number of routing protocols which help in selection of optimal path to undergo smooth transportation.

A. Topology Based Routing Protocol

This protocol relies on the topology of the underlying network [8] [9]. This protocol maintains routing tables for storing the link information and based on this stored data it forwards packet from source vehicles to destination vehicles. It makes use of global information for making routing decisions. Many existing algorithms of this category try to bring balance between being conscious of the probable routes and minimizing the control overhead. The overhead here mentions bandwidth and time involved in routing the packet.

It can be classified into types:

- *Proactive Routing Protocols*

  Proactive routing denotes routing the information [8]. This protocol is also known as a table-driven protocol and each node maintains a routing table will consist of the information of routing to every node in the network. Since the nodes are mobile, they keep on the changing their location. It maintained the routing tables which are periodic or whenever a change occurs, are updated provide a number of proactive routing protocols. It differs in the various areas like number of routing table will maintain and how the changes are propagating in the network. The examples of proactive routing protocols are: Optimized Link State Routing (OLSR) and DSDV (Destination-Sequenced Distance Vector).

- *Reactive Routing Protocols*

  This protocol [9] [10] is also known as the on-demand routing protocol which they don't maintain the routing information or activity of routing at the network nodes which there is no communication. In this protocol, the node desires to send a packet to the opposite node whereas for the route in Associate in Nursing on-demand routing manner and establish the affiliation of route to transmit and receive the packet so as to manner.

B. Position Based Routing Protocols

Position based mostly routing protocol use extra info concerning the position of mobile nodes. It uses location services to work out the precise position of supply node, neighbor node and also the destination node [5] [6]. By the use of GPS or some kind of location services, it maintains the position information about the nodes and determines the exact co-ordinates of the nodes in any geographical direction, and thus leads in route discovery mechanism. It doesn't require the establishment and maintenance of the route, neither it has to update the routing table. It will all its activity by the utilization of location services and a few quite forwarding strategies, that is employed in forwarding the packets from supply node. The advantage of this protocol can support the delivery of packets to all nodes in a given region of geographic this type of service is known as a geo-casting. It can distinguish three mains forwarding the packets strategy for position based routing: Greedy forwarding, restricted directional flooding and hierarchical approach.

Table I: Comparison Among Routing Protocols

Sign	Comparison Among Routing Protocols		
	Routing Protocols	Overview	Examples
1	Topology based routing protocol	Maintains node topology by storing path information in routing table	DSDV, FSR
2	Position based routing protocol	Forms an optimal path by calculating the position of nodes using GPS service	CAR, VADD
3	Broadcast routing protocol	Packets of messages are transferred through flooding	Broadcomm
4	Clustering based routing protocol	Clusters of vehicles are made into an network based on static sources	HCB, COIN
5	Geocast based routing protocol	A specific area is set as destination and packets are send to all nodes in that area	ROVER, IVG

C. Broadcast Routing Protocol

Broadcast routing is usually used in VANET for traffic updates, weather conditions, road information among vehicles and delivering ads and announcements. Broadcasting is used when message needs to be disseminated to the vehicle beyond the transmission range i.e. multi hops are used [1]. Broadcasting a packet determines that the packet is sent to all nodes in the network, basically using flooding. The delivery of the packet is ensured but bandwidth is dislocated, and nodes receive duplicates. In VANET, it performs better for a small number of nodes. The various Broadcast routing protocols are BROADCOMM, UMB, V-TRADE, DV-CAST, EAEP, SRB, PBSM, PGB, DECA and POCA [7].

D. Clustering Based Protocol

In Clustering based routing schemes, one vehicle from each cluster is selected as Cluster Head (CH) which main function is to manage other nodes in a cluster called as cluster members [2]. If any node which is in the range of two or more clusters, it is called as border node. There are number of techniques or protocols are proposed in literature for the selection of cluster head and how efficient routing is achieved through clustering. There is a classification of nodes into CHs, gateway or cluster member. There is one CH per cluster. If a node is connected to more than one cluster, it is termed as gateway. The information about the members and gateways is maintained by CH. Routing of the packets from source to destination is done in greedy manner. In case the location of destination is not available, the Location Request (LREQ) packets are sent by the source. Only CH will disseminate the LREQ and Location Reply (LREP) messages [8].

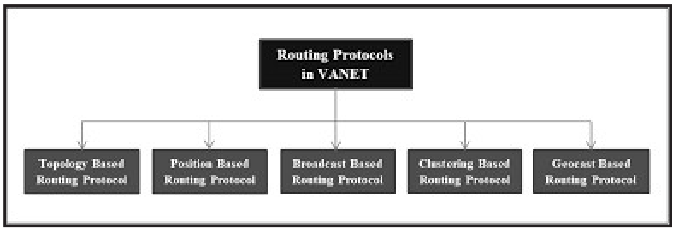

Fig. 1: A Classification of Routing Protocols in VANET

E. Geocast Based Routing Protocol

It is primarily a location based mostly multicast routing. Its aim is to deliver the packet from beginning node to all or any different nodes at intervals a nominative geographic area referred to as Zone of connection (ZOR) [3] [4]. In Geocast routing, convertibles outside the ZOR are not disturbed to avoid unnecessary immediate reaction. Geocast is considered as a variant of multicast routing pertaining to a specific geographic region. It defines a forwarding zone where it targets the transfer of packets in order to cut on message overhead and network irradiation caused by simply transferring packets everywhere. In the destination zone, unicast routing can be used to forward the packet [5]. One disadvantage of this protocol is network partitioning and also unhealthy neighbours which may disrupt the proper forwarding of messages.

IV. Comparative Study on Previous Works

A. Hybrid Scatter Search ABC Algorithm

This algorithm uses multicasting routing protocol as its base operation module. But this protocol is implemented on clusters formed by the nodes of network. A cluster consists of cluster members and a cluster head. The cluster head is usually a static traffic device or an RSU. Clusters within an area contact through cluster heads [9]. Using multicasting in various clusters leads to formation of numerous paths. Selection of an optimal path from these paths is the basic idea. This selection is to be done on the basis of two parameters- quality and position.

The multicast routing selection for VANET is proposed using optimization algorithm called metaheuristics [11]. The main idea of this algorithm is to maintain a set of tentative solutions. This set of solutions is characterized by its quality and variety. This set is divided into subset of solutions on which further improvement is made.

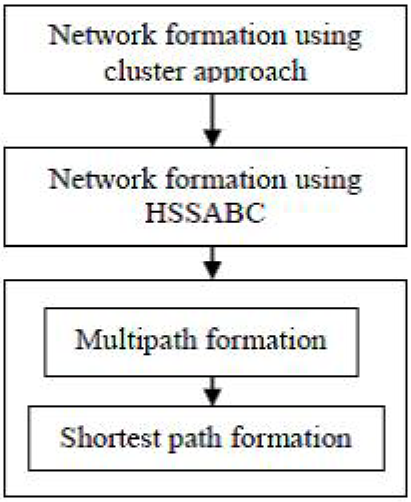

Fig. 2: Block Diagram of Proposed Work

The ABC algorithm makes use of artificial bee colony population based heuristic approach [6]. In this, it classifies the artificial bee colony into three categories- employed bees, onlookers and scouts. The employed bees are associated with a food source which they exploit. They carry the information regarding the food source and share it with the onlookers. The onlookers wait at the hive for the information provided by the employed bees and then decide upon which food source to choose. Scouts perform random search. In the ABC algorithm, first half of the colony belongs to employed artificial employed bees and the second half belongs to onlookers. Each food source is allocated to only one employed bee. The employed bee whose food source has been completely utilized by the bees becomes a scout. The position of food source denotes the outcome of optimization algorithm and the nectar amount denotes the quality of outcome.

B. Acute Position Based Routing

Like other position-based routing protocol, this protocol uses greedy technique when it comes to vehicle-to-vehicle communication. Acute position routing protocol uses restricted greedy when there is V2I communication and there is a RSU (Road Side Unit) on every intersection point [10]. These RSUs take all the decision regarding the direction of the flow of packet. RSUs being static cover a larger network area than vehicles. Restricted greedy is being used because in this technique the data packet will forward to the RSU and not beyond the RSU. Loss of packet is less. If there is no intersection point, then V2V communication will take place through greedy technique.

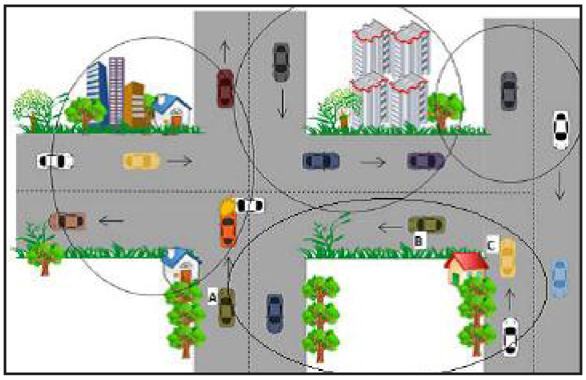

Fig. 3: Restricted Greedy without RSUs

We illustrate in Fig. 3, accident happens in the intersection point. In this situation, all vehicles should be informed to avoid the traffic. In Fig. 1, car A and car B come towards the accident area and there is no car which informs these cars about the accident in their network area. In that case, car A and car B will not get informed or informed later.

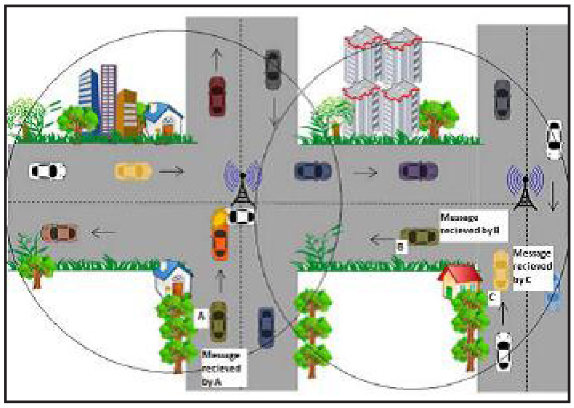

Fig. 4: Restricted Greedy with RSUs

As illustrated in Fig. 4, RSUs are take place at intersection point with more covered network area. Now data packets will go through these RSUs. The problem that arises in Fig. 1 is overcome in Fig. 2. Car A and car B received message and they take U-turn, if possible and Car C also received message and avoid this route and go straight. So, these cars will not be stuck in traffic.

V. Conclusions

VANET is an emerging research topic with high probabilities of improvement and innovation. It is a variation of MANET with more complexities involved as the nodes in this approach are vehicles and infrastructures. In the present article, a review of the various routing protocols is done to give an insight as to the preliminaries in the working of VANET. Furthermore, comparisons of two published research papers have been made to give an idea as to how various algorithms perform with regard to the unsteady and dynamic nature of VANET.

These comparisons show us that there are avenues where VANET still needs to be worked upon and if improved, can lead to a better solution. This gives us a look and encouragement into the future work and the possibility of reducing the limitations imposed up till now.

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