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REVIEW ARTICLE

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A Review on Routing Protocols used in VANET

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Abstract: Vehicular Ad-hoc Network (VANET) in the recent years brings enormous attention of the Researchers as the concept of wireless networking for vehicle to vehicle (V2V)and vehicle Roadside Units (RSUs) or (V2I) plays a significant role in providing advantage, benefits to the drivers, passengers and also provides high level of security. VANEThas become an active area of research, standardization, andDevelopment but still it has some challenges in research study like routing, broadcasting, quality of service etc. In this paper we survey on some routing protocols used in Vehicular Adhoc Network which provides the way for communication.In addition, the comparison is done between different routing protocols using the parameters throughput, end to end delay and no of packets dropped for toconclude which one is better to use in VANET.

Keywords- Vehicular Ad Hoc Network (VANET), Mobile Adhoc Network (MANET), Road Side Units (RSUs), Dedicated ShortRange Communication (DSRC), Wireless Access in Vehicular Environment (WAVE), Intelligent transportation system (ITS).

I. INTRODUCTION

Vehicular Adhoc network is a distinct type of Mobile Adhoc Network (MANET) which is Vehicle to Vehicle and Vehicle Road Side wireless communication network. Vehicular Adhoc Network are the technical foundation of an envisage Intelligent Transportation System. VANET offers a large number of applications for the purpose of safety and driving comfort. Vehicular Adhoc Network provides vehicle to vigorously communicate to each other and to better recognize the traffic situation for the safety purpose like accidents and traffic jams. Vehicular Adhoc Network create its own wireless network with a node same as mobile node in MANET like cars, buses, motorcycle and the node range varies between 100 to 300m to perform every participating vehicle into wireless node. These participating nodes carry and interchange messages with the alternative vehicles or nodes within the network to provide the road safety.

As vehicles changes their position in motion with respect to time frequently and communicate by exchanging data when comes in a range. Vehicular Adhoc network works on Dedicated Short Range Communication (DSRC) which is involved as a communication medium and it comes under IEEE 802.11a standard. Vehicular Adhoc Network also works on Wireless Access in Vehicular Environment (WAVE)which is based on IEEE 1609 and it is standardized as IEEE 802.11p for special vehicular communication [1]. To communicate between the vehicles, VANET needs to provide the routing protocols for this purpose.These routing protocols provide the way for vehicle to vehicle communication (V2V) and vehicle to infrastructure communication (V2I).

These are describing below in section routing protocols used in VANET.

The paper is categorized as 2nd part describes the overview of VANET. The next part we presents routing protocols used for communication in VANET and then we make some concluding remarks.

II. OVERVIEW OF VANET

A. Inter-vehicle communication:

In this section we will focus firstly on Inter-vehicle communications which is included in Intelligent Transportation System (ITS) [1]. IVC (Fig.1) grant for instant, automatic, wireless transfer of information between two or more vehicles on a roadway. Wireless communication and processing of live data on a road way provides drivers useful information through which they can become aware of critical information before it's too late. The knowledge of IVC is necessary, taking data from each of the cars on the roadway, (i.e. their position, location, speed, proximity to other cars, origin, of miles driven on current trip, destination, etc.) and sending it to other IVC implemented cars. The greater part of this data would be collected through a built in GPS device and on-board sensors. All this data can then be conveyed to nearby cars on the road and exhibited to drivers to be informed about the road ahead.

There are two types of message forwarding scheme ininter-vehicle communications:

a. Naïve broadcasting and
b. Intelligent broadcasting

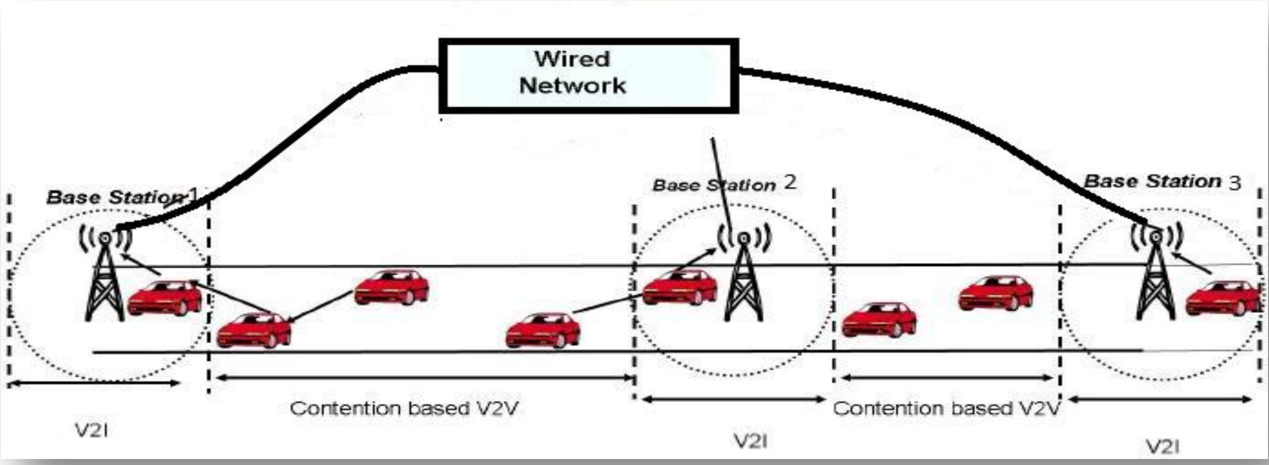

Figure.1

a. Naïve Broadcasting: In *naïve broadcasting*, vehicles send broadcast messages periodically and at regular intervals.When message are received; the vehicle ignores the message if it has come from a vehicle behind it. And if the messagecomes from a vehicle in front, the receiving vehicle sendsits own broadcast message to vehicles behind it. This assuresthat all enabled vehicles moving in the forward directionand get all broadcast messages [2].
b. Intelligent broadcasting*:* InIntelligent broadcastingwith implicit acknowledgement overcomes the problems inherent in naïve broadcasting by limiting the number of messages broadcast for a given emergency event. If the event-detectingvehicle receives the same message from behind, it assumesthat at least one vehicle in the back has received it and stopbroadcasting. The assumption is that the vehicle in the backwill be responsible for moving the message forward to the restof the vehicles. If a vehicle receives a message from more than one source it will act on the first message only.

B. Vehicle to Roadside Unit Communication:

The vehicle-to-roadside communication configuration(Fig. 2) represents a single hop broadcast where the roadsideunit sends a broadcast message to all equipped vehiclesin the vicinity.Vehicle-to-roadside communication configuration providesa high bandwidth link between vehicles and roadsideunits. The roadside units may be placed every kilometer orless, enabling high data rates to be maintained in heavy traffic.For instance, when broadcasting dynamic speed limits,the roadside unit will determine the appropriate speed limitaccording to its internal timetable and traffic conditions. Theroadside unit will periodically broadcast a message containingthe speed limit and will compare any geographic or directionallimits with vehicle data to determine if a speedlimit warning applies to any of the vehicles in the vicinity. Ifa vehicle violates the desired speed limit, a broadcast will bedelivered to the vehicle in the form of an auditory or visualwarning, requesting that the driver reduce his speed.

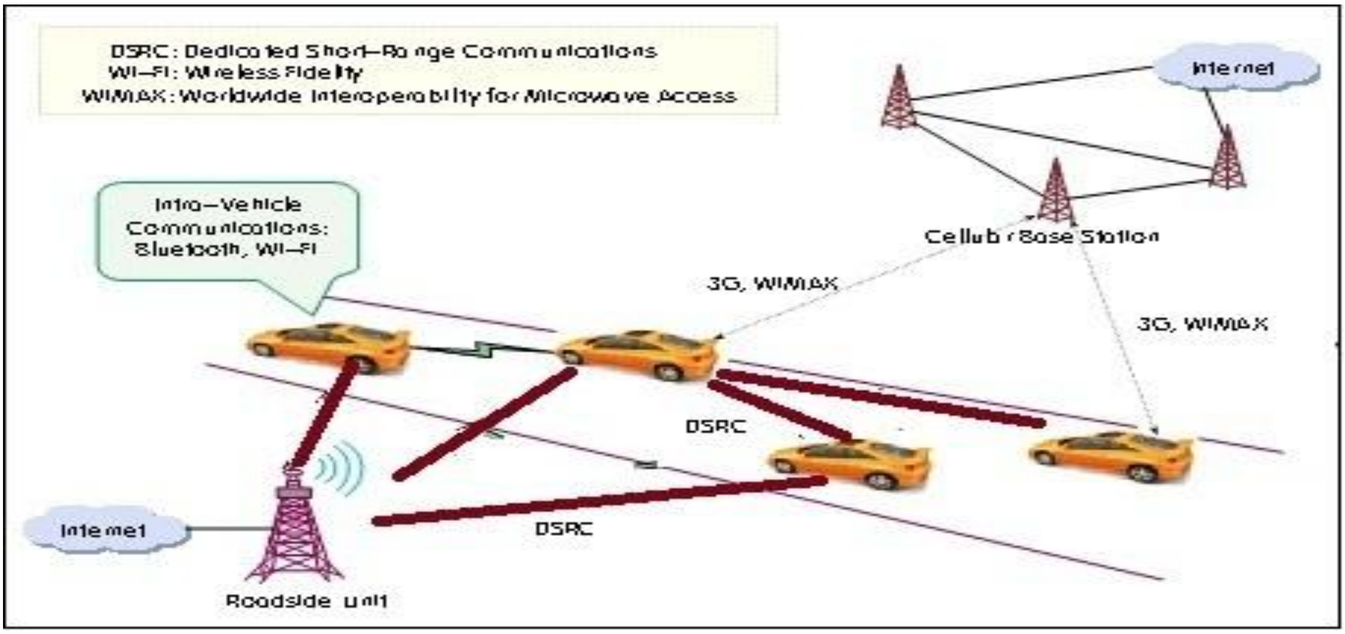

Figure. 2

III. ROUTING PROTOCOLS IN VANET

A routing protocol includes the procedure in establishing a route from source to destination by using the mechanism forward from one node to next participating node, decision in forwarding packets, and action in maintaining the route or recovering from routing failure. Routing protocol governs the way that two communication entities exchange information [3]. In VANET routing protocol are divided into two categories: -

***a. Topology based Routing Protocols*: -** These routing protocols used the network links' information that exists in the network to perform packet forwarding. Most traditional topology based MANET routing protocols were designed focusing on the efficiency and performance of the network [4]. These protocols should meet some basic requirements like self-starting, self-organizing, loop free paths, dynamic topology maintenance, minimal traffic overhead etc. to deal with the challenges involved in routing. Existing topology based routing protocols can be classified into mainly two types- proactive routing protocols and reactive routing protocols. Table driven (proactive) routing protocols such as Optimized Link State Routing (OLSR), Destination-Sequenced Distance-Vector routing (DSDV),Fish eye State Routing (FSR) and On-demand (reactive) routing protocols such as Ad hoc On demand Distance Vector (AODV), Dynamic Source Routing (DSR). Proactive protocols are table driven protocols much similar to conventional routing, have little delay in route discovery and routing overhead is high. On-demand routing protocols are reactive protocols which obtain route information only when needed and the overhead is low since there is no periodic update of tables. Now we discuss about both proactive (table-driven) and reactive (on-demand) routing one by one.

***a) Proactive Routing Protocol* -** Proactive routing maintains the routing information such as the next forwarding hop is maintained in the background. Control packets are constantly broadcast and flooded among nodes to maintain the paths or the link states between any pair of nodes even though some of paths are never used. A table is then constructed within a node such that each entry in the table indicates the next hop node toward a certain destination. The advantage of the proactive routing protocols is that there is no route discovery since route to the destination is maintained in the background and is always available upon lookup. It providing low latency for real-time applications, the maintenance of unused paths occupies a significant part of the available bandwidth, especially in highly mobile VANETs. It also maintains that routes which are not needed at that time.

***b) Reactive (On Demand Routing protocols)* -** It maintains only the routes that are currently in use, thereby reducing the burden on the network. Reactive routings typically have a route discovery phase where query packets are flooded into the network in search of a path. The phase completes when a route is found. It is suitable for a large network whereas proactive is not suitable for large network because proactive table maintained is not easy task. \

***b. Position based routing protocol* -** Analyzes of traditional routing protocols for MANETs demonstrated that their performance is poor in VANETs [5, 6]. The main problem with these protocols [7, 8] in VANETs environments is their route instability, which leads to packets drops, increased overhead from route repairs, low delivery ratios and high transmission delays.

An alternative routing approach is offered by geographical routing protocols (e.g., GPSR [9], GPSR+AGF[3], GPCR[10] etc.), which decouple forwarding from the nodes identity; they do not establish routes, but use the position of the destination and the position of the neighbor nodes to forward data. Any node ensuring progress toward the destination can be used for forwarding.

The dynamic and highly mobile nature of VANET, where nodes behave very rapid changes in its location in VANET due to which VANET demands such routing method that can deal with the environment of such network. These demands tend the researchers to use positions of nodes in order to provide successful communication from source to destination. Such method in which geographical positions of nodes are used to perform data routing from source to destination is called position based routing.

The forwarding decision by a node is based on the position of a packet's destination and the position of the node's one hop neighbors. The position of the destination is stored in the header of the packet by the source. The position of the node's one-hop neighbors is obtained by the beacons sent periodically with random jitter (to prevent collision). Nodes that are within a node's radio range will become neighbors of the node. Geographic routing assumes each node knows its location, and the sending node knows the receiving node's location by the increasing popularity of Global Position System (GPS) unit from an onboard Navigation System and the recent research on location services [7].

Here we summarize some routing protocols which are based on topology and positionand are following as:-

***a. GPSR (Greedy Perimeter Stateless Routing)* -** In this routing protocol a node forwards a packet to an immediate neighbor which is geographically closer to the destination node. This mode of forwarding is termed greedy mode. In GPSR each node has knowledge of its current physical position and also the neighboring nodes. The knowledge about node positions provides better routing and also provides knowledge about the destination. On the other hand neighboring nodes also assists to make forwarding decisions more correctly without the interference of topology information. All information about nodes position gathered through GPS devices. The forwarding strategy can fail if no neighbor is closer to the destination than the node itself. In this case, we say that the packet has reached the local maximum. When a packet reaches a local maximum, a recovery mode is used to forward a packet to a node that is closer to the destination than the node where the packet encountered the local maximum. The packet resumes forwarding in greedy mode when it reaches a node whose distance to the destination is closer than the node at the local maximum to the destination. GPSR protocol normally devised in to two groups:

- ***a) Greedy forwarding:*** This is used to send data to the closest nodes to destination.
- ***b) Perimeter forwarding:*** This is used to such regions where there is no closer node to destination. In other words we can say it is used where greedy forwarding fails. Perimeter forwarding uses nodes in the void regions to forward packets towards destination. The perimeter forwarding used the right hand rule. In "right hand rule", the voids regions are exploited by traversing the path in counterclockwise direction in order to reach at specific destination.

b. Border-node based Most Forward within Radius Protocol (B-MFR) - Next-hop forwarding method like greedy forwarding scheme for linear network does not support well in highly mobile ad hoc network such as vehicular ad hoc network. Therefore, other position based protocols BMFR have been used for VANET. It is a routing protocol that uses Border-Nodes with maximum projection. The B-MFR utilizes the border-node to avoid using interior nodes within the transmission range for further transmitting the packet [12]. For forwarding packet from source to destination this method selects the border node as a next node. In this method, a packet is sent to the border node with the greatest progress as the distance between source and destination projected onto the line drawn from source to destination.

c. DSDV (Destination Sequenced Distance Vector) - DSDV [13] stands for Destination Sequenced Distance Vector. It is a Proactive routing protocol based on topology routing protocols that use information stored in routing table to take routing decisions. In DSDV, each node maintains route to all known destinations in the form of table. The table has entries as destination node, next hop, and cost metric i.e. number of hops to destination, sequence number assigned by destination to avoid loops and install time i.e. time when entry was made that is used to remove stale entries. The topology changes are updated by immediate advertisements to the neighbors. The tables are updated by full update in which a node sends all information to other nodes, or incremental update in which a node sends only changed entries to other nodes.

Destination	Next hop	Cost metric	Sequence number	Install timing

The advantages of DSDV protocol are that it is simple and path is loop free due to the use of sequence numbers and there is no latency as the path is obtained from the routing table maintained by the nodes.

The drawbacks of the protocol are overhead as some of the information is never used and tables need to be updated regularly that consume a significant amount of bandwidth.

d. Anchor-Based Street and Traffic Aware Routing (A-STAR) - Anchor-Based Street and Traffic Aware Routing [14] (A-STAR) is a position primarily based routing protocol that is specially style for city situations for hiding the vehicle communication system. It assures high property in packet delivery by utilization vehicle traffic city bus data for associate degree end-to-end Association. A-STAR is traffic aware; the traffic on the road determines whether or not the anchor points of the road are going to be thought of within the shortest path. A-STAR routes supported 2 sorts of overlaid maps: a statically rated map and a dynamically rated map. A statistically rated map could be a graph that displays bus routes that usually imply stable quantity of traffic. The development of ASTAR was thoughtlessness with town surroundings. A-STAR conjointly uses traffic data and street awareness in path finding [15].

The advantage of A-STAR routing protocols in low traffic density, A-STAR ensures forlocating AN end-toned connection and by scrutiny with the greedy approach ofelectrical skin response & amp; the Perimeter mode of GPSR. A-STAR uses abrand new native recovery strategy that isadditional appropriate for townsurroundings.

The disadvantage is that packet delivery quantitative relation of ASTARis less than Psych galvanic response& GPSR. And the other is to seek out a path from Supply todestination it uses static informationsupported town bus routes that causes Property problem on some portion of

IV. CONCLUSION

In this paper, we have mentioned many VANET protocols. Position of the vehicle is one among the necessary information for vehicles. Mostly position based routing protocols would like the data concerning the physical location of the collaborating vehicles to be created on the market. When analyzing the survey of protocols, it's found that the position based mostly routing has higher performance. As we survey that within the position based routing protocol, all thepackets area unit received with tiny average delay, higher turnout, and effective utilization and conjointly helps to stop the accidents on the road effectively. In future these protocols can also be used for any analysis in VANET. In later section of the paper we've got mentioned the 3 most dynamic position based mostly routing protocols and one topology based routing protocol and thus drawn the conclusion that's routing protocols has its own benefits and downsides specifically senior. There are variety of schemes forhandling routing and data disseminationhowever there are few units that touch uponsafety needs owing to overhead in discoveringand maintaining routes.To judge the performance varied protocols, VANET will be evaluatedsupported varied performance parameters.Routing vehicle safety communications stay adifficult task. By finding out completelydifferent routing protocol in VANET we've gotseen that more performance analysis is neededto verify performance of a routing protocol withdifferent routing protocols based on variedtraffic eventualities. Comparison may be doneamong the routing protocols within the Overlayso on.

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