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Hybrid routing protocol in Vehicular Ad-hoc Network

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ABSTRACT

A vehicular ad-hoc network is a class of Mobile Ad-hoc Network (MANET), consisting of a network of vehicles, moving at a relatively high speed that communicate among themselves with different purposes. The wireless access in vehicular environment system has been developed to enhance driving safety and comfort of automotive users. The main drawback of VANET network is the network instability, which reduces the efficiency of the network. One of the major challenging issues in VANET is routing due to high mobility and dynamic topology change. Since the routing protocol decides how better the communication occurs among the vehicles, the design of the routing protocol is very important. There are some well-known VANET routing protocol like AODV (Ad hoc On-Demand Distance Vector Routing Protocol), DSR (Dynamic Source Routing (DSR) Protocol), OLSR (Optimized Link State Routing (OLSR) Protocol), GPSR (Greedy Perimeter Stateless Routing), etc. and those routing protocol have some advantages and disadvantages. No routing protocol is efficient alone for all the scenarios of VANET, so it is required to review the existing protocols and find out a hybrid routing protocol for VANET for better connectivity and better communication.

Keywords— *VANET, DSR, OLSR, GPSR*

1. INTRODUCTION

During recent years, there has been an unprecedented growth in wireless networks. This can be attributed to the high demand for wireless multimedia services such as data, voice, video, and the development of new wireless standards. There are a lot of other driving factors that have led to the rapid and continuous change of wireless networks worldwide. Mobility is a major driver for mobile networks because mobile users continue to demand access remotely anywhere and anytime. The ever-growing need for mobile Internet access, interactive services, training.

A form of mobile ad hoc network, to provide communications among nearby vehicles and between vehicles and nearby fixed equipment, usually described as roadside equipment In VANETs, participating vehicles are equipped with a set of wireless sensors and On-Board Units (OBUs) to allow for the possibility of wireless communication between the vehicles and their environs. These devices make each vehicle function as packet sender, receiver and router which enable the vehicles to send and receive messages to other vehicles or Road Side Units (RSUs) within their reach via a wireless medium. These sets of wireless sensors, OBUs or some typical radio interfaces enable vehicles to form short-range wireless ad hoc networks to broadcast kinematic data to vehicular networks or transportation authority's/agencies which process and use the data to foster traffic efficiency and safety on the motorways. VANET-enabled vehicles are fitted with the appropriate hardware which allows for acquisition and processing of location (or position) data such as those from Global Positioning System (GPS) or Differential Global Positioning System (DGPS) receiver. The fixed RSUs are connected to the backbone network and situated at strategic positions across the roads to aid effective, reliable and timely vehicular communications.

RSUs are equipped with network devices to support dedicated short-range wireless communication using IEEE 802.11p radio technology. The possible vehicular communication configurations in Intelligent Transportation System (ITS) include vehicle-to-vehicle (or inter-vehicle), vehicle-to-infrastructure and Routing-Based (RB) communication. Vehicles can directly establish communication wirelessly with one another forming V2V communication or with fixed RSUs forming V2I communications. These vehicular communication configurations rely heavily on the acquisition of accurate and up-to-date kinematic data of both the vehicles and the surrounding environment with the aid of positioning systems and intelligent wireless communication protocols and access technologies for reliable, efficient and timely information exchange. Considering the network environment of VANETs with unreliable, shared communication medium and limited bandwidth [10], smart cross-layer communication protocols are required to guarantee reliable and efficient delivery of data packets to all vehicles and infrastructures (RSUs) within the vehicles' radio signal transmission coverage.

2. REVIEW WORK

As per the proposal of HLAR protocol, combines features of reactive routing with location-based geographic routing in a manner that efficiently uses all the location information available [1]. The protocol is designed to exit to reactive routing as the location information degrades. But their analysis is valid for AODV based on the minimum hop count. And they have assumed that the received packet error at all nodes is same, and in this limit, the route that was picked by the minimum hop count and EXT (Expected Transmission Count) will be same. And they have mainly talked about the extension of AODV and less about geographic routing and merging of these two. In the void region, the REQ packet is flooded to all neighbor vehicles which may increase network overload. In HLAR, the RREQ packets include a Time-To-Live (TTL), which will set by source vehicle and the value of TTL they assumed is 1 which will increase the chance of broadcasting of REQ message cause network overload. Then they proposed to repeat the process of flooding the RRP (Route Repair Packet) to all its neighbor vehicles by reducing the TTL field when the closer neighbor vehicle is not available which is not possible is the TTL value is 1.

Marwane Ayaida et.al [2] proposed Hybrid Hierarchical Location Service (HHLS) in VANET which is a combination of Greedy Perimeter Stateless Routing (GPSR) and Hierarchical Location Service (HLS). GPRS takes care of routing packets and HLS is called to get the destination position when the target node position is not known or is not fresh enough. As per the authors HLS shares, the network into several subsets called regions and close regions are grouped into region level which is fixed and known by all the participating nodes. And the cell dimension is less than the transmission range so that a broadcasted message can reach to all the nodes in the same cell but at the same time this message will reach to another region which not intended. GPSR, a reactive routing protocol to forward the packet to the destination's nearest neighbour until reaching the destination may lead to reach the message lifetime and lose the importance of the message.

A hybrid vehicular routing protocol that facilitates unicast routing by dynamically changing its routing decisions in the presence of RSU infrastructure in order to maximize packet delivery rate has been proposed by [3]. The utilization of infrastructure extends multi-hop routing capabilities to facilitate robust wide area communications and to improve network connectivity but at the same time, it will be costly due to a number of infrastructures (RSU) setup. Beacon messages containing motion (velocity) and position vector (current and previous position) are used to predict if a vehicle has moved out and to determine the next hop neighbour. With these two important fields direction of a vehicle can be an important field by which we can stay connected in the long term.

Table 1: Comparison based on routing mechanism, communicating type and PDR

Proposed Protocol	Protocol Type	Routing Mechanism	Protocol Compared	Communication Type	PDR
LRRT [1]	Position Based Routing Protocol	Unicast	LOUVRE, GSR	V2V	-
MoZo [2]	Cluster Based routing	Unicast	CBDRP, BRAVE	V2V	High
UVAR [3]	Topology Based Routing protocol	Unicast	IRTIV, VDLA	V2V, V2I	High
CBLTR [4]	Cluster Based Routing	Unicast	CBDRP, CBVANET, AODV-CV	V2V	High
DSDV, DSR, AODV [5]	**DSDV:** Topology Based Proactive Routing **DSR, AODV:** Topology Based Proactive Routing	Unicast	Each Other	V2V	AODV: maximum DSDV: Low (in higher vehicle density)
MDORA [6]	Position based Routing	Unicast	AODV, GPSR-L, HLAR	V2V, V2I	High
CBDRP [7]	Cluster Based Routing	Unicast	AODV, GPSR	V2V	Medium
Improved-GPSR [8]	Position Based Routing	Unicast	GPSR	V2V	High compared to GPSR
DAPBR [9]	Position Based Routing	Unicast	GPSR	V2V	Increases with number of vehicles

Following is the table of comparison based on the message, communication overhead and forwarding Strategy

Table 2: Comparison based on the message, communication overhead and forwarding Strategy

Proposed Protocol	Messages	End to end Delay	Communication Overhead	Simulator	Forwarding Strategy	Digital map Required
LRRT [1]	Beaconless and AP Assisted	-	Low	NS2	Greedy	Yes
MoZo [2]	moving Cluster	Average	Low	NS2, SUMO	Dijkstra Algorithm	Yes
UVAR [3]	Exchange hello messages	Less	Low	NS2	Carry & Forward	Yes
CBLTR [4]	Hello Message, CHAD Messages, Leave Messages	-	Low	SUMO, MATLAB	Store and Forward	-
DSDV, DSR, AODV [5]	-	AODV DSR achieved similar performance DSDV: maximum Delay	Not Specified	MOVE, SUMO	Greedy Forwarding and Intersection forwarding	No
MDORA [6]	Hello Message		Low	MATLAB	-	yes
CBDRP [7]	RREQ (Route Request) RREP (Route Reply)	Low	Increase with distance	NS2	Store and Forward	-
Improved-GPSR [8]	-	Increase with distance	Low	MATLAB, MySQL	Greedy Forwarding and Intersection forwarding	Yes
DAPBR [9]	Hello Message	Decrease with no of vehicle	-	NS2, SUMO	Greedy Forwarding	Yes

Table 3: Comparison of various type of routing algorithm

Sl. No.	Classification of Routing Protocol	Merit	Demerit
1.	Position Based Routing Protocol.	a) Need of global route from source to destination hops are not required to be created and maintained. b) Route discovery delay is avoided. c) Beacon message at regular interval made the geographical position available.	Fully dependent on Global Positioning System (GPS).
2.	Topology Based Routing	It classified in 3 types: **Proactive:** Maintain an up to date network topology from each node to other nodes. No route discovery takes place to avoid delay. **Reactive:** Setup the link on demand **Hybrid:** Hybrid routing protocol combines the features of both proactive and reactive routing protocol sometimes called cluster-based routing.	**Proactive:** Frequently update the routing table because of the high dynamic topology. Network traffic is increased. **Reactive:** Searching delay is high for route discovery.
3.	Broadcast based routing protocol	Used for safety related information	Consume the large amount of network bandwidth
4.	Cluster Based Routing Protocol	Attempt to capture the mobility of VANET nodes by creating relatively stable clusters of vehicles for communication.	Increase the communication overhead by finding cluster head.
5.	Geo Cast Based Routing Protocol	Follows the principle of multicasting which reduce the chance of collision.	Deliver the messages to nodes within a geographical region.

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "3½ in the disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refer to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the centre dot to separate compound units, e.g., "A·m^2."

3. CONCLUSION

In this paper, we present several routing protocols in VANET that may be a promising technology for Intelligent Transportation (ITS). The merits and demerits of the studied protocols are also described. The table1 and table2 show the comparative analysis of all the above-stated routing protocols. The domain of Vehicular Ad Hoc Network (VANET) and its related analysis are still in progression phases. This survey paper has given differences among major classifications of routing protocols. In this brief study on various VANET routing protocols; different related research issues and challenges/difficulties are represented that require more effort and research to address them.

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