COMPARATIVE STUDY OF VARIOUS ROUTING PROTOCOLS FOR VEHICULAR AD HOC NETWORKS(VANET)

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Abstract - Vehicular Ad Hoc Network (VANET) uses mobile ad hoc network (MANET) for the implementation of the technology. VANET is used for communication between the vehicles to avoid accidents or the traffic jam occurring during the collision and various other information can also be communicated between the vehicles based on the required applications. Warning message to other vehicles can be broadcasted by the use of VANET technology to control the collision. Based on the performance the protocol for the increased number of vehicle on the road is proposed. In this paper the comparative study of all the protocols is presented. With focus on Position based routing protocol for VANETs. In this protocol, it is assumed that all vehicles are provided with Global Positioning System (GPS) in order to know the locations. Protocol uses restricted GPRS protocol to transfer a data packet and for recovery, carry and forwarding strategy will be used. Both the vehicle-to-vehicle (V2V) and vehicle to-RSU (V2R) communication is considered. All the crossing point on the roads have an RSU (Road Side Unit) which takes all the conclusions that decides in which path the data is transmitted. If no suitable path is found, then the RSUs will store the data packet until they find the suitable way to transmit the data packet. The paper focuses on the novel routing protocol which will be used in the VANET system. The proposed protocol stretches the new development for communication among the vehicles. During emergencies the cost effective VANET technology plays a vital rule.

Keywords - VANET,GPRS, MANET

I. INTRODUCTION

VANET: Vehicular Ad Hoc Network– a stable link and continuous connectivity is achieved by characterizing speed value while distributing the vehicles. VANET comprises of communication occurring with the set of moving vehicles. Vehicular communication systems are networks in which vehicle and roadside units are the communicating node, providing each other with information, such as safety warnings and traffic information. VANET is divided into three parts which is vehicle to vehicle, vehicle to road side unit and vehicle to infrastructure.
Communicating wirelessly among the moving vehicles has been an area of interest for researchers, engineers and practitioners in the last decade with a variety of important applications. One of the main reasons for the slow rate progress in this area is that the implementation is costlier. The objective is to implement VANET technology in all vehicles. The proposed model [1] gives long distance, effective transmission of the information by using wireless transceiver. It consists of a GPS and a wireless transceiver which will be installed to the vehicles and the data communication occurs. The information has to be transferred and if whenever the receiving signal is found to be weaker than the storage device is used to store the data, and when the strength of the signal is high the stored data can be transmitted. Also, based on the applications the information transmitted will be of much use in a larger extent. Objective is to design and implement the module which meets up all the expected desired outcomes involving many applications satisfied with the proper implementation involving programming for transmission. For the communication purpose Internet of Everything (IOE) will be used. To develop novel Techniques based on Dual tree complex wavelets based on OFDM is used for communication because of its lower cost and its efficiency, used in critical applications.

II. LETERATURE SURVEY

In IVC (Inter Vehicle Communication) continuous wireless data transmission occurs either between Road Side Units (RSUs) or On-Board Units (OBUs) in the vehicles. This paper discus uses of SUMO (Simulation of Urban Mobility) and MOVE (Mobility model generator for VANET) to create the traffic and scenarios, and the simulation is done using NS-2; paper [1] compares the simulation of two different protocols namely GPSR (Greedy Perimeter Stateless Routing) and MGPSR (Modified Greedy Perimeter Stateless Routing). GPSR is one of the position-based protocols; it has two ways of forwarding the data packets namely Greedy and Perimeter forwarding [1]. The former one considers the closest node as the destination; the latter is used whenever the former fails. MGPSR increases the lifetime of the network nodes. SUMO – uses net convert (to get road networks to recognize nodes, junctions), poly converts (to get geometrical shapes) and randomTrips.py (to build random roads).
Ad-hoc On-Demand (AODV) and Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocols are examined for different speeds in this paper. Packet Delivery Ratio, Residual Energy, Average End to End Delay and Average Throughput

are the quantities that are measured. AODV – It is a reactive, single path routing protocol, considers only the active paths and stores the information of the active paths, a particular path is disabled if it's not active for a specific amount of time. AOMDV – it is an extension of AODV, involves two methods route discovery and maintenance, it is a multi-path routing protocol so it is best suited for multi-hopping VANETs. In route discovery phase this protocol discovers multiple paths, so whenever there's a path breakage no need of starting the procedure all over again, an alternate path can be chosen from the discovered paths which reduce the time required to find the new paths. Packet delivery ratio is the ratio of number of packets delivered to the total number of packets sent. End to end delay is the time required from the instant the packet is sent to the time it is available at the receiver node including all other delays. Residual energy is the energy remaining after all the communication is achieved. Throughput is the ratio of total number of received packets to the total simulation time [2]. All these parameters are simulated and examined for two different speeds namely 50 and 100.

[2] Discusses about Position based and Topology based protocols. In position-based routing protocols the positions of the nodes are considered. It uses the global positioning system (GPS) for finding the positions of the nodes. Examples of position-based routing protocols are: greedy perimeter stateless routing (GPSR) and distance routing effect algorithm for mobility (DREAM). The disadvantage of position-based protocol is that the GPS might enter a deadlock state, and if the network does not reach the node then the location will not get updated. In topology-based protocol the information about the path between the source node and the destination node is available in the network. Examples of topology-based protocols are: Destination-sequenced Distance-Vector (DSDV), Optimized link state routing (OLSR), Ad hoc on-demand distance vector routing (AODV), dynamic supply routing (DSR), temporally ordered routing protocol (TORA)[3]. In this paper [3] mainly GPSR and E-GPSR is discussed and a protocol by name D-GPSR is proposed. It is stated that D-GPSR can overcome the limitations of both GPSR and E-GPSR protocols. DGPSR protocol considers the angle of orientation and range of the nodes. It considers the node which is at the frame of the collection of the transmitting node as the intermediary node. Considering speed value as the control value the results are simulated for GPSR and DGPSR. The performance parameters such as end to end delay, throughput, and network load and packet delivery ratios are calculated at different speed values and are compared. And it is concluded that DGPSR is better that EGPSR in terms of performance parameters.

In [4], a acute position based routing protocol (APR) for VANETs is proposed, its performance is at its best when the number of vehicle increases on the road when compare to GPSR. Here, it is assumed that all vehicles are provided with Global Positioning System (GPS) in order to know the locations. APR uses restricted GPRS protocol to transfer a data packet and for recovery carry and forwarding strategy will be used. Both the vehicle-to-vehicle (V2V) and vehicle to-infrastructure (V2I) communication is considered. All the crossing point on the road have a RSU (Road Side Unit) which takes all the conclusions that decides in which path the data is transmitted. If no suitable path is found, then the RSUs will store the data packet until they find the suitable wat to transmit the data packet [4]. This practice is appropriate for city environment where the vehicle density is more. Simulation is done in NS-2.35 and the results that are obtained for APR are compared with GPSR.

In [5], a new routing scheme is proposed to make a more consistent path from transmitting node to the receiving node. The simulation is accomplished to estimate the performance of the proposed algorithm is compared with existing AODV-L and the traditional AODV protocols. Packet delivery ratio and Loss packet ratio are few of the performance parameters that are considered in this paper in order to prove the efficiency of the proposed algorithm. Packet Delivery Ratio - is a very important metric that is to be measured when considering the performance of any protocol. It is the ratio of number of sachets arrived at the receiving node to the number of sachets transmitted from the transmitting node [5]. This ratio needs to be high for better performance. Loss Packet Ratio - it is the ratio of the number of sachets that does not arrive at the destination node to the number of sachets generated by the transmitter. Route Stability – it is defined as the stable period of the link between two vehicles. In this paper, an existing system with good performance metrics is introduced. AODV-L is the Artery Mobility Model with LET calculation applied, LET is the method of selecting stable routes. This protocol gives provides effective packet delivery ratio, loss packet ratio and route reliability.

VANETs (Vehicular Adhoc Networks) is a subtype of MANETS (Mobile Adhoc Networks) in which wireless communication is achieved between vehicles, this can help in terms of safety, comfort and also prevention of various obstacles, collisions, accidents with proper communication between the vehicles. High mobility, dynamic topologies, high vehicle velocity are few of the special and different features of VANETs, when considering the communication between multiple vehicles VANETs face problems such as frequent packet drops, path breaks etc as the vehicles are dynamic nodes. This leads to more delay and less data delivery ratio. Therefore, more efficient routing protocols are required in order to handle multi-hop VANETs. One such protocol is geographical routing protocol [6]

which uses the location services such as GPS, in this protocol a node has to store only the information of the vehicles which are in its transmission range is stored. These are called RAR (road-aware-routing) protocols as they include spreading awareness in the road about the vehicles. Different types of RAR protocols are discussed and compared in [6].

Vehicular network is spurred by the growth of the advancement in Internet and various developments in relative communications. The creation of multi-hop car to car communications is useful for providing many vehicular applications that provides safety and suitability ranging. The ranging from office on the wheel to real traffic query, parking space searching, vehicle safety and on-road advertisement are some of the basic applications which can be implemented. Emerging multi-hop communication in vehicular ad hoc networks is a thought-provoking problem due to the rapidly changing topology, frequent network disconnections, which cause failure or inefficiency in traditional ad hoc routing protocols.

The frequent network disconnections are faced and this is addressed by using a carry-and forward mechanism. These mechanisms may incur higher delay. Optimal route with the minimum probability of network disconnection is chosen and this evades carry-and-forward delay. This is achieved using new probabilistic model of network connectivity which takes into justification phenomenon of vehicle traffic in various scenarios. Simulation results show that the proposed CAR protocol outpaces existing VANET routing protocols. In [7] an algorithm is presented for selecting routes with the highest probability of connectivity for evading network disconnections in VANETs. The algorithm uses a new model for network connectivity.

The selection procedure is independent of nodes; this method is tested to perform well in both dense and scarce networks. CAR gives the lowermost interruption related to the modified GPSR and GSR, i.e. GPSR-Buffer and GSR-Buffer [7]. The simulation outcomes also show that the perimeter mode of GPSR can reduce performance in highly dynamic vehicular networks.

The nodes in VANETs can get precise position information from Global Positioning System receivers. The position-based routing is very capable routing strategy for VANETs. The packets are sent to the destination in a stable route.

The novel Position-based Directional Vehicular Routing (PDVR) method is presented. PDVR tries to maintain a stable and efficient route, by selecting the next-hop vehicle based on the neighbor vehicles positions. Due to the high movement of vehicles, routing of data packets over VANETs is difficult. PDVR chooses the next-hop from vehicles moving in the same direction as the forwarding vehicle based on their angular directions relative to the destination. Many scenarios are considered and are presented in the algorithm. The algorithm is based on position and velocity vectors. The evaluation of method is done using NS2 and compared with typical ad hoc routing protocol, Distance Routing Effect Algorithm for Mobility (DREAM), Ad hoc On-Demand Distance Vector (AODV) and VANETs routing based on Cartesian space method. As vehicles can be equipped with GPS receivers, position-based routing algorithms may be employed. In [8] novel position based directional routing method, PDVR is proposed. PDVR is compared with other routing methods by evaluating these methods using the NS2.33 network simulator. Under the similar VANET environment, the simulation results show that PDVR can maintain more steady routes.

In [9] flooding technique is used to transmit data packets from a source to many destinations over a network topology. But the simple flooding technique in VANETs can cause difficulties related to redundancy, medium contention and collision. A strategy is proposed for well-organized flooding in VANET in different networks. An emergency message on accidents that happened around 5 kilometers ahead, this information is sent to prevent vehicles from bumping into bad traffic congestions which might have caused long hours of delay from the unawareness of traffic conditions.

To achieve such requirement, a routing protocol that is capable of reducing packet loss which results in fast message dissemination and reduced redundancy must be utilized. Combined method of location-based and time reservation-based with the aid of Global Positioning System (GPS) of neighboring nodes to minimize duplicate retransmissions in VANET is proposed and opposite direction nodes are used to relay emergency packets to intended receivers by using multi-hop routing method.

The routing algorithm is checked for packet forwarding between two nodes and results prove that the equation is reliable to help reduce losses. Information losses could occur both in high node and low node density, causes packet drops. In high node density, packet collisions and channel fading also contribute to the increase in packet loss which leads to low success rate of receptions by next relay nodes. In low node density, packet drops increase due to low connectivity, thus contribute to low success rate of receptions. For routing, the time reservation-based method calculates the time reservation ratio provided for each node and chooses a node with the lowest ratio to be the next relay node [8]. However, if there is more than one node receiving lowest duplicate packets, then the nodes distances from the border will be compared and the node nearest to the border will be chosen. It is expected from the proposed scheme to yield reduce in redundancy by reducing packet drops which resulted from packet collisions and channel fading, hence increase successful delivery rate. The end-to-end delay and period of delivery is calculated for varying node densities and successful message receptions.

III. ROUTING PROTOCOLS IN VANET

The objective of routing protocols is to find the optimum paths from source to destination with minimum overheads in different verticals. The routing protocols are categorised based on the underlying architectures and scenarios:

A. Unicast Routing

This protocol aims to deliver data from single source and intermediate nodes are used to forward data to single destination or store and forward scheme can be used for delivering data. The network overhead and packet delay is less in this protocol.

B. Multicast Routing

These protocols are used to deliver the data packets from one source to the nodes present in a group by multi-hop communication. Cluster heads are selected for group of nodes in the network in this scheme to communicate inside and outside of the cluster. This routing involves minimum network consumption and packet delivery delay. Cluster head selection in this protocol is itself big research issue. Few algorithm names are mentioned here. Geocast based routing protocol, mobile just in time multicasting protocol (Mobicast), Robust vehicular routing (ROVER), Cluster-based routing protocol Cluster-based directional routing protocol (CBDRP) and Clustering for Open IVC network (COIN)

C. Broadcast Routing

These protocols involve flooding of data packets to all nodes in the broadcast domain for route discovery. Flooding consumes bandwidth, congest the network and there are chances of packet collisions with delay in packet transmission along with low network throughput. Few algorithm names are mentioned here:
Distributed vehicular broadcast protocol (DV-CAST), Distribution-Adaptive distance with channel quality (DADCQ), Density-aware reliable broadcasting protocol (DECA), Position-aware reliable broadcasting protocol (POCA). [2][6]

D. Source-initiated (Reactive or on-demand)

These routing protocols are also called on-demand protocols. When a source node requires a path to new destination, it starts a route discovery process by flooding the network by a route request message to starting with the immediate neighbours of the source. A node sends a route reply message back to source node using unicast communication if any intermediate node has path to destination node or if it is destination node. Few algorithm names are mentioned here: Dynamic source routing (DSR), Ad-hoc on-demand distance vector (AODV), Temporally ordered routing algorithm (TORA), Associativity-based routing (ABR), Routing on-demand acyclic multipath (ROAM). [7]

E. Table-driven (Pro-active)

In these protocols, each node maintains the up-to-date network topology from each node to other nodes in the network in the form of routing tables. Nodes exchange routing information periodically. Whole network is generally flooded with the routing information. Whenever any source node requires to send a packet to destination node in the network, it need a path from source to that destination and for that any appropriate path-finding technique/algorithm is run by source node on the topological information it maintains.
In this table-driven approach, it is important for every node to maintain its routing Few algorithm name are mentioned below: Destination-Sequenced Distance-Vector (DSDV), Optimized link state routing (OLSR), Wireless routing protocol (WRP), Global state routing (GSR), Source-tree adaptive routing (STAR), Cluster head gateway switch routing (CGSR) [7].

F. Hybrid Routing

These routing techniques have best elements from proactive and reactive routing protocols. If destination nodes are under certain distance from source node or within particular geographical routing range then table-driven approach is used. For nodes outside a geographical range, on-demand routing is used. Few algorithm names are mentioned below: Zone routing protocol (ZRP), Fisheye state routing (FSR), Distributed dynamic routing (DDR) Algorithm, Hybrid ant colony optimization (HOPNET), Zone based hierarchical link state routing protocol (ZHLS), Distributed spanning tree (DST) routing, Distributed dynamic routing (DDR) Algorithm. [7]

G. Location-aware (Geographical)

These routing schemes assume that nodes are aware of locations of all other nodes within network through Global Positioning System (GPS) to know the exact location coordinates. Since this approach involves the use of geographical information about all the nodes, the protocol which belongs to these schemes effectively uses this information to provide improvement in the routing performance and reduction in control overhead. Few algorithm names are mentioned below:
Location-aided routing (LAR), Distance Routing Effect Algorithm for Mobility (DREAM), Greedy Perimeter Stateless Routing (GPSR), Dynamic route maintenance (DRM) for geographic forwarding, On-demand geographic path routing (OGPR), Geographic landmark routing (GLR), and Maximum expectation within transmission range (MER)[7][8].

H. Multipath Routing

Standard routing protocols like AODV, DSR are generally used to find a path from source to destination. But multipath routing find multiple

routes b/w source and destination which can help in cases of un-predictable nature of ad hoc network, load balancing in bursty traffic within the network, fault tolerance, higher aggregate bandwidth and improved security.

These multiple paths are generated on-demand or sing a pro-active approach and is of great significance as routes generally get disconnected quickly due to node mobility. The three main components of multipath routing are route discovery, route maintenance and traffic allocation [7] [8]. Few algorithm names are mentioned below: Caching and multipath routing protocol (CHAMP), Ad hoc on-demand multipath distance vector routing (AOMDV), Split multipath routing (SMR), Neighbour table based multipath routing (NTBR),

I. Hierarchical Routing

These protocols build a logical hierarchy of nodes in the network typically through clustering techniques and an associated addressing scheme.

The hierarchy could be based out of geographical information or hop count. Node at upper level works for improving scalability and efficiency of routing. These approaches lead to increased routing tables and control packet overhead when the networks grow in size. Few algorithms names are mentioned below: Hierarchical state routing (HSR), Core-extraction distributed ad hoc routing (CEDAR), Hierarchical landmark routing (H-LANMAR).

J. Geographical Multicast Routing

These protocols may use Global Positioning System to route the packet from a source to destination located within a specific geographical region. Few algorithm names are mentioned below: Direction guided routing (DGR), Geocast adaptive mesh environment for routing (GAMER), a geocasting protocol for mobile ad hoc networks based on GRID (GeoGRID), Geocasting in mobile ad hoc networks (GeoTORA).

K. Power-aware Routing

The ultimate objective of these protocols is to maximize the lifetime of the network by taking routing decisions based on the available energy of nodes, their heterogeneous nature, uneven energy consumption in nodes due to topology of the network and the nature of dataflow [7]. Some algorithm names are mentioned below: Device and energy aware routing (DEAR), Minimum energy hierarchical dynamic source routing (MEHDSR) [7].

Rerouting in VANET can also be classified into five major categories namely as:

- Ad-hoc or Topology Driven Protocols
- Location Based Routing Protocols
- Cluster Based Protocols
- Broadcast Protocols
- Geocast Protocols

IV. CHALLENGING FACTORS IN VANET PROTOCOL

However, a lot of research work has been carried out in this area of VANETs to design an appropriate and effective routing algorithm but most of the research work is still simulation based which may not be suitable for real world situations. On the other hand due to the nature of dynamic network topology, routing in VANET play a vital role for the performance of the networks.

There are various studies and researches in this field and an attempt to propose more efficient routing protocols. However, there is no single routing protocol that can perform efficiently in every situation. Due to high mobility of network nodes and infra structure-less structure of VANET, the traditional routing protocols that are designed especially for mobile ad-hoc networks are not suited well with it.

There are some features of VANET that have to be kept in mind while designing routing protocols.. In a fixed network updating, routing table approximately takes place for every 30sec. This updating frequency might be very low for VANET networks. Due to the high node movement the path does not remain constant.

V. COMPARISION RESULTS

Table 1- Various Simulation parameter values

Protocol	Area in meter^2	Nodes	Range in meter	Data rates in bytes
Connectivity Aware Routing, 2008	-	200	250	512
Position Based Directional Vehicular Routing, 2009	200*50	-	-	1000
Road to Road Routing Scheme, 2009	3600*2500	500	400	4096
GPSR Routing Strategy, 2011	1000*1000	100-150	250	-
Geographic Routing Strategy, 2016	1000*1000	100	250	512
Unicast Routing, 2016	2000*2000	150	-	131,072(128kb)
On-Demand Routing,2017	1000*1000	300	75	2,097,152(2mb)

Table2- Comparison of Various Protocols parameters

Protocol	Data Delivery Ratio	Delay	Bandwidth	Range
Car Routing	Higher	5-10secs	125kbps	1000m
AODV Routing	Higher	-	2mbps	200m
Cluster Based Location Routing	Very Higher	40ms	2mbps	400m

CONCLUSION

VANET is emerging research topic. Routing information from one node to other, protocol plays an important role in such type of networks. Selecting protocol for particular VANET is difficult task. In this paper different VANET routing protocols have been discussed and their parameters are compared. A combination of routing protocols will give an optimized solution for VANETS.

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