

# DATA DISSEMINATION TO REGULATE VEHICULAR TRAFFIC USING HVRP IN URBAN MOBILITY MODEL

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**Abstract**—Vehicular Ad hoc Networks (VANETs) is to enable the dissemination of data for road conditions and emergency situations by independently moving vehicles. This problem can be described as the directional propagation of information originating from linear-network nodes. By using Bidirectional antennas, it is desirable to propagate information in both the forward and backward directions without any congestion. By using multi-hop routing in clusters of connected vehicles to achieve a better propagation rate that exceeds the speeds of individual carrier vehicles. We introduce a new technique for information propagation under various traffic patterns to achieve the better bounds than the existing ones. In order to evaluate the performance of typical ad hoc routing protocols in particular, we used Hybrid Vanet Routing Protocol (HVRP). In our technique the combination static and dynamic sources for both data traffic and vehicle traffic. In order to illustrate the feasibility of HVRP, it is implemented and compared with the existing routing protocols by using NS-2 simulator.

**Index Terms**—VANET, Routing, Cluster, HVRP, Ns-2.

## I. INTRODUCTION

Vehicle ad hoc Network (VANET) is a special type of wireless network in which a group of vehicles form a temporary network without the aid of any established infrastructure or centralized administration. It is featured by dynamic topology, multihop communication, cluster formation and limited security. The primary objectives of VANET routing protocols are to maximize network throughput, maximize network lifetime, minimizing delay and to regulate the traffic congestions. Throughput is usually measured by packet delivery ratio while the most significant contribution to energy consumption is measured by routing overhead which is the number or size of routing control packets. In VANET location specific information's such as restaurants and fuel stations or it can originate from moving vehicles that detect events such as road congestion or road conditions. The models and techniques for addressing each of these scenarios can be quite different. In this paper, we focus on the efficient routing protocol for data dissemination to regulate vehicular traffic that is useful for other vehicles in the system.

The purpose of HVRP protocol is to alert vehicles regarding the traffic conditions and road conditions to guide the vehicle in a right direction. While authors in [4] have concentrated on tight latency bounds to enable immediate response systems, we focus on the more general problem of information propagation. We are going to choose two types of information sources, static source and dynamic source. Static sources such as towers are mounted at certain locations, for example at road intersections, traffic signals, bazaar roads and flyovers. Bidirectional antennas are used as static sources which transmits the movement of vehicle in two usually opposite directions. If any vehicle carrying the information of its current cluster enter into a new zone immediately it will transmit the information's to its corresponding static source and it will retransmits it into those vehicles that are nearer to the next zone in the opposite direction.

There are different architectures for enabling communication between vehicles discussed in [5], including pure ad hoc, wired backbone with wireless last hop, and hybrid architectures. Considering the large scale ad hoc network scenario, and that there can be numerous number of clusters participating in network routing and update process. Each cluster can have different properties and behaviors depending on factors such as the number of cluster members, number of member nodes bordering with other clusters etc. Therefore, in this work, we introduce a new algorithm for estimating the quality of the transmissions in an ad hoc network, termed as high route cluster.

## II. LOCALIZATION

A common requirement for these vehicular networks is the existence of in-vehicle computing and communication capabilities and the assumption that geo-location is achieved via GPS. All of these applications require, or can take advantage of, some sort of localization technique. In the localization problem, the definition of a reference system among nodes is performed by identifying their physical location (e.g., latitude, longitude, and altitude) or their relative spatial distribution in relation to each other. For instance, Map Location is usually done using Global Positioning System (GPS) receivers with a Geographic Information System, while Vehicle Collision Warning

Systems can be implemented by comparing distances between nodes locations combined with geographic information dissemination. VANETs are characterized by extremely high mobility and rapidly changing topology as shown in Fig 1. However, this mobility is constrained in motion due to the existence of roadways and can therefore be cleverly exploited for message propagation. There are some existing routing protocols that have been explored for application in this domain but they have not used these characteristics; mobility, direction of motion, and location information, to enhance the performance of the routing protocols. There are several challenges to adopting existing routing protocols from the field of MANETs [6].

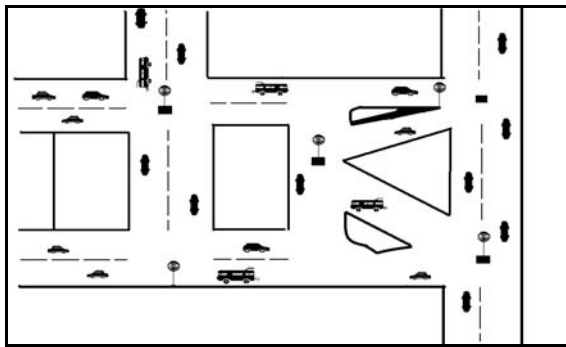


Figure 1. Sample road scenario involving intersections

In our proposed scheme, called Hybrid Vanet Routing Protocol (HVRP), we utilize the vehicles for directionality of data propagation. HVRP is comprised of two components; Inter-Cluster Routing Protocol, and an Intra-Cluster Routing Protocol. Inter-Cluster communication, the message exchange between nodes within a cluster, is a function of the clustering mechanism, while the Intra-Cluster Routing Protocol governs the communication between clusters to achieve the global routing goal. This scheme, operating in cluster entry mode, permits the routing of network partitions when they exist. In hop-by-hop reactive routing protocols like AODV [8], every intermediate node decides where the routed packet should be forwarded next. Route requests are generated at each hop by local broadcasting in case of path discovery. A simple flooding broadcast for route requests generates a considerable redundant packet overhead which is a major cause of inefficiency of VANET routing protocols. The technique in which constrained route request broadcast which is based on node caching [7]. The general consensus based on simulations in the network simulator Ns2 [9].

### III. EXISTING WORK

The design of a MAC protocol to send vehicle to vehicle safety messages is investigated. The paper address the need to give safety messages a higher priority than nonsafety messages. MAC protocol is developed that based on 802.11a which allows messages to be prioritized. The

protocol was then simulated using the Friis and two ray models. The paper addressed the need of creating a protocol to send safety messages in DSRC with varying priorities. The authors found that the protocol will should be feasible if network designers and safety application designers work together. In 200 ms a vehicle should be able to collect information from 140 vehicles in its surrounding. The average time it takes for a driver to react to an accident is 0.7 seconds. The area of intersection communication is an area of future work. Additional adaptive control at the MAC and physical layer is needed. Also, further characterization of the classes of messages is needed [1].

The problem addressed is improving the efficiency of a flooding algorithm, by using a probabilistic broadcast method. The authors use a probabilistic algorithm for relaying a broadcast message, where a node has probability  $p$  of rebroadcast a message and  $1 - p$  probability of taking no action in the rebroadcast of the message. The paper explores the possibility of applying phase transitions for selecting the probability of rebroadcast a message. Phase transition is a well known phenomenon from percolation theory and random graphs. Many other studies try to optimize flooding in ad hoc networks by using a deterministic approach. This paper explores if a probabilistic approach which may be more suitable to ad hoc networks since they are highly dynamic [2].

The problem addressed is developing a broadcast protocol that provides high reliability and low propagation delay. The paper proposes a distributed, position aware "Smart Broadcast" algorithm. Each node that receives a broadcast forwards the packet after a random backoff that is determined based on the nodes position from the source. The algorithm makes use of GPS to speed up the propagation of a message. Little attention has been applied in designing efficient and reliable broadcast propagation algorithms. The simulation showed the algorithm performed well, approaching the performance bound of the MCDS based solutions. A problem with the algorithm is the difficulty of setting some of the parameters used by the algorithm such as the contention window size [3].

### IV. VANET CHARACTERISTICS

We concentrate on information propagation in a urban scenario in which there are multiple vehicles traveling on both sides of the roads with possibly multiple lanes. In this context, information warning messages are destined for multiple and possibly all vehicles in a region. Location information is used as an attribute to limit data propagation to regions. We model the urban mobility model under the assumption that signals are tolerant to local variations. We define each direction of the roadway as a directed pathway; and thus each roadway has two opposing directed pathways. Vehicles are assumed to be equipped GPS capabilities such that vehicles can form nodes of an infrastructure-less ad hoc network. Vehicles traveling in the same direction are assumed to travel with a relatively

constant velocity bounded by  $V_{\min}$  and  $V_{\max}$ . In this paper, we only discuss the propagation of data through the static and dynamic sources at cluster with minimal delay by multihop routing protocols.

#### A. Clustering

In *Distributed Dynamic Clustering Algorithm* the  $(\alpha, t)$  criteria indicate that every mobile node in a cluster has a path to every other node that will be available over some time period  $t$  with a probability  $\geq \alpha$  a regardless of the hop distance between them. DDCA does not require periodic re-clustering. If a mobile node receives multiple replies from different clusters indicating the availability of these paths, it chooses the cluster with the highest path availability probability to join. Re-clustering of DDCA does not invoke ripple effect since the cluster size in DDCA is adaptive and there is no hop limit between two neighboring clusterheads. This is beneficial for keeping the stability of the cluster topology and reducing the control overhead for cluster maintenance.

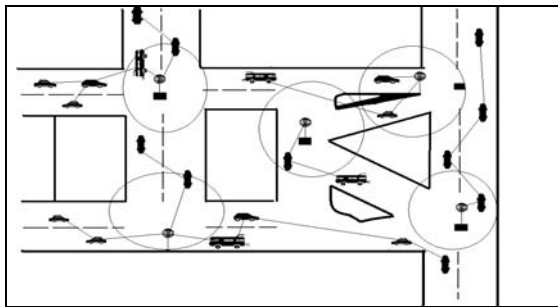


Figure 2. Data Transmission

In *Adaptive Multi-hop Clustering* maintains a multihop cluster structure based on load-balancing clustering. AMC does not describe how the clusters are initially constructed. However, for cluster maintenance each mobile node periodically broadcasts its information, including its ID, CID, and status to others within the same cluster. AMC keeps a multi-hop cluster structure for both the formation and maintenance phases. AMC does not address how to form the multi-hop cluster structure initially, so we cannot evaluate its cost in terms of stationary assumption, computation round, and communication complexity. Thus, AMC brings no ripple effect of re-clustering and maintains good cluster stability [10]. Vehicles traveling on the same direction and those coming from the opposite direction can form interconnected blocks of vehicles, illustrated in Fig. 2. We envision this kind of node arrangement to represent common urban behavior of vehicles.

#### B. Routing

Designing efficient routing protocols for VANET is quite a challenging task owing to the fast speed of nodes and mobility constraints on the movement of nodes. An attempt has been made in this paper to help accomplish this task better. Under some simplifying assumptions, the analysis of this paper has established that the solution of the optimization problem under consideration tends to equalize the lifetimes of adjacent links in a route. A routing protocol usually has three main functions: route discovery, optimal route selection among various candidate routes discovered and route maintenance. End core node attempt to buffer received packet and find another route to destination and send traffic from new path as shown in Fig 3.

In, CBGR Protocol core nodes selected to perform more function. We use source routing in CBGR but put only core nodes in packet header. For overcoming location servers inaccuracy and also search near destination we use RF method. For route failure, proportional of devastated place we use different solution to eliminate breakdown. Results of simulation show that CBGR in compare with some of popular routing protocol in MANET from view point of packet delivery rate, amount of control overhead and average delay has better performance [11].

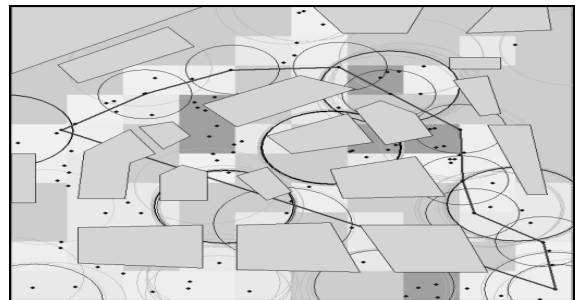


Figure 3 Real time cluster formation including Obstacles

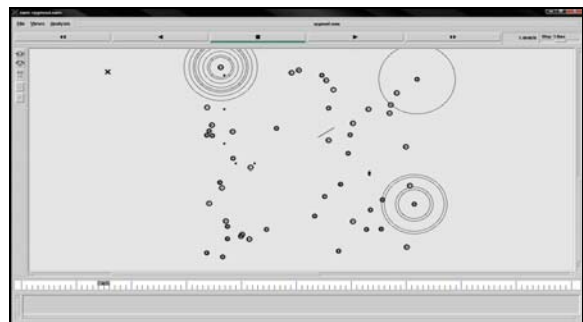


Figure 4. Ns-2 implementation with static sources and cluster heads

### V. HVRP ROUTING PROTOCOL

We assume that vehicles are spread-out along the urban scenario is dense in the sense that in a sufficiently small neighborhood of any point on a lane we can always find at

least one node on the same lane. This is like assuming that the transmission range 'r' of a node is significantly large as compared to the distances between two successive nodes in any lane. It is also assumed that the width of the lanes on an urban model is negligible when compared to the transmission range of mobile nodes along the length of highway. In ad hoc networks, nodes may move at different speed. By limiting the transmission coverage, packets transmitted by a node may not be received by the next node over some established data route as shown in Fig 6.

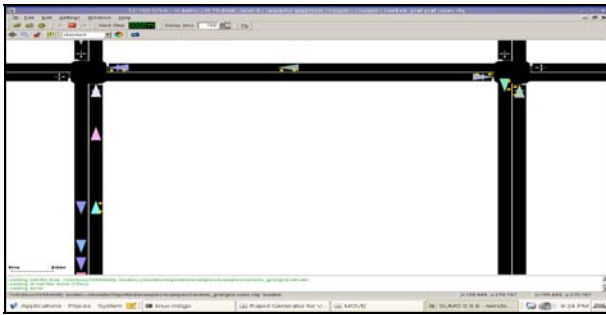


Figure 5. Real time traffic scenario using VANET simulator.

When a link breakage is detected by the source, it must recreate a route if still needed to send data. To retransmit quickly the source to the destination. Whether the source finds any dynamic sources within the range it will retransmit the message otherwise until it enter it should keep the message once it will enter into the new cluster zone message will the delivered to the static source and it will be propagated thru the bidirectional antennas as shown in Fig 5. In order to achieve this, we propose that during data transmission, the vehicles that those which are in the transmission range should send the short life time beacon signals containing its location, speed and direction periodically to clusterhead.

HVRP Algorithm

1. Initialize the location of static sources and it radio range.
2. Choose the dynamic source with slow mobility as a clustehead.
3. Transmit the information to the vehicles within the range.
  - If sender Msg\_ID == Receiver Msg\_ID.
  - Receivers discard and Source keeps the message.
4. Each vehicle carry and forward messages to neighbor one.
5. Update the message to the exit node of the cluster.
6. If any new cluster entry node
  - Update if any new veh\_ID and its Clu\_ID
7. Received the information and update to those vehicles in the opposite direction.
8. IF sender direction is opposite to receiver direction.
  - IF sender Clu\_ID == receiver Clu\_ID
  - Transmit the messages

- IF sender Clu\_ID != receiver Clu\_ID
  - Check the lookup table for valid entry (security )
  - Transmit the message to it nearby node and static source discard the message.
- 9. END.

The network fragmentation prevents continuous end-to-end connectivity between all nodes. The dense traffic is described as high density of vehicles with end-to-end connectivity and no fragmentation (in the area of interest) and propagation is limited by routing, medium access.

VI. SIMULATION

The simulation model was based on the Network Simulation (NS2) as shown in Fig 4. An unslotted carrier sense multiple access with collision avoidance (CSMA/CA) is used for data transmission in MAC layer. The radio model uses characteristics similar to a commercial radio interface. HVRP establishes a better data dissemination path based on Cluster ID without flooding and additional phase as shown in Fig 8.

TABLE I. SIMULATION OF PARAMETER VALUES

Channel type	Channel/WirelessChannel
Propagation model	Propagation/TwoRayGround
Mac protocol type	Mac/802_11
Antenna type	Antenna/Bidirectional
Max packet in queue	250
CPTresh_	10.0
CSTresh_	5.011872e-12
RXThresh_	5.82587e-09
dataRate_	11Mb
basicRate_	1Mb

We define the number of visitors to be the number of users who either were already in the region at the start of the hour or entered during the hour. Note that a user can be counted at most once for a region in a given hour. While our model considers the variations for the beginning and ending of each working day, it currently does not consider the variation for certain hours during the day.

Most existing routing protocols continue using a route until a link breaks. By using updated information with the clustering technique HVRP protocol. Experiments demonstrate that adding node location prediction to HVRP can significantly reduce the total number of dropped data packets (by at least 40%). We also found that the proactive route maintenance does not cause significant increase in average packet latency and average route length. Enhanced route cache maintenance based on the link status can further reduce the number of dropped packets as shown in Fig 7.

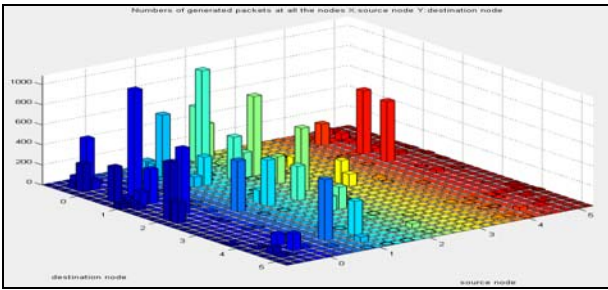


Figure 6. Data dissemination from station sources

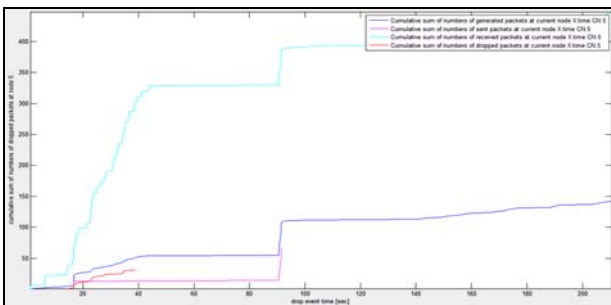


Figure 7. Packet delivery ratio using HVRP

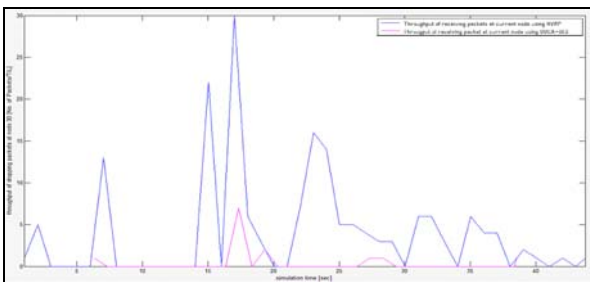


Figure 8. Throughput HVRA Vs DDCA

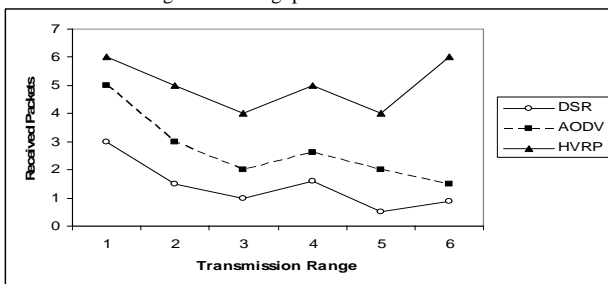


Figure 9. Received Packets.

Maximum achievable throughput is limited by the maximum number of permitted concurrent transmissions. First, note that the maximum number of paths which can pass through an arbitrary section on the road is  $n$ , the total number of vehicles; this happens when half the vehicles are to the right and the other half to the left of that section. Constraint on the number of simultaneous transmissions affects the achievable throughput as shown in Fig 8 and also even if the transmission range increases by using

HVRP each node receives more number of packets than other protocols.

VII. CONCLUSION

In this work, we have proposed a new algorithm to enable data propagation of messages in VANETs by using both static and dynamic sources. The algorithm is distributed in nature which does not require global information and can perform irrespective of the traffic density. Additionally, this study constructs a geographic structure to simulate real streets. A generator tool is implemented to generate a mobility trace file for ns2. The researchers have to adopt a proper mobility model to estimate their methods in accordance with their demand. We believe that this model, and the methods used to construct it, will be useful for research in many areas of mobile computing and communications.

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