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Survey on Data Discovery and Dissemination Improvement in Vanet Using Bio-Inspired Algorithm

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Abstract—Several Vehicular Ad hoc Network (VANET) studies have focused on the communication methods based on IEEE 802.11p, which forms the standard for Wireless Access for Vehicular Environments (WAVE). This paper proposes a hybrid architecture, namely VMaSC-LTE, combining IEEE 802.11p based multi-hop clustering and the fourth generation cellular system, Long Term Evolution (LTE), with the goal of achieving high data packet delivery ratio and low delay while keeping the usage of the cellular architecture at minimum level. In VMaSC-LTE, vehicles are clustered based on a novel approach named VMaSC: Vehicular Multi-hop algorithm for Stable Clustering.

Keywords: VANET, WAVE, VMaSC, LTE, MANET.

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) studies have focused on the communication methods based on IEEE 802.11p, which forms the standard for Wireless Access for Vehicular Environments (WAVE). In the networks employing IEEE 802.11p only, the broadcast storm and disconnected network problems at high and low vehicle densities respectively degrade the delay and delivery ratio of safety message dissemination. Recently, as an alternative to the IEEE 802.11p based VANET, the usage of cellular technologies has been investigated due to their low latency and wide range communication. However, a pure cellular based VANET communication is not feasible due to the high cost of communication between the vehicles and the base stations, and high number of hand-off occurrences at the base station considering the high mobility of the vehicles.

In VMaSC-LTE, vehicles are clustered based on a novel approach named VMaSC: Vehicular Multi-hop algorithm for Stable Clustering. The features of VMaSC are cluster head selection using the relative mobility metric calculated as the average relative speed with respect to the neighboring vehicles, cluster connection with minimum overhead by introducing direct connection to the neighbor that is already a head or member of a cluster instead of connecting to the cluster head in multiple hops, disseminating cluster member information within periodic hello packets, reactive clustering to maintain cluster structure without excessive consumption ofnetworkresources,andefficientsizeand hop limited cluster merging mechanism based on the exchange of the cluster information among the cluster heads. These features decrease the number of cluster heads while increasing their stability therefore minimize the usage of the cellular architecture. From the clustered topology, elected cluster heads operate as dual-interface nodes with the functionality of IEEE 802.11p and LTE interface to link VANET to LTE network. Using various key metrics of interest including data packet delivery ratio, delay, control overhead and clustering stability,

II. SURVEY RELATED DETAILS

Several VANET studies have focused on the communication methods based on IEEE 802.11p, which forms the standard for WAVE. IEEE 802.11p provides data rate ranging from 6 Mbps to 27 Mbps at short radio transmission distance, around 300 m. Disseminating safety information over a large area requires an intelligent multi-hop broadcast mechanism handling two major problems: broadcast storm [6] and disconnected network [7]. The broadcast storm problem occurs at high vehicle traffic density where the packet delay and number of collisions at the medium access control layerincrease dramatically as the number of vehicles attempting to transmit simultaneously increases. Probabilistic flooding [6] and clustering are commonly used to address the broadcast storm problem. On the other hand, the disconnected network problem occurs at low vehicle traffic density where the number of nodes is not sufficient to disseminate the information to all the vehicles in a certain region. Store-carryforward, where the vehicles in the opposite lane are used for message dissemination, is commonly utilized to address the disconnected network problem [7]. The solutions addressing both broadcast storm and disconnected network problems however have been shown to provide network delays varying from a few seconds to several minutes and the percentage of the vehicles successfully receiving the packets going down to 60% .

Recently, as an alternative to the IEEE 802.11p based VANET, the usage of cellular technologies has been investigated. The key enabler of such usage is the standardization of the advanced content broadcast/multicast services by the Third Generation Partnership Project (3GPP), which provides efficient message dissemination to many users over a geographical area at fine granularity. The use of the third generation mobile cellular system, called Universal Mobile Communication System (UMTS), in the safety application of the vehicles has already been experimented in Project Cooperative Cars (CoCars). The traffic hazardous warning message has been shown to be disseminated in less than one second. The fourth generation cellular system, called Long Term Evolution (LTE), is an evolution of UMTS increasing the capacity and speed using a different radio interface together with core network improvements. The LTE specification provides down-link peak rates of 300 Mbps, up-link peak rates of 75 Mbps, transfer latency of less than 5 ms and transmission range up to 100 km in the radio access network. Despite the high rate coupled with wide-range communication, however, a pure LTE based architecture is not feasible for vehicular communication due to the high cost of LTE communication between the vehicles and the base stations, high number of hand-off occurrences at the base station considering the high mobility of vehicles, and overload of the base station by the broadcast of high number of vehicles at high vehicle traffic density.

III. FUNDAMENTALS OF ROUTING IN VANET

The core design goal of VANETs is to reliably and efficiently disseminate safety messages to all the related (endangered) vehicles on the road. The intended propagation region could be the immediate transmission range of about 300 meters or the long multi-hop forwarding range spanning more than a kilometer distance depending on the type of safety application. 5 Highly dynamic VANET topology and wireless signal environment make message propagation and routing a constant challenge. The distribution of vehicles is highly non-uniform, and the connectivity among them is highly random. Furthermore, the inevitable use of the common control channel for safety applications makes message propagation immensely vulnerable to collisions and interference. In the following, some of the challenges faced in VANET safety-message propagation are briefly outlined. Several safety messages need to be propagated to vehicles beyond the immediate transmission range, e.g., safety alert messages about hazardous driving situations such as dangerous road surface, unexpected road block, accidents, and unexpected fog banks. The propagation of a message beyond the immediate transmission range involves multi-hopping in the highly dynamic network. Consequently, the propagation scenario becomes much more complex since multi-hop increases the chances of collision and also causes the over consumption of radio resource resulting from unnecessary retransmissions. The propagation requires multi-hop forwarding of the message by selected vehicles among a large number of contenders. The problem becomes severe in dense urban traffic where a higher number of contending vehicles results in excessive packet collisions. Since these collisions greatly impact the reliability of reception and the overall message-dissemination speed, it remains the core concern while developing ideas for message routing in VANETs [13]. The lack of feedback mechanism resulting from the broadcast communication scenario is another serious problem in VANET message propagation. The propagation path, either single-hop or multi-hop, involves a number of factors that obstruct some vehicles along the way from receiving the safety-alert message. As a result, the obstructed vehicles either receive the message not intact or are completely oblivious of the activity in the channel. Furthermore, since safety-message dissemination is carried using broadcasting, there is no feedback mechanism to recover the impeded vehicles, thus always compromising reliability.

IV. PROPOSED WORK

Proposed multi-hop cluster based IEEE 802.11p-LTE hybrid architecture for the first time in the literature. The features of the multi-hop clustering algorithm used in this hybrid architecture, called VMaSC, are cluster head selection using the relative mobility metric calculated as the average relative speed with respect to the neighboring vehicles, cluster connection with minimum overhead by introducing direct connection to the neighbor that is already a head or member of a cluster instead of connecting to the cluster head in multiple hops, disseminating cluster member information within periodic hello packets, reactive clustering to maintain cluster structure without excessive consumption of network resources, and efficient size and hop limited cluster merging mechanism based on the exchange of the cluster information among the cluster heads. Combining all of these features in a multihop cluster based hybrid architecture, using minimum overhead cluster connection, and size and hop limited cluster merging mechanism are unique characteristics of VMaSC.

Using the Genetic Algorithm (GA), we are planning to reduce the delay, and improve the energy efficiency and increase throughput of the system. This will also improve the lifetime of the network. So to reduce delay in data dissemination and also to improve the energy efficiency of the system, Genetic algorithm (GA) is used.We propose a Genetic Algorithm based data discovery and dissemination protocol which gives a near optimum solution for the system as the fitness function incorporates all the 3 parameters, it works as follows:

1. Generate a random set of solutions for the system.
2. For each iteration-
   A. Find the fitness of each of the solutions (fitness is a function of delay, energy and throughput).
   B. Find the mean value of fitness.
   C. If fitness of a solution is less than mean fitness, then discard the solution and generate a new one on its place, else use the solution for the next iteration.

3. At the end of Nth iteration, the best fitness solution will be the most optimal one .Using Genetic Algorithm (GA), we are planning to reduce the delay, and to improve the energy efficiency and increase throughput of the system. This will also improve the lifetime of the network.

V. AIMS AND OBJECTIVES

A Hybrid architecture, namely VMaSC-LTE, combining IEEE 802.11p based multi-hop clustering and the fourth generation cellular system, Long Term Evolution (LTE) ,with the goal of achieving following objectives:

1) High data packet delivery ratio.

2) Low delay while keeping the usage of the cellular architecture at minimum level.
3) Decreasing the number of cluster heads and increasing stability.

VI. CONCLUSION

The main objective of the review paper was to throw some light on the previous proposed work. We also discussed the various architecture and their strengths and weaknesses associated. We believe that all of the algorithms surveyed in this paper are effective , but the advantages favors more for Genetic Algorithm due to its iterative selection from the population to produce most optimized and efficient results .

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