Data Discovery and Dissemination Improvement in VANET using Hybrid Architecture

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Abstract—Vehicular Ad-Hoc Network (VANET) is a promising Intelligent Transportation System (ITS) technology that enables numerous applications such as safety message dissemination, dynamic route discovery, gaming and entertainment. This paper proposes an architecture which is the integration of IEEE Wireless Access in Vehicular Environments (WAVE), VMaSC: Vehicular Multi-hop algorithm for Stable Clustering and 3GPP networks (LTE), combining these two technologies to achieve the high data rates of IEEE 802.11p-based VANETs and wide coverage of 3GPP (LTE) technology simultaneously. In this architecture, vehicles are clustered based on this approach. VMaSC, and elected heads operate as dual-interface node with the functionality of IEEE 802.11p and LTE interface.

Key words: Data Discovery, Data Dissemination

I. INTRODUCTION

VANET is a promising Intelligent Transportation System (ITS) technology that enables many applications such as safety message dissemination [1][3], dynamic route planning [4], content distribution, gaming and entertainment [5].

A. Routing Architecture for VANET

The architecture of routing in VANET is basically the same as the architecture of routing in other connectionless networks. As usual, the conceptual framework and terminology of VANET are more highly elaborated than those of its roughly equivalent peers [6]. The VANET routing architecture applies to hop-by-hop connectionless open systems routing in general. The routing architecture for VANET is given in figure-1. The VANET routing scheme consists of:

- A set of routing protocols that allow end systems and intermediate systems to collect and distribute the information necessary to determine routes.
- A routing information base containing this information, from which routes between end systems can be computed i.e. directory information base, the routing information base is an abstraction and it doesn't exist as a single entity. The routing information base can be thought of as the collective (distributed) information of an entire subsystem concerning the routing relevant connectivity among the components of that subsystem.
- A routing algorithm that uses the information contained in the routing information base to derive routes between end systems. End systems (ES) and intermediate systems (IS) use routing protocols to distribute some or all of the information stored in their locally maintained routing information base. ES and IS send and receive these routing updates, and use the information that they contain and information that may be available from the local environment, such as information entered manually by an operator to modify their routing information base. The routing information base consists of a table of entries that identify a destination [9].

II. PROPOSED METHODOLOGY

A. LTE Based Heterogeneous Architecture For VANET

In this chapter, we propose a novel framework where the main idea is to integrate WAVE and LTE radio modules into a single device and permit them work concurrently in order to disseminate data packets.

1) Heterogeneous Architecture System Model

The network illustration of union of clustered VANETs and LTE network is demonstrated in Figure 2. The topology shows a road with VANETs where vehicles are grouped based on their direction of movement and average relative speed. In our proposed hybrid architecture, vehicles are equipped with two set of interfaces denoted by IEEE 802.11p and LTE which can operate simultaneously. An eNB base station is positioned in the center of the road and the VANET is considered to be under the coverage region of eNB. The main objective of proposed hybrid architecture is effectively and efficiently forwarding data packets over multi-hop clustered network in a large scale network with the help of LTE. Vehicles are clustered based on multi-hop clustering technique VMaSC by considering cluster stability and clustering cost. In this architecture, vehicles are assumed to be under coverage of single eNodeB where roaming and handover issues are not considered. After cluster formation CM vehicles forward data packets to its connected CM or CH. When CH receives data packets, it applies update in the LOCAL_KNOW and disseminates data packets to the cluster members and to other clusters. In hybrid architectures, CHs function based on Algorithm[1].
In CH state, vehicles are responsible for coordinating the dissemination of DATA_PACKET. DATA_PACKET can come from either eNodeB or cluster itself. CH _rst controls the DATA_PACKET if it comes from eNodeB (Line 2). If DATA_PACKET comes from eNodeB, CH decodes the data packet and extracts the generator id ID DATA and data packet sequence number SEQDATA in order to refresh the LOCAL_KNOW (Line 3).

After extracting information, uniqueness of the received packet is checked. This is achieved by investigation of the LOCAL_KNOW in regard to (IDDATA-SEQDATA) 2-tuple (Line 4). If current data packet is received for the _rst time, CH refreshes the LOCAL_KNOW and disseminates into own cluster by including its own id (Lines 5-7). If DATA_PACKET is generated by cluster member, same steps are applied except current data packet is also delivered to eNodeB to be disseminated to other CHs.

2) Algorithm: VANET-LTE CH State Data Forwarding Algorithm
   for all received DATA_PACKET do
     if DATA_PACKET is from eNodeB then
       Extract IDDATA and SEQDATA
       if (IDDATA-SEQDATA) not 9 in LOCAL_KNOW then
         Update LOCAL_KNOW
         Attach CH id into DATA_PACKET
         Broadcast DATA_PACKET into cluster
       else
         Update LOCAL_KNOW
       end if
     else if DATA_PACKET is from CM or CH itself then
       Extract IDDATA and SEQDATA
       if (IDDATA-SEQDATA) not 9 in LOCAL_KNOW then
         Attach IDDATA and CH id into DATA_PACKET
         Broadcast DATA_PACKET into cluster
         Create LTE DATA_PACKET
         Forward to eNodeB
       else
         Update LOCAL_KNOW
       end if
     else
       Update LOCAL_KNOW
     end if
   end for

III. ADVANTAGES
   The performance of proposed VMaSC-LTE integrated architecture is better than previous one in terms of data packet delivery ratio (DPDR).
   Compared to VMaSC, the DATA_PACKET dissemination in VMaSC-LTE is performed via using the eNodeB which facilitates higher DPDR. the high number of cluster change does not have huge effect on VMaSC-LTE architecture.
   - High data packet delivery ratio.
   - Minimize delay while keeping the usage of the cellular architecture at minimum level.
   - Decreasing the number of cluster heads and increasing stability.

IV. RESULTS AND DISCUSSION

Fig. 3: Screenshot No.4.1: Comparison of delay metric between previous methods and proposed system
Above graph shows that metric delay is minimum using our proposed system as compared to existing system.

Fig. 4: Screenshot No.4.2: Comparison of energy metric between previous methods and proposed system
This graph shows energy consumed by proposed system is less than that of existing system. Green color shows energy consumed by proposed system and red color shows energy consumed by existing system.

Fig. 5: Screenshot No.4.3: Comparison of jitter metric between previous methods and proposed system

Fig. 2: Integrated VANET-LTE Hybrid Architecture
Above graph shows that metric jitter is good in our proposed system as compared to existing system.

Fig. 6: Screenshot no.4.4: Comparison of packet delivery ratio metric between previous methods and proposed system

This graph shows that packet delivery ratio is maximum in our proposed system than existing system. This shows that packet delivered is more in proposed system.

Fig. 7: Screenshot no.4.5: Comparison of routing load metric between previous methods and proposed system

This graph shows that number of packets routing per router is maximum in case of proposed system than the existing one. This shows that metric routing load is maximum in proposed system.

Fig. 8: Screenshot no.4.6: Comparison of throughput metric between previous methods and proposed system

This graph shows that throughput is high using our proposed system as compared to the existing system.

V. CONCLUSION

Among the hybrid architectures, VMaSC-LTE achieves the lowest delay and highest DPDR due to better clustering stability, minimal clustering overhead and minimal overlap among clusters. The DPDR and delay analysis at different number of maximum hops allowed within clusters shows that increasing the maximum number of hops up to 3 increases the DPDR at the cost of slight increase in the delay

VI. FUTURE SCOPE

Future work, aims to investigate the use of VMaSC-LTE(vehicular multi-hop algorithm for stable clustering in VANETs) in urban traffic scenarios and extend VMaSC-LTE architecture with data aggregation and calculation of the clustering metric with additional information such as the most probable path information of the vehicle.

REFERENCES

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