ISSN: 2321-7782 (Online)
Volume 2, Issue 5, May 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Multi-hop Stable Clustering in VANET on Highways

Sheth Parita M[1]
IT department
Parul Institute of engineering and Technology
Limda, Vadodara – India

Hemangi Kothadiya[2]
IT department
Parul Institute of engineering and Technology
Limda, Vadodara – India

Abstract: ***Vehicular ad hoc networks (VANET) clustering is one of the control mechanisms used to make VANET global topology less dynamic. There are various VANET clustering algorithms are derived from mobile ad hoc networks (MANET). However, VANET nodes are differentiated by their high mobility and the presence of VANET nodes in the same geographic manner that does not mean that they give the same patterns of mobility. Therefore, VANET clustering mechanisms would take under consideration the degree of the speed varies among near nodes to generate relatively stable clustering structure. We tried to develop the stable clustering algorithm for the highway scenario. With the use of the parameters like direction of vehicle and its average speed we distributed them in the cluster of pre specified range of the speed. Thus we can decrease the change in the topology.***

Keywords: VANET; Clustering ; Cluster Head ;State Election; VMaSC.

I. INTRODUCTION

The **Vehicular Ad hoc Network (VANET)** is a technology having the art of integrating ad-hoc network, wireless LAN and cellular technology to achieve intelligent Inter-Vehicle Communications (IVC) also known as Vehicle-to Vehicle (V2V or C2C) communications and Roadside-to-Vehicle Communications (RVC or R2V) [1]. In one-hop clustering each member node is at most 1-hop distance far from a central coordinator said as the cluster head. That is why each member node remains at most 2-hops distance far from each other within a logical cluster. But in multi hop clustering, the constraint of immediate neighborhood of members from the head is eliminated by allowing the nodes to be available at most hop distance far from one another to create a cluster.

II. EXISTING WORK RELATED TO CLUSTERING IN VANET

A. Clustering

Clustering is one of the techniques applied on the unsupervised dataset. Different types of clustering methods are hierarchical, partition, the goal of develop an algorithm is to construct stable multi-hop clusters with minimum number of cluster heads in VANET. They proposed a novel mobility metric, that is periodically exchanged and used for similarity calculation among vehicles. They use multi-hop clustering with stable mobility metric in highly dynamic scenario. They have used simulation of multi-hop clustering under realistic vehicle mobility which is generated by realistic mobility generator SUMO [9].

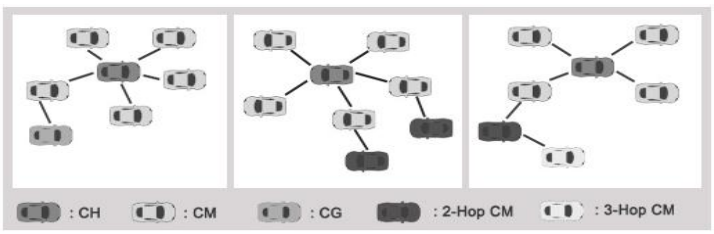

Figure 1 Clustered network topology [3]

The nodes in VANET aim to form clusters such that each has one cluster head and all nodes in a cluster can communicate with the cluster heads in a number of hops that is less than a maximum pre-determined value. Figure shows three example clusters, namely 1-hop, 2-hop and 3hop, where in each case middle vehicle is the cluster head (CH), and vehicles that are n-hop far away, are n-hop cluster members (CM).

B. Cluster Formation and Maintenance

Upon collecting the clustering related metrics; direction, current state, current speed, current hop counter, $AVGREL_{speed}$, MAX_HOP, $MEMBER_{ch}$, $GUEST_{cm}$, in INITIAL,LOCAL KNOW, $AVGREL_{speed}$ is updated. When the vehicle timer is expired, vehicles change state to STATE ELECTION and clustering process is triggered. $AVGREL_{speed}$ can be calculated as below:

$$AVGREL_{speed} = \frac{\sum_{j=1}^{n} |S_{current}(t) - S_j(t))|}{n}$$

where n is the number of same direction neighbors, current is the index of the vehicle evaluating the relative mobility, Sj(t) is the speed of the j-th same direction neighbor.

C. Algorithm

States of Vehicles

Each vehicle can operate under one of the five states as described below.

- INITIAL is the starting state of the vehicle. Vehicles stay in this state and start to receive and send HELLO PACKETs with clustering related attributes.
- STATE ELECTION is the state where the vehicle makes decision about the next state based on state election algorithm (Algorithm-1) by using LOCAL KNOW which is constructed upon reception of packets.
- CLUSTER HEAD is the state of the vehicle which is less mobile with respect to its neighbors.
- CLUSTER MEMBER is the state where the vehicle is connected to a constructed cluster.
- CLUSTER GUEST is the state which is enabled only in one-hop scenarios and used for preventing system from unnecessary cluster head election in case when a vehicle cannot hear head related message, it declares itself as new cluster head. Vehicle in this state is regarded as a cluster member which accesses to cluster with the help of a cluster member.

D. Limitations of previous work

- Increase cluster head changes
- Do not provide more stability
- It makes more clusters in one lane.

III. Propose Scheme

Clusteing

The proposed system will use the speed threshold for clustering. While vehicle is in state 'STATE_ELECTION' it will search the neighbors of the speed in the range of its own average speed e.g. if vehicle is at the speed of the 85kmph than it will search the vehicles with the average speed in the range of 80-100 kmph. The proposed system uses the custom defined ranges described below:

Range 1: 100-80 kmph

Range 2: 79-60 kmph

Range 3: 59-40 kmph

If a vehicle's average speed is more than the 100 kmph than it will join the cluster with 100 kmph as a guest of a cluster Thus we can maintain the stability of the cluster.

The proposed algorithm will not choose the cluster head which has lowest relative average speed but will choose the head based on the average speed of all the available vehicles of the cluster member.

Algorithm

Proposed system is to assign the state to the vehicles currently in the 'STATE_ELECTION' state. It is as follows:

Step 1: While Vtimer is not expired

Step 2: Check if any of the available neighbor with the same Direction for the speed range

Step 3: If Cluster with same speed range is found than

- If cluster head is in transmission range then join the cluster and change the state to 'CLUSTER MEMBER'
- Else cluster head is not in range than connect to its cluster member as a guest and change the state to the 'CLUSTER_GUEST'

Step 4: Else if Cluster with the different speed range is found than

Join the cluster as a cluster guest and change the state to the 'CLUSTER_GUEST'.

Step 5: Else If no cluster is found then

- If own average relative speed is average between the neighbors' of the same speed range then Broadcast CH_ADV packet and change the state to 'CLUSTER_HEAD'
- Else wait for CH_ADV_PACKET until Vtimer Expires

Step 6: If Vtimer Expires

- Change state to STATE_ELECTION
- Trigger cluster forming process again

IV. SIMULATION

To evaluate performance Ns3 software is used and following parameters are considered for obtaining results.

TABLE 1 Basic Simulation Parameters

Parameters	**values**
High way length	1000m
Number of vehicles	Auto generate
Number of RSU	5
Cluster head changes	0-10
Simulation time	0-350sec
Transmission range	100-300 m
HELLO_PACKET period	200 ms
Vtimer value	2 s
Cluster head duration	0-150

V. Simulation Result

Here the graphical representation of result is given. As we can observe that, according to simulation time, number of changes in cluster head varies. As simulation time increases, the number of changes in cluster head is also going to increase. Same scenario is run with same system configuration and different simulation time with different number of vehicles as can be seen in the screen-shots.

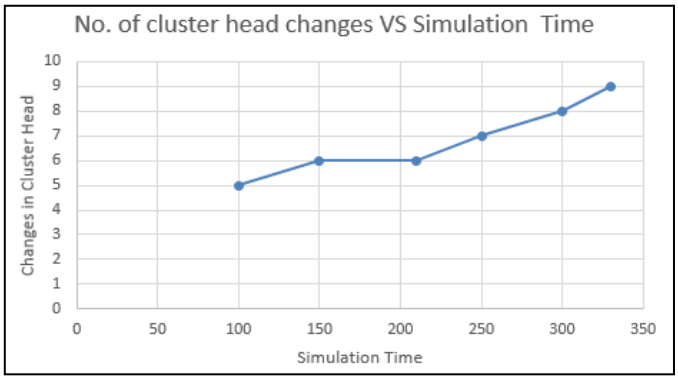

Figure 3. No. of cluster head VS Simulation Time

As seen in the following graph that increase in the simulation time will increase in the average CH time. The increase in the average CH time in not much compared to simulation time.

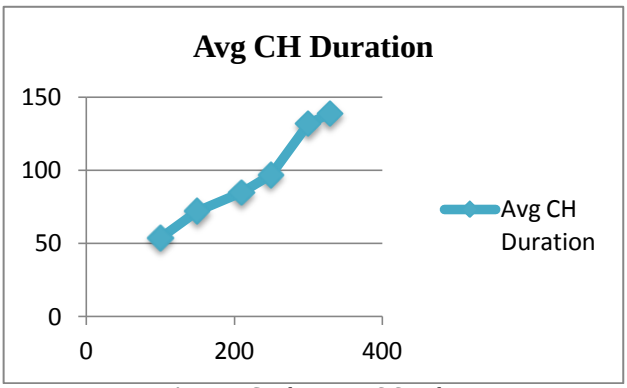

Figure 4. Average CH duration VS Simulation Time

VI. Conclusion

The state election algorithm is simulated on the ns-3 with varying the simulation time. As can be seen in the graph of the result analysis section that increase in the simulation time increases the change of the cluster heads. The proposed algorithm will use the pre-specified speed range and will cluster the vehicles according to the speed range. So it will decrease the number of changes in the cluster heads. As a result more stable clusters will be generated compared to state election algorithm.

Acknowledgement

The Authors wish to thanks Hemangi Kothadiya this work was supported by her.

References

1. O. Riva, T. Nadeem, C. Borcea, and L. Iftode, “Context-aware migratory services in adhoc networks,” IEEE Transactions on Mobile Computing , vol. 6, no. 12, pp. 1313–1328,December 2007
2. O. Riva, J. Nzouonta, and C. Borcea, “Context-aware fault tolerance in migratory services,” in Proceedings 5th Annual International Conference on Mobile and Ubiquitous Systems:Computing, Networking and Services (MobiQuitous) , Dublin, Ireland, July 2008.
3. Seyhan Ucar, Sinem Coleri Ergen, Oznur Ozkasap, “VMaSC: Vehicular Multi-hop algorithm for Stable Clustering in Vehicular Ad Hoc Networks”, Wireless Communications and Networking Conference (WCNC), IEEE, 2013
4. Zaydoun Y Rawashdeh, Syed Masud Mahmud, “A novel algorithm to form stable clusters in vehicular ad hoc networks on highways”, EURASIP Journal on Wireless Communications and Networking 2012
5. Adil Mudasir Malla, Ravi Kant Sahu, “A Review on Vehicle to Vehicle Communication Protocols in VANETs”, IJARCSSE, Volume 3, Issue 2, February 2013

6. Peng Fan, James G. Haran,V.R. Sirotiuk,E. Chávez (Eds.) Cluster-Based Framework in Vehicular Ad-Hoc Networks NOW 2005, LNCS 3738, pp. 32, Springer-Verlag Berlin Heidelberg 2005

7. Zhenxia Zhang, Azzedine Boukerche and Richard W. Pazzi "A Novel Multi-hop Clustering Scheme for vehicular ad hoc network".

8. Mohammad S. Almalag and Michele C. Weigle "Using Traffic Flow for Cluster Formation in vehicular ad hoc network .

9. Suchismita Chinara Æ Santanu Kumar Rath "A Survey on One-Hop Clustering Algorithms in Mobile Ad Hoc Networks" J Netw Syst Manage (2009)

10. Telecommunications Research Lab (TRL) School of Computing Queen's University Kingston, Ontario, Canada, K7L 3N6 December 2011 " Routing for Wireless Multi Hop Networks – Unifying and Distinguishing Features".

11. NS2 versus NS3: http://www.nsnam.org

12. http://vnt.disi.unitn.it/usage.php

