

A Cluster Management System for VANETs

Swati Changdeo Pakhale

Assistant Professor, Department of Computer Science & Engineering, Sanmati Engineering College,
Washim, Maharashtra, India

ABSTRACT: Vehicular ad-hoc networks (VANETs) are a key solution for the communication in intelligent transportation systems (ITS). Where, high portability of vehicles on roads may due to changing delays and message losses which can limit the use of VANETs in some ITS summery. This paper proposes and calculate a cluster management system for VANETs (CMS) which makes communication in VANETs are more powerful and useful enabling the collection of data of individual vehicles that travel on roads at any time. Assumed experiments show that the proposed system accomplishes upgraded communication in VANETs approve their use in ITS applications such as the real-time road traffic management and control.

KEYWORDS: ITS, VANETs, Traffic Control, Data Collection, Cluster Formation, Communication.

I. INTRODUCTION

The main purpose of Vehicular Ad-hoc Networks (VANETs) is to enable the communication among vehicles (V2V) and with roadside infrastructure (V2R) thus supporting the implementation of Intelligent Transportation Systems (ITS). ITS consist of applications of traffic control and management. These applications depend on accurate vehicle data at any time while in traffic in order to limit crashes, to control traffic lights and to manage public transit and urgency services. However, frequent failure on communication links and message delays as well as message loss through the nodes are some of the issues to be solved in order to use VANETs communication. The main causes of these problems are related to high mobility of vehicles and the conditions of the physical space in which communication takes place. Solutions for improving VANETs communication have been proposed in Morden years. Among the main ones are those that assume hierarchical network architecture partitioning the nodes into virtual clusters? Organizing VANETs hierarchically provides scalability development and allows treating problems related to mobility and communication within the clusters preventing them from generating in the network. However, creating and maintaining clusters at the changing space of vehicle networks requires self-organization and self-adaptation solutions. These solutions should allow the node to decide at any time the most appropriate actions to maintain integrity of its cluster. The clustering level constructs hierarchically the network communication architecture, uniting vehicles travelling on the same lane in virtual clusters. As for the communication level, it makes the nodes become more tolerant about message delays and losses.

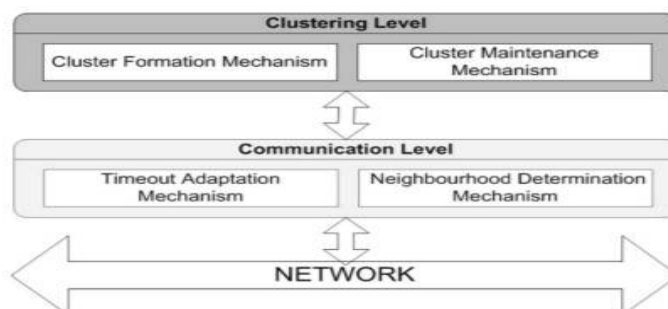


Fig. 1 Cluster Management System - CMS

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While the communication level tries to correct the changes of the physical environment, avoiding link losses, the clustering level uses this mechanism to form and manage clusters. The joint performance levels of communication and clustering contributes to increased robustness and capability in communication between nodes of vehicular networks, increasing the time of the groups and compressing the number of topological changes in the network, as indicated by the results of the experiments given in section. The operated experiments to evaluate the system show that the collective and equivalent performance of the mechanisms and algorithms implemented in both levels commit to improve the VANETs communication performance and allow accurate data selection about the road traffic.

II. RELATED WORK

In recent years some proposals have used hierarchical organization for VANETs are to control medium access (Cluster-MAC Protocols). Others have used routing approach to advertise information about traffic conditions on the road. Two proposals are the Mobility Based measured for Clustering (MOBIC) and the Weighted Utility Function (WUF). These proposals were chosen for comparison for the sense that, just as the CMS, these algorithms try to rise the stability of cluster and allow data selection of vehicles that travel on the roads.

MOBIC organizes travelling vehicles in clusters taking as its mandatory criterion their mobility in relation to the neighbours within one communication hop. Node mobility is determined based on the relative velocities through the node and its neighbours on the equal road. The node that presents the lowest mobility in its neighbourhood turn into the leader (cluster head) and others in its communication range are related to it complete the cluster. The cluster head quits its function when it leaves the road or when it performs a integration with its cluster and another one in its neighbourhood. In order for a fusion to develop between two clusters, each cluster head must continue under the communication area of the other for an assertive time. This time is denominated Cluster Contention Interval (CCI) later which one cluster joins the other. Along with the fusion, MOBIC has a time-based mechanism that grants the node to undergo message losses, thus trying to split the number of fusions and cluster reconfigurations.

In the solution proposed by WUF vehicles on the same road are organized in clusters. In this motion, the vehicles periodically performance messages containing information about velocity, position, ID and time. Based on the information obtained from its neighbourhood, the node uses a function to calculate its analogous weight which indicates the usefulness of the node to become the cluster head. The node with lowest weight in its surrounding concludes the function of cluster head and the others join it to form the cluster. After the development of clusters, the nodes that keep calculating their corresponding weights and every time that a member of the cluster has a lower weight than the top, a cluster restructuring take place. Similar to the proposals represent above, CMS also organizes vehicles travelling on the road in clusters. The next category describes the communication model adopted for CMS nodes.

III. NODE MODEL

In order to implement CMS it is assumed that the nodes are supplied with a Global Position System (GPS) and a digital map of the roads. Each node also has a local clock that is adjust with the GPS. The vehicles that travel on the road are organized in clusters. Their organization is resolved by the actions of the mechanisms of cluster construction and conservation which are described in the next section. During the cluster formation mechanism, a node must assume one of the following states: UNDECIDED if it doesn't capable in any cluster, CLUSTERHEAD if it is a cluster leader, MEMBER if it is connected to its leader, GATEWAY if it is affiliated to its leader but at the same time it further communicates with nodes that do not belong to its cluster. The cluster head has the function of save each member's data and provide them for other vehicles or for the roadside framework. The Fig. 2 illustrates the states that a node can consider during its timeline and the conditions that source state changes. Such changes appear from the performance of mechanisms complete at the clustering level.

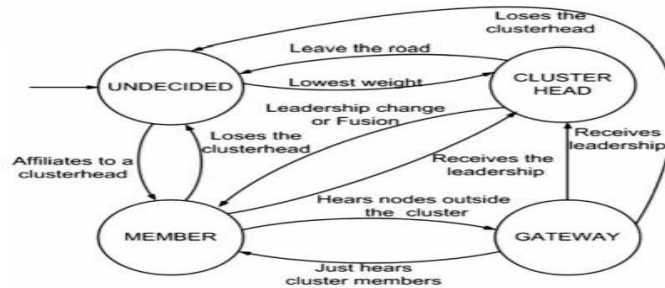


Fig. 2 State machine model of node states and possible transitions

IV. CLUSTERING LEVEL

The objective of the clustering level is to decrease the number of failure on communication links as well as to cut the number of changes in the network geology caused by the great movement of its nodes. At this level, vehicles travelling on the road are organized in virtual clusters construct hierarchical communication architecture.

This level consists of two strictures: cluster formation and cluster maintenance. The first one joins the vehicles in groups with identical mobility characteristics while the second one escape that vehicle movements lead to cluster partition.

4.1 Cluster Formation Mechanism

The cluster development mechanism joins in the same virtual cluster vehicles with similar velocity, location and direction. This mechanism's function is to form clusters in which vehicles continue together as long as possible. Cluster formation appears from the selection of a leading vehicle (CLUSTERHEAD). This choice is built in a scattered way by calculating the weight of each node. Such weight is a real value calculated by the node using data about its behaviour, the road and other nodes in its communication range. In the end, each node's weight expresses how much it is capable for this function. The formation process starts assuming that all nodes are UNDECIDED. As soon as the vehicle starts traveling on a road determined at its digital map, it starts to run the algorithm define below.

TS: An UNDECIDED node traveling on one of the roads described at its digital map disseminates a signalling message which contains its Id_i , its (x_i, y_i) coordinates and its v_i velocity

TS+1: A node calculates a weight after receiving information about its neighbours. At this moment the vehicle attaches the received neighbours' data to the N_{bi} field.

TS+2: A node receives the messages sent by its neighbours, updates their data and disseminates a new signalling message which contains its weight and the weights received by its UNDECIDED neighbours that travel with it on the same road.

TS+3: A node analyses if it has the lowest weight among its UNDECIDED neighbours in two communication hops. This ensures the algorithm convergence and the most appropriate node choice that fits the CLUSTERHEAD function in each neighbourhood.

TS+4: An UNDECIDED node that hears to a CLUSTERHEAD in its neighbourhood requests to branch to it. If the affiliation is confirmed, the node changes its status to a MEMBER. The CLUSTERHEAD may revoke a node affiliation request if the number of affiliated members has refused the τ maximum limit.

4.3 Cluster Maintenance Mechanism

The maintenance mechanism purpose is to cut down the number of partition, affiliation and clusters reconfiguration caused by vehicle action on the road. This mechanism is composed by: a leadership transference algorithm, a combine cluster algorithm and a affiliation algorithm. It is completed as soon as the node assumes the status of CLUSTERHEAD or MEMBER.

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4.4. Re-affiliation Algorithm

In this paper, as well as other proposals, a re-affiliation ensure when a vehicle leaves its cluster and joins to a Morden group of vehicles in your neighbourhood. In other proposals, the re-affiliation only occurs when the member fail contact with its leader. For a given time, this involve the node is not part of any group and therefore its data is not possible for collection. However, in CMS each member regularly monitors its leader and other leaders in its neighbourhood, guessing a G_c connectivity degree for each. Based on this conclusion, the member decides to remain a member of its current leader or re-affiliate to a new leader ahead the link between them will break. The G_c connectivity amount is calculated by the node and provides an estimate of period and quality of the link between it and each leader in its neighbourhood. Calculate the G_c relatedness degree as follows:

$$G_c = c_1.S + c_2.F + c_3.E \quad \left| \sum c_i = 1, \right.$$

in which the S component serve as an estimate duration of the link between the node and a leader in its neighbourhood. The F component expresses which leader in the neighbourhood has the link with less communication problem. The S component in G_c is calculated as shown below:

$$S = \frac{r_i - d_{(i,j)}}{v_r} \begin{cases} v_r = (|v_i - v_j|) & \text{if } |v_i - v_j| \geq 1 \\ v_r = 1 & \text{if } |v_i - v_j| < 1 \end{cases}$$

in which r_i is the communication area of i node, $d_{(i,j)}$ is the distance between it and a j leader and v_r is the corresponding velocity among them. The F component which represents the element of the link between nodes i and j is retrieve from:

$$F = T_S - A_{(i,j)}$$

in which T_S is the warning time of the nodes and $A_{(i,j)}$ is the average delay of the last n signalling report that the i node received from its j neighbour. In this equation, the larger the value of F, the lower the average waits for communication between nodes. Details of $A_{(i,j)}$ delay calculation are granted in Section 5.1. Finally, the E component which is also a quality symbolic of the link between i node and j leader in its neighbourhood is determined by

$$E = 1 - \frac{m_p}{n}$$

In which m_p is the number of messages that an i node stopped gathering from a j leader in its neighbourhood in the last n signalling time.

V. COMMUNICATION LEVEL

Other aspect besides mobility affects the communication between the nodes of VANETs. Questions such conflict, crashes or intervention in the physical space are the cause of constant delays and loss of messages among the nodes. The communication level of CMS appliance two mechanisms to deal with these problems. The structure of neighbourhood dedication allows the node calculate whether a neighbour, from which is not receiving signalling messages, should be stored or removed from its neighbourhood. The mechanism of timeout transformation allows the node to adjust to dynamic conditions of network communication permitting delays among the signalling messages. The collective action of these mechanisms devote to increased robustness and efficiency in connection among the nodes of VANETs as indicated by the decision of the experiments.

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V. EXPERIMENTAL RESULTS

The CMS is calculated in simulated environment under practical conditions of vehicular mobility and network communication. The purpose of the experiments is to establish the robustness and capability provided by CMS and if this permit the collection of data at any time on vehicles that travel on the roads. This decision is based on the following metrics: & Number of reconfigurations: produce the average number of changes in the network topology per system time. & Number of re-affiliations: illustrate the average number of re-affiliations among the clusters appearing per unit of time. & Clusters' period: The mean duration time of the clusters. & Data efficiency: It is the difference between the traffic identified by the cluster heads in relationship to the traffic simulated on the road.

VI. CONCLUSION

This article express a cluster management system to organize vehicular ad hoc networks that compose VANET communication more robust and effective, permissive its use in collecting data around urban traffic on the roads. The results access from the experiments demonstrate that the CMS devote to improving communication in VANETs, display low rates of reconfigurations and re-affiliations and increasing the clusters' span and skill of data available for roadside framework. The analysis of the obtained results also shows that the CMS can permit the implementation of other ITS operations as routing and P2P conversation among the vehicles.

REFERENCES

1. P. Basu, N. Khan, and T.D.C. Little. A Mobility Based Metric for Clustering in Mobile Ad Hoc Networks. ICDCSW, 2001.
2. M. Behrisch, L. Bieker, J. Erdmann, and D. Krajzewicz. Sumosimulation of urban mobility-an overview. 3th International Conference on Advances in System Simulation, p. 63–68, 2011.
3. Biswas, S., Tatchikou, R., Dion, F.: Vehicle-to-vehicle wireless communication protocols for enhancing highway traffic safety. Communications Magazine, IEEE 44(1), 74–82 (2006)
4. O. Brickley, C. Shen, M. Klepal, A. Tabatabaei, and D. Pesch. A Data Dissemination Strategy for Cooperative Vehicular Systems. IEEE 65th Vehicular Technology. p. 2501–2505, 2007.
5. W.R. Chang, H.T. Lin, and B.X. Chen. TrafficGather: An Efficient and Scalable Data Collection Protocol for Vehicular Ad Hoc Networks. 5th CCNC, pages 365–369, 2008.
6. OMNeT++ Community. [Online], <http://www.omnetpp.org/>, January 2012.
7. P. Fan. Improving Broadcasting Performance by Clustering with Stability for Inter-Vehicle Communication. IEEE 65th Vehicular Technology article-Spring, 2007.
8. Girinath, D.R., Selvan, S.: A novel cluster based routing algorithm for hybrid mobility model in VANET. IJCA 1(15), 35–42 (2010)
9. T.O. Kim, S.D. Jung, and S.S. Lee. Cmm: Clustering-based multichannel mac protocol in VANET. In Computer and Electrical Engineering. volume 1, pages 380–383. IEEE, 2009.
10. R. Kumar and M. Dave. A comparative study of various routing protocols in VANET. Arxiv, 2011.
11. T.L. Sheu and Y.H. Lin. Cluster-based slot allocations for intervehicle communications in VANETs. 7th IWCMC, pages 1500–1505. IEEE, 2011.
12. D. Conan and P. Sens and L. Arantes and M. Bouillaguet. Failure, Disconnection and Partition Detection in Mobile Environment. 7th International Symposium on Network Computing and Applications, pages 119–127, 2008.