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The Degree-Based Dynamic Clustering Technique for Vehicular Ad Hoc Network

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Abstract: - Vehicle communication is a best technique of intelligent Transport systems. The, ad hoc networking in the vehicular environment was explored intensively. This paper proposes a new Dynamic clustering technique for high flow vehicular ad hoc networks. The cluster formation is determined by the degree of nodes and the priorities associated with the vehicle traffic information. Each cluster elects one node as its cluster head. The cluster size is controlled by a predefined maximum distance between a cluster head and its members. Clusters are independently controlled and dynamically reconfigured as nodes move. This paper presents the stability of the proposed cluster structure, and communication overhead for maintaining the structure and connectivity in an application context

Keywords: VANET, Cluster, Cluster head, RSU, degree.

I. INTRODUCTION

VANET is mainly used to provide safety and other internet applications to its users. It provides information about road conditions, accidents and congestion [4].VANET is the sub-category of MANET. It is network of vehicles and enables communication among vehicles and also between vehicles and fixed infrastructure points [1].it is self-mobilize network that provide intelligent way of communication on road. Each vehicle in this network contains a device that is able to send and receive data [13, 5].communication held in VANET network are inter-vehicle (V2V), vehicles to infrastructure and infrastructure to infrastructure. In V2V, vehicle send hello messages to other vehicles and share information regarding to the road conditions and other alter messages.V2I communication have wide range. It is mainly base of some routing protocols [6].due to high mobility and dynamic nature use of standard routing protocols is not possible. Because existing routing protocols are not efficient enough to enhance the performance of the network. Game theoretic method is widely used to present the operation of VANET network in real world. It helps to design self-administrative routing algorithms and interaction models for moving nodes [2].VANET network has several safety advantages but on the other side it has few disadvantages such as delay, communication overhead , lack of quality of service , connectivity and security problems etc [12].

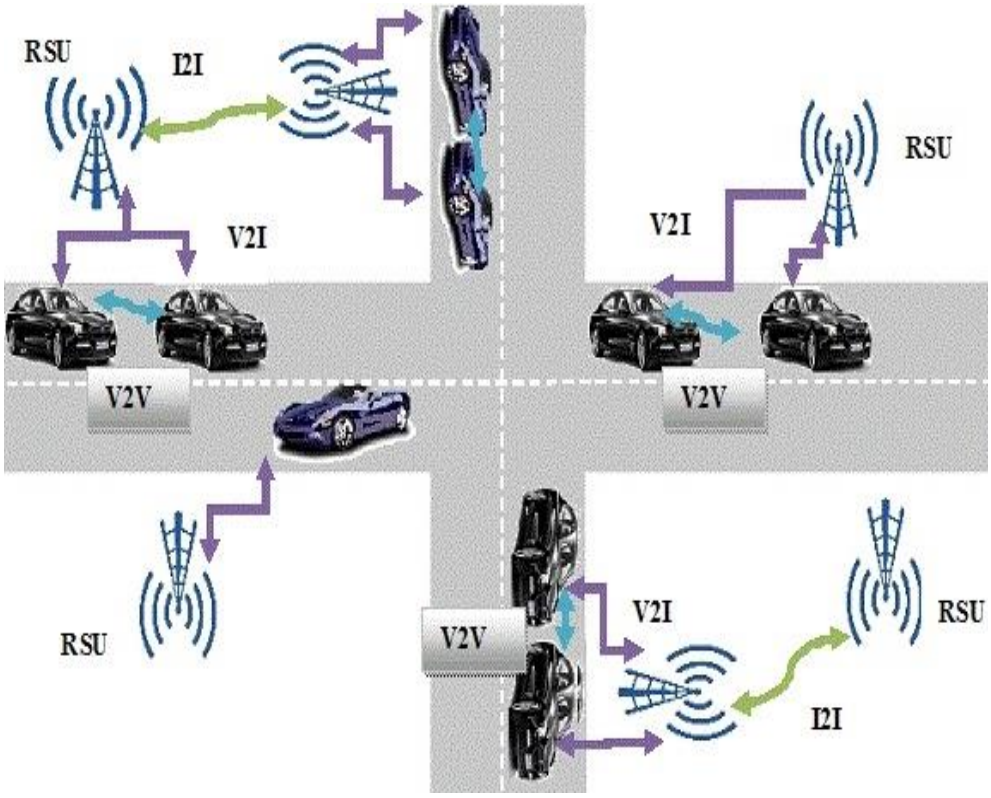

Fig. 1 (VANETS)

II. CLUSTERING

Clustering is a mechanism of grouping network into clusters to enable efficient communication.[10]each cluster has three types of nodes : cluster head, gateway and cluster members. Cluster head maintain the cluster and all routing jobs of a cluster. Gateway node is the nodes that enable inter cluster communication. Other nodes inside the cluster are the member nodes of cluster they can communicate with each other directly or indirectly through CHs [11]. clustering make the system more capable and it also reuse the resources. It also makes the network smaller and stable. Clustering perform the routing, bandwidth allocation and channel access function [10].

Clustering process is the combination of three processes: cluster formation, cluster maintenance and cluster reconfiguration.

2.1 Cluster Formation

It is process of making a cluster in which cluster formation algorithm and a cluster head selection algorithms are used. Non members of cluster or other nodes will to join cluster send hello messages. Formation of a cluster is based on these messages.

2.2 Cluster Maintenances

It is the process of managing a cluster. It keeps track every cluster and cluster members. Some node wants to leave or join a cluster mostly based on pre –assumption defines in formation algorithm.

2.3 Cluster Reconfiguration

It is the process of making new clusters or splitting and merging the existing clusters. In this process new algorithms are used to done reconstruction or other processes.[3]

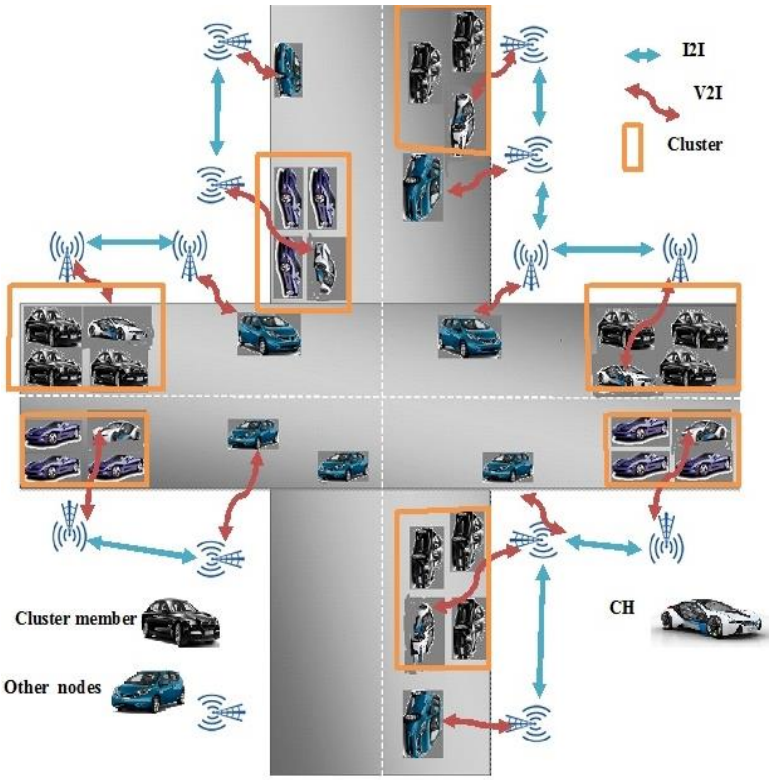

Fig 2.(clustering)

Clustering process divided into two sub-parts: static and dynamic clustering. Static clustering or clustering process partitioned the network into clusters. Sometimes these clusters are formed by using RSUs as its part. This process mainly uses the MANET mechanisms' of clustering.

Dynamic clusters are formed by using similar parameters. Reconfigurations of clusters are also done in mobile clusters. Merging and splitting of clusters are also possible in dynamic cluster. Routing protocols are used for all clustering processes. Clustering reduce the delay time and improve the delivery rate [14]

III. RELATED WORK

Raik Aissaoui et al. [7] suggest a location service for urban area by using hierarchical cluster. It is lightweight method. Maps of cities are defined in advance. Overhead of traffic signals are avoided because of these maps. Assumptions are used to update digital maps. This algorithm increases the success, improve the performance and also reduce the cost of the network. It also give better scaling results. Many security and reliability mechanism are defined. This algorithm is used to provide accurate real time positioning information. HCBL give quick response to every location query. This response is based on hierarchy of layers. Each layer have different kind of data. LTE and GPS technologies are used in HCBL.

Jaskaranpreet Singh et al.[8] propose a hybrid clustering algorithm for VANET. Mobility models and number of neighbor are used for cluster formation. Backbone is formed by using higher degree of nodes. A backbone helps in election of heads. Location information defines the mobility model for clusters. in formation process neighbor sensing is done to find near nodes. Hello messages are send for detecting nodes. Election of head mainly based on leadership of cluster called backbone. Reconfiguration of cluster is done when all members of cluster leave the cluster. Two or more cluster merge to make new cluster and head is elected again. This method also shows the cluster life time in rural area. This method reduced the cost and increases the stability of network. Lifetime of cluster is increased to form stable cluster.

Jianli Xie et al. [9], suggest a dynamic entropy based weighted clustering scheme that improve the network. Entropy is the uncertainty extent of information. So it is used to present the mobility parameters of vehicles. Number of neighbor nodes, distance between nodes and node energy consumption factors are considered for forming a cluster. Minimum weighted node elected as the cluster head. Changes are made time to time because of higher mobility factor. Monte Carlo method is used to maintain the cluster. This method defines the reconfiguration and election process of new head by using weight. Suggested algorithm make clustering stable .this method gives better performance and also improve the inter cluster commutation. Whole algorithm use too many mathematics formula's and equations. Results show the effectiveness of proposed algorithm in high speed environment.

IV. PROPOSED WORK

In our proposed Algorithm, The complete distributed system like VANET, every node can act as a source or a relay node, which motivates the need for efficient algorithms to select servers according to the outlined system goals. Each vehicle store the information related to the cluster within the transmission range of source node. In our Algorithm, a fixed number of dynamic and static sources are known to every vehicle of the system, and a static source is always available for processing large amount of data.

A. System model

Vehicular Ad-hoc Network is a set of vehicles needs to form stable clusters and maintain the stability during the communications and should have connectivity with RSU in respect of getting traffic information and internet services. We consider a highway scenario with two types of communications in the proposed scheme

- V2I, that one RSU is deployed in different regions of the area. The RSU sends/receives the information from the central base station to vehicles moving in different predefined road segments.
- V2V, which each vehicle communicates and shares the information with the other vehicles

Vehicles form dynamic clusters and the ones that are more suitable become cluster head (CH). CH is responsible for controlling the data broadcast inside the cluster. Dynamic cluster heads within the range of static cluster head (i.e. RSU) become its members. As a result, the dynamic clusters are themselves mobile, moving along with the high-speed vehicles and the vehicles communicate with the RSU through CH node. This ensures that even with high-speed vehicles, the moving cluster architecture remain with a stable topology, as long as velocity of the vehicles remains more or less the same

B. Proposed clustering algorithm

1) *Dynamic cluster formation.* : A leading vehicle entering a new segment of road would first searches for any available cluster by broadcasting a cluster join request message or by communicating with a RSU when it in its communicating range. According to Algorithm, when the leading vehicle waits for a while and did not receive any response, it initiates the cluster formation process to identify cluster members by broadcasting message. In general, vehicles to build their neighborhood relationship broadcast their current speed and position data embedded in HELLO messages to other vehicles within their communication range consequently. The vehicles moving in the same direction and in the vicinity of each other come under a original group, as illustrated in Figure 3.

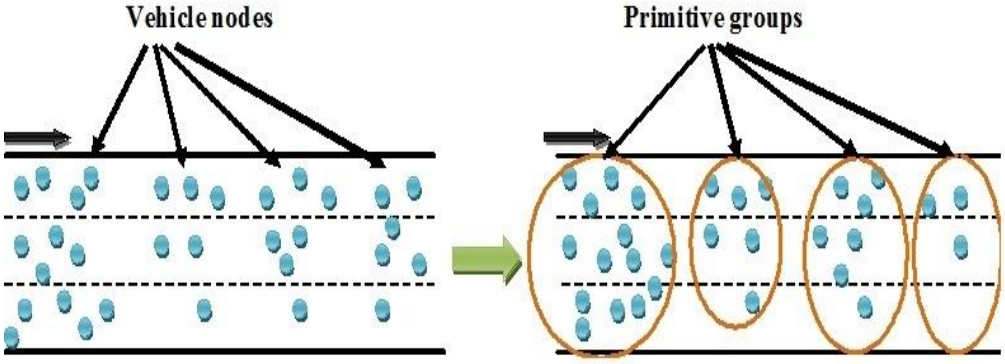

Fig3. Cluster joining process

However, the speed levels in certain area are different and this variation might be very high; thus, all neighboring vehicles are not suitable ones to be included in one cluster. Besides, we define a member's threshold to prevent the formation of small clusters with few members

2) *Cluster head selection:* A cluster head selection algorithm that allows to electing a set of Stable cluster heads. Cluster head election information for any node is limited to the nodes that are within R distance from the node itself (int) the priority of a node to become a CH is determined by its Degree of Node. So, first the nodes start calculating their Degree value to become a CH and broadcast messages (Mdeg) containing their Degree values, each node votes for its neighbor having the local maximum degree value. A node can. Once the election procedure is done, the elected node acknowledges electing as a cluster head by changing (Msel) its state to a CH and sending an Ack message (MCack) subsequently, neighboring vehicles change their cluster ID to the ID of the new CH and dynamic cluster head is formed in this way. Table I shows all message types used in proposed clustering algorithm.

Mcreq	Cluster joining Request
Mcint	Initialization cluster Formation Process
Mdeg	Vehicle Degree Value
Msel	Vehicles Votes
MCack	Cluster Election Acknowledgement
Sthr	Cluster Threshold
Dn	Real Neighbor

Table 1 Message Proposed

3) *Cluster maintenance:* Beside the cluster formation algorithm, we also need a cluster maintenance algorithm to cope with the topology changes caused by the frequently joining and leaving cluster by vehicles. Contains three different scenarios as following:

4) *Cluster joining*: When a cluster head receives a cluster joining request (Mcreq) from a nonclustered vehicle, the cluster head checks whether its relative speed is within the threshold of cluster (Sthr); If so, then the cluster head will accept the vehicle by adding its ID to the cluster members list.

5) *Cluster leaving :* when a vehicle moves out of the cluster, the cluster head loses the contact. Therefore, the cluster head removes this vehicle from the cluster members list. In order to build relatively stable cluster structure, vehicles with better neighborhood degree could be considered as the cluster head. We use the relative average speed to identify real neighbors of vehicle v. As a result, the neighborhood degree (Dn) is defined as the number of corresponding real neighbors of v that their speed differences is lower than Sthr.

6) *RSU link quality*: Through this metric, we attempt to choose vehicles that have maximum robustness of the communication with RSU, as the dynamic cluster heads. For this reason, we prefer as a dynamic CH which is connected to the RSU, the vehicle v providing the highest value of link quality represents the quality of connection between vehicle v and RSU.

The fig 4 three shows the conditions for cluster head .the node with higher degree i.e. having highest no nodes in its neighbor and having maximum transmission range with in the neighbor nodes technique

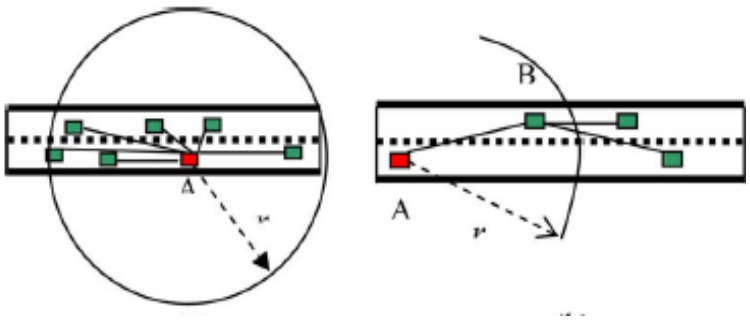

Fig4 Cluster head condition

7) Cluster Reconfiguration: If the distance between two cluster head nodes is detected less than the dismiss threshold (Sth), the cluster with fewer members is dismissed to reduce communication overheads while its members join other clusters. Each node of this cluster launches new registration stage to join other clusters. The threshold determines the rate of cluster reconfiguration, and also, depends on the radio transmission range.

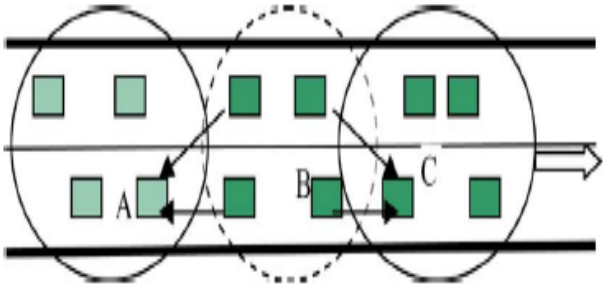

Fig5 Cluster Reconfiguration

8) Proposed Algorithm :

Step 1: Generate Cluster scenario using NS2

Step 2**:** Start with some initial elements like 'no of nodes', 'neighbor node', 'Cluster Head.

Step 3: Initialize with n no. of nodes.

Step 4: Implement DCBM technique.

Step 5: initially Start DCBM algorithm for Cluster Formation by finding degree of nodes, Shape, Direction

Step 6: In DCBM the CH Cluster Head Formation is done by finding the degree of node .if degree of node is higher than node will be considered as cluster Head. If cluster had leaves or new node is introduce or speed increase by DCBM a new cluster will formed automatically

Step 7: Then finally With DCBM Algorithm the Dynamic Cluster with dynamic Cluster head will be formed.

Step 8: This process continuation until the Dynamic Cluster and Cluster head is formed.

V. Result Analysis

Figure 6 shows the comparison of cluster stability percentage between defined cases. As depicted in this figure, Fig7 experiences the highest value of cluster stability among the case studies in all flow rates. The reason of this superiority is participation of both QoS and aggregated mobility metrics in this case. Furthermore, as expected, the results shown in Figure5 describe that we have more stable clusters by increasing the flow rate.

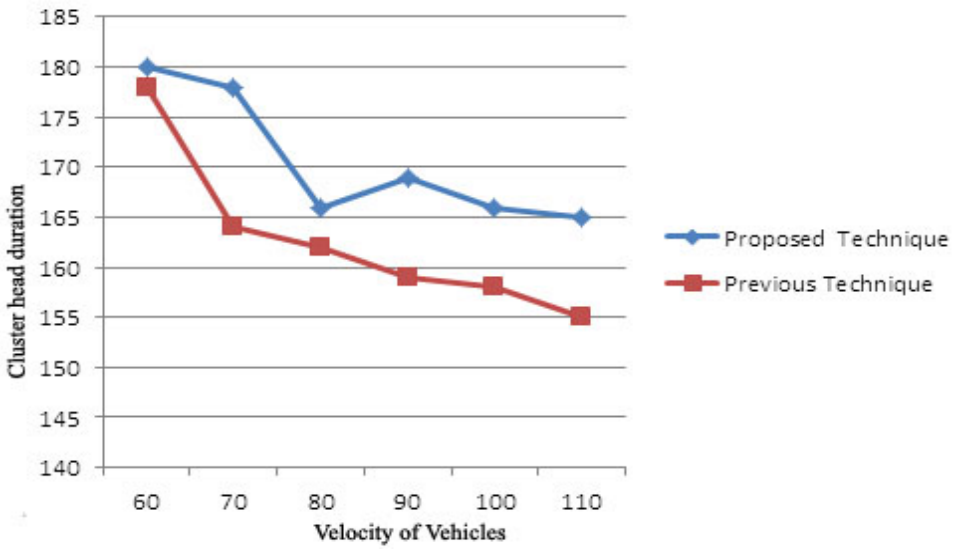

Fig6 low Flow Rate

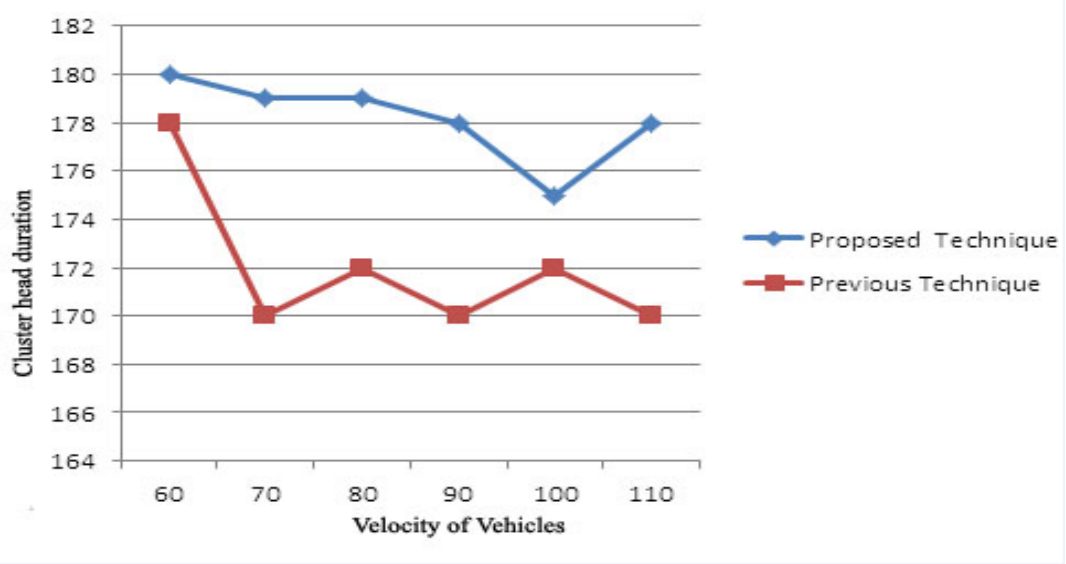

Fig7 High Flow Rate

VI. Conclusion

In this paper, a Dynamic clustering technique for ad hoc vehicle networks is proposed. To achieve the stable cluster structure, a cluster is controlled by the Degree associated with vehicles 'traffic information the Efficiency of VANETs highly depends on vehicle traffic status. The predefined maximum distance between the cluster head and its members, then, controls the cluster size. It helps nodes to move during cluster setup and maintenance. The less threshold controls the cluster reconfiguration. VANET can be considered. This paper performs basic analysis of Dynamic Clustering performance under some assumptions. Results show that this new technique has nice flexibility and stability. Future research should include the influence in terms of available bandwidth and capacity.

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