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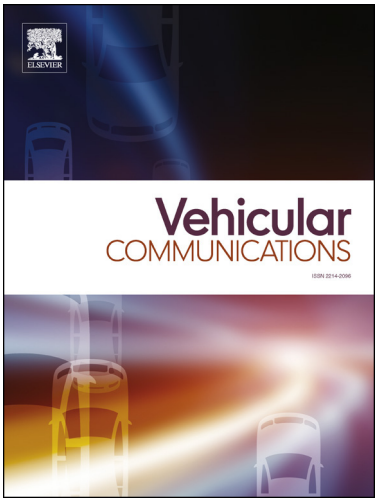

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A Mobility-based Scheme for Dynamic Clustering in Vehicular Ad-hoc Networks (VANETs)

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***Abstract*—Vehicle clustering is an efficient approach to improve the scalability of networking protocols in vehicular ad-hoc networks (VANETs). However, some characteristics, like highly dynamic topology and intermittent connections, may affect the performance of the clustering. Establishing and maintaining stable clusters is becoming one of big challenging issues in VANETs. Recent years' researches prove that mobility metric based clustering schemes show better performance in improving cluster stability. Mobility metrics, including moving direction, vehicle density, relative velocity and relative distance, etc., are more suitable for VANETs instead of the received radio strength (RSS) and identifier number metrics, which are applied for MANETs clustering. In this paper, a new dynamic mobility-based and stability-based clustering scheme is introduced for urban city scenario. The proposed scheme applies vehicle's moving direction, relative position and link lifetime estimation. We compared the performance of our scheme with Lowest-ID and the most recent and the most cited clustering algorithm VMaSC in terms of cluster head duration, cluster member duration, number of clusters, cluster head change rate and number of state changes. The extensive simulation results showed that our proposed scheme shows a better stability performance.**

***Index Terms*—Vehicular Ad Hoc Networks (VANETs), clustering algorithm, wireless communication.**

I. Introduction

Vehicular ad hoc networks (VANETs), is a vital part of Intelligent Transportation System (ITS), which aims to improve road safety and information transmission efficiency on the road. With the developments of automotive manufacturing, intelligent vehicle and wireless communication technologies, vehicles which are equipped with wireless interfaces can communicate with nearby vehicles directly through a V2V (Vehicle-to-Vehicle) communication mode, as well as with fixed equipment, called Road Side Units (RSUs), through a V2I (Vehicle-to-Infrastructure) or I2V (Infrastructure-to-Vehicle) communication manner [1].

These types of wireless communications enable vehicles to share different kinds of information, including safety related information and (non-safety related) infotainment information, corresponding respectively to road safety and non-safety applications. Safety applications focus mainly avoiding accidents. They require low latency and high reliability, whereas non-safety applications aim to improve drivers and passengers comfort level and enhance traffic efficiency [2]. A detailed classification for road safety applications and their requirements are given in the standard of European Telecommunications Standard Institute (ETSI) [3].

VANETs have several characteristics that distinguish them from other multi-hop networks. Nodes in VANETs are highly mobile, leading to a high probability of network partitions, especially under highway scenarios. Therefore, the end-to-end communication cannot be guaranteed [4]. Intermittent connection may cause severe packet loss problem, and further influence traffic safety. Meanwhile, as a decentralized self-organizing network, VANETs is lack of a centralized management and coordination entity which is responsible for managing the bandwidth and contention operations. Moreover, VANETs is a large scale network; however, the communication range of a vehicle is limited which may also cause a weak connectivity between nodes. Therefore, maintaining a global network topology is indispensable for a node. For these reasons, a flat network topology is no longer effective for information transmission in VANETs [5]. To solve this problem, a hierarchical network topology, called cluster, has been proposed for VANETs.

A cluster is a virtual group of nodes having similar characteristics. Clustering scheme is the method to divide vehicles into different groups according to some rules. Each cluster elects at least one leader, called cluster head, who serves as a local central management entity, performing intra-cluster communication arrangement, local information aggregation, and local information dissemination, etc. [4]. A cluster head is followed by one or more than one cluster members. As a hierarchical network, the first level of the network is called intra-cluster communication, where a cluster member can directly communicate with its cluster head or nearby cluster members within the same cluster. The second level of the network is inter-cluster communication, of which a cluster head communicates with nearby cluster heads or road side infrastructures. Sometimes, cluster gateway node is proposed for neighboring cluster communication [6].

In [6], a detailed survey of clustering schemes for VANETs is well presented. Clustering scheme performance is usually