Density-connected cluster-based routing protocol in vehicular ad hoc networks

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Abstract

With the development of Vehicular ad hoc networks (VANETs), intelligent transportation system is gaining more attention for providing many services. However, mobility characteristic of VANETs causes frequent route disconnection, particularly during the data delivery. Clustering is one of most efficient approaches to achieve stable structure of topology. The real-time applications need the data transmission delay time to be relatively stable. In position based routing with sufficient density in the neighborhood can achieve the above objective easily. In this work, we propose density-connected cluster-based routing (DCCR) protocol, a position based density adaptive clustering oriented routing protocol. The approach maintains the connectivity between two successive forwarders by considering different matrices like density and standard deviation of average relative velocity. The proposed protocol demonstrates improvement in the packet delivery ratio, end-to-end delay compared with existing approaches.

Keywords Cluster head · Best fit forwarder · Cluster member · Gateways member · VANETs

1 Introduction

Vehicular ad hoc networks (VANETs) play a significant role in shaping the future of intelligent transportation systems. These networks help lot many applications like, road safety, acquisition of current traffic and weather information, and sharing of multimedia content.

The communication system in VANET adopts certain technology from IEEE802.11 with some modification like IEEE 802.11p. These networks can communicate broadly in two different categories like Vehicle-to-Vehicle (V2V)communication and Vehicle-to-Infrastructure (V2I) communication. In V2V communications, vehicles transfer information among themselves and do not take the help of road side units. However, in the V2I communications, the road side units also become a part of, and actively participate

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in data transfer. Moreover, the wireless communication can provide a broadcast range between 200 and 500 m [1]. In case of V2V communication, every vehicle is considered to have been installed with various onboard sensing units, which allow large scale sensing, decision making, and controlling actions to perform a number of tasks that arises in wireless communication system. Furthermore, they communicate with each other primarily in multi-hop manner. However, for multi-hop communication, the stability of the topology and availability of the communication links are critical for the performance. VANETs are known for highly dynamic topology, i.e., connectivity duration between two vehicles is very less. To enhance this time period, the topology needs to be made more stable. Clustering approach plays a significant role in making this highly dynamic topology more stable. Routing approaches based on clustering give significant performance enhancement in V2V communication scenario. A group of vehicles identify itself to be a part of cluster and each cluster has only one cluster-head, which is responsible for intra and inter-cluster communication. For intra-cluster communication within each cluster, the cluster head is connected via direct link and for inter-cluster communication, the cluster head is connected via other cluster-heads or gateway nodes. In cluster-based routing, the cluster head broadcasts the data packets within the cluster, which provides good scalability whereas network delay and routing overhead increases for highly mobile VANETs. More nodes present in the cluster