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An adaptive approach for information dissemination in Vehicular Ad hoc Networks

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ABSTRACT

Vehicular Ad hoc Networks (VANETs) appeared as a subclass of MANETs for inter-vehicle communication. However, VANETs have a relatively more dynamic nature as compared to MANETs concerning the network topology. The design and implementation of an efficient and scalable algorithm for information dissemination in VANETs constitutes a major issue that should be tackled. Indeed, in this dynamic environment, an increasing number of redundant broadcast messages will increase resource utilization, which would indirectly affect the network performance. In the past few years, several statistical-based broadcasting schemes, such as counter-based protocol, for information dissemination have been proposed in the context of MANETs. These schemes are based on various threshold parameters to help nodes to decide whether to rebroadcast or discard received messages. However, in dynamic networks, such as in VANETs, it is difficult even impossible to determine a priori these threshold values. Dynamically changing these values, to minimize the number of redundantly received messages while maintaining good latency and reachability, is a complex issue in the absence of centralized controllers or constant threshold parameters. This paper presents a decentralized and adaptive approach for information dissemination (AID) in VANETs. Simulations are conducted and results are presented to show that adaptive approaches have a better performance over statistical-based approaches.

1. Introduction

In the past few years, due to the expansion of wireless communication technologies, substantial research efforts have been devoted to Vehicle Ad hoc NETworks (VANETs) for inter-vehicle communications. VANETs are decentralized and self-organizing networks composed of high speed moving vehicles (Fiore et al., 2007). They can be used to establish communication between vehicles and therefore, develop pervasive applications for road safety (Dar et al., 2010). The main goal is to efficiently transmit a message from a source to other nodes situated in the same geographical area. For example, information about potential congested areas can be relayed from a vehicle to another, in order to inform the drivers of eventual accidents or possible traffic jams. Thus, drivers could be notified that they are proceeding toward a location where an accident has occurred. Moreover, the system would be able to compute alternate routes if such information is used as an input into a vehicle navigation system in order to avoid congested areas. Similarly, a vehicle detecting, for example, an icy road, via embedded sensors, could inform other vehicles like those traveling in the opposite direction and those traveling in the same lane (Fuchs et al., 2007).

The dynamic nature and directional mobility of the vehicles, delivering messages to one or all vehicles, represents a major challenge. Moreover, because of the absence of the infrastructure and the higher mobility of the vehicles, relying messages between vehicles require broadcasting schemes. The core problem in multi-hop broadcasting is how to minimize the number of redundantly received messages while maintaining good latency and reachability, since rebroadcasting causes tradeoff between reachability and efficiency under different host densities (Ni et al., 1999). Therefore, the selection of relay nodes is a major design consideration in broadcasting algorithms.

Several broadcasting schemes have been proposed in the context of MANETs and can be classified as topology-based or statistical-based schemes. In topology-based schemes, nodes require neighbor topology information to decide to rebroadcast a message. These schemes can minimize the number of rebroadcast messages and ensure reachability, but maintaining neighbor information requires extra overhead especially for network with high speed nodes. In statistical-based schemes, no information about neighbors is required to be maintained by the nodes and rebroadcast decision is based only on local information. These schemes are based on

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