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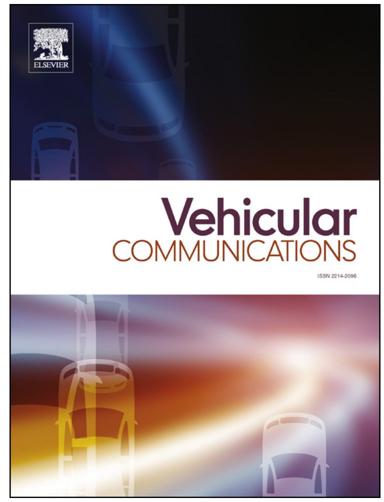

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PII: S2214-2096(18)30026-3
DOI: https://doi.org/10.1016/j.vehcom.2018.04.003
Reference: VEHCOM 127

To appear in: *Vehicular Communications*

Received date: 5 February 2018
Revised date: 21 March 2018
Accepted date: 10 April 2018

Please cite this article in press as: J. Toutouh, E. Alba, A Swarm Algorithm for Collaborative Traffic in Vehicular Networks, *Veh. Commun.* (2018), https://doi.org/10.1016/j.vehcom.2018.04.003

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A Swarm Algorithm for Collaborative Traffic in Vehicular Networks

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Abstract

Vehicular ad hoc networks (VANETs) allow vehicles to exchange warning messages with each other. These specific kinds of networks help reduce hazardous traffic situations and improve safety, which are two of the main objectives in developing Intelligent Transportation Systems (ITS). For this, the performance of VANETs should guarantee the delivery of messages in a required time. An obstacle to this is that the data traffic generated may cause network congestion. Data congestion control is used to enhance network capabilities, increasing the reliability of the VANET by decreasing packet losses and communication delays. In this study, we propose a swarm intelligence based distributed congestion control strategy to maintain the channel usage level under the threshold of network malfunction, while keeping the quality-of-service of the VANET high. An exhaustive experimentation shows that the proposed strategy improves the throughput of the network, the channel usage, and the stability of the communications in comparison with other competing congestion control strategies.

Keywords: Broadcasting, Swarm Intelligence, Applications, Network Layer Issues

1. Introduction

Over the last few decades, the synergistic utilization of *information and communication technologies* (ICT) in vehicular environments has revolutionized the automotive industry. This has encouraged the emergence of a great variety of new services based on *Intelligent Transportation Systems* (ITS) focused on improving road safety and travelers' experience. Most of these great advances rely on vehicular networks that allow the periodic exchange of messages between the different agents that are part of road transportation (e.g., vehicles or elements of the infrastructure) [26]. This communication technology is commonly known as *vehicular ad hoc networks* (VANETs), which are principally composed by vehicles equipped with wireless interfaces in their on-board units (OBUs) that allow direct short range communications (DSRC) by utilizing the wireless access in vehicular environments (WAVE) standards, i.e., IEEE 802.11p and IEEE 1609 [4].

VANETs are applied to deploy ITS to provide a large number of smart mobility services and applications. The most important category of applications based on VANETs are designed to provide safe environments for road travel and intelligent road traffic management. Those are are known as *cooperative vehicle safety* (CVS) and *traffic efficiency applications*, respectively [5, 6].

CVS principally relies on exchanging short messages (known as *beacons*) through the DSRC channel [8]. These messages are broadcasted in the neighborhood (1-hop) defined by the communication range of the nodes (r). Beacons include vehicle kinematics and other relevant information. VANET nodes are continuously broadcasting beacons (*beaconing*) with a given *beacon frequency* or *beacon rate* (see Figure 1).

A challenging issue in the deployment of CVS is the network congestion when the scale of the system grows. This is mainly due to the critical increase of the periodic beacons, which generates a heavy communication load. Congestion increases packet losses and communication delays, i.e., it degrades the performance

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