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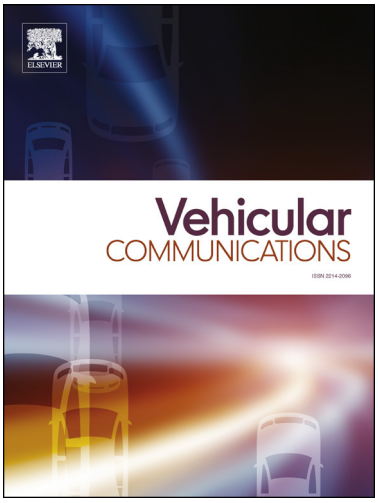

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Adaptive Beaconing for RSU-based Intersection Assistance Systems: Protocols Analysis and Enhancement

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Abstract

Current envisaged cooperative vehicular applications require moderate to severe requirements of reliability and latency according to their purpose. Dedicated Short Range Communications (DSRC)-based applications mainly rely on the periodic exchange of information that under certain circumstances may cause congestion problems on the communication channel obtaining unreliable and outdated information at application level. Adaptive beaconing protocols adapt transmission parameters to different criteria such as the channel load and application requirements to improve the overall performance of the vehicle network. Nevertheless, it has not been determined yet if the information disseminated by these protocols is suitable enough for the implementation of specific applications, e.g., Road Side Unit (RSU)-based Intersection Assistance Systems (IAS) like Intersection Collision Risk Warning (ICRW). In this context, we first analyze the network behavior in a realistic simulated intersection area where probability of packet reception becomes difficult to predict and models become highly complex. In that scenario, we present a critical analysis on the performance of current EU and US decentralized congestion control protocols while their performance is evaluated with respect to tracking accuracies required by Intelligent Transportation System (ITS) applications. Results obtained lead us to conclude that adaptation criteria of beaconing protocols is not able to support different safety applications at the same time, that is, there is a tradeoff in the selection of such criteria between enhancing applications supporting vehicles or infrastructure. In that sense, we discuss and provide novel adaptation criteria (Intersection Assistance State Machine, IASM) to improve the performance of beaconing protocols towards assisting safety RSU-based IAS. Finally, we propose and validate through simulations a novel beaconing protocol (Intersection Assistance Protocol, IAP) that improves performance over studied protocols.

Keywords: DSRC, Vehicular Networks, Adaptive Beaconing, RSU, Vehicle to Infrastructure, ITS applications, Intersection Assistance Systems, Intersection Collision Risk Warning
2010 MSC: 00-01, 99-00

1. Introduction

In the new envisaged paradigm of vehicular communications, vehicular safety applications that are to be implemented in the coming years have strict requirements in terms of reliability and latency due to the critical nature of their mission. In this context, information disseminated by vehicles within Vehicular Ad-hoc NETworks (VANETs) must be accurate, continuous and up-to-date to sustain those applications. To begin with, information exchange through latencies of the order of 100 *ms* is needed to facilitate the so-called *cooperative awareness* among vehicles and to be able to meet critical safety requirements. Under the current framework, Dedicated Short Range Communications (DSRC) enabled safety applications mainly rely on the periodic exchange of safety information between vehicles and infrastructure using Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications. Consequently, Cooperative Awareness

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