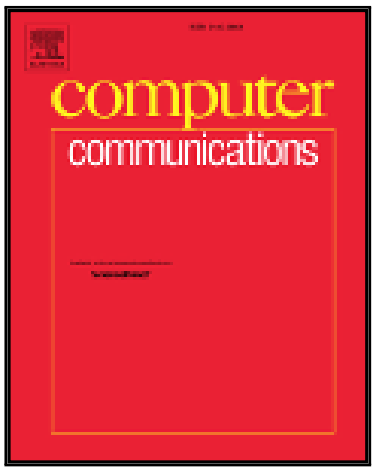


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PII: S0140-3664(17)30498-X
DOI: 10.1016/j.comcom.2018.03.009
Reference: COMCOM 5667

To appear in: *Computer Communications*

Received date: 29 April 2017
Revised date: 14 February 2018
Accepted date: 11 March 2018

Please cite this article as: Hendrik-Jörn Günther, Raphael Riebl, Lars Wolf, Christian Facchi, The Effect of Decentralized Congestion Control on Collective Perception in Dense Traffic Scenarios, *Computer Communications* (2018), doi: 10.1016/j.comcom.2018.03.009

# The Effect of Decentralized Congestion Control on Collective Perception in Dense Traffic Scenarios

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**Abstract**

In conjunction with automated vehicles, Inter-Vehicle Communication represents the next 'big thing' towards the vision of cooperative driving, where road participants share information about their planned behaviour and where hazardous situations are solved or avoided jointly. One prerequisite to fulfill this long-term goal is a common information base, where all road participants are fully aware of each other. The idea of collective perception contributes to this information base by sharing local sensor data with other road users. Whereas most related work focuses on the aspects of sensor data fusion, we focus on the implications of an ETSI ITS G5 based network for collective perception. We present and analyse different message formats and dissemination variants for sharing sensor data. Their usability is validated in two extensive microscopic simulation studies with different traffic densities and up to several hundred concurrent vehicles. In particular, implications caused by standardised Decentralized Congestion Control are assessed in a controlled environment.

*Keywords:* Collective Perception, Decentralized Congestion Control, ITS-G5, VANET, V2X

## 1. Introduction

Most of today's Advanced Driver Assistance Systems (ADASs) require information about other vehicles and objects in the surroundings of a vehicle. Local perception sensors, such as radar or camera sensors, are commonly used to perceive other road participants and obstacles within a sensor's Field-of-View (FoV). Gathered information is fused into a local environment model, which represents the vehicle's surroundings. Whereas nowadays the environment model's scope is limited to its local perception sensors' FoV, Vehicle-to-X (V2X) communication can dramatically increase both, the scope and information quality of an environment model.

In Europe, V2X communication is standardised by the European Telecommunications Standards Institute (ETSI) and is based on the IEEE 802.11p standard [1]. ETSI's Technical Committee for Intelligent Transportation System (ITS) has standardised several messages, which may be employed by ITS stations. Vehicles represent one particular station type and are expected to periodically broadcast so-called Cooperative Awareness Messages (CAMs) [2], thereby propagating their current positions and driving states. Vehicles located within each other's communication range may therefore learn about their presence mutually even before a local perception sensor is able to detect them. Furthermore, information exchanged via V2X messages is not limited to the measurement principle of a particular sensor type but may be enriched by ADAS specific data, e.g. a control variable like the safety gap.

However, especially during the phase of market introduction of V2X communication, the number of communication partners is insufficient for operation of most V2X applications. Hence, any measure reducing the number of required communication partners should be pursued to counteract this issue. Collective perception aims at disseminating information gathered by local perception sensors

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