Summary
Intelligent Transport Systems (ITS) are aiming to provide innovative services related to different modes of transport and traffic management, and enable various users to be better informed and make safer, more coordinated and smarter use of transport networks. Cooperative-ITS (C-ITS) support connectivity between vehicles, vehicles and roadside infrastructure, traffic signals as well as with other road users. In order to enable vehicular communications European Telecommunication Standards Institute (ETSI) delivered ITS-G5 – a set of C-ITS standards. Considering the goals of C-ITS, inter-vehicle communications should be reliable and efficient. The subject of this thesis is evaluation of the performance, efficiency, and dependability of ITS-G5 communications for cooperative driving applications support. This thesis includes eight scientific papers and extends the research area in three directions: evaluation of the performance of ITS-G5 beaconing protocols; studying the performance of ITS-G5 congestion control mechanisms; and studying the radio jamming Denial-of-Service (DoS) attacks and their detection methods.

First, an overview of currently available and ongoing standardization targeting communications in C-ACC/platooning cooperative driving applications is provided. Then, as part of the first research direction, we demonstrate via a number of studies, that the adaptive beaconing approach where message generation is coupled to the speed variation of the originating ITS-ss may lead to a message synchronization effect in the time domain when vehicles follow mobility scenarios that involve cooperative speed variation. We explain in detail the cause of this phenomenon and test it for a wide range of parameters. In relation to the second problem, we, first, study the influence of different available ITS-G5 legitimate setups on the C-ACC/platooning fuel efficiency and demonstrate that proper communication setup may enhance fuel savings. Then we thoroughly study the standardization of the congestion control mechanism for ITS-G5, which will affect the operation of all cooperative driving C-ITS applications as a mandatory component. We study the influence of congestion control on application performance and give recommendations for improvement to make the congestion control to target at optimizing the applications performance metrics. In the scope of the last research direction, we propose two real-time jamming DoS detection methods. The main advantage of our detection techniques is their short learning phase that not exceed a few seconds and low detection delay of a few hundreds of milliseconds. Under some assumptions, the proposed algorithm.