An 802.11p Cross-Layered Pilot Scheme for Time- and Frequency-Varying Channels and Its Hardware Implementation

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Abstract:

Robust channel estimation in IEEE 802.11p systems in highly time-and frequency-varying vehicular channels in combination with long data packets is a challenging task due to the ill-suited pilot pattern. Solutions of increased receiver complexity that use decision feedback and iterative decoding have been proposed to overcome the difficulty in robust channel estimation. In this work, a cross-layered method to introduce complementary training symbols into an 802.11p frame is proposed. In the proposed approach, known bits are multiplexed with the data in higher layers and a modified receiver can ut ilize these bits as training data for improved channel estimation. A standard receiver treats these bits as data and passes them to the higher layers where they can be removed. This makes the method backward compatible with the standard 802.11p transceivers with the requirement of a software/firmware update of the higher layers to remove the multiplexed bits. A modified receiver with low complexity channel estimation schemes that utilizes the complementary training symbols is implemented in a field programmable gate array platform. Frame error rate measurements have been performed by interfacing the hardware implementation with a channel emulator. The measurement results follow the computer simulation results validating the hardware implementation. Moreover, measurement results show the that the modified receiver significantly outperforms a commercial receiver.