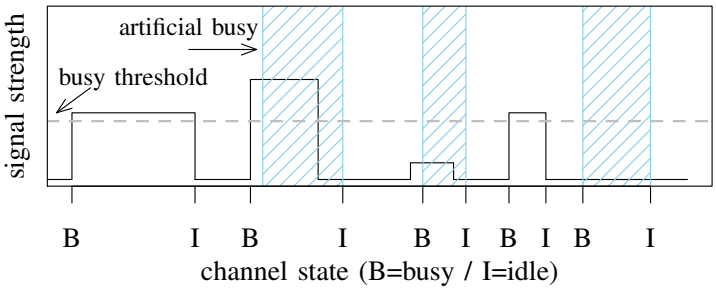
Master's Thesis

Development and Implementation of a Simulation Model for Artificial Channel Load in Wireless Networks



Wireless communication is the key technology for Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication. Among the big challenges in this field is to avoid overloading the wireless channel when many nodes participate in the network and at the same time to provide decent networking performance. This is particularly beneficial for safety applications which have to be aware of the exact position of vehicles between two successive transmissions – thus packet loss has a disastrous effect.

Research in this area builds mainly upon network and road traffic simulation to evaluate protocol behavior in different scenarios. One of the most fundamental requirements of these simulation studies is to investigate the performance of the protocol under consideration in the context of varying radio channel characteristics - e.g., channel utilization.

To this end artificially increasing channel load in a network is done by scaling the density of vehicles and/or adapting the message rate of dummy packets. However this comes at the cost of high computational efforts as every frame on the wireless channel needs to be modeled in detail.

Goals of the thesis

The simulation framework Veins (written in C++ and based on OMNeT++) we are using in some of our recent research supports realistic models of MAC and PHY for vehicular communication. The performance of simulations can be improved by using a model to create artificial channel load within the simulation without having to send dummy packets among nodes. This model will serve the lower layers of the communication stack with information about the wireless channel state according to its parameterization.

The main challenge is how to accurately model wireless channel busy/idle times for a given channel utilization ρ in order to represent realistic behavior of wireless networks in the context of vehicular communication scenarios. Analytical approaches employing Markov chains to model the channel state of wireless networks have been found to be beneficial [1], [2].

This thesis designs and implements a model to saturate the wireless channel for nodes to a given fraction ρ and thus lowers the necessary computational effort in comparison of sending dedicated packets on the wireless channel. The quality of the approach is then evaluated in different scenarios.

Keywords

CSMA/CA

[1] G. Bianchi, "Performance Analysis of the IEEE 802.11 Distributed Coordination Function," *IEEE Journal on Selected Areas in Communications*, vol. 18, no. 3, pp. 535–547, Mar. 2000. DOI: 10.1109/49.840210.

[2] M. Amiri-Nezhad, M. Guerrero-Zapata, B. Bellalta, and L. Cerdà-Alabern, "Simulation of multi-radio multi-channel 802.11-based mesh networks in ns-3," *EURASIP Journal on Wireless Communications and Networking*, vol. 2014, no. 1, pp. 1–19, Jul. 2014. DOI: 10.1186/1687-1499-2014-118.

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