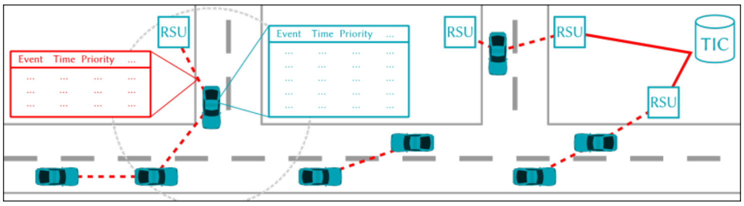
Master's Thesis

A multi-channel beacon scheduling system for the exchange of traffic information in vehicular networks

Intelligent Transportation Systems (ITS) are a promising solution to today's problem of ever increasing volumes of road traffic. Most recent approaches for inter-vehicular communication rely on the exchange of knowledge via broadcast or using peer-to-peer like systems. We are mainly interested in broadcast-based approaches, specifically relying on **periodic beaconing**. ITS rely on accurate and timely information to enable informed decisions for routing and accident prevention, thus, a major challenge that periodic beaconing approaches face is incorporating the needs for both delay-sensitivity and congestion awareness. In other words, a protocol for ITS has to always **trade channel load for speed of information dissemination** – a tradeoff which should be optimal for any combination of traffic density, penetration rate, and network utilization.



Addressing these issues, we have designed the **Adaptive Traffic Beacon (ATB)** protocol, which is adaptive in two dimensions: network conditions and infrastructural support. ATB uses a **variable beacon period**, which dynamically adapts the frequency of information exchange to a wide range of parameters such as vehicle density, vehicles' speed, radio communication reliability, and delay. These parameters are the basis for two key metrics to form indicators of channel quality and message priority. Furthermore, ATB is able to rely on fully decentralized information exchange among participating vehicles. For message transmissions in vehicular networks, the emerging IEEE 1609 **Wireless Access in Vehicular Environments (WAVE)** standard provides a complete protocol stack covering protocols from the data link layer to the physical layer. The WAVE stack is based on IEEE 802.11p and employs EDCA functionality based on that of IEEE 802.11e and an OFDM scheme using one control channel and **six data channels**. This way, both coarse-grade and fine-grade **message prioritization** can be guaranteed and enforced, respectively.

Currently, our implementation of ATB is using a single channel, handling all prioritization of messages purely at the application layer. In the context of this thesis, the first aim is to study ATB's channel and message priorities and how to take advantage of the enhanced message prioritization mechanisms provided by the WAVE stack. Message sending will therefore have to consider a classic scheduling problem, namely which parts of the local knowledge base to assemble into a single beacon, what priority to assign to the beacon, and when to send it on which of the available channels. After designing the enhanced scheduling algorithms, the objective is to extend the ATB protocol and the corresponding C++ simulation model of ATB. Following this, the design and implementation need to be evaluated in a set of simulation scenarios, comparing the final implementation to that of the single-channel-based approach used in earlier evaluations of ATB.

Partner

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