Development of Simulation Framework for Time-Sensitive Networking and Performance Evaluation in Automotive Settings

Master's Thesis Topic

ABSTRACT:

Currently Ethernet has been considered one of the most popular candidates for future automotive communication network. In recent years Ethernet has become increasingly more deterministic and are offering enhanced QoS. With its advantages in high bandwidth, flexibility, scalability and mixed-criticality nature, it is becoming promising for applications in the safety-critical domains. With the upcoming IEEE802.1 Time-Sensitive Networking standards, Ethernet is expected to meet requirements in the automotive domain. However, unlike conventional bus systems like FlexRay or CAN, the behaviors of the recent and upcoming Ethernet protocols in complex systems are still not thoroughly studied. As a useful tool to understand and analyze the behavior of these Ethernet protocols, an easily configurable simulation framework is necessary, especially for automotive E/E systems.

There exist already open-source simulation frameworks for Ethernet based communication under the OMNeT++ environment, most notably INET for basic Ethernet features and CoRE4INET framework for AS6802 and some AVB features. However these frameworks do not include the upcoming features of Time-Aware Shaper and Frame Preemption and are not very convenient for usages in automotive settings.

The goal of this thesis is to develop a simulation framework for Time-Sensitive Networking (TSN) Ethernet, based upon the INET, CoRE4INET and our existing implementations. The simulation framework should include main features of current IEEE802.1Q and possible features in IEEE802.1Qbu and IEEE802.1Qbv. Additionally, the simulation framework should be adapted to usages in the automotive domain. Finally the simulation framework is used to simulate automotive case studies and evaluate whether the requirements in the automotive domain can be met.

TASKS:

- Build a structured simulation framework using features from INET and CoRE4INET and existing implementations (e.g. frame preemption) and adapt the simulation models for convenient usage in automotive domain
- Implementation of Time-Aware Shaper
- Implementation of simple processor task models
- Implementation of clock models and optionally the clock synchronization (IEEE1588 or IEEE802.1AS)
- Development of a measurement module that enables convenient statistics gathering and analysis
- Performance evaluation based on example automotive E/E systems

KNOWLEDGE REQUIRED:

- Very good knowledge on C++
- Good knowledge on computer networks, Ethernet protocols and automotive E/E systems
- Previous knowledge on network simulation, knowledge on OMNeT++ preferred

CONTACT:

If you are interested in this topic as Master’s Thesis,

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