

Modeling the effect of Time Sensitive Networking standards on the timing performance in Automotive Ethernet networks

The nodes in a vehicle’s electronic architecture communicate via one or more interconnected in-vehicle networks (IVNs). Automotive Ethernet is one of the IVN technologies. When safety-critical applications share the IVN with non-safety-related applications, this network has to include a number of mechanisms to ensure the timely arrival of safety-critical information. For Automotive Ethernet, the AVnu Alliance and Time Sensitive Networking (TSN) working groups have created IEEE standards to specify and standardize these mechanisms.

With this graduation project, NXP Semiconductors seeks to model the effects of specific TSN standards on the timing performance in Automotive Ethernet networks. The task of the student is to create a set of analytical models representing the relation between the parameters in the IEEE 802.1AS-rev (time synchronization), IEEE 802.1CB (redundancy), IEEE 802.1Qbu (frame preemption) and the IEEE 802.1Qbv (scheduled traffic) standards, and the resulting timing performance of certain Automotive Ethernet network topologies and their switches. The target output of these models is the achievable timing accuracy of a schedule execution and the boundary conditions for which end-to-end latency guarantees can be met of an Ethernet frame through an Automotive Ethernet Network.

The analytical models shall be evaluated using analysis and/or simulation, and - where applicable - measurements in a practical setup. Based on the results, the student will provide recommendations on the implementation considerations of these standards in Automotive Ethernet networks.
Tasks

- Literature study on prior work regarding formal analyses and timing models on TSN standards in Automotive.
- Create an analytical model on the relation between achievable timing performance and the parameters in the IEEE 802.1AS-rev, IEEE 802.1CB, IEEE 802.1Qbu, and the IEEE 802.1Qbv standards.
- Evaluate the analytical model by using simulation of relevant use cases.
- Document your progress, results and conclusion in a final thesis report.

Your profile

- Mathematics, Computer Science, Automotive, Electrical Engineering or Embedded Systems Master students
- Background on digital communication, preferably with Ethernet networking
- Good analytical skills
- Affinity with automotive electronics

This graduation project can start as soon as possible. The total time of this project is 6 months including the writing of a final MSc thesis. It is possible to extend the project to 9 months in agreement with your supervisors, to include for example an internship or a preparation phase.

This project will be carried out on-site at NXP Semiconductors on the High Tech Campus in Eindhoven, The Netherlands, due to the required high-intensity knowledge transfer and supervision, as well as the availability of specific hardware and software tools. Working in this project implies working in a stimulating, multidisciplinary environment at the forefront of technology, with knowledgeable colleagues, and an excellent infrastructure.

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