Comparing Time-Triggered Ethernet with FlexRay: An Evaluation of Competing Approaches to Real-time for In-Vehicle Networks

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Abstract
FlexRay is considered the next generation state-of-the-art technology for in-car networks, while time-triggered Ethernet (e.g. TTEthernet by TTTech [2]) emerges with the promise to integrate real-time and best-effort traffic into one homogeneous backbone. By showing that it is possible to transfer a fully utilized FlexRay system to a system based on time-triggered Ethernet, it is demonstrated that time-triggered Ethernet is a suitable replacement of current in-vehicle bus-systems.

Motivation
- Bandwidth requirements increase rapidly
- Current in-vehicle networks are inhomogeneous
- Usage of components of the shelf
- Benefit from the expertise of plenty of Ethernet developers

Objectives
- Competitive analysis of FlexRay & TTEthernet
- Mathematical model that shows the eligibility of TTEthernet for in-vehicle applications
- Discussion of group communication for in-vehicle applications

Comparison
- Comparison based on a sample configuration with a topology of two active stars / switches and a cycle time of 16 ms
- Number of real-time messages per cycle and the correspondent maximum bandwidth is compared over various payload sizes
- Latency and Jitter are calculated based on the sample configuration

Analytical Results

Conclusion
- FlexRay real-time traffic can be embedded in real-time Ethernet
- The TTEthernet correspondent of a fully utilized FlexRay configuration is utilised by approx. 11%
- Bandwidth utilisation can further profit from group communication

Outlook
- Currently we analyse in-vehicle networks in simulation and build a mockup based on TTEthernet for measurement and load analysis
- Future work will analyse how event-triggered traffic, segmentation and priority functionalities of Ethernet can guarantee a smooth integration of time-triggered Ethernet
- Further questions concern the consolidation of current in-vehicle bus systems into one homogeneous backbone, or the optimisation and validation of configuration parameters

References