TIMICO Middleware and Communication Protocols for Dependable Systems
Module 6: Time Triggered Ethernet – TT-Ethernet

Practicalities

About: This note covers a module. A module consists of two consecutive lecture days.
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Subject

The theme for this module will be an introduction to the fairly new Time Triggered Ethernet protocol called TT-Ethernet. TT-Ethernet combines the traditional switched Ethernet with time triggered functionality for obtaining dependable real-time communication on top of the Ethernet protocol.

Introductory background readings

- Wikipedia: http://en.wikipedia.org/wiki/TTEthernet

Agenda

Day 1

- **Lecture 6.1: Introduction to Time Triggered Ethernet**
- **Lecture 6.2: TT-Ethernet protocol and Safety Critical TT-Ethernet**
- **Exercise: Time Triggered Ethernet (TT-Ethernet)**

Day 2

- **Lecture 6.3: Summary**
- **Student Article Presentation:** ***Application of a CAN BUS transport for DDS middleware.***

Details

Day 1

- **Lecture 6.1: Introduction to Time Triggered Ethernet**
  This lecture introduces the basic ideas behind TT-Ethernet and the basic architecture and functionality of a TT-Ethernet based system including the functionality of the TT-Ethernet switch. Readings 1 and 2 with reading 5 as an optional reading..
- **Lecture 6.2: TT-Ethernet protocol and Safety Critical TT-Ethernet**
  This lecture presents some protocol details and continues with a presentation of how a safety critical TT-Ethernet system is build. Readings 3 and 4.
- **Exercises: Time Triggered Ethernet (TT-Ethernet)**

Day 2

- **Lecture 6.3: Summary**

- **Student Article Presentation: *Application of a CAN BUS transport for DDS middleware***
  The article integrates the lessons about DDS with the CAN bus lesson, as it describe how DDS middleware can be implemented on to of a CAN Bus.

Readings

1. Hermann Kopetz; Astrit Ademaj; Petr Grillinger; Klaus Steinhammer. *"The Time-Triggered Ethernet (TTE) Design"*. 8th IEEE International Symposium on Object-oriented Real-time distributed Computing (Seattle, Washington: TU Wien), May 2005: page 22–33.
   - This paper introduces the Time-Triggered Ethernet protocol.
2. K. Steinhammer et al. ”*A Time-Triggered Ethernet (TTE) Switch”.* DATE '06 Proceedings: Design, Automation and Test in Europe, 2006, page 1-6.
   - This paper introduces the design of a TTE switch.
3. A. Ademaj et. al. *“Fault-Tolerant Time-Triggered Ethernet Configuration with Star Topology”.* Arcs’06 19th International Conference on Architecture of Computing System. 2006, page 95-105.
   - This paper describes the architecture for a safety critical and fault-tolerant Time-Triggered Ethernet system.
4. A. Ademaj, H. Kopetz, “Time-Triggered Ethernet and IEEE1588 Clock Synchronization”. 2007 International symposium on Precision Clock Synchronization, Vienna 2007, page 41-43.
   - This paper describes how IEEE1588 can be combined with TT-Ethernet.
5. Hermann Kopetz: “*The rationale for Time-Triggered Ethernet”,* Real-Time Systems Symposium, 2008.
   - This is more a background paper, which describes the rationale behind time triggered systems in general and more specific the rationale for inventing TT-Ethernet.
6. T. Steinbach, F. Korf, T. C. Schmidt. *"Comparing time-triggered Ethernet with FlexRay: An evaluation of competing approaches to real-time for in-vehicle networks"*. 8th IEEE International Workshop on Factory Communication Systems (WFCS), May, 2010: page 199–202.
7. Rojdi Rekik, Salem Hasnaoui, “*Application of a CAN BUS transport for DDS middleware”.* Proceedings ICADIWT '09. Second International Conference on the Applications of Digital Information and Web Technologies. 2009: page 766-771.
   - SAP Article: Shows how DDS can be implemented on top of a CAN Bus.

Slides

- **Time Triggered Ethernet – TT-Ethernet**

Exercise: Time Triggered Ethernet (TT-Ethernet)

Goal: Obtain experience with design of a Time-triggered system using Time Triggered Ethernet.

Assignments:
TBD.

Evaluation: