TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Applied Computer Science, Industrial Communications

Technische Universität Dresden, 01062 Dresden

Prof. Dr.-Ing. habil.
Martin Wollschlaeger

Phone: +49-351-463-39670
Fax: +49-351-463-39668
Mobile: +49-173-201 5346
E-Mail: martin.wollschlaeger@tu-dresden.de
Secretary: Mrs. Hirsch
Phone: +49-351-463-39669
E-Mail: sekrmspk@mailbox.tu-dresden.de

Dresden, 2015-05-25

Review of Master Thesis of
Mr. Bc. Jan Prášek
entitled
Modelling of Profinet Communication

In modern automation and control systems, industrial Ethernet is one of the most important communication technologies. Depending on the application requirements, such technologies need to guarantee the correct timing and the fulfillment of the real-time constraints. Therefore, special protocols like PROFINET IO have been developed.

The configuration of the connected devices, the network topology, and the network traffic influence the timing behavior of such networks. Because of the complexity of the influence factors, an analytic approach of calculating the installation's performance is complex. This brings simulation methods into the interest of the network designer. However, simulation needs appropriate models for delivering good results.

The work of Mr. Prášek is addressing this topic. His task was to develop a model of a PROFINET network, including basic models for the networked components, and to verify and improve the model by comparison with measured values.

Mr. Prášek used OMNeT++ as a basis of his work. Besides the modeling, he performed intensive software design in C++ for the model's components and for support functions for the users.

In chapter 1 of his thesis, he briefly introduces the tasks and describes the main technologies he used. However, no detailed justification for using OMNeT++ was given and the design criteria were described only briefly. Unfortunately, there is no detailed presentation of the state of the art. Thus, a comparison of the results he obtained with

other approaches is difficult.

In chapter 2, Mr. Prášek describes the structure of OMNeT++ and presents the extensions of the framework that he developed during his work. He modeled the Ethernet Frame, the Channel, a PROFINET device, and a switching component. He discusses in detail the class structures, the attributes, and the definition of the NED files. Based on the modeled entities, he is able to create aggregations of the entities in form of a compound module representing a generic PROFINET device. The modeling approach is both very detailed and very flexible. It allows easy creating of specific configurations of PROFINET devices.
The parameterization of a model is done by providing configuration data in JSON format. In chapter2, the details of the configuration data are discussed, including configuration of events and of whole networks.
In order to allow easy access to the simulation model, Mr. Prášek designed and implemented a simulation API.

The whole definition is using general Ethernet concepts and terms. It is missing PROFINET protocol details, like FrameIDs, the specific structure of the RTC, RTA, and alarm telegrams. Of course, a user can define this structure, but this is not further supported by Mr. Prášek's work. On the other hand, the model entities are rather generic, allowing the model to be used for other industrial Ethernet technologies with low effort.

In chapter 3, Mr. Prášek describes how to use the entities from chapter 2 for modeling a specific example. Since the statistical parameters for the model are difficult to calculate, he introduces a concept of deriving such data from measurements of real systems. This is useful, even if it might have some drawbacks regarding generalization.
In chapter 3.4, Mr. Prášek presents the results from five different experiments. He defines and runs simulations and the compares the timing results and the statistics with the measurements using MATLAB. From a discussion of the results, he derives compensation features and enhancements. For the experiments 1 to 3, the overall simulation error is 10^{-5}, which is very good and proves the modeling Mr. Prášek has proposed. The usage of the model for diagnostics of a network is done in the experiments 4 and 5.
Overall, the experiments validated the model. However, the results need to be discussed in more detail.

Chapter 4 of the work provides a short conclusion of the work and indicates a few of possible enhancements.

The thesis includes only a few references to the technologies used, but none to state of the art. It contains an appendix with a description of additional scripts and tools, and a CD with source codes, experiment data, figures, etc.
Overall, the description is very detailed for the model and the software Mr. Prášek developed himself. However, it is missing this level of detail for a state of the art analysis, partly for the explanation of experiment results, and for the conclusion.

To summarize the review, the master thesis of Mr. Prášek gives evidence that he is able of analyzing a complex task and of solving a technical problem with a deep knowledge of networks and software development.

I propose the Faculty of Electrical Engineering of the Czech Technical University in Prague to accept the thesis in its current form, and I assess it with mark

"C (Good)".

Dresden, May 25th, 2015

Prof. Dr.-Ing. habil.
Martin Wollschlaeger