

## Doctoral Thesis Review

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Thesis Title: Scheduling Algorithms for Time-Triggered Communication Protocols

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Reviewer: doc. Ing. Jiří Novák, Ph.D., CTU FEE, Dept. of Measurement

### Introduction

The thesis is focused on scheduling in distributed systems based on time-triggered communication. I am convinced it is an up-to-date topic, as such systems are being used in number of industrial applications, including transportation and especially in-vehicle networking. I especially appreciate candidate's approach to incorporate important practical aspect of solved tasks like variant scheduling and backward compatibility of new schedules.

### General Thesis Evaluation

At the beginning the general thesis goals and objectives are defined, that conform to the commonly accepted requirements for this kind of work. Chapters 1.4 and 1.5 summarize thesis contributions and provide a detail overview of its structure.

The thesis brings new contributions in three fields; each of them is described in a separate chapter. The structure of these chapters (2 – 4) is the same – after the introduction describing the state-of-the-art the solved problem is formally defined as well as specific goals to be achieved. Next the designed algorithm is introduced, described and explained in detail and evaluated using (where possible) industry sourced data sets. Finally the discussion of results is provided focused on influence of specific aspects of the solved task.

Chapter 5 provides a comprehensive summary of achieved results and proves that the theses goals were really achieved.

### Detailed evaluation and questions

In Chapter 2 the heuristic algorithm for static segment scheduling on two independent FlexRay channels is introduced. The results are summarized in Tables 2.1, 2.2, and 2.3 and clearly prove that the designed Channel Assignment Heuristic algorithm provides close to optimum results in shorter time.

***I have 2 questions, the first concerning the feasibility of the schedule to FlexRay specification. Could you provide counterexample of schedule that is not feasible and how can it be generated?***

***The second, would it be possible to integrate the GW functionality into one of the common nodes? Could your algorithm be used in this case with some modification?***

In Chapter 3 the heuristic algorithm for multi-variant scheduling on safety-related FlexRay network is introduced and extended for incremental design support. I consider this chapter to be the most important part of theses, as it actually reflects and solves the problems that the designers of modern cars encounter. Again the algorithm behavior is proved using the datasets that reflect the industrial requirements. Finally, an influence of particular algorithm features (e.g. the extensibility optimization) is discussed.

***I have just one question; in this chapter you several times have mentioned the relation between the scheduling and electromagnetic compatibility issues. Could you explain this relation more in detail?***

Chapter 4 of the theses focuses on incremental scheduling algorithm for time-triggered communication in Time Triggered Ethernet. It works in three steps, looking for optimal route assignment, communication cycle assignment, and the link schedule assignment. Particular optimization steps are formally defined and suitable methods are applied. The main advantage of the designed algorithm is the support for incremental development, which is typical in practice. The algorithm is verified using synthetic datasets and the results prove the expected algorithm behavior. As in previous chapters, an influence of particular algorithm and/or dataset features is discussed.

***I have a question concerning graph in Figure 4.6. I believe it presents the utilization of time-triggered communication segment but the vertical axis label says it is average link porosity. Could you clarify it?***

### **Conclusion**

**On my view the thesis bring new and valuable contributions on field of time-triggered communication scheduling both from theoretical and practical points of view. Beyond any doubt the presented work fulfills the requirements assumed for doctoral thesis. Therefore I recommend the thesis for the defense.**

Prague, March 30, 2021

doc. Ing. Jiří Novák, Ph.D.