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## **A Review of the PhD thesis of Michal Sojka entitled “Resource Reservation and Analysis in Heterogeneous and Distributed Real-Time Systems”**

The thesis presents the results of research that Michal Sojka has conducted in the area of development of real-time, possibly distributed, applications.

The challenge of this research consists in the necessity to facilitate the resource management in dynamic and distributed real-time applications. This is very important for temporal behavior of such applications which can be seriously endangered by transitory unavailability of needed resources. The solution in today's systems is not simple because of their complex structure. They are often distributed, composed from heterogeneous hardware and requirements on them dynamically change in the course of run/time. So the subject of the theses is very challenging and up to date.

Submitted thesis presents the achieved results in 7 chapters on 108 pages. The author approaches the problem through design and development of a new contract based reservation framework called FRSH/FORB. The framework is build on the base of FRSH framework as its superset to enable abstract better various resources to provide higher modularity of the framework. The valuable and very important feature of the FRSH/FORB framework is that it can be used as a run-time environment for a component-based real-time middleware. In chapter 3.1 the author gives the reasons why to design new framework instead of using the existing one. In the main it is due to the requirement to support Wireless Sensor Networks and FPGAs. I rate author's approach to extend existing framework as adequate and optimal not only for current implementation but also for future possible extendings.

The relevant contributions of the thesis are contained in chapters 4 to 6. In my opinion thesis contributions could be classified as both theoretical and practical. Moreover achieved results were evaluated to demonstrate their credibility and quality which certainly consumed a big deal of experimental work as documented in the thesis.

Fundamental contribution of the thesis is represented by design and implementation of the resource reservation framework (chap.3). Flexibility of the developed framework was demonstrated through integration of six different resources as described in Chap.4. Very important contribution is the integration of FPGA resource since use of FPGA can considerably increase the timing of RT systems. Also integration of Wi-Fi networks represents further important contribution because its influence on overall systems performance could be essential due to very variable burden they produce. This way the framework represents substantial contribution to the development of real-time systems in general

The evaluation of the framework and integration of mentioned elements (=resources) could be considered as rather practical contributions and fulfillment of evaluation tests on them as necessary for their attestation. Nevertheless the thesis contains also a theoretical results represented by a formulation of schedulability analysis for tasks with offsets as an integer linear programming problem (Section 6.3) and evaluation of the performance of this approach (Section 6.4). As a significant contribution of the thesis I consider FRSH API Change proposal contained in appendix A which appeals the open development community. The proposal is focused on improving implementation tools which can influence future development of FRSH network.

One of the most evident proofs of the work excellence is presented in Figure 5.7 containing graphs showing the influence of FRSH framework on performance of the system resource portfolio in comparison with the case when framework is not used.

To summarize the review I would like to pick up explicitly that the goals set for this thesis has been successfully completed as detailed below:

- a. The subject of the thesis is topical
- b. The goals, which were set in the thesis beginning, were completely fulfilled.
- c. The methods of elaboration are adequate and comparable with methods used in other similar projects and adds the new results to existing state of the art in this area.
- d. The thesis enthrones the actual and demanding theme, the presented results are excellent, and can substantially contribute to the both theory and praxis of real-time systems development. The main contributions are discussed in the text above.
- e. The results of the thesis could be applied in number of everyday's applications dealing with development of real-time systems. The FRSH/FORB framework was and is developed as open project and as such it creates excellent opportunity to further scientific continuation and development
- f. The thesis fulfills the conditions of single/independent scientific work and contains original results which have been published by the author of the thesis. The list of author's publications listed in thesis documents his qualification and competence for scientific work.

All that is why **I recommend the thesis to be accepted for a defense** and upon its successful completion to assign Michal Sojka by the PhD degree.



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