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Review
of PhD Disseration
Online and Distributed Algorithms for Packet Dissemination in Wireless Networks
by Paweł Garncarek

This report has been prepared on request from Wrocław University, Faculty of Mathematics and Computer Science.

This report is written in English, since I expect that the other reviewer does not speak Polish.

Overall evaluation

In my opinion the PhD dissertation meets the requirements for PhD degree in computer science, in Polish classification: *informatyka, nauki ścisłe*. The specific field of the dissertation is theory of distributed algorithms.

Moreover, taking into account the number and depths of the results I would say that it belongs to the top 5% of PhD dissertations defended in good and very good universities in Europe. It would deserve *summa cum laude*, if Wrocław University provides such or a similar distinction, regardless of some imperfectness of presentation.

Details

The PhD dissertation is based on a series of papers published in top conferences in distributed computing (DISC, SPAA, IPDPS) and in *Theoretical Computer Science*. In principle, according to the Polish law the author could take the collection of these papers and present them as a research record for receiving PhD degree. The contribution of Paweł Garncarek in the results from these papers has not been specified in detail. An exception is the sentence: *I generalized the results from [42] to the model of crashes and contributed to the improvements of the final versions of the proofs of the results.* In remaining cases the default rule applies - each of the co-authors (including Paweł Garncarek) has the same share in making the research contribution. This share is perfectly sufficient for receiving PhD. Given my experience, I have to say that in not just a few successful Habilitation procedures in computer

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science in Poland the contribution of the applicant is comparable with what has been presented by Paweł Garncarek.

The dissertation is devoted to a very specialized but clear topic. It attempts to answer to the question how to transmit messages on a shared channel or channels, given that

- the packets to be sent are arriving continuously to the nodes, but according to some random pattern,
- the adversary can both attack via scheduling the arriving packets in a way that makes troubles for the scheduler and by crashing communication,
- the collision on the shared channel results in a transmission failure.

These are very reasonable assumptions and the problem is well motivated.

On the other hand, the author(s) devote a lot of effort to design the schemes where the nodes have very limited knowledge about the history of the past transmissions. This is a little bit controversial at many places. While limiting the computation power of the scheduler meets the demands of fast routing devices, it is a little bit artificial to prevent to use only an extremely limited memory or even to focus on memoryless protocols. Even a few memory bits can make a difference, even in the dissertation it has been observed that weaker information to the scheduler lead to substantial challenges (see e.g. Chapter 4).

On the other hand, it has been assumed that the sending node can always see if its transmission has been successful. Exactly this might be a technical challenge leading to the Byzantine Generals' Problem. So the model assumes implicitly a kind of acknowledgment sent back to the sender. As only the sender learns this acknowledgment, an out-of-band reliable channel must be used. However, the feedback channel could be used for other purposes as well, potentially even single bits can make difference.

Of course, these remarks cannot be treated a serious weakness of the dissertation – it is frequently very hard to explore the most desirable direction. Weakening the information available to the scheduler is in principle very important issue – if in theory the effectiveness of a scheduler does not drop down significantly it might be much better in practice.

The results obtained in the dissertation contain some quite tricky constructions and arguments. Even if one cannot talk about breakthrough new paradigms of a universal nature, there are some ideas that can be reused in other scenarios. The dissertation contains not a single proof or construction that could be called a trivial one or written in a way that would make an impression of being more complicated than it really is.

Probably due to the number of results and amount of work needed for editing, there are many formulations that are imperfect. They reflect the

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intuitions of the author(s), but sometimes written without a necessary care about the reader. A good example are Definitions 3.1 and 3.2: *An arrival pattern is a function that for each round t and each node v represents whether a packet is injected into v at s.* A clear formulation would be that *Each function $f : V \times T \to \{0,1\}$ is called an arrival pattern, where $f(t,v) = 1$ means that at time t a packet is injected to node v.* In turn, Definition 3.2 reads: *A scenario is a class of pattern arrival patterns where only a specific subset of stations have packets injected into them.* Hard to say what does it mean, as for each arrival pattern only some specific subset of stations receive packets. Later, one can learn from the proof that a scenario means a restriction: only stations from a subset related to the scenario may receive a packet. So it would be better to talk about subsets of the set of all stations and arrival patterns compliant with them, instead of *a class of arrival patterns*.

There are numerous places of this kind in the dissertation. Nevertheless, I have to admit that the author attempts always to precede a formal description of an algorithm or a formal proof by an overview giving some intuitions to the reader. In most cases this is quite helpful.

I believe that the results presented in the dissertation are correct. Given the time given for preparing the review and the above mentioned problems, it was impossible to check all the details and confirm validity of the claims.

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