

Review of a Doctoral Thesis at FIT BUT

Doctoral thesis (hereinafter referred to as "thesis"), title of the thesis: MAPPING OF PACKET PROCESSING FROM P4 LANGUAGE TO FPGA TECHNOLOGY

Name of the doctoral student (hereinafter referred to as "student"), name and surname: MICHAL KEKELY

Name and institution of the reviewer (full name of the reviewer, full name and country of the institution):

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I. Thesis

Appropriateness and relevance

This thesis is timely, relevant, and appropriate to the area of programmable network devices on FPGA.

The thesis addresses several important problems in the research area, namely: (i) identifying suitable architectures for packet classification on FPGA (ii) achieving high throughput and throughput scalability (iii) minimizing the memory resources (on chip and off chip) required for packet classification.

These are all important problems in the research area of computer networks, and more specifically in the design of future network devices.

A summary of the contributions of the thesis

The goal of this thesis is to develop architectures for packet classification, and to design and implement them on FPGA. Furthermore, the thesis aims to optimise the implementations and enable scalability for future generations. The thesis achieves its chosen goal, and makes the following core contributions by the student:

- i. Introducing an efficient hardware architecture for packet classification aimed at 100Gbps.
- ii. Introducing a scalable Cuckoo hashing algorithm that enables higher throughput.
- iii. Exploring the efficiency and scalability for different use cases of general packet classification with proposed architectures.
- iv. Optimising external memory accesses for packet processing, enabling more table rules while maintaining high throughput.

Novelty and significance:

This thesis introduces novel work of a level suitable for a PhD. The introduced solutions, especially where applied to the scalability of programmable pipelines architectures, are significant and will be an important building block in future research in this field.

While the work focuses on packet classification, the results are also applicable to related application areas of programmable network devices. Moreover, these results are practical and can be used by industry in their FPGA-based networking products.

Evaluation of the formal aspects of the thesis:

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The formal quality of the thesis is good, and the language level is suitable for a PhD thesis. The thesis is a collection of published peer-reviewed research papers, and as such the organization of the content and the writing style is well suitable to the publication venues, as well as to a papers-based thesis.

Quality of publications

The work included in this thesis was published in several international venues, including IEEE International Conference on Field Programmable Logic and Applications, and Elsevier Science Microprocessors and Microsystems journal, both considered high quality publication venues in the research field.

Overall, the student has published eight papers, six of them as the lead author. This is an above the average number of publications for a PhD student in this field.

II. Student's overall achievements

Overall R&D activities evaluation:

The student's thesis and the results included into it indicate that he is a person with scientific erudition and creative abilities. The presented results are innovative and interesting, and likely to lead to further research innovations.

Assessment of other characteristics (optional):

There are several additional characteristics to support the student's thesis. First, his paper "Memory Aware Packet Matching Architecture for High-Speed Networks", where the candidate was the lead author, won the best student paper award of EuroMicro DSD. Second, during his PhD studies he participated in 8 research projects, one of them as lead researcher. Last, his work as part of Intel/Netcope (in collaboration with FIT) is on a world leading project and of major importance to the research area.

III. Conclusion

In conclusion, in my opinion, the thesis and the student's achievements until now meet the generally accepted requirements for the award of a PhD academic degree.

The candidate has demonstrated ability to carry out independent activities in the Network Devices area of research, the results are appropriate, relevant and of suitable quality. The research demonstrated novelty and innovation of significance to the field, and there is supporting evidence of the candidate's high-quality level of research.

Oxford 09.06.2024

Signature of the reviewer