REVIEW

by Prof. Stanimir Nedyalkov Stoyanov, PhD,

Institute of Information and Communication Technologies (IICT), BAS,

of a dissertation for awarding the educational and scientific degree 'doctor',

in the field of higher education: 4. Natural sciences, mathematics and informatics

professional direction: 4.6. Informatics and Computer Science

doctoral program: Informatics

Author: Tasho Dimitrov Tashev

Title: "CONFLICT-FREE SCHEDULING ALGORITHMS OF A SWITCH MATRIX PACKET SWITCH"

Scientific consultant: Prof. Vladimir Monov, PhD

1. General description of the received materials

By order No. 65/27.02.2023 of the director of the IICT, I have been appointed as a member of the scientific jury to ensure a procedure for the defense of a dissertation on the topic "ALGORITHMS FOR CONFLICT-FREE SCHEDULING OF A PACKET SWITCH WITH A MATRIX SWITCH" for acquisition of the educational and scientific degree "doctor" in the field of higher education 4. Natural sciences, mathematics and informatics, professional direction 4.6. Informatics and Computer Science, doctoral program Informatics. The author of the dissertation is Tasho Dimitrov Tashev - PhD student at IICT - BAS, with scientific consultant Prof. Vladimir Monov, PhD, from IICT.

The set of materials presented by Tasho Dimitrov Tashev is in accordance with the Rules for the Development of the Academic Staff of IICT.

2. Relevance of the topic and appropriateness of the goals and tasks

The problem investigated in the dissertation is topical. The use of formal tools, such as the Generalized Networks (GNS) formal apparatus, for modeling telecommunication flows provides various possibilities for computer simulations (for example, of the throughput of a matrix-switched

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packet switch) to determine positive properties, and also disadvantages. The results of such simulations allow targeting future research to improve the algorithms used. In addition, the development and use of visual tools supporting formal systems for modeling scenarios and processes in cyber-physical systems is an up-to-date task with opportunities for wide practical application.

3. Knowing the problem

From the presented materials, I can conclude that the PhD student knows the state of the problem in detail and is able to creatively evaluate the literary sources related to the topic of the dissertation. Proof of this is also the appropriately selected and up-to-date publications referenced in the dissertation, as well as the achieved research results.

4. Research methodology

Although it is explicitly not presented in the text of the dissertation, based on the structure of the dissertation and the presentation of the obtained results, I can conclude that it is correctly selected and allows the achievement of the formulated goal of the research and the solution of the relevant tasks.

5. Characterization and evaluation of the dissertation work

The dissertation consists of 151 pages of introduction, five chapters, conclusion, list of publications on the subject of the dissertation, noted citations, declaration of originality of results and bibliography. The used literature, including 130 sources, is up-to-date and appropriately selected in accordance with the nature of the research. In my opinion, the thesis is structured logically correctly and coherently presents the evolution of the research. Each chapter ends with conclusions and references to the doctoral student's publications relevant to the problem under consideration.

The introductory part of the dissertation briefly motivates the need to conduct such research. The structure of the dissertation is also presented.

In the first chapter, an analytical overview of the approaches and methods for the synthesis of information interaction models and the structure of complex systems is made. The non-necessity of using the apparatus of generalized networks (GNS) as a formal tool for modeling such kind of systems is motivated. Based on the analysis, the goal of the research conducted within the dissertation was formulated: to gain methodological experience in the use of the GNS apparatus for modeling algorithms for conflict-free scheduling for a packet switch with a matrix switch with input buffering of the type "virtual output queues" and to propose a suitable algorithm and a formal GNS-model for conflict-free scheduling in it. Additionally, to validate a methodology for large-scale computer simulations of its throughput, providing an unambiguous comparison of different algorithms. To

achieve the goal, four tasks have been defined. I think that, set in this way, they correspond to the purpose of the study.

In the second chapter, the developed GNS-models for the "Wavefront" and "Observation" algorithms and their three modifications are presented. Algorithms are sequentially computed. In this way, the methodology for selecting the minimally necessary components of the GNS for the formal specification of the algorithms for conflict-free scheduling has been worked out. The results of the throughput study for the two first modifications under the simplest inbound traffic model are presented.

In the third chapter, an approach to sequentially build an GNS-model of various variants of the PIM algorithm, which uses parallel computation of a conflict-free schedule, is presented. The results of computer simulation experiments on this model are discussed. One of the results is an explicit display of the synchronization points of the parallel processes involved. The model allows easy determination of the heaviest computational operation, which is sorting. For the purpose of computer simulation of the throughput of the switch, patterns of different types of incoming traffic are defined.

In the fourth chapter, the MiMa algorithm is described. The algorithm is of a "weighted" type with a sequential calculation based on a pre-specified so-called "heavy" conflict criterion. The weak, strong and full forms of the algorithm are presented. The GNS model of this algorithm is presented in detail. The four options for choosing weighting coefficients were investigated. This chapter also discusses the results of experiments with the computer simulation of the model, which confirm that the classic "max-max" gives maximum throughput, and "min-min" - minimum throughput.

In the fifth chapter, a numerical procedure is specified for calculating an exact upper limit of the throughput of the switch, with an unlimited input buffer. A heuristic solution has been found for a given range of dimensions of the switching field of the commutator. On this basis, a comparison of PS for the PIM, MiMa and LPF algorithms is made. Suggestions are made to improve the MiMa algorithm.

In the conclusion, the results of the research are summarized. Directions for future research and development are identified. A list of scientific publications on the topic and marked citations is presented.

6. Contributions and significance of the development for science and practice

I think that the objectives of the dissertation and the tasks specifying them have been fully achieved. I can assess the contributions of the research presented in the dissertation mainly as scientific and applied, and I would summarize them as follows:

- A MiMa (MinimumofMaxima) algorithm for contention-free scheduling in a matrix switch packet switch is proposed and studied in detail. In the conditions of computer simulation, the properties of the algorithm were investigated.

- With the apparatus of generalized networks, and models of four classical algorithms for conflict-free scheduling in a switch-matrix packet switch are created and studied.

- Four families of templates for four classical types of incoming traffic are proposed, designed for large-scale computer simulations of the throughput of conflict-free scheduling algorithms, under full load of incoming lines.

- A numerical procedure is developed to calculate an exact upper bound on the throughput of contention-free scheduling algorithms in a matrix switch packet switch.

7. Assessment of dissertation publications

The doctoral student has indicated seven publications reflecting and summarizing the results of the dissertation. Three of the publications are with SJR, two publications are referenced in WoS and five are referenced in Scopus. With the exception of one, the rest of the publications are co-authored. Five publications are in English, one is in Bulgarian and one is in Russian. I think that the publications to a significant extent summarize the results of the research presented in the dissertation.

8. Personal participation of the PhD student

From the materials presented to me for review, I am left with the impression that the results of the conducted research were mainly obtained with the personal participation of the PhD student.

9. Abstract

The abstract summarizes the results of the dissertation work. Its volume is larger than commonly accepted.

10. Personal impressions

I have no personal impressions of the PhD student. For the preparation of this review I used only the materials suggested by me.

11. Critical notes

My main critical comments are on the text of the dissertation. It needs major editing. Many spelling, grammatical and stylistic errors were made. The way of numbering the figures in the individual chapters is different. The numbering of the figures in the third chapter is a complete mess.

In my opinion, there are generally descriptive texts that are redundant. For example, point 1.1. can be shortened.

CONCLUSION

The dissertation contains scientific-applied and applied results that represent an original contribution to science and meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of this law and the IICT Regulations.

The dissertation shows that the doctoral student Tasho Dimitrov Tashev has in-depth theoretical knowledge and professional skills in the scientific specialty of informatics, demonstrating qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results and contributions, and I propose to the honorable scientific jury to award the educational and scientific degree "doctor" to Tasho Dimitrov Tashev in field of higher education: 4. Natural sciences, mathematics and informatics, professional direction: 4.6. Informatics and Computer Science, PhD Program: Informatics.

05.05.2023 г.
Sofia

На основание
ЗЗЛД

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