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Security of Grid Structures with Cut-through Switching Nodes

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Eighth Workshop *Program Semantics, Specification and Verification: Theory and Applications?* PSSV 2017, June 26, 2017

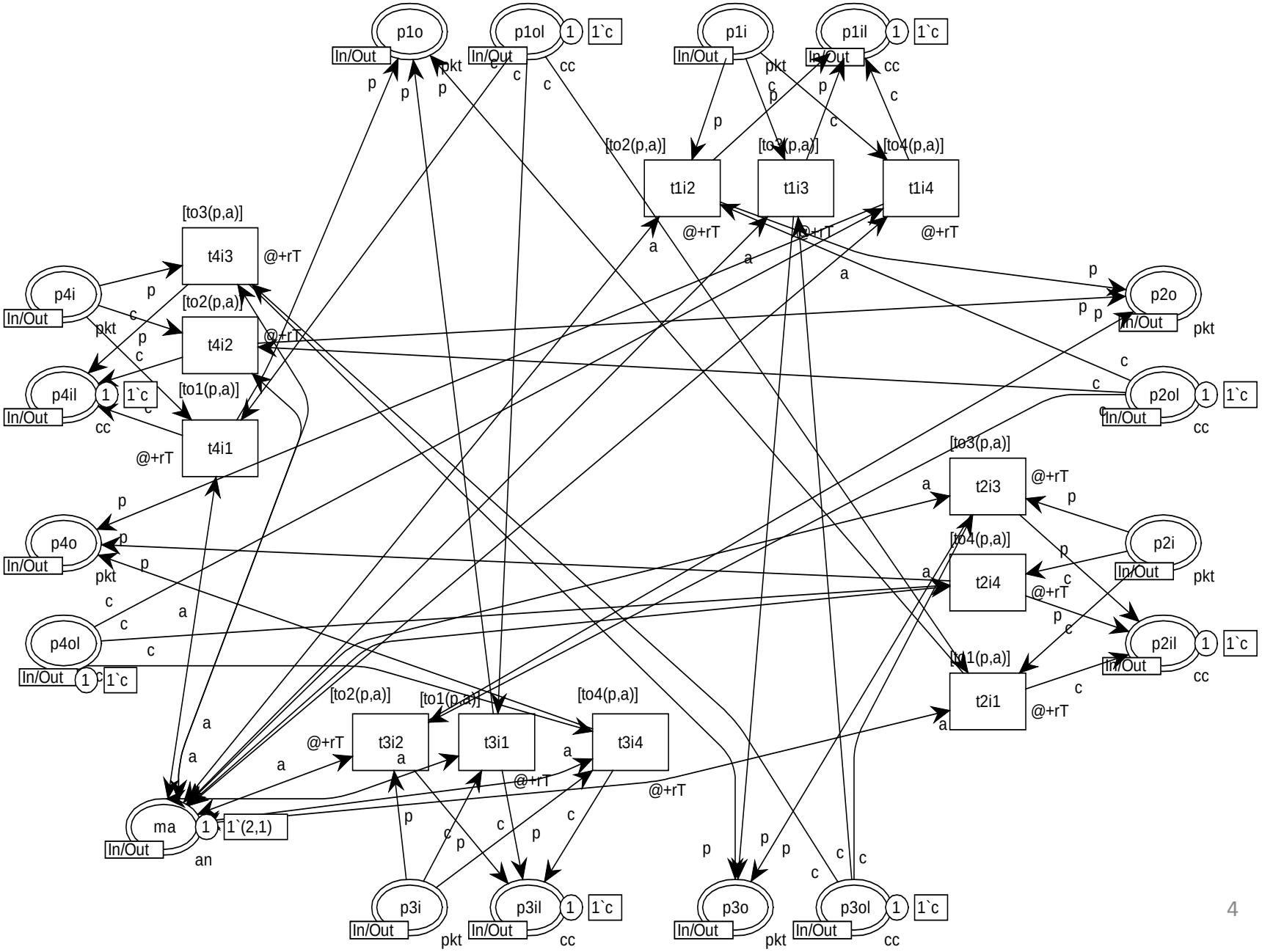
Introduction

- The present work is the further development of methods for analyzing of the rectangular communication grid model, which nodes perform the cut-through switching
- The methods are intended for application in the design process of computing grids; in the development of new telecommunications devices; in intelligent defense systems
- Blocking of computing grids was studied
- The model is developed using a colored Petri nets and modeling system CPN Tools

Application of cuts-through packet switching

- The SAF technology is traditional for most networks. It provides the packet transmission to the sender only after receiving of the packet and the check the control sum (CRC)
- The switching technology “on the fly” buffers the packet head only. The cut-through switches do not produce the packets selection; therefore they are the fastest in its class. The disadvantage of this switching is that it transmits any packets including with incorrect control sum. The cut-through switches are primarily used in data centers, where it is necessary to ensure the continuous transmission of a large traffic value with minimal delays

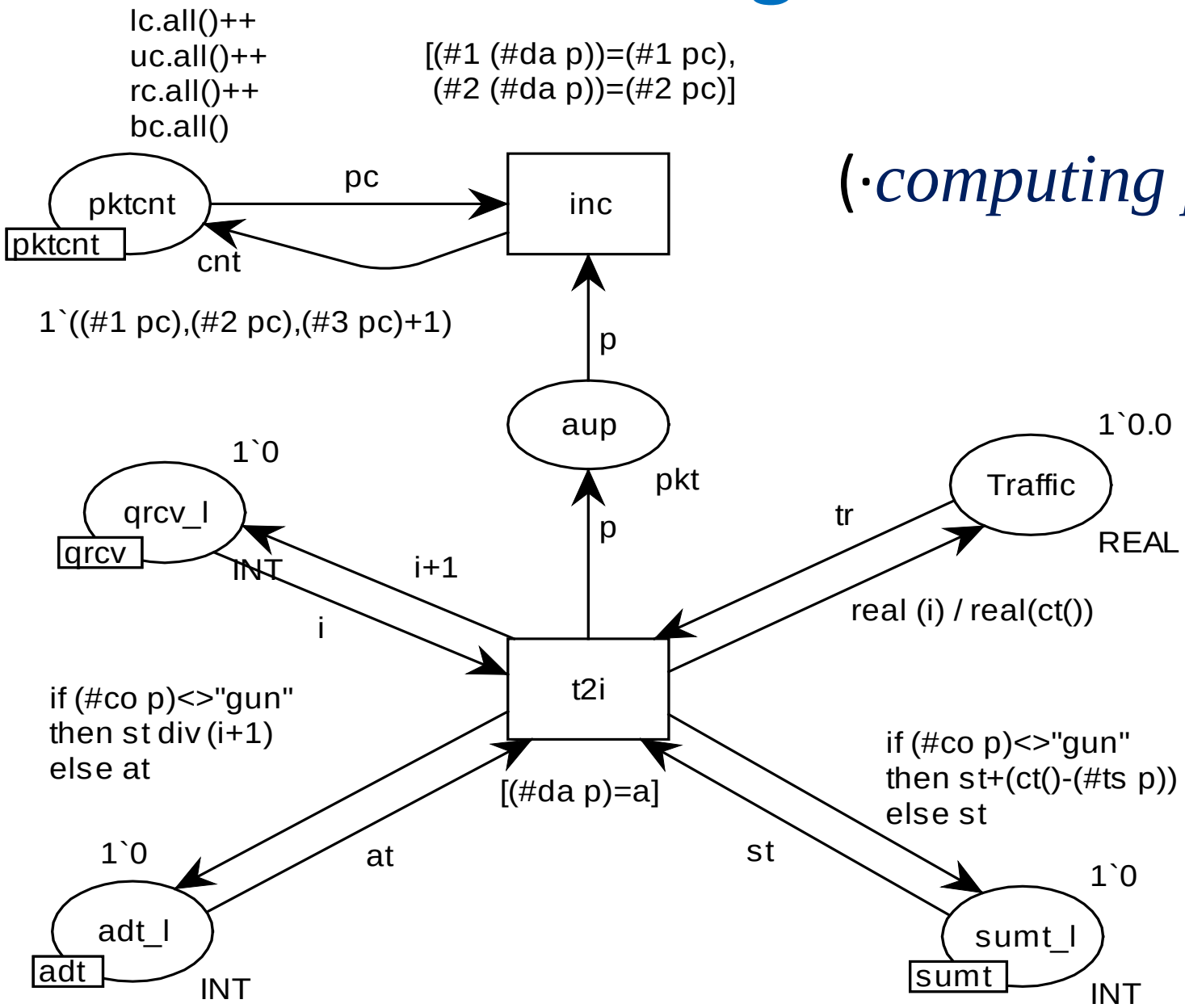
Model of communication node



Model of traffic generator

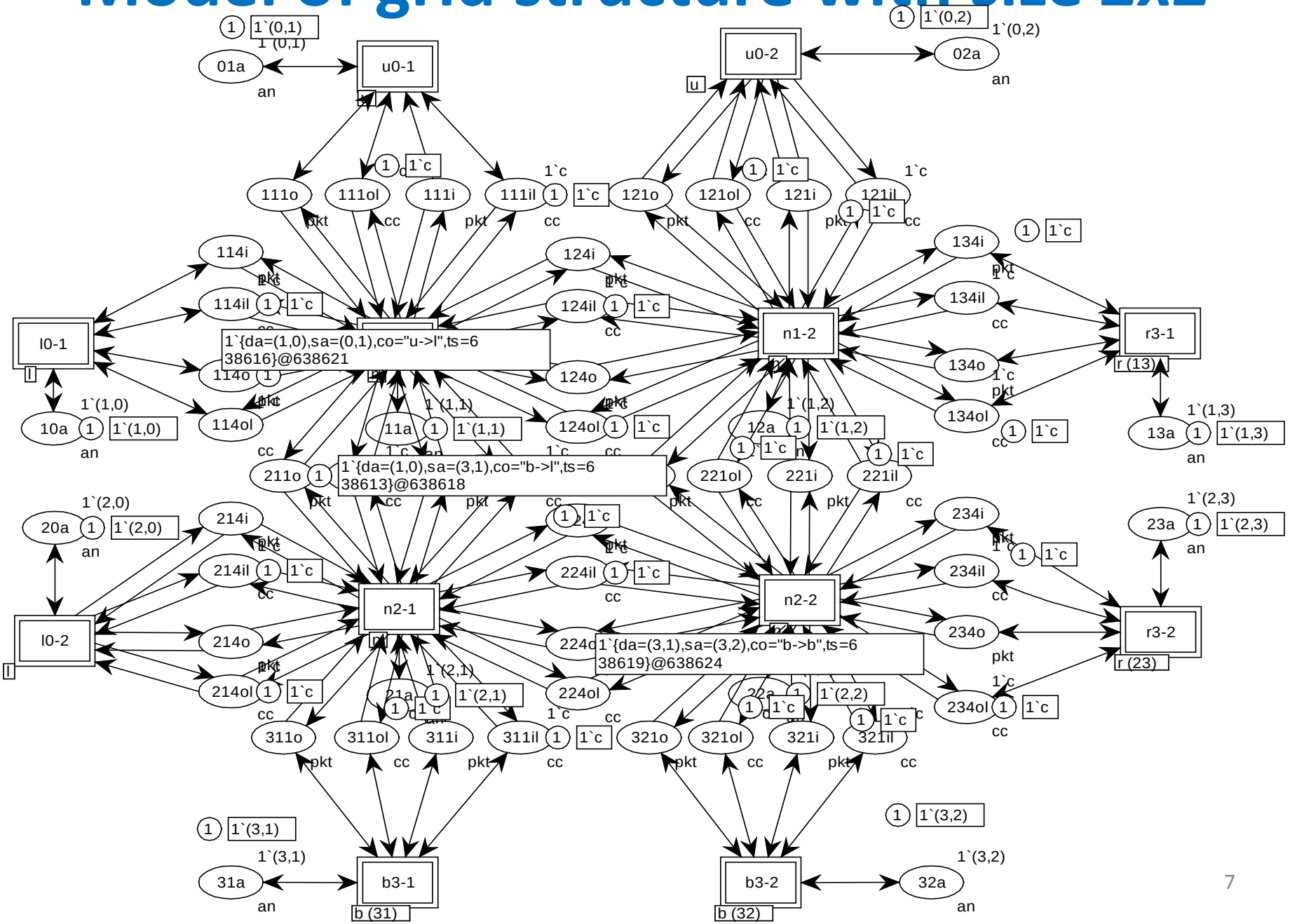
- For investigation of QoS parameters of the grid structure the model of the traffic generator was constructed. This model consists of the following parts: receiving, sending and computing submodels
- The sending part describes the process of traffic generation, the intensity and type of the traffic function distribution, rules of packet sending. Each packet consists of a destination address, a sender address, a string with some content and timed stamp of the sending time
- The receiving part of the model does not process an incoming packet; all packets are used in the computing part for QoS parameters calculation

Model of traffic generator



(·*computing part*)

Model of grid structure with size *2x2*



Grid characteristics under workload

Workload intensity (wl)	Type of switching	Average packet delivery time (MTU)	Grid performance gp (packets/MTU)
50.0	cut-through*	10	**0,14**
50.0	SAF	21	**0,14**
30.0	cut-through*	11	**0,23**
30.0	SAF	21	**0,23**
16.0	cut-through*	11	**0,44**
16.0	**SAF***	**22**	**0,42**

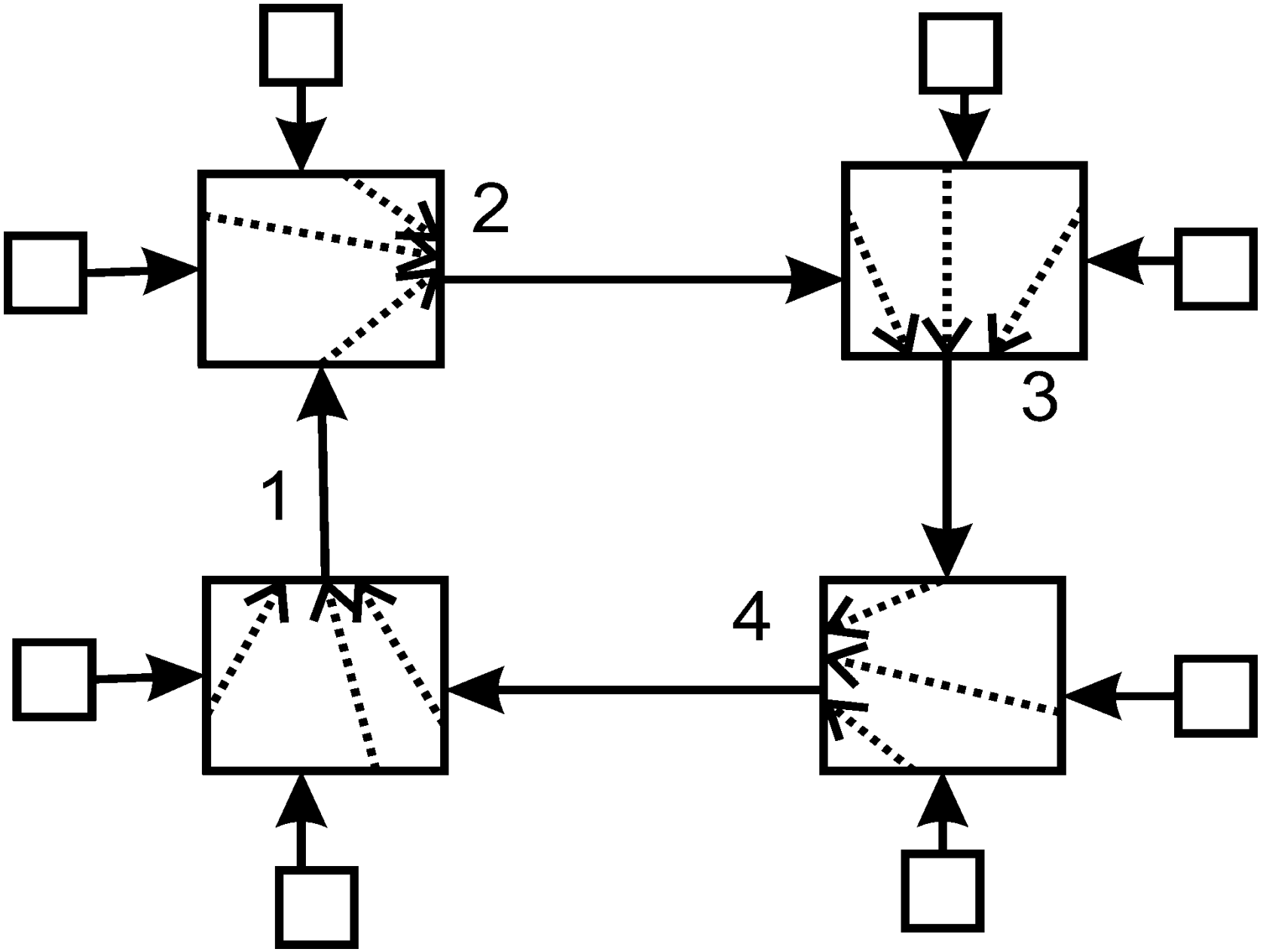
*Step=1000000, rT=5, bs=10, k1=2, k2=2; **

– the grid comes to a full deadlock – no permitted transitions

Analysis of generated models

- Workloads with *50.0* and *30.0* intensities are light workloads for investigated grids. The grid performance is equal for two switching modes. Average packet delivery time for SAF mode is twice greater than for cut-through mode
- Workloads with intensity about *16.0* are middle workloads for the investigated grids. The grid performance of cut-through mode is greater than for SAF mode, the average packet delivery time for SAF mode is twice greater than for cut-through mode

Example of a full deadlock



CONCLUSIONS

- Models of grid structures with **cut-through** switching nodes were constructed in the colored Petri net form.
- Security of grid structures, in particular possibility of deadlocks, was investigated under **workload** in the environment of modeling system CPN Tools.
- The **importance** of obtained results for the grid computing domain consists in the conclusion that modern architecture of the switching devices does not guarantee the grid security.
- Special **protocols** which involve interoperability of a several nodes should be developed for the deadlocks detection and avoidance.

Future research direction

A future research direction will be

- to investigate the grid structures with cut-through switching nodes under a workload and **traffic attacks**;
- to study **types of deadlocks** and **QoS** characteristics of grid under disguised traffic attacks;
- to construct a **re-enterable model** for investigation of grid structures with a big size, where initial characteristics of grid are model parameters.

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