Editorial

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Biographical notes: Wojciech Zamojski obtained his Master's in Electronic Engineering and PhD in Computer Engineering from Wrocław University of Technology in 1965 and 1969, respectively. In 1986 he was awarded the title of Full Professor by the President of the Republic of Poland. Since then he holds the position of a Professor of Computer Engineering at the Wroclaw University of Technology. His current research interests are focused on the theory of system dependability and maintenance, computer systems reliability, modelling and simulation of transport systems, neurocomputing and its applications. He is the Chairman of annual *International Conferences on Dependability of Computer Systems DepCoS – RELCOMEX*. He was the Main Organiser of periodical conferences *Reliability and Exploitation of Computer Systems RELCOMEX and MICROCOMPUTER Schools*.

Jaroslaw Sugier obtained his Master's in Electronic Engineering and PhD in Computer Engineering from Wrocław University of Technology in 1990 and 1999, respectively. He is currently an Assistant Professor in the Department of Electronics at Wrocław University of Technology. His research interest includes computer-aided geometric design, numerical methods in CAE systems, probabilistic models for dependability analysis, digital systems design, programmable logic and hardware programming. He is also a member of Programme and Organizing Committees of DepCoS-RELCOMEX conference series and has been the Editor of the conference proceedings in 2006–2009.

Dear Readers,

We would like to present you a few papers selected from presentations given during the Conference on Dependability of Computer Systems DepCoS - RELCOMEX '08 (held from 26–28 June 2008 in Szklarska Poręba, Poland) that was organised by Wrocław University of Technology (Poland) with support from Moscow Power Engineering Institute (Technical University) (Russia).

The annual DepCoS - RELCOMEX conferences propagate multi-disciplinary approach to theory and technology of dependability and maintenance of systems and networks. The DepCoS - RELCOMEX approach is based on the main assumption: systems and networks, particularly computer systems and networks, accomplish user tasks on the basis of available services (functionalities) and information and technical resources. This means that a realised task is dynamically mapped on services and then the services are dynamically mapped on system resources. The system operate in unfriendly

environment and its components (services and resources) are working with limited performance and dependability parameters, so in consequence the user tasks are executed with limited performability parameters too. Sometimes a combination of unfriendly conditions of environment together with possible faults produced by technical infrastructure and/or by users may create a critical situation in system operation which may lead not only to incorrect task realisation but even to a system collapse.

In our approach critical computer-based systems should be analysed in one common way based above all on analysis of system functionality and then on examination how system infrastructure and their technical parameters (considered as probabilistic or deterministic values) are influenced by realisation of these functionalities. This approach to system analysis and system development is complicated and, unfortunately, it implies implementation of numerous dissimilar steps such as mathematical modelling, evaluation, optimisation, designing, testing etc., which are often inter-dependent. It should be noted that organisation of system development including application of specialised platforms and computer tools is crucial to reaching desired dependability and performance parameters of the designed critical computer-based system.

In the following few paragraphs we will present the main subject areas of the papers selected for this issue. They are a good representation of the general DepCoS-RELCOMEX topics as well.

The system development process

Development of contemporary computer systems or networks, for example a computer system on the chip or a distributed real-time system, is a distributed process performed by several workgroups/teams very often located in different organisations. Coordination of team activities and then integration and testing of design products (starting with ‘small devices with their interfaces’ and finishing with network architectures with functional processes and data flows linked to software systems) needs special computer tools. Because the designed system/network will operate in information environment which may produce such unfriendly events like failures of devices or communication channels, faults of software or management systems and even intended attacks, then problems of integration and testing grow very quickly up. Certainly, selection of proper and representative parameters which describe the system environment depends on future operating environment of the system and it is strongly connected with choice of adequate performability measures.

The paper by V. Balashov et al. included in this selection presents a system computer tool used for integration, testing, simulation and evaluation of a distributed real-time system. Computer systems that realise monitoring and control processes in nuclear power plants are archetypal cases of critical systems; in the work of V. Kharchenko and V. Sklyar you may find description of a platform and applied computer tools used in their design. Problems of critical safety scheduling in large distributed computer systems are, in turn, discussed by V. Toporkov and A. Tselishchev.

Tools

As previously noted, there are many hardware or software techniques used in order to improve dependability and performance parameters of systems under development. They

may be connected with extension of the system infrastructure (redundancies) or with improving system functionalities (fault detection, fault tolerance).

Redundancy at the system level, functionality level, devices (units) level or basic circuits level is commonly applied in order to increase abilities of the system. Usually, the main problem is where and how to introduce redundancies into a critical system. The system availability depends not only on redundancy levels but on such technical and maintenance parameters as time required for replacement of a faulted unit by an efficient one. An embedded redundancy allows among others for reconfiguration of the system with lower performance costs.

The work by V. Koutras and A. Platis presents a mathematical model based on the semi-Markov processes which enables estimation of availability parameters of a system with active redundancy. A few new engineering solutions for improving security, cryptographic and fault-tolerant properties of computer systems are presented in the papers by K. Kępa et al. (a system self-reconfiguration controller built in the FPGA device), Ł. Krukowski and J. Sugier (an FPGA implementation of the advanced encryption standard), and J. Biernat (new faster versions of an arithmetic block for FTC systems).

For discussion on monitoring and fault detection (including intended attacks) in system operation please see papers by I. Wolforth et al., E .Toth et al., J. Magott and M. Woda, and W. Tylman.

Mathematical models

Mathematical models of computer systems are frequently built on a set of defined system states and possible transitions between them. The latter are products of such system events like an appearance of a new task in the system, a change of a functionality that is currently in use, a failure of any device or a fault of management system, etc. The most popular method applies the state-transition graphs. A more refined way is based on a special probabilistic Petri net in which the transitions are connected with interval pass time and the marking model introduces additional conditions for firing the transitions between the states (see W. Zuberek et al.). Furthermore, computer tools often need automatic translation from mathematical models to computer-described models; examples of approaches to this problem can be found in papers by L. Kotulski and D. Dymek and A. da Silva et al.

Evaluation of model parameters

One of the most difficult problem in development of the critical computer based systems is evaluation of system measures that are strongly related to probabilistic description of events in environment under consideration. Application of the Markov processes is the simplest way but when real systems are considered some mathematical assumptions may be omitted.

The work by W. Zuberek et al. presents very interesting approach to modelling of a software system with a Petri net and in the paper by K. Sacha you may find interesting discussion about modelling “such a simple unit as a dependable controller” using UML state machine diagrams.

Simulation of system operation using Monte Carlo methods is often the only feasible way of evaluation of dependability measures of the system. Of course, simulation tools allow for passing over a lot of difficult mathematical problems, especially if assumptions of the Markov processes are not satisfied, but at the same time they are laborious and do not provide universal solutions. T. Walkowiak and J. Mazurkiewicz adopted scalable simulation framework (SSF) for examination of dependability and performance parameters of a discrete transport system in which punctual delivery of parcels depends not only on technical parameters of system elements but also on reliability characteristics and abilities of repair teams.

Finally, random numbers have many applications related to simulation and cryptography. They assure safety and accurate transactions in computer networks which support e-business operations. B. Fechner and A. Osterloh discuss a concept of a true random number generator which is especially resistant to nonintrusive attacks.

As can be seen from this overview the modelling, implementation and monitoring of contemporary critical computer-based systems require multi-disciplinary approach that combines many diverse areas of system, computer and information engineering. We hope that DepCoS-RELCOMEX'08 papers included in this special issue of *International Journal of Critical Computer-Based Systems*, although limited in number, appropriately demonstrate this fact and provide good examples for the reader.