Advances in Intelligent Systems and Computing 365

Wojciech Zamojski · Jacek Mazurkiewicz
Jarosław Sugier · Tomasz Walkowiak
Janusz Kacprzyk *Editors*

Theory and Engineering of Complex Systems and Dependability

Proceedings of the Tenth International Conference on Dependability and Complex Systems DepCoS-RELCOMEX, June 29 – July 3 2015, Brunów, Poland

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10 Years
DepCoS-RELCOMEX
2006 – 2015

Preface

We are pleased to present the proceedings of the Tenth International Conference on Dependability and Complex Systems DepCoS-RELCOMEX which was held in a beautiful Brunów Palace, Poland, from 29th June to 3th July, 2015.

DepCoS - RELCOMEX is an annual conference series organized since 2006 at the Faculty of Electronics, Wrocław University of Technology, formerly by Institute of Computer Engineering, Control and Robotics (CECR) and now by Department of Computer Engineering. Its idea came from the heritage of the other two cycles of events: RELCOMEX (1977 – 89) and Microcomputer School (1985 – 95) which were organized by the Institute of Engineering Cybernetics (the previous name of CECR) under the leadership of prof. Wojciech Zamojski, now also the DepCoS chairman. In this volume of "Advances in Intelligent Systems and Computing" we would like to present results of studies on selected problems of complex systems and their dependability. Effects of the previous DepCoS events were published (in historical order) by IEEE Computer Society (2006-09), PWr Publish House (2010-12) and by Springer in "Advances in Intelligent and Soft Computing" volumes 97 (2011), 170 (2012), 224 (2013) and 286 (2014).

Today's complex systems are integrated unities of technical, information, organization, software and human (users, administrators and management) resources. Complexity of modern systems stems not only from their involved technical and organization structures (hardware and software resources) but mainly from complexity of system information processes (processing, monitoring, management, etc.) realized in their defined environment. System resources are dynamically allocated to ongoing tasks. A rhythm of system events flow (incoming and/or ongoing tasks, decisions of a management system, system faults, "defensive" system reactions, etc.) may be considered as deterministic or/and probabilistic event stream. Security and confidentiality of information processing introduce further complications into the models and evaluation methods. Diversity of the processes being realized, their concurrency and their reliance on in-system intelligence often significantly impedes construction of strict mathematical models and calls for application of intelligent and soft computing.

Dependability is the modern approach to reliability problems of contemporary complex systems. It is worth to underline the difference among the two terms: system dependability and systems reliability. Dependability of systems, especially computer systems and networks, is based on multi-disciplinary approach to theory, technology, and maintenance of systems working in a real (and very often unfriendly) environment. Dependability of systems concentrates on efficient realization of tasks, services and jobs by a system considered as a unity of technical, information and human resources, while "classical" reliability is restrained to analysis of technical system resources (components and structures built from them).

Important research area on contemporary dependable systems and computer networks is focused on critical information systems. These problems were the subject of "Critical Infrastructure Security and Safety (CrISS) - Dependable Systems, Services & Technologies (DESSERT) Workshop" which was prepared by prof. Vyacheslav Kharchenko within the framework of the conference.

In the closing words of this introduction we would like to emphasize the role of all reviewers who took part in the evaluation process this year and whose valuable input helped to refine the contents of this volume. Our thanks go to Ali Al-Dahoud, Andrzej Białas, Dmitriy Bui, Frank Coolen, Manuel Gil Perez, Zbigniew Huzar, Vyacheslav Kharchenko, Dariusz Król, Michał Lower, Jan Magott, István Majzik, Jacek Mazurkiewicz, Marek Młyńczak, Tomasz Nowakowski, Oksana Pomorova, Mirosław Siergiejczyk, Ruslan Smeliansky, Janusz Sosnowski, Jarosław Sugier, Victor Toporkov, Tomasz Walkowiak, Marina Yashina, Irina Yatskiv, Wojciech Zamojski, Wlodek Zuberek.

DepCoS-RELCOMEX 2015 is the 10th conference so we feel obliged and honored to express our sincerest gratitude to all the authors (and there was over 500 of them), participants and Programme Committee members of all the ten events. Their work and dedication helped to establish scientific position of DepCoS-RELCOMEX series and contributed to progress in both basic research and applied sciences dealing with dependability challenges in contemporary systems and networks.

Wojciech Zamojski
Jacek Mazurkiewicz
Jarosław Sugier
Tomasz Walkowiak
Janusz Kacprzyk
(Editors)

Tenth International Conference on Dependability and Complex Systems DepCoS-RELCOMEX

Organized by
Department of Computer Engineering,
Wrocław University of Technology
under the auspices of Prof. Tadeusz Więckowski, Rector

Brunów Palace, Poland, June 29 – July 3, 2015

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The 5th CrISS-DESSERT Workshop

Critical Infrastructure Security and Safety (CrISS) –
Dependable Systems, Services & Technologies (DESSERT)

The CrISS-DESSERT Workshop evolved from the conference Dependable Systems, Services & Technologies DESSERT 2006–2014. The 4th CrISS-DESSERT was held in Kiev, May 17, 2014. The CrISS Workshop examines modelling, development, integration, verification, diagnostics and maintenance of computer and communications systems and infrastructures for safety-, mission-, and business-critical applications.

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Papers

Contents

Secure Hybrid Clouds: Analysis of Configurations Energy Efficiency

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Abstract. The paper examines energy efficiency of running computational tasks in the hybrid clouds considering data privacy and security aspects. As a case study we examine CPU demanding high-tech methods of radiation therapy of cancer. We introduce mathematical models comparing energy efficiency of running our case study application in the public cloud, private data center and on a personal computer. These models employ Markovian chains and queuing theory together to estimate energy and performance attributes of different configurations of computational environment. Finally, a concept of a Hybrid Cloud which effectively distributes computational tasks among the public and secure private clouds depending on their security requirements is proposed in the paper.

Keywords: security, hybrid cloud, energy efficiency, Markovian chain, IT-infrastructure.

1 Introduction

Modern tendencies of computing globalization and increase of computational tasks complexity stipulate the development and application of large-scale distributed systems. Such systems can be built through the use of Grid technologies, cluster technologies and supercomputing, but recently the concept of Cloud Computing has become an industrial trend which is primarily used for deploying modern distributed application and delivering computing services.

Centralization of computing facilities within large data centres on the one hand requires and on the other creates opportunities for the implementation of Green technologies enhancing energy efficiency of computing [1]. Therefore, the problem of energy-aware computational tasks scheduling and distribution among available computing resources, both private and public, becomes crucial.

However, many companies are still unwilling to place their IT infrastructure in the cloud because of reasonable fears over data security and unawareness about the benefits offered by cloud computing [2]. In this concern a hybrid cloud can provide a compromise solution storing and processing private data in in-house computational

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resources and delegating non-critical computations to public clouds. In this paper we examine various configurations of using private and cloud computing to process sensitive security information considering the overall energy efficiency.

Measure p_{ue} is used as a factor of energy efficiency of computing in the Cloud. It is equal to the ratio of the power allocated and distributed for a data center to the power consumed by computer equipment [2]:

$$p_{UE} = P_{uptime} / P_{active} = \left(P_{active} + P_{downtime}\right) / P_{active} \tag{1}$$

where

P_{active} is the power consumed by equipment in the active operating mode,
P_{uptime} is the total power allocated and distributed for this data center,
$P_{downtime}$ is the power consumed by this data center in the idle mode.

Energy consumption of data centers with different p_{ue} values is compared in the table 1. It shows a relative ratio between p_{ue} and $P_{downtime}$ values provided the constant total power allocated and distributed for data centers (P_{uptime} = 1, where 1 is a conventional unit).

Table 1. Comparison of data centers energy consumption

p_{ue}	P_{uptime}	$P_{downtime}$
3	1	0.66
1.25	1	0.2
1.16	1	0.138

According to [3] and [4], a commodity rack-mounted server (taking out of considerations power overheads related to rack cooling, etc.) consumes three times less energy than a standard personal computer (39-45 W versus 0.15 kW).

Discussing the concept of green and sustainable cloud computing, the main attention is traditionally given to the technologies which aim at energy consumption reduction [5] without considering security-related power overheads. In [6] researches analyse the concept of change-over to the public Cloud without accounting security issues. At the same time, studies [2, 3] discuss security risks of deploying IT infrastructures in the public Clouds without employing additional security mechanisms. Some aspects of energy efficiency and security for different Cloud platforms are analysed in [7].

In this work we discuss main principles of secure task solving in the private and public Clouds and also introduce models evaluating its energy efficiency.

The rest of the paper is organised as follows. The second section contains the formalization of problems related to secure and public computing. A few models of the deployment of computing in the public Cloud with consideration of additional protective measures for provision of security are represented in the third part. The fourth part describes two examples of the energy efficiency computation for models of deployment of IT in the public Cloud without and with additional security countermeasures. The fifth section discusses the results and present future steps of research and development.

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