Communications in Computer and Information Science

864

Commenced Publication in 2007 Founding and Former Series Editors: Phoebe Chen, Alfredo Cuzzocrea, Xiaoyong Du, Orhun Kara, Ting Liu, Dominik Ślęzak, and Xiaokang Yang

Editorial Board

Simone Diniz Junqueira Barbosa

Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Rio de Janeiro, Brazil

Joaquim Filipe

Polytechnic Institute of Setúbal, Setúbal, Portugal

Igor Kotenko

St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, St. Petersburg, Russia

Krishna M. Sivalingam

Indian Institute of Technology Madras, Chennai, India

Takashi Washio

Osaka University, Osaka, Japan

Junsong Yuan

University at Buffalo, The State University of New York, Buffalo, USA

Lizhu Zhou

Tsinghua University, Beijing, China

More information about this series at http://www.springer.com/series/7899

Donald Ferguson · Víctor Méndez Muñoz Jorge Cardoso · Markus Helfert Claus Pahl (Eds.)

Cloud Computing and Service Science

7th International Conference, CLOSER 2017 Porto, Portugal, April 24–26, 2017 Revised Selected Papers



Editors
Donald Ferguson
Columbia University
New York, NY
USA

Víctor Méndez Muñoz Escola d'Enginyeria Barcelona

Spain

and

Jorge Cardoso Departamento de Engenharia Informatica Universidade da Coimbra Coimbra Portugal

Huawei European Research Center Munich Germany Markus Helfert Dublin City University Dublin 9 Ireland

Claus Pahl Free University of Bozen-Bolzano Bolzano, BZ Italy

ISSN 1865-0929 ISSN 1865-0937 (electronic) Communications in Computer and Information Science ISBN 978-3-319-94958-1 ISBN 978-3-319-94959-8 (eBook) https://doi.org/10.1007/978-3-319-94959-8

Library of Congress Control Number: 2018947458

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The present book includes extended and revised versions of a set of selected papers from the 7th International Conference on Cloud Computing and Services Science (CLOSER 2017), held in Porto, Portugal, during April 24–26, 2017.

CLOSER 2017 received 102 paper submissions from 33 countries of which 28% are included in this book. The papers were selected by the event chairs and their selection is based on a number of criteria that include the classifications and comments provided by the Program Committee members, the session chairs' assessment, and also the program chairs' global view of all papers included in the technical program. The authors of selected papers were then invited to submit a revised and extended version of their papers having at least 30% innovative material.

The 7th International Conference on Cloud Computing and Services Science, CLOSER 2017, focused on the emerging area of cloud computing inspired by some of the latest advances that concern the infrastructure, operations, and available services through the global network. Furthermore, the conference considers as essential the link to services science, acknowledging the service orientation in most current IT-driven collaborations. The conference is nevertheless not about the union of these two (already broad) fields, but about cloud computing where we are also interested in how services science can provide theory, methods and techniques to design, analyze, manage, market, and study various aspects of cloud computing.

The papers selected to be included in this book contribute to the understanding of relevant trends of current research ranging from cloud infrastructure-level virtualization to service science in various application domains. Directions that emerge as being of particular importance are resource elasticity, performance, and energy, and how they are monitored and optimized. Furthermore, how to migrate and architect for the cloud is an ongoing challenge. The effective orchestration and provisioning of cloud services is another specific focus of current research. Recent technology advancements like containers have also being investigated in terms of their benefits as an application deployment framework.

We would like to thank all the authors for their contributions and also the reviewers who helped ensure the quality of this publication.

April 2017

Donald Ferguson Víctor Méndez Muñoz Jorge Cardoso Markus Helfert Claus Pahl

Organization

Conference Co-chairs

Markus Helfert Dublin City University, Ireland

Claus Pahl Free University of Bozen-Bolzano, Italy

Program Co-chairs

Donald Ferguson Columbia University, USA

Víctor Méndez Muñoz Mind the Byte and Universitat Autònoma de Barcelona,

UAB, Spain

Jorge Cardoso University of Coimbra, Portugal and Huawei German

Research Center, Munich, Germany

Program Committee

Jörn Altmann Seoul National University, South Korea Vasilios Andrikopoulos University of Groningen, The Netherlands Claudio Ardagna Universitá degli Studi di Milano, Italy

Danilo Ardagna Politecnico di Milano, Italy Amelia Badica University of Craiova, Romania

Marcos Barreto Federal University of Bahia (UFBA), Brazil

Simona Bernardi Centro Universitario de la Defensa, Academia General

Militar, Spain

Nik Bessis Edge Hill University, UK Luiz F. Bittencourt IC/UNICAMP, Brazil Ivona Brandić Vienna UT, Austria

Anna Brunstrom Karlstad University, Sweden

Rebecca Bulander Pforzheim University of Applied Science, Germany Tomas Bures Charles University in Prague, Czech Republic

Massimo Cafaro University of Salento, Italy Manuel Isidoro University of Granada, Spain

Capel-Tuñón

Miriam Capretz University of Western Ontario, Canada

Jorge Cardoso University of Coimbra, Portugal and Huawei German

Research Center, Munich, Germany

Eddy Caron École Normale Supérieure de Lyon, France

John Cartlidge University of Bristol, UK

Valentina Casola University of Naples Federico II, Italy

Augusto Ciuffoletti Università di Pisa, Italy

Daniela Barreiro Claro Universidade Federal da Bahia (UFBA), Brazil

Thierry Coupaye Orange, France

António Miguel Rosado

da Cruz

Meiko Jensen

Oleksiy Khriyenko

Eduardo Huedo Cuesta Universidad Complutense de Madrid, Spain

IBM Research Haifa, Israel Eliezer Dekel

Yuri Demchenko University of Amsterdam, The Netherlands

Robert van Engelen Florida State University, USA Ruksar Fatima KBN College of Engineering, India

Columbia University, USA Donald Ferguson

Mike Fisher BT. UK

Chirine Ghedira IAE, University Jean Moulin Lyon 3, France

University of Surrey, UK Lee Gillam

Katja Gilly Miguel Hernandez University, Spain Technische Universität Dresden, Germany Dirk Habich Carmem Satie Hara Universidade Federal do Paraná, Brazil Souleiman Hasan National University of Ireland, Ireland

University of Applied Sciences Darmstadt, Germany Benjamin Heckmann

Markus Helfert Dublin City University, Ireland Suez Canal University, Egypt Mohamed Hussien

IBM Nederland B.V., The Netherlands Ilian Ilkov University Politehnica of Bucharest, Romania Anca Daniela Ionita National Institute of Informatics, Japan Fuyuki Ishikawa Hiroshi Ishikawa Tokyo Metropolitan University, Japan University of Stavanger, Norway Martin Gilie Jaatun

Keith Jeffery Independent Consultant (previously Science

and Technology Facilities Council), UK Kiel University of Applied Sciences, Germany

Instituto Politécnico de Viana do Castelo, Portugal

Yiming Ji University of South Carolina Beaufort, USA Ming Jiang University of Sunderland, UK Péter Kacsuk MTA SZTAKI, Hungary

Yücel Karabulut Oracle, USA

M-tahar Kechadi University College Dublin, Ireland Gabor Kecskemeti Liverpool John Moores University, UK University of Szeged, Hungary Attila Kertesz University of Jyväskylä, Finland

University of Applied Sciences and Arts Hannover, Carsten Kleiner

Germany

George Kousiouris National Technical University of Athens, Greece Nane Kratzke Lübeck University of Applied Sciences, Germany

Miguel Leitão ISEP, Portugal

Siemens AG, Austria, Austria Fei Li Donghui Lin Kyoto University, Japan

School of Computer Science and Technology, Shijun Liu

Shandong University, China

WalmartLabs, USA Yanchen Liu

Francesco Longo Università degli Studi di Messina, Italy Antonio García Loureiro University of Santiago de Compostela, Spain Joseph P. Loyall BBN Technologies, USA

Simone Ludwig North Dakota State University, USA

Glenn Luecke Iowa State University, USA

Hanan Lutfiyya University of Western Ontario, Canada

Theo Lynn Dublin City University, Ireland
K. Maly Old Dominion University, USA
Mohammad Masdari Islamic Azad University, Iran
Ioannis Mavridis University of Macedonia, Greece

Richard McClatchey UWE, Bristol, UK

Jose Ramon Gonzalez Universidad Publica de Navarra, Spain

de Mendivil

Víctor Méndez Muñoz

Hidemoto Nakada

Andre Miede Hochschule fuer Technik und Wirtschaft des

Saarlandes, Germany

Mirella M. Moro Federal University of Minas Gerais (UFMG), Brazil

Universitat Autònoma de Barcelona, Spain National Institute of Advanced Industrial Science

and Technology (AIST), Japan

Philippe Navaux Federal University of Rio Grande Do Sul, Brazil

Jean-Marc Nicod Institut FEMTO-ST, France

Mara Nikolaidou Harokopio University of Athens, Greece
Enn Ounapuu Tallinn University of Technology, Estonia
Claus Pahl Free University of Bozen-Bolzano, Italy

Michael A. Palis Rutgers University, USA

Nikos Parlavantzas IRISA, France

David Paul The University of New England, Australia Tomás Fernández Pena Universidad Santiago de Compostela, Spain

Agostino Poggi University of Parma, Italy

Antonio Puliafito Università degli Studi di Messina, Italy Francesco Quaglia Sapienza Università di Roma, Italy

Cauligi (Raghu) University of Southern California, Los Angeles, USA

Raghavendra Rajendra Raj

Arcot Rajasekar University of North Carolina at Chapel Hill, USA

Manuel Ramos-Cabrer University of Vigo, Spain

Christoph Reich Hochschule Furtwangen University, Germany

Kun Ren Yale University, USA

Norbert Ritter
Rizos Sakellariou
University of Manchester, UK
Evangelos Sakkopoulos
Elena Sanchez-Nielsen
Patrizia Scandurra
Erich Schikuta
Lutz Schubert
University of Patras, Greece
Universidad de La Laguna, Spain
University of Bergamo, Italy
Universität Wien, Austria
Ulm University, Germany

Stefan Schulte Technische Universität Darmstadt, Germany
Michael Schumacher University of Applied Sciences and Arts Western

Switzerland (HES-SO), Switzerland

Rochester Institute of Technology, USA

Organization

X

Uwe Schwiegelshohn TU Dortmund University, Germany

Rami Sellami Cetic, Belgium

Wael Sellami Higher Institute of Computer Sciences of Mahdia,

Tunisia

Giovanni Semeraro University of Bari Aldo Moro, Italy

Carlos Serrao ISCTE-IUL, Portugal

Armin Shams Sharif University of Technology, Iran

Keiichi Shima IIJ Innovation Institute, Japan Richard O. Sinnott University of Melbourne, Australia

Frank Siqueira Universidade Federal de Santa Catarina, Brazil

Cosmin Stoica Spahiu University of Craiova, Romania

Josef Spillner Zurich University of Applied Sciences, Switzerland

Ralf Steinmetz Technische Universität Darmstadt, Germany

Yasuyuki Tahara The University of Electro-Communications, Japan

Cedric Tedeschi IRISA, University of Rennes 1, France

Gilbert Tekli Nobatek, France, Lebanon

Joe Tekli Lebanese American University, Lebanon
Guy Tel-Zur Ben-Gurion University of the Negev, Israel

Michele Tomaiuolo University of Parma, Italy
Orazio Tomarchio University of Catania, Italy
Francesco Tusa University College London, UK

Astrid Undheim Telenor ASA, Norway
Athina Vakali Aristotle University, Greece

Geoffroy Vallee Oak Ridge National Laboratory, USA Sabrina de Capitani Università degli Studi di Milano, Italy

di Vimercati

Bruno Volckaert Ghent University, imec, Belgium

Jan-Jan Wu Academia Sinica, Taiwan

Bo Yang University of Electronic Science and Technology

of China, China

George Yee Carleton University, Canada

Ustun Yildiz University of California, San Diego, USA

Michael Zapf Georg Simon Ohm University of Applied Sciences,

Germany

Ennan Zhai Yale University, USA

Wolfgang Ziegler Fraunhofer Institute SCAI, Germany

Farhana Zulkernine Queen's University, Canada

Additional Reviewers

Ankita Atrey Ghent University, Belgium

Leo Iaquinta University of Milano-Bicocca, Italy Neel Mani Dublin City University, Iceland

Alfonso Panarello Università degli Studi di Messina, Italy

Plamen Petkov Dublin City University, Iceland

Eduardo Roloff UFRGS, Brazil

Giuseppe Tricomi Università degli studi di Messina, Italy

Invited Speakers

Stefan Tai TU Berlin, Germany

Francisco Herrera University of Granada, Spain Hamido Fujita Iwate Prefectural University, Japan

Roy Cecil IBM Portugal, Portugal

Contents

Performance Principles for Trusted Computing with Intel SGX Anders T. Gjerdrum, Robert Pettersen, Håvard D. Johansen, and Dag Johansen	1
About the Complexity to Transfer Cloud Applications at Runtime and How Container Platforms Can Contribute?	19
A Decentralized on Demand Cloud CPU Design with Instruction Level Virtualization	46
Heterogeneous Resource Management and Orchestration in Cloud Environments	61
Using Docker Swarm with a User-Centric Decision-Making Framework for Cloud Application Migration	81
A Decentralized Cloud Management Architecture Based on Application Autonomous Systems	102
From Metadata Catalogs to Distributed Data Processing for Smart City Platforms and Services: A Study on the Interplay of CKAN and Hadoop Robert Scholz, Nikolay Tcholtchev, Philipp Lämmel, and Ina Schieferdecker	115
An Optimization Model to Reduce Energy Consumption in Software-Defined Data Centers	137
The Benefits of Using Experimental Exploration for Cloud Migration Analysis and Planning	157

XIV Contents

Dynamic Reconfiguration of Computer Platforms at the Hardware Device Level for High Performance Computing Infrastructure as a Service Akihiro Misawa, Susumu Date, Keichi Takahashi, Takashi Yoshikawa, Masahiko Takahashi, Masaki Kan, Yasuhiro Watashiba, Yoshiyuki Kido, Chonho Lee, and Shinji Shimojo	177
Controlling Cloud-Based Systems for Elasticity Test Reproduction Michel Albonico, Jean-Marie Mottu, Gerson Sunyé, and Frederico Alvares	200
Cost Analysis for Big Geospatial Data Processing in Public Cloud Providers	223
A Flexible Semantic KPI Measurement System	237
A Framework for the Orchestration and Provision of Cloud Services Based on TOSCA and BPMN	262
Component Migration in a Trans-cloud Environment	286
A Lexical and Semantical Analysis on REST Cloud Computing APIs Fabio Petrillo, Philippe Merle, Francis Palma, Naouel Moha, and Yann-Gaël Guéhéneuc	308
Author Index	333