

*Commenced Publication in 1973*

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

## Editorial Board

David Hutchison

*Lancaster University, Lancaster, UK*

Takeo Kanade

*Carnegie Mellon University, Pittsburgh, PA, USA*

Josef Kittler

*University of Surrey, Guildford, UK*

Jon M. Kleinberg

*Cornell University, Ithaca, NY, USA*

Friedemann Mattern

*ETH Zurich, Zurich, Switzerland*

John C. Mitchell

*Stanford University, Stanford, CA, USA*

Moni Naor

*Weizmann Institute of Science, Rehovot, Israel*

C. Pandu Rangan

*Indian Institute of Technology, Madras, India*

Bernhard Steffen

*TU Dortmund University, Dortmund, Germany*

Demetri Terzopoulos

*University of California, Los Angeles, CA, USA*

Doug Tygar

*University of California, Berkeley, CA, USA*

Gerhard Weikum

*Max Planck Institute for Informatics, Saarbrücken, Germany*

More information about this series at <http://www.springer.com/series/7411>

Lydia Y. Chen · Hans P. Reiser (Eds.)

# Distributed Applications and Interoperable Systems

17th IFIP WG 6.1 International Conference, DAIS 2017  
Held as Part of the 12th International Federated Conference  
on Distributed Computing Techniques, DisCoTec 2017  
Neuchâtel, Switzerland, June 19–22, 2017  
Proceedings

*Editors*

Lydia Y. Chen  
IBM Research Zurich Lab  
Zurich  
Switzerland

Hans P. Reiser  
University of Passau  
Passau  
Germany

ISSN 0302-9743                      ISSN 1611-3349 (electronic)  
Lecture Notes in Computer Science  
ISBN 978-3-319-59664-8              ISBN 978-3-319-59665-5 (eBook)  
DOI 10.1007/978-3-319-59665-5

Library of Congress Control Number: 2017941504

LNCS Sublibrary: SL5 – Computer Communication Networks and Telecommunications

© IFIP International Federation for Information Processing 2017

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.

Printed on acid-free paper

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

# Foreword

The 12th International Federated Conference on Distributed Computing Techniques (DisCoTec) took place in Neuchâtel, Switzerland, during June 19–22, 2017. It was organized by the Institute of Computer Science of the University of Neuchâtel.

The DisCoTec series is one of the major events sponsored by the International Federation for Information Processing (IFIP). It comprises three conferences:

- COORDINATION, the IFIP WG6.1 International Conference on Coordination Models and Languages
- DAIS, the IFIP WG6.1 International Conference on Distributed Applications and Interoperable Systems
- FORTE, the IFIP WG6.1 International Conference on Formal Techniques for Distributed Objects, Components and Systems

Together, these conferences cover a broad spectrum of distributed computing subjects, ranging from theoretical foundations and formal description techniques to systems research issues.

Each day of the federated event began with a plenary speaker nominated by one of the conferences. The three invited speakers were Prof. Giovanna Di Marzo Serungendo (UniGE, Switzerland), Dr. Marko Vukolić (IBM Research, Switzerland), and Dr. Rupak Majumdar (MPI, Germany).

Associated with the federated event were also three satellite events that took place during June 21–22, 2017:

- The 10th Workshop on Interaction and Concurrency Experience (ICE)
- The 4th Workshop on Security in Highly Connected IT Systems (SHCIS)
- The EBSIS-sponsored session on Dependability and Interoperability with Event-Based Systems (DIEBS)

Sincere thanks go to the chairs and members of the Program and Steering Committees of the aforementioned conferences and workshops for their highly appreciated efforts. The organization of DisCoTec 2017 was only possible thanks to the dedicated work of the Organizing Committee, including Ivan Lanese (publicity chair), Romain Rouvoy (workshop chair), Peter Kropf (finance chair), and Aurélien Havet (webmaster), as well as all the students and colleagues who volunteered their time to help. Finally, many thanks go to IFIP WG6.1 for sponsoring this event, Springer's *Lecture Notes in Computer Science* for their support and sponsorship, and EasyChair for providing the reviewing infrastructure.

April 2017

Pascal Felber  
Valerio Schiavoni

# Preface

This volume contains the proceedings of DAIS 2017, the 17th IFIP International Conference on Distributed Applications and Interoperable Systems, sponsored by the IFIP (International Federation for Information Processing) and organized by the IFIP Working Group 6.1.

DAIS was held during June 19–22, 2017, in Neuchatel, Switzerland, as part of DisCoTec, the 12th International Federated Conference on Distributed Computing Techniques, together with FORTE (the 37th IFIP International Conference on Formal Techniques for Distributed Objects, Components and Systems) and COORDINATION (the 19th IFIP International Conference on Coordination Models and Languages). There were 23 submissions for DAIS. Each submission was reviewed by at least three, and on average 3.7, Program Committee members. The committee decided to accept 11 full papers, two practical experience reports, and two short papers.

The accepted papers represent a compelling sample of the state of the art in the area of distributed applications, services, and systems. There was great emphasis on data storage and security this year. The proceedings include contributions on optimizing distributed applications and systems (SQL streaming processing, and P2P) as well as novel techniques to store data (data deduplication, block placement, and executable choreographies). The focus of the security area ranges from practical evaluation of cryptographic schemes, specialized hardware like Intel SGX, to emerging blockchain access control. In the area of distributed services, there are contributions on building collaborative services and packaging micro-services are included, and the techniques to process distributed graph.

The conference was made possible by the work and cooperation of many people working in several committees and organizations that are listed in these proceedings. In particular, we thank the Program Committee members for their commitment and thorough reviews and for their active participation in the discussion phase, and all the external reviewers for their help in evaluating submissions. We would also like to thank Maco Vukolic, our invited keynote speaker. Finally, we also thank the DisCoTec general chair, Pascal Felber, organization chair, Valerio Schiavoni, and the DAIS Steering Committee chair, Rui Oliveira, for their constant availability, support, and guidance.

April 2017

Lydia Y. Chen  
Hans P. Reiser

# Organization

## Program Committee Chairs

Lydia Y. Chen IBM Research Zurich Lab, Switzerland  
Hans P. Reiser University of Passau, Germany

## Program Committee

Luciana Arantes Université Pierre et Marie Curie-Paris 6, France  
Carlos Baquero HASLab, INESC TEC and Universidade do Minho, Portugal

Sonia Ben Mokhtar LIRIS CNRS, France  
Alysson Bessani University of Lisbon, Portugal  
Robert Birke IBM Zurich Research Laboratory, Switzerland  
Andrea Bondavalli University of Florence, Italy  
Sara Bouchenak INSA Lyon, France  
Nikolaos Chrysos Foundation for Research and Technology (FORTH), Greece

Miguel Correia INESC-ID, Instituto Superior Técnico, Universidade de Lisboa, Portugal

Wolfgang De Meuter Vrije Universiteit Brussel, Belgium  
Jim Dowling Swedish Institute of Computer Science, Sweden  
Frank Eliassen University of Oslo, Norway  
David Eyers University of Otago, New Zealand  
Kurt Geihs Universität Kassel, Germany  
Karl M. Goeschka Vienna University of Technology, Austria  
Franz J. Hauck Ulm University, Germany  
K.R. Jayaram IBM Research, USA  
Mark Jelasity University of Szeged, Hungary  
Vana Kalogeraki Athens University of Economics and Business, Greece  
Evangelia Kalyvianaki City University London, UK  
Ruediger Kapitza TU Braunschweig, Germany  
Attila Kertesz University of Szeged, Hungary  
Benny Mandler IBM Haifa Research, Israel  
Miguel Matos INESC TEC and Universidade do Minho, Portugal  
Rene Meier Lucerne University of Applied Sciences, Switzerland  
Alberto Montresor University of Trento, Italy  
Kiran-Kumar Harvard University, USA  
Muniswamy-Reddy

Juan Perez Universidad del Rosario, Columbia  
Peter Pietzuch Imperial College London, UK

Altair Santin  
Spyros Voulgaris

Pontifical Catholic University of Paraná, Brazil  
VU University Amsterdam, The Netherlands

### **Steering Committee**

Alysson Bessani  
Sara Bouchenak  
Jim Dowling  
Frank Eliassen  
Pascal Felber  
Karl Goeschka  
Rüdiger Kapitza  
Kostas Magoutis  
Rui Oliveira  
Peter Pietzuch  
Romain Rouvoy  
François Taiani

Universidade de Lisboa, Portugal  
INSA Lyon, France  
KTH Royal Institute of Technology, Sweden  
University of Oslo, Norway  
Université de Neuchâtel, Switzerland  
Vienna University of Technology, Austria  
Technical University of Braunschweig, Germany  
FORTH-ICS, Greece  
Universidade do Minho, Portugal  
Imperial College, UK  
University of Lille 1, France  
Université de Rennes 1, France



# Contents

## Running System Efficiently (Distributed System)

Similarity Aware Shuffling for the Distributed Execution of SQL Window Functions . . . . .	3
<i>Fábio Coelho, Miguel Matos, José Pereira, and Rui Oliveira</i>	
DIsCO: Dynamic Data Compression in Distributed Stream Processing Systems . . . . .	19
<i>Nikos Zacheilas and Vana Kalogeraki</i>	
Distributed Random Process for a Large-Scale Peer-to-Peer Lottery. . . . .	34
<i>Stéphane Grumbach and Robert Riemann</i>	

## Storing Data Smartly (Data Storage)

DDFLASKS: Deduplicated Very Large Scale Data Store. . . . .	51
<i>Francisco Maia, João Paulo, Fábio Coelho, Francisco Neves, José Pereira, and Rui Oliveira</i>	
Block Placement Strategies for Fault-Resilient Distributed Tuple Spaces: An Experimental Study (Practical Experience Report) . . . . .	67
<i>Roberta Barbi, Vitaly Buravlev, Claudio Antares Mezzina, and Valerio Schiavoni</i>	
Private Data System Enabling Self-Sovereign Storage Managed by Executable Choreographies . . . . .	83
<i>Sinică Alboaiie and Doina Cosovan</i>	

## Roaming in Graph (Graph Processing)

Scalable Anti-KNN: Decentralized Computation of k-Furthest-Neighbor Graphs with HyFN . . . . .	101
<i>Simon Bouget, Yérom-David Bromberg, François Taïani, and Anthony Ventresque</i>	
Lifting Low-Level Workflow Changes Through User-Defined Graph-Rule-Based Patterns . . . . .	115
<i>Alexander Jahl, Harun Baraki, Huu Tam Tran, Ramaprasad Kuppili, and Kurt Geihs</i>	

**Building Collaborative Services (Services)**

Packaging Microservices (Work in Progress) . . . . . 131  
*Fabrizio Montesi and Dan Sebastian Thrane*

*formic*: Building Collaborative Applications  
with Operational Transformation (Work in Progress) . . . . . 138  
*Tim Jungnickel and Ronny Bräunlich*

Filament: A Cohort Construction Service for Decentralized Collaborative  
Editing Platforms . . . . . 146  
*Ariyattu C. Resmi and François Taiani*

**Making Things Safe (Security)**

Benchmarking Cryptographic Schemes for Securing Public Cloud Storages  
(Practical Experience Report) . . . . . 163  
*Stefan Conti, Emmanuel Leblond, and Laurent Réveillère*

Secure Cloud Micro Services Using Intel SGX . . . . . 177  
*Stefan Brenner, Tobias Hundt, Giovanni Mazzeo,  
and Rüdiger Kapitza*

Adaptive Cheat Detection in Decentralized Volunteer Computing  
with Untrusted Nodes . . . . . 192  
*Nils Kopal, Matthäus Wander, Christopher Konze,  
and Henner Heck*

Blockchain Based Access Control . . . . . 206  
*Damiano Di Francesco Maesa, Paolo Mori,  
and Laura Ricci*

**Author Index** . . . . . 221