

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Alfred Kobsa

University of California, Irvine, CA, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Jörn Altmann Dirk Neumann
Thomas Fahringer (Eds.)

Grid Economics and Business Models

5th International Workshop, GECON 2008
Las Palmas de Gran Canaria, Spain, August 26, 2008
Proceedings

Volume Editors

Jörn Altmann
International University
Campus 3, 76646 Bruchsal, Germany
E-mail: jorn.altmann@acm.org

Dirk Neumann
University of Freiburg
Platz der Alten Synagoge, 79085 Freiburg, Germany
E-mail: dirk.neumann@vwl.uni-freiburg.de

Thomas Fahringer
University of Innsbruck, Institute of Computer Science
Technikerstraße 21a, 6020 Innsbruck, Austria
E-mail: tf@dps.uibk.ac.at

Library of Congress Control Number: 2008933380

CR Subject Classification (1998): C.2, K.4.4, H.3, J.1

LNCS Sublibrary: SL 5 – Computer Communication Networks
and Telecommunications

ISSN 0302-9743
ISBN-10 3-540-85484-3 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-85484-5 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media
springer.com

© Springer-Verlag Berlin Heidelberg 2008
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 12464715 06/3180 5 4 3 2 1 0

Preface

The Grid computing concept, which allows users to integrate administratively and geographically dispersed computing resources, has been gaining traction in a number of application areas during the past few years. By interconnecting many – heterogeneous, though usually virtualized – computing resources, virtual computer centers or supercomputers can be created, providing a seamless supply of computing resources. Grid computing provides benefits not only for scientific computing (e.g., SETI@home, which interconnects one million computers across 226 countries with a total processing power of 711 TFLOPS) but also in a commercial environment. It is projected that computing Grids can lower the total IT costs of businesses by 30%.

The report “Grid Computing: A Vertical Market Perspective 2005–2010” (by The Insight Research Corporation) estimates an increase of worldwide Grid spending from \$714.9 million in 2005 to approximately \$19.2 billion in 2010. One of the most prominent activities in academia is the EGEE project being funded with 30 MEuro by the European Commission. EGEE brings together researchers from over 27 countries with the common aim of developing a service Grid infrastructure, which is suited for scientific computing with very high demand for processing power.

Despite existing Grid technology and commercial needs, up to now, not many Grid service offerings exist. One of the few examples is Amazon. It has floated the idea of Cloud Computing with the Elastic Compute Cloud service, which has introduced a business model based on virtualized Grid infrastructures. More sophisticated market places such as zimory.com or strikeiron.com have emerged, selling more complex Cloud services dynamically.

However, even though there are some examples in the commercial area and Grid technology has been adopted strongly in academia (eScience), the general adoption by companies has been slow. The reasons are mainly due to the lack of viable business models coupled with chargeable Grid services and commercial transactions on them. What is needed is a set of mechanisms that enable users to discover, negotiate, and pay for the use of Grid services. According to a report by The451Group, the application of resource trading and allocation models is one of the crucial success factors for establishing commercial Grids.

The 5th International Workshop on Grid Economics and Business Models, GECON 2008, served as a forum for the presentation of current and innovative research results pertaining to the above-mentioned issues with special focus on business models and Grid computing technology. The review process attracted prime research papers on amendments to existing technologies, aiming at the successful deployment of global, commercial service-oriented Grid systems. The workshop received a great deal of attention, obtaining 27 high-quality research papers from researchers and practitioners worldwide. Of those, 10 were accepted, constituting an acceptance rate of 37 %. Each paper was reviewed 3 times at least and in average 3.6 times.

The first paper, “Business Value Chains in Real-Time On-line Interactive Applications” by Mike SurrIDGE, Justin Ferris, and E. Rowland Watkins, presents an in-depth

analysis of value chains for the application areas of online gaming and e-learning, an initial implementation, and the implications for constructing value chains using bipartite and bi-directional Service Level Agreements.

The second contribution, entitled “Cost Analysis of Current Grids and its Implications for Future Grid Markets” by Marcel Risch and Jörn Altmann, analyzes the question whether using the Grid is financially advantageous over owning resources. Amazon’s EC2 service is used as a reference. The comparison of the costs reveals that Grid is cheaper in the short run but not so in the long run.

In the third paper, “Business Relationships in Grid Workflows” written by Ioannis Papagiannis, Dimosthenis Kyriazis, Magdalini Kardara, Vassiliki Andronikou and Theodora Varvarigou, an approach for modeling strategic business relationships is described. As these relationships affect the offered Quality of Service (QoS) level, a metric for characterizing a service provider’s “friendliness” is introduced.

Lior Amar, Ahuva Mu’alem and Jochen Stöber showcase “The Power of Preemption in Economic Online Markets” settings by extending the decentralized local greedy mechanism. This mechanism is known to be 3.281-competitive with respect to the total weighted completion time. The authors show that the preemptive version of this mechanism is even 2-competitive. In addition to this, they provide an in-depth empirical analysis of the average case performance of the original mechanism and its preemptive extension based on real workload traces.

In the fifth contribution “Market Mechanisms for Trading Grid Resources”, Costas Courcoubetis, Manos Dramitinos, Thierry Rayna, Sergios Soursos, and George Stamoulis present a market for hardware providers and consumers, who are interested in leasing Grid resources for a certain time period. The proposed market mechanism comprises a stock-market-like mechanism that enables the trading of computational resources on a spot and a futures market. This Grid market is more complicated than the standard spot/futures markets of storable commodities, because of the fact that the computational services traded are perishable and need to be described in terms of quantity and duration.

The contribution of Nikolay Borissov, Arun Anandasivam, Niklas Wirström, and Dirk Neumann titled “Rational Bidding Using Reinforcement Learning: An Application in Automated Resource Allocation” proposes an agent-based bidding procedure for participating in Grid markets. The paper introduces a scenario, which demonstrates the components and methodologies for automated bid generation. In addition to this, the authors introduce a reinforcement learning strategy for agents enabling agents to generate bids and asks rationally. This strategy is evaluated against a truth-telling bidding strategy.

In the seventh contribution, Davidi Maria Parrilli discusses tax issues in decentralized computing environments in his paper titled “Grid and Taxation: the Server as a Permanent Establishment in International Grids”. Taxation can be a barrier to the development of international Grids. Based on his analysis of the current taxation approaches, he makes suggestions for amendments.

The eighth paper, “The Pricing Strategy Analysis for the Software-as-a-Service Business Model” by Ma Dan and Abraham Seidman, presents an analytical model of the competition between software-as-a-service and the traditional commercial off-the-shelf software. The authors find that the two distribution channels could coexist in a

competitive market in the long run. However, they show that under certain conditions software-as-a-service could gradually take over the whole market for software.

Carmelo Ragusa, Francesco Longo, and Antonio Puliafito describe in their contribution “On the Assessment of the S-Sicilia Infrastructure: a Grid-Based Business System” the S-Sicilia project, a 2-year collaboration between Oracle and the COMETA consortium that targets at setting up a Grid-based business infrastructure to provide business services with guaranteed QoS to companies. It is intended to make it a benchmark infrastructure, with which other scenarios can be compared.

Omer Rana, Martijn Warnier, Thomas Quillinan, and Frances Brazier identify in their paper “Monitoring and Reputation Mechanisms for Service Level Agreements” a lack of research on SLAs. This paper addresses how SLOs may be impacted by the choice of specific penalty clauses. It is devoted to the specification of penalties within the Web Services Agreement (WS-Agreement) negotiation language and how clauses can be enforced based on monitoring the SLAs.

In addition to these papers, we received many paper submissions from research projects on Grid economics, giving an overview of current and ongoing research in this area. Out of these submissions, we selected papers from nine projects (ArguGrid, AssessGrid, BEinGrid, BREIN, D-Grid, Edutain@Grid, Grid4All, GridEcon, and SORMA). These papers can be grouped into three categories. The first category comprises papers on business modeling. The paper contributions in this category come from BEinGrid, Edutain@Grid, and Brein. The second category, which addresses Grid markets, includes papers from SORMA, GridEcon, and Grid4All. In particular, these papers describe market places, market mechanisms, and market-based resource allocation schemes. D-Grid, ArguGrid, and AssessGrid contributed papers to the third category. This category is characterized by papers on Grid architectures.

Finally, we would like to thank the organizers of the 2008 Euro-Par conference, in particular Emilio Luque, for their support in hosting the GECON 2008 workshop in Las Palmas, Spain. We would also like to thank Alfred Hofmann and Ursula Barth from Springer, who ensured a very efficient publication process. Finally, our highest gratitude goes to Sonja Klingert. Without her dedication and substantial efforts in preparing the manuscript, these proceedings would not have been ready on time.

August 2008

Dirk Neumann
Jörn Altmann
Thomas Fahringer

Organization

GECON 2008 was organized by the International University in Germany, Bruchsal, Germany, Department of Computer Networks and Distributed Systems. It was given organizational support by the University of Freiburg, Germany and the University of Innsbruck, Austria and held in collaboration with EuroPar 2008.

Executive Committee

Chair	Jörn Altmann (Intl. University in Germany, Germany)
Vice Chairs	Dirk Neumann (University of Freiburg, Germany) Thomas Fahringer (University of Innsbruck, Austria)
Organization Chair	Sonja Klingert (Intl. University in Germany, Germany)

Program Committee

Hermant K. Bhargava (UC Davis, USA)
Rajkumar Buyya (University of Melbourne, Australia)
Costas Courcoubetis (Athens University of Economics and Business, Greece)
Jeremy Cohen (Imperial College London, UK)
Dang Minh Quan (Intl. University of Bruchsal, Germany)
John Darlington (Imperial College London, UK)
Karim Djemame (University of Leeds, UK)
Torsten Eymann (University of Bayreuth, Germany)
Wolfgang Gentzsch (D-Grid, Germany)
Kartik Hosnager (University of Pennsylvania, USA)
Chun-Hsi Huang (University of Connecticut, USA)
Junseok Hwang (Seoul National University, South-Korea)
Bastian Koller (HLRS, Germany)
Harald Kornmayer (NEC Laboratories Europe, Germany)
Ramayya Krishnan (Carnegie Mellon University, USA)
Kevin Lai (HP Labs, USA)
Hing-Yan Lee (National Grid Office, Singapore)
Jysoo Lee (KISTI, South Korea)
Steven Miller (Singapore Management University, Singapore)
Omer Rana (Cardiff University, UK)
Rajiv Ranjan (University of Melbourne, Australia)
Thierry Rayna (Imperial College London, UK)
Peter Reichl (Telecommunications Research Center Vienna, Austria)
Simon See (Sun Microsystems, Singapore)
Satoshi Sekiguchi (AIST, Japan)
Burkhard Stiller (University of Zurich, Switzerland)

Yoshio Tanaka (AIST, Japan)
Maria Tsakali (European Commission, Belgium)
Bruno Tuffin (IRISA/INRIA, France)
Dora Varvarigou (National Technical University of Athens, Greece)
Gabriele von Voigt (University of Hanover, Germany)
Kerstin Voss (University of Paderborn, Germany)
Christof Weinhardt (University of Karlsruhe, Germany)
Stefan Wesner (HLRS, Germany)
Phillip Wieder (University of Dortmund, Germany)
Ramin Yahyapour (University of Dortmund, Germany)
Wolfgang Ziegler (Fraunhofer Institute SCAI, Germany)

Sponsoring Institutions

International University in Germany, Bruchsal, Germany
University of Freiburg, Germany
University of Innsbruck, Austria
Springer LNCS, Heidelberg, Germany
EU-FP6 Project GridEcon (Project No. 033634)
EuroPar 2008, Las Palmas, Spain

Table of Contents

Grid Business Modeling

Business Value Chains in Real-Time On-Line Interactive Applications.....	1
<i>Justin Ferris, Mike SurrIDGE, and E. Rowland Watkins</i>	
Cost Analysis of Current Grids and Its Implications for Future Grid Markets	13
<i>Marcel Risch and Jörn Altmann</i>	
Business Relationships in Grid Workflows	28
<i>Ioannis Papagiannis, Dimosthenis Kyriazis, Magdalini Kardara, Vassiliki Andronikou, and Theodora Varvarigou</i>	

Market Mechanisms for the Grid

The Power of Preemption in Economic Online Markets	41
<i>Lior Amar, Ahuva Mu'alem, and Jochen Stößer</i>	
Market Mechanisms for Trading Grid Resources	58
<i>Costas Courcoubetis, Manos Dramitinos, Thierry Rayna, Sergios Soursos, and George D. Stamoulis</i>	
Rational Bidding Using Reinforcement Learning: An Application in Automated Resource Allocation.....	73
<i>Nikolay Borissov, Arun Anandasivam, Niklas Wirström, and Dirk Neumann</i>	

Grid Markets

Grid and Taxation: The Server as Permanent Establishment in International Grids.....	89
<i>Davide Maria Parrilli</i>	
The Pricing Strategy Analysis for the “Software-as-a-Service” Business Model	103
<i>Dan Ma and Abraham Seidmann</i>	

Grid Architectures

On the Assessment of the S-Sicilia Infrastructure: A Grid-Based Business System	113
<i>Carmelo Ragusa, Francesco Longo, and Antonio Puliafito</i>	

Monitoring and Reputation Mechanisms for Service Level Agreements 125
Omer Rana, Martijn Warnier, Thomas B. Quillinan, and Frances Brazier

Research Projects on Business Modeling

BEInGRID: Development of Business Models for the Grid Industry 140
Katarina Stanoevska-Slabeva, Davide Maria Parrilli, and George Thanos

Edutain@Grid: A Business Grid Infrastructure for Real-Time On-Line Interactive Applications 152
Justin Ferris, Mike Surridge, E. Rowland Watkins, Thomas Fahringer, Radu Prodan, Frank Glinka, Sergei Gorlatch, Christoph Anthes, Alexis Arragon, Chris Rawlings, and Arton Lipaj

BREIN, Towards an Intelligent Grid for Business 163
Eduardo Oliveros, Henar Muñoz, David Cantelar, and Steve Taylor

Research Projects on Market Mechanisms

SORMA – Business Cases for an Open Grid Market: Concept and Implementation 173
Jens Nimis, Arun Anandasivam, Nikolay Borissov, Garry Smith, Dirk Neumann, Niklas Wirström, Erel Rosenberg, and Matteo Villa

GridEcon: A Market Place for Computing Resources 185
Jörn Altmann, Costas Courcoubetis, George D. Stamoulis, Manos Dramitinos, Thierry Rayna, Marcel Risch, and Chris Bannink

Grid4All: Open Market Places for Democratic Grids 197
Ruby Krishnaswamy, Leandro Navarro, René Brunner, Xavier León, and Xavier Vilajosana

Research Projects on Grid Architecture

The German Grid Initiative: A Uniform Accounting Service in Multiple Middleware Environments 208
Jan Wiebelitz, Stefano Dal Pra, Wolfgang Müller, and Gabriele von Voigt

The ArguGRID Platform: An Overview 217
Francesca Toni, Mary Grammatikou, Stella Kafetzoglou, Leonidas Lymberopoulos, Symeon Papavassileiou, Dorian Gaertner, Maxime Morge, Stefano Bromuri, Jarred McGinnis, Kostas Stathis, Vasa Curcin, Moustafa Ghanem, and Li Guo

AssessGrid Strategies for Provider Ranking Mechanisms in Risk-Aware
 Grid Systems 226
*Dominic Battré, Karim Djemame, Iain Gourlay,
 Matthias Hovestadt, Odej Kao, James Padgett, Kerstin Voss, and
 Daniel Warneke*

Author Index 235