

Hermann de Meer  
Nina Bhatti (Eds.)

LNCS 3552

# Quality of Service – IWQoS 2005

13th International Workshop, IWQoS 2005  
Passau, Germany, June 2005  
Proceedings



ifip



Springer

Hermann de Meer Nina Bhatti (Eds.)

# Quality of Service – IWQoS 2005

13th International Workshop, IWQoS 2005  
Passau, Germany, June 21-23, 2005  
Proceedings



**Volume Editors**

**Hermann de Meer**  
University of Passau  
Faculty of Mathematics and Informatics  
Innstraße 33, 94032 Passau, Germany  
E-mail: [demeer@fmi.uni-passau.de](mailto:demeer@fmi.uni-passau.de)

**Nina Bhatti**  
Hewlett-Packard Laboratories  
1501 Page Mill Road, Palo Alto, CA 94304, USA

Library of Congress Control Number: 2005927231

CR Subject Classification (1998): C.2, D.4.4, H.3.5-7, H.4, H.5.1, K.4.4, K.6.5

ISSN 0302-9743  
ISBN-10 3-540-26294-6 Springer Berlin Heidelberg New York  
ISBN-13 978-3-540-26294-7 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

[springeronline.com](http://springeronline.com)

© IFIP International Federation for Information Processing, Hofstrasse 3, A-2361 Laxenburg, Austria 2005  
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India  
Printed on acid-free paper SPIN: 11499169 06/3142 5 4 3 2 1 0

*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*

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

*New York University, NY, USA*

Doug Tygar

*University of California, Berkeley, CA, USA*

Moshe Y. Vardi

*Rice University, Houston, TX, USA*

Gerhard Weikum

*Max-Planck Institute of Computer Science, Saarbruecken, Germany*

# Lecture Notes in Computer Science

For information about Vols. 1–3439

please contact your bookseller or Springer

- Vol. 3556: H. Baumeister, M. Marchesi, M. Holcombe (Eds.), *Extreme Programming and Agile Processes in Software Engineering. XIV*, 332 pages. 2005.
- Vol. 3557: H. de Meer, N. Bhatti (Eds.), *Quality of Service – IWQoS 2005. XV*, 400 pages. 2005.
- Vol. 3543: L. Kutvonen, N. Alonistioti (Eds.), *Distributed Applications and Interoperable Systems. XI*, 235 pages. 2005.
- Vol. 3537: A. Apostolico, M. Crochemore, K. Park (Eds.), *Combinatorial Pattern Matching. XI*, 444 pages. 2005.
- Vol. 3535: M. Steffen, G. Zavattaro (Eds.), *Formal Methods for Open Object-Based Distributed Systems. X*, 323 pages. 2005.
- Vol. 3532: A. Gómez-Pérez, J. Euzenat (Eds.), *The Semantic Web: Research and Applications. XV*, 728 pages. 2005.
- Vol. 3531: J. Ioannidis, A. Keromytis, M. Yung (Eds.), *Applied Cryptography and Network Security. XI*, 530 pages. 2005.
- Vol. 3528: P.S. Szczepaniak, J. Kacprzyk, A. Niewiadomski (Eds.), *Advances in Web Intelligence. XVII*, 513 pages. 2005. (Subseries LNAI).
- Vol. 3527: R. Morrison, F. Oquendo (Eds.), *Software Architecture. XII*, 263 pages. 2005.
- Vol. 3526: S.B. Cooper, B. Löwe, L. Torenvliet (Eds.), *New Computational Paradigms. XVII*, 574 pages. 2005.
- Vol. 3525: A.E. Abdallah, C.B. Jones, J.W. Sanders (Eds.), *Communicating Sequential Processes. XIV*, 321 pages. 2005.
- Vol. 3524: R. Barták, M. Milano (Eds.), *Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problems. XI*, 320 pages. 2005.
- Vol. 3523: J.S. Marques, N.P. de la Blanca, P. Pina (Eds.), *Pattern Recognition and Image Analysis, Part II. XXVI*, 733 pages. 2005.
- Vol. 3522: J.S. Marques, N.P. de la Blanca, P. Pina (Eds.), *Pattern Recognition and Image Analysis, Part I. XXVI*, 703 pages. 2005.
- Vol. 3521: N. Megiddo, Y. Xu, B. Zhu (Eds.), *Algorithmic Applications in Management. XIII*, 484 pages. 2005.
- Vol. 3520: O. Pastor, J. Falcão e Cunha (Eds.), *Advanced Information Systems Engineering. XVI*, 584 pages. 2005.
- Vol. 3519: H. Li, P.J. Olver, G. Sommer (Eds.), *Computer Algebra and Geometric Algebra with Applications. IX*, 449 pages. 2005.
- Vol. 3518: T.B. Ho, D. Cheung, H. Li (Eds.), *Advances in Knowledge Discovery and Data Mining. XXI*, 864 pages. 2005. (Subseries LNAI).
- Vol. 3517: H.S. Baird, D.P. Lopresti (Eds.), *Human Interactive Proofs. IX*, 143 pages. 2005.
- Vol. 3516: V.S. Sunderam, G.D. van Albada, P.M.A. Sloot, J.J. Dongarra (Eds.), *Computational Science – ICCS 2005, Part III. LXIII*, 1143 pages. 2005.
- Vol. 3515: V.S. Sunderam, G.D. van Albada, P.M.A. Sloot, J.J. Dongarra (Eds.), *Computational Science – ICCS 2005, Part II. LXIII*, 1101 pages. 2005.
- Vol. 3514: V.S. Sunderam, G.D. van Albada, P.M.A. Sloot, J.J. Dongarra (Eds.), *Computational Science – ICCS 2005, Part I. LXIII*, 1089 pages. 2005.
- Vol. 3513: A. Montoyo, R. Muñoz, E. Métais (Eds.), *Natural Language Processing and Information Systems. XII*, 408 pages. 2005.
- Vol. 3512: J. Cabestany, A. Prieto, F. Sandoval (Eds.), *Computational Intelligence and Bioinspired Systems. XXV*, 1260 pages. 2005.
- Vol. 3510: T. Braun, G. Carle, Y. Koucheryavy, V. Tsatsoulis (Eds.), *Wired/Wireless Internet Communications. XIV*, 366 pages. 2005.
- Vol. 3509: M. Jünger, V. Kaibel (Eds.), *Integer Programming and Combinatorial Optimization. XI*, 484 pages. 2005.
- Vol. 3508: P. Bresciani, P. Giorgini, B. Henderson-Sellers, G. Low, M. Winikoff (Eds.), *Agent-Oriented Information Systems II. X*, 227 pages. 2005. (Subseries LNAI).
- Vol. 3507: F. Crestani, I. Ruthven (Eds.), *Information Context: Nature, Impact, and Role. XIII*, 253 pages. 2005.
- Vol. 3506: C. Park, S. Chee (Eds.), *Information Security and Cryptology – ICISC 2004. XIV*, 490 pages. 2005.
- Vol. 3505: V. Gorodetsky, J. Liu, V.A. Skormin (Eds.), *Autonomous Intelligent Systems: Agents and Data Mining. XIII*, 303 pages. 2005. (Subseries LNAI).
- Vol. 3504: A.F. Frangi, P.I. Radeva, A. Santos, M. Hernandez (Eds.), *Functional Imaging and Modeling of the Heart. XV*, 489 pages. 2005.
- Vol. 3503: S.E. Nikoletseas (Ed.), *Experimental and Efficient Algorithms. XV*, 624 pages. 2005.
- Vol. 3502: F. Khendek, R. Dssouli (Eds.), *Testing of Communicating Systems. X*, 381 pages. 2005.
- Vol. 3501: B. Kégl, G. Lapalme (Eds.), *Advances in Artificial Intelligence. XV*, 458 pages. 2005. (Subseries LNAI).
- Vol. 3500: S. Miyano, J. Mesirov, S. Kasif, S. Istrail, P. Pevzner, M. Waterman (Eds.), *Research in Computational Molecular Biology. XVII*, 632 pages. 2005. (Subseries LNBI).
- Vol. 3499: A. Pelc, M. Raynal (Eds.), *Structural Information and Communication Complexity. X*, 323 pages. 2005.
- Vol. 3498: J. Wang, X. Liao, Z. Yi (Eds.), *Advances in Neural Networks – ISNN 2005, Part III. L*, 1077 pages. 2005.

- Vol. 3497: J. Wang, X. Liao, Z. Yi (Eds.), *Advances in Neural Networks – ISNN 2005*, Part II. L, 947 pages. 2005.
- Vol. 3496: J. Wang, X. Liao, Z. Yi (Eds.), *Advances in Neural Networks – ISNN 2005*, Part II. L, 1055 pages. 2005.
- Vol. 3495: P. Kantor, G. Muresan, F. Roberts, D.D. Zeng, F.-Y. Wang, H. Chen, R.C. Merkle (Eds.), *Intelligence and Security Informatics*. XVIII, 674 pages. 2005.
- Vol. 3494: R. Cramer (Ed.), *Advances in Cryptology – EUROCRYPT 2005*. XIV, 576 pages. 2005.
- Vol. 3493: N. Fuhr, M. Lalmas, S. Malik, Z. Szlávik (Eds.), *Advances in XML Information Retrieval*. XI, 438 pages. 2005.
- Vol. 3492: P. Blache, E. Stabler, J. Busquets, R. Moot (Eds.), *Logical Aspects of Computational Linguistics*. X, 363 pages. 2005. (Subseries LNAI).
- Vol. 3489: G.T. Heineman, I. Crnkovic, H.W. Schmidt, J.A. Stafford, C. Szyperski, K. Wallnau (Eds.), *Component-Based Software Engineering*. XI, 358 pages. 2005.
- Vol. 3488: M.-S. Hacid, N.V. Murray, Z.W. Ra, S. Tsumoto (Eds.), *Foundations of Intelligent Systems*. XIII, 700 pages. 2005. (Subseries LNAI).
- Vol. 3486: T. Helleseth, D. Sarwate, H.-Y. Song, K. Yang (Eds.), *Sequences and Their Applications - SETA 2004*. XII, 451 pages. 2005.
- Vol. 3483: O. Gervasi, M.L. Gavrilova, V. Kumar, A. Lanan , H.P. Lee, Y. Mun, D. Taniar, C.J.K. Tan (Eds.), *Computational Science and Its Applications – ICCSA 2005*, Part IV. XXVII, 1362 pages. 2005.
- Vol. 3482: O. Gervasi, M.L. Gavrilova, V. Kumar, A. Lanan , H.P. Lee, Y. Mun, D. Taniar, C.J.K. Tan (Eds.), *Computational Science and Its Applications – ICCSA 2005*, Part III. LXVI, 1340 pages. 2005.
- Vol. 3481: O. Gervasi, M.L. Gavrilova, V. Kumar, A. Lanan , H.P. Lee, Y. Mun, D. Taniar, C.J.K. Tan (Eds.), *Computational Science and Its Applications – ICCSA 2005*, Part II. LXIV, 1316 pages. 2005.
- Vol. 3480: O. Gervasi, M.L. Gavrilova, V. Kumar, A. Lanan , H.P. Lee, Y. Mun, D. Taniar, C.J.K. Tan (Eds.), *Computational Science and Its Applications – ICCSA 2005*, Part I. LXV, 1234 pages. 2005.
- Vol. 3479: T. Strang, C. Linnhoff-Popien (Eds.), *Location- and Context-Awareness*. XII, 378 pages. 2005.
- Vol. 3478: C. Jermann, A. Neumaier, D. Sam (Eds.), *Global Optimization and Constraint Satisfaction*. XIII, 193 pages. 2005.
- Vol. 3477: P. Herrmann, V. Issarny, S. Shiu (Eds.), *Trust Management*. XII, 426 pages. 2005.
- Vol. 3475: N. Guelfi (Ed.), *Rapid Integration of Software Engineering Techniques*. X, 145 pages. 2005.
- Vol. 3474: C. Grelck, F. Huch, G.J. Michaelson, P. Trinder (Eds.), *Implementation and Application of Functional Languages*. X, 227 pages. 2005.
- Vol. 3468: H.W. Gellersen, R. Want, A. Schmidt (Eds.), *Pervasive Computing*. XIII, 347 pages. 2005.
- Vol. 3467: J. Giesl (Ed.), *Term Rewriting and Applications*. XIII, 517 pages. 2005.
- Vol. 3465: M. Bernardo, A. Bogliolo (Eds.), *Formal Methods for Mobile Computing*. VII, 271 pages. 2005.
- Vol. 3464: S.A. Brueckner, G.D.M. Serugendo, A. Karageorgos, R. Nagpal (Eds.), *Engineering Self-Organising Systems*. XIII, 299 pages. 2005. (Subseries LNAI).
- Vol. 3463: M. Dal Cin, M. Ka niche, A. Pataricza (Eds.), *Dependable Computing - EDCC 2005*. XVI, 472 pages. 2005.
- Vol. 3462: R. Boutaba, K.C. Almeroth, R. Puigjaner, S. Shen, J.P. Black (Eds.), *NETWORKING 2005*. XXX, 1483 pages. 2005.
- Vol. 3461: P. Urzyczyn (Ed.), *Typed Lambda Calculi and Applications*. XI, 433 pages. 2005.
- Vol. 3460: . Babaoglu, M. Jelasity, A. Montresor, C. Fetzer, S. Leonardi, A. van Moorsel, M. van Steen (Eds.), *Self-star Properties in Complex Information Systems*. IX, 447 pages. 2005.
- Vol. 3459: R. Kimmel, N.A. Sochen, J. Weickert (Eds.), *Scale Space and PDE Methods in Computer Vision*. XI, 634 pages. 2005.
- Vol. 3458: P. Herrero, M.S. P rez, V. Robles (Eds.), *Scientific Applications of Grid Computing*. X, 208 pages. 2005.
- Vol. 3456: H. Rust, *Operational Semantics for Timed Systems*. XII, 223 pages. 2005.
- Vol. 3455: H. Treharne, S. King, M. Henson, S. Schneider (Eds.), *ZB 2005: Formal Specification and Development in Z and B*. XV, 493 pages. 2005.
- Vol. 3454: J.-M. Jacquet, G.P. Picco (Eds.), *Coordination Models and Languages*. X, 299 pages. 2005.
- Vol. 3453: L. Zhou, B.C. Ooi, X. Meng (Eds.), *Database Systems for Advanced Applications*. XXVII, 929 pages. 2005.
- Vol. 3452: F. Baader, A. Voronkov (Eds.), *Logic for Programming, Artificial Intelligence, and Reasoning*. XI, 562 pages. 2005. (Subseries LNAI).
- Vol. 3450: D. Hutter, M. Ullmann (Eds.), *Security in Pervasive Computing*. XI, 239 pages. 2005.
- Vol. 3449: F. Rothlauf, J. Branke, S. Cagnoni, D.W. Corne, R. Drechsler, Y. Jin, P. Machado, E. Marchiori, J. Romero, G.D. Smith, G. Squillero (Eds.), *Applications of Evolutionary Computing*. XX, 631 pages. 2005.
- Vol. 3448: G.R. Raidl, J. Gottlieb (Eds.), *Evolutionary Computation in Combinatorial Optimization*. XI, 271 pages. 2005.
- Vol. 3447: M. Keijzer, A. Tettamanzi, P. Collet, J.v. Hemert, M. Tomassini (Eds.), *Genetic Programming*. XIII, 382 pages. 2005.
- Vol. 3444: M. Sagiv (Ed.), *Programming Languages and Systems*. XIII, 439 pages. 2005.
- Vol. 3443: R. Bodik (Ed.), *Compiler Construction*. XI, 305 pages. 2005.
- Vol. 3442: M. Cerioli (Ed.), *Fundamental Approaches to Software Engineering*. XIII, 373 pages. 2005.
- Vol. 3441: V. Sassone (Ed.), *Foundations of Software Science and Computational Structures*. XVIII, 521 pages. 2005.
- Vol. 3440: N. Halbwachs, L.D. Zuck (Eds.), *Tools and Algorithms for the Construction and Analysis of Systems*. XVII, 588 pages. 2005.

## Preface

We welcome you to the proceedings of IWQoS 2005 held at the University of Passau, in the beautiful state of Bavaria, Germany. We hope that all attendees enjoyed their time in that ancient and historic city.

Quality of Service(QoS) continues to be an important area of research. Traditionally very focused on the area of networking, it has grown to include mobile applications, wireless environments, 3G and 4G cellular networks, user experience, overlay networks, large-scale systems and other important areas of application. Six full-paper sessions that comprised selected papers of very high quality were devoted to the above mentioned, cutting-edge topics in this volume. We had a fascinating cross-disciplinary program and hope to have seeded connections between different disciplines and between industry and academia.

In addition to the reviewed paper sessions, we were pleased to present two inspiring keynote speakers in this year's program: *Randy Katz*, University of California, Berkeley, USA, and *Michael Stal*, Siemens AG, Munich, Germany. One speaker being from academia and one from industry, reflected well the balanced view of this workshop. Both keynotes extended the scope of QoS and addressed pressing issues, such as "spam," and leading trends, such as "service orientation," and their relevance to QoS.

We worked towards returning IWQoS back to its roots as a workshop where emerging research can be presented. In addition to the regular paper sessions, we therefore extended the program for inclusion of two short-paper sessions and a panel session. These three extra sessions were designed to be particularly interactive between speakers and audience. The Work in Progress short-paper track featured ideas and early research that is still open for discussion and commentary and therefore was given room to be innovative, provocative and visionary. The Position Papers session featured short papers that investigate the impact of QoS: where industry meets academia. The papers in this session paid tribute to the maturing state of QoS-related research and were intended to expose the community to new applications of QoS and to help understanding the barriers to deployment. The Panel session was devoted to discussing a provocative new paradigm, namely whether QoS can be achieved in a "self-organizing" manner, and brought up a controversial and novel view, which implied a shift away from more traditional paradigms.

As always a great deal of effort went into creating this program. More than 120 submitted papers were received with 317 co-authors from 32 countries belonging to all five continents. We were particularly pleased with the relatively large number of papers received from Asia and South America. The five countries with the most co-authors of the submitted papers were: USA (49), Germany (43), South Korea (31), China (29) and Brazil (20). The best 23 full papers, all of which are technically excellent, were selected after a thorough peer-reviewing

process, where each paper was independently evaluated by at least three reviewers. In addition to the full papers, 17 short papers were selected based on their merit for the respective session and their general quality.

We wish to thank the Program Committee for its hard work to ensure that high-quality papers were accepted and that new research was viewed with an open mind. Finally, the authors are to be thanked for their submissions and continuing excellence.

As with any large endeavor, there are many people who managed the computational and physical logistics. We wish to thank Ivan Dedinski for his heroic efforts to manage the IWQoS Web site and online support, and Silvia Lehmbbeck for her fabulous organizing efforts. Eva Gutzmiedl did an excellent job with the careful compilation of the camera-ready papers for the preparation and final editing of the proceedings. David Hutchison is to be thanked for his effort and excellence in organizing a fascinating panel, and Georgios Karagiannis, together with François Le Faucheur, helped greatly to shape the industrial session. Jan de Meer excelled in organizing the floor exhibition as an accompanying program. In alphabetic order, many thanks also to Richard Holzer, Alois Höng, Amine Houyou, Anton Kornexl, Elisabeth Loibl, Jens Oberender, Patrick Wüchner and to the other many people who helped with the workshop organization during various phases.

Passau

April – June 2005

Hermann de Meer and Nina Bhatti

# Organization

## Program Chairs

Hermann de Meer, University of Passau, Germany

Nina Bhatti, Hewlett-Packard Laboratories, Palo Alto, California, USA

## Steering Committee

Thomas Gross, ETH Zürich, Switzerland

Kevin Jeffay, University of North Carolina, Chapel Hill, USA

Baochun Li, University of Toronto, Canada

Jörg Liebeherr, University of Virginia, USA

Ion Stoica, University of California, Berkeley, USA

Zhi-Li Zhang, University of Minnesota, Twin Cities, USA

## Program Committee

Tarek Abdelzaher, University of Virginia, USA

Eitan Altman, INRIA, Sophia-Antipolis, France

Supratik Bhattacharyya, Sprint ATL, Burlingame, California, USA

Nina Bhatti, Hewlett-Packard Laboratories, Palo Alto, California, USA

Olivier Bonaventure, Université Catholique de Louvain, Belgium

Chen-Nee Chuah, University of California, Davis, USA

Hermann de Meer, University of Passau, Germany

Jan de Meer, IHP Microelectronics, Frankfurt/Oder, Germany

Sonia Fahmy, Purdue University, USA

Jean-Marie Farines, Federal University of Santa Catarina, Brazil

Stefan Fischer, University of Lübeck, Germany

Erol Gelenbe, Imperial College, London, UK

Thomas Gross, ETH Zürich, Switzerland

Abdel Hafid, University of Montreal, Canada

Gísli Hjálmtýsson, Reykjavík University, Iceland

Geoff Huston, Telstra Internet, Australia

David Hutchison, Lancaster University, UK

Georgios Karagiannis, University of Twente, The Netherlands

Gunnar Karlsson, Royal Institute of Technology (KTH), Kista, Sweden

Magnus Karlsson, Hewlett-Packard Laboratories, Palo Alto, California, USA

Jasleen Kaur, University of North Carolina, Chapel Hill, USA

Srinivasan Keshav, University of Waterloo, Canada

## VIII Organization

Kalevi Kilkki, Nokia Research Center, Helsinki, Finland  
Eckhardt Körner, University of Applied Science, Mannheim, Germany  
Daniel Kofman, ENST/INFRES/RHD, France  
Yevgeni Koucheryavy, Tampere University, Finland  
Geng-Sheng Kuo, National Chengchi University, Taiwan  
Guy Leduc, Université de Liège, Belgium  
Baochun Li, University of Toronto, Canada  
Raymond Liao, Siemens, Berkeley, USA  
Jörg Liebeherr, University of Virginia, USA  
Claudia Linnhoff-Popien, LM University, Munich, Germany  
Bryan Lyles, Telcordia Technologies, USA  
Jogesh Muppala, Hong Kong University of Science & Technology, China  
Klara Nahrstedt, University of Illinois at Urbana-Champaign, USA  
Elie Najm, École Nationale Supérieure des Télécommunications, Paris, France  
Srihari Nelakuditi, University of South Carolina, Columbia, USA  
Konstantina Papagiannaki, Intel Research, Cambridge, UK  
Sambit Sahu, IBM Research, New York, USA  
Jens Schmitt, University of Kaiserslautern, Germany  
Raghupathy Sivakumar, Georgia Institute of Technology, Atlanta, USA  
Michael Smirnov, FhG FOKUS Berlin, Germany  
Ralf Steinmetz, Technical University of Darmstadt, Germany  
Burkhard Stiller, ETH Zürich, Switzerland  
Joseph Sventek, University of Glasgow, UK  
Peter van der Stok, Philips Research, Eindhoven, The Netherlands  
Klaus Wehrle, University of Tübingen, Germany  
Qian Zhang, Microsoft Research Asia, Beijing, China  
Zhi-Li Zhang, University of Minnesota, Twin Cities, USA  
Martina Zitterbart, University of Karlsruhe, Germany

## Publicity Chair

Jan de Meer, IHP Microelectronics, Frankfurt/Oder, Germany

## Organization Committee

**Chair:** Silvia Lehmbeck, University of Passau, Germany  
Ivan Dedinski, University of Passau, Germany  
Eva Gutsmiedl, University of Passau, Germany  
Richard Holzer, University of Passau, Germany  
Amine Houyou, University of Passau, Germany  
Jens Oberender, University of Passau, Germany  
Patrick Wüchner, University of Passau, Germany

## Reviewers

Tarek Abdelzaher	Andrey Krendzel
Eitan Altman	Geng-Sheng Kuo
Attila Báder	Olaf Landsiedel
Supratik Bhattacharyya	Guy Leduc
Nina Bhatti	Baochun Li
Thomas Bohnert	Raymond Liao
Olivier Bonaventure	Jorg Liebeherr
Claude Chaudet	Peixiang Liu
Kai Chen	Claudia Linnhoff-Popien
Chen-Nee Chuah	George Loukas
Florence Clévenot-Perronnin	Bryan Lyles
Pieter-Tjerk de Boer	Abdelilah Maach
Hermann de Meer	David Mayer
Jan de Meer	Jogesh Muppala
Daniel Dietterle	Klara Nahrstedt
Elias Doumith	Elie Najm
Avadora Dumitrescu	Srihari Nelakuditi
Roman Dunaytsev	Arturo Núñez
Antonio Estepa Alonso	Jens Oberender
Sonia Fahmy	Konstantina Papagiannaki
Jean-Marie Farines	Leo Petrak
Stefan Fischer	Krzysztof Piotrowski
Erol Gelenbe	Simon Richie
Michael Gellman	Sambit Sahu
Thomas Gross	Georgia Sakellari
Abdel Hafid	Jens Schmitt
Jarmo Harju	Samarth Shah
Boudewijn Havercort	Raghupathy Sivakumar
Gísli Hjálmtýsson	Michael Smirnov
Richard Holzer	Ralf Steinmetz
Amine Houyou	Burkhard Stiller
Geoff Huston	Pu Su
David Hutchison	Joseph Sventek
Georgios Karagiannis	Vanish Talwar
Gunnar Karlsson	Steve Uhlig
Magnus Karlsson	Remco van de Meent
Jasleen Kaur	Hans van den Berg
Kalevi Kilkki	Peter van der Stok
Ram Keralapura	Srivatsan Varadarajan
Srinivasan Keshav	Klaus Wehrle
Eckhart Körner	Yan Wu
Yevgeni Koucheryavy	Patrick Wüchner

X Organization

Yuan Xue  
Ossama Younis  
Yinzhe Yu

Qian Zhang  
Zhi-Li Zhang  
Martina Zitterbart

## Organizer



## Technical Sponsors



## Sponsoring Companies and Institutions



# Table of Contents

---

## I Invited Program

---

### Keynotes

COPS: Quality of Service vs. Any Service at All <i>Randy Katz, George Porter, Scott Shenker, Ion Stoica, Mel Tsai (University of California, Berkeley, USA)</i> .....	3
Beyond Middleware and QoS - Service-Oriented Architectures - Cult or Culture? <i>Michael Stal (Siemens AG, Munich, Germany)</i> .....	16

### Panel

Would Self-organized or Self-managed Networks Lead to Improved QoS? <i>Panel Convener: David Hutchison (Lancaster University, UK) Panellists: Gísli Hjálmtýsson (Reykjavík University, Iceland), James P.G. Sterbenz (University of Massachussets, Amherst, USA), Giorgio Ventre (University of Napoli, Italy), John Vicente (Intel Corp., USA)</i> .....	17
--	----

---

## II Full Papers

---

### QoS in Overlay Networks

Overlay Networks with Linear Capacity Constraints <i>Ying Zhu, Baochun Li (University of Toronto, Canada)</i> .....	21
A High-Throughput Overlay Multicast Infrastructure with Network Coding <i>Mea Wang, Zongpeng Li, Baochun Li (University of Toronto, Canada)</i> .....	37

### On Topological Design of Service Overlay Networks

<i>Arunabha Sen, Ling Zhou, Bin Hao, Bao Hong Shen (Arizona State University, Tempe, USA), Samrat Ganguly (NEC Laboratories, USA)</i> .....	54
---	----

## **QoS in Wireless Environments**

### On Transport Layer Adaptation in Heterogeneous Wireless Data Networks

- Aravind Velayutham (Georgia Institute of Technology, Atlanta, USA), Hung-Yun Hsieh (National Taiwan University, Taiwan, Rep. of China), Raghupathy Sivakumar (Georgia Institute of Technology, Atlanta, USA) . . . . .* 69

### LT-TCP: End-to-End Framework to Improve TCP Performance over Networks with Lossy Channels

- Omesh Tickoo, Vijaynarayanan Subramanian, Shivkumar Kalyanaraman (RPI, Troy, USA), K.K. Ramakrishnan (AT&T Labs Research, USA) . . . . .* 81

### QoS Guarantees in Multimedia CDMA Wireless Systems with Non-precise Network Parameter Estimates

- H. Cahit Akin, Ozdemir Akin (University of California, San Diego, USA), Kimberly M. Wasserman (Cisco Systems, Research Triangle Park, USA) . . . . .* 94

### Analyzing Object Detection Quality Under Probabilistic Coverage in Sensor Networks

- Shansi Ren, Qun Li, Haining Wang, Xin Chen, Xiaodong Zhang (College of William and Mary, Williamsburg, USA) . . . . .* 107

## **The User Experience of QoS**

### A Self-tuning Fuzzy Control Approach for End-to-End QoS Guarantees in Web Servers

- Jianbin Wei, Cheng-Zhong Xu (Wayne State University, Detroit, USA) . . . . .* 123

### Calculation of Speech Quality by Aggregating the Impacts of Individual Frame Losses

- Christian Hoene, Sven Wiethölter, Adam Wolisz (Technical University of Berlin, Germany) . . . . .* 136

### Best-Effort Versus Reservations Revisited

- Oliver Heckmann (Technical University of Darmstadt, Germany), Jens B. Schmitt (University of Kaiserslautern, Germany) . . . . .* 151

An Advanced QoS Protocol for Real-Time Content over the Internet <i>John Adams (British Telecom, Suffolk, UK), Avril IJsselmuizen  (University of Duisburg-Essen, Germany), Lawrence Roberts  (Anagran, USA)</i> . . . . .	164
<b>QoS in Large Scale Systems</b>	
Designing a Predictable Internet Backbone with Valiant Load-Balancing <i>Zhang-Shen Rui, Nick McKeown (Stanford University, USA)</i> . . . . .	178
Preserving the Independence of Flows in General Topologies Using Turn-Prohibition <i>Markus Fidler (NTNU Trondheim, Norway),  Oliver Heckmann, Ralf Steinmetz (Technical University of  Darmstadt, Germany)</i> . . . . .	193
Supporting Differentiated QoS in MPLS Networks <i>Roberto A. Dias (Federal Technology Center of Santa  Catarina, Brazil), Eduardo Camponogara, Jean-Marie Farines  (Federal University of Santa Catarina, Brazil)</i> . . . . .	206
Avoiding Transient Loops Through Interface-Specific Forwarding <i>Zifei Zhong (University of South Carolina, Columbia, USA),  Ram Keralapura (University of California, Davis, USA),  Srihari Nelakuditi (University of South Carolina, Columbia,  USA), Yinzie Yu (University of Minnesota, Minneapolis, USA),  Junling Wang (University of South Carolina, Columbia, USA),  Chen-Nee Chuah (University of California, Davis, USA),  Sanghwan Lee (University of Minnesota, Minneapolis, USA)</i> . . . . .	219
<b>Stochastic QoS</b>	
Analysis of Stochastic Service Guarantees in Communication Networks: A Server Model <i>Yuming Jiang, Peder J. Emstad  (Norwegian University of Science and Technology, Norway)</i> . . . . .	233
Preemptive Packet-Mode Scheduling to Improve TCP Performance <i>Wenjie Li, Bin Liu, Lei Shi, Yang Xu  (Tsinghua University, Beijing, Rep. of China), Dapeng Wu  (University of Florida, Gainesville, USA)</i> . . . . .	246

Edge-Based Differentiated Services <i>Henrik Lundqvist, Ignacio Más Ivars, Gunnar Karlsson (Royal Institute of Technology, Kista, Sweden)</i> .....	259
Processor Sharing Flows in the Internet <i>Nandita Dukkipati (Stanford University, USA), Masayoshi Kobayashi (NEC Corporation, Japan), Zhang-Shen Rui, Nick McKeown (Stanford University, USA) .....</i>	271
<b>QoS in 3<sup>rd</sup>/4<sup>th</sup> Generation Mobile Systems</b>	
A Practical Method for the Efficient Resolution of Congestion in an On-path Reduced-State Signalling Environment <i>András Császár, Attila Takács, Attila Báder (Ericsson Telecommunication, Budapest, Hungary) .....</i>	286
Case Study in Assessing Subjective QoS of a Mobile Multimedia Web Service in a Real Multi-access Network <i>Tiia Sutinen (VTT Electronics, Oulu, Finland), Timo Ojala (University of Oulu, Finland).....</i>	298
WXCP: Explicit Congestion Control for Wireless Multi-hop Networks <i>Yang Su, Thomas Gross (ETH Zürich, Switzerland) .....</i>	313
A Non-homogeneous QBD Approach for the Admission and GoS Control in a Multiservice WCDMA System <i>Ioannis Koukoutsidis, Eitan Altman (INRIA, Sophia Antipolis, France), Jean Marc Kelif (France Telecom R&amp;D, Issy-les-Moulineaux, France) .....</i>	327

---

### III Short Papers

---

#### Work in Progress - Innovative, Provocative and Visionary Statements

Quality of Service Authentication, Authorization and Accounting <i>Tseno Tsenov, Hannes Tschofenig (Siemens AG, Munich, Germany).....</i>	343
Preliminary Results Towards Building a Highly Granular QoS Controller <i>Cristian Koliver (University of Caxias do Sul, Brazil), Jean-Marie Farines (Federal University of Santa Catarina, Brazil) .....</i>	346