Editorial Board

Ozgur Akan
Middle East Technical University, Ankara, Turkey

Paolo Bellavista
University of Bologna, Italy

Jiannong Cao
Hong Kong Polytechnic University, Hong Kong

Falko Dressler
University of Erlangen, Germany

Domenico Ferrari
Università Cattolica Piacenza, Italy

Mario Gerla
UCLA, USA

Hisashi Kobayashi
Princeton University, USA

Sergio Palazzo
University of Catania, Italy

Sartaj Sahani
University of Florida, USA

Xuemin (Sherman) Shen
University of Waterloo, Canada

Mircea Stan
University of Virginia, USA

Jia Xiaohua
City University of Hong Kong, Hong Kong

Albert Zomaya
University of Sydney, Australia

Geoffrey Coulson
Lancaster University, UK
It is my pleasure to welcome you to the proceedings of TridentCom 2012, the 8th International ICST Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities. I was truly honored to organize Tridentcom 2012 in Thessaloniki, Greece, during June 11–13, 2012, with the vision bringing together technical experts and researchers from academia, industry, and government from all around the world to discuss experimental research infrastructures of the Future Internet.

This year’s Tridentcom was very exciting. We set up a single-track technical program with 21 high-quality paper presentations on experimentation and testbeds in the field of wired and wireless networks, cloud, measurements, routing, and sensors. Apart from the regular paper presentations, Tridentcom 2012 featured a rich variety of other activities. A record number of 33 demos and posters were hosted in the demo section of the conference, presenting live the last trends on experimentation activities all over the world. Two keynote speakers, Piet Demeester from University of Ghent in Belgium and Jeff Chase from Duke University in the US, gave very interesting talks on research infrastructures and deployment platforms. The program included a fascinating tutorial on state-of-the-art tools for accessing and using federated research testbeds in a systematic way. Last but not least, the Infinity workshop was collocated with Tridentcom 2012, with the aim of gathering information on the existing research testbeds in Europe.

Tridentcom 2012 would not have been a success without the invaluable efforts of the Organizing Committee. I would like to thank Max Ott from NICTA and Michael Zink from the University of Massachusetts in Amherst for putting together an excellent technical program. Ivan Seskar from Rutgers University did a great job setting up a demo and poster section full of innovative ideas and implementations. I am grateful to Leandros Tassiulas from University of Thessaly for his significant support on several organization issues. Timur Friedman from UPMC and Aki Nakao from University of Tokyo worked hard on the publicity of the conference. The very nice website of this year’s Tridentcom was a result of the creative work of Stratos Keranidis from CERTH. Gentian Jakllari from the University of Toulouse helped really in putting together the proceedings of the conference right on time. A big thank you to Stavroula Maglavera from CERTH for her tireless help with the complicated but exciting local arrangements. This year, for the first time, we launched student travel grants for Tridentcom. I would like to thank Serge Fdida from UPMC for his enormous work to secure resources in order to make these travel grants a success. Finally, I would like to thank Ruzanna Najaryan and Elisa Mendini from EAI for their collaboration on the organization of the conference.

Thanasis Korakis
Welcome to the proceedings of the 8th International ICST Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities, which was held in Thessaloniki, Greece. The conference comprised four days of workshops, conference sessions, keynote presentations, poster discussions, networking, and most importantly, a good time among fellow researchers.

Every year Tridentcom grows in reputation and stature and has become a very selective venue for research publications in the broad area of methods and techniques for experimental-based networking research. After a careful and rigorous review process, 21 high-quality papers were selected among submissions from Europe, North America, Africa, Australia, Brazil, China, Japan, Korea, and Singapore.

The conference program this year consisted of six single-track sessions covering a diverse range of very timely topics such as wireless, clouds and networks, measurements, sensor networks, routing, and testbeds.

The main conference also featured two excellent and thought provoking keynotes from Piet Demester and Jeff Chase. Given the nature of the Tridentcom community, the poster and demo session, organized by Ivan Seskar, was one of the highlights of the conference and showcased the latest achievements in the field of testbeds and experimentation.

The technical program is the result of the dedicated and hard work of many people. We are most grateful to the authors who submitted their work to TridentCom 2012, as well as to the reviewers, who generously contributed their time and expertise to the review process. We also want to thank the conference Steering Committee and the General Chair for their guidance as well as the local Organizing Committee members in Thessaloniki for the smooth running of the conference.

It was a privilege to work with so many excellent and knowledgeable people leading up to the conference and a joy to engage in so many interesting conversations throughout the conference.

Max Ott
Michael Zink
Conference Organization

Executive Committee

General Chair
Thanasis Korakis Polytechnic Institute of NYU, USA - University of Thessaly, Greece

TPC Chairs
Max Ott National ICT Australia
Michael Zink University of Massachusetts Amherst, USA

Poster/Demo Chair
Ivan Seskar Rutgers University, USA

Workshop Chairs
Leandros Tassiulas University of Thessaly, Greece
Tanja Zseby Fraunhofer Institute FOKUS, Germany

Student Travel Grant Chair
Serge Fdida UPMC, France

Publication Chair
Gentian Jakllari University of Toulouse, France

Publicity Chairs
Timur Friedman UPMC, France
Aki Nakao University of Tokyo, Japan

Web Chair
Stratos Keranidis CERTH, Greece

Local Arrangements Chair
Stavroula Maglava CERTH, Greece

EAI Conference Manager
Ruzanna Najaryan EAI, Italy
Steering Committee

Imrich Chlamtac  Create-Net, University of Trento, Italy
Thomas Magedanz  TU Berlin, Fraunhofer Fokus, Germany
Csaba A. Szabo  BUTE, Hungary

Technical Program Committee

Sudhir Aggarwal  Anastasius Gavras  Eugen Mikoczy
Jeannie Albrecht  Deniz Gurkan  Paul Mueller
Ilia Baldine  Jason Hallstrom  Max Ott
Paolo Bellavista  Marco Hoffmann  Pablo Serrano
Prasad Calyam  David Irwin  Ivan Seskar
Justin Cappos  Henry Jerez  Mineo Takai
Emmanuel Cecchet  Jongwon Kim  Kurt Tutschku
Spyros Denazis  Andre Koenig  Scott A. Valcourt
Serge Fdida  Koutsopoulos Iordanis  Yang Yang
Stefan Fischer  Rick McGeer  Sun Yi
Alex Galis  Ruben Merz  Michael Zink
# Table of Contents

## Infinity Workshop

A Satellite Network Emulation Platform for Implementation and Testing of TCP/IP Applications ............................... 1  
   *Michele Luglio, Cesare Roseti, and Francesco Zampagnaro*

GAIA Extended Research Infrastructure: Sensing, Connecting, and Processing the Real World .................................... 3  
   *Pedro Martinez-Julia, Antonio J. Jara, and Antonio F. Skarmeta*

MTT CropInfra .................................................................. 5  
   *Ari Ronkainen, Frederick Teye, Markku Koistinen, Jere Kaivosoja, Liisa Pesonen, and Pasi Suomi*

The IBBT w-iLab.t: A Large-Scale Generic Experimentation Facility for Heterogeneous Wireless Networks ............................... 7  
   *Stefan Bouckaert, Bart Jooris, Pieter Becue, Ingrid Moerman, and Piet Demeester*

UMA Testing Facility .................................................. 9  
   *Almudena Díaz Zayas, Francisco Javier Rivas, and Pedro Merino Gomez*

Infrastructure Overview with Focus on Experimental Facility .......... 11  
   *Rudolf Vohnout, Lada Altmannova, Stanislav Sima, and Pavel Skoda*

## Wireless

LTE Emulation over Wired Ethernet ........................................ 18  
   *Roman Chertov, Joseph Kim, and Jiayu Chen*

Environment-Independent Virtual Wireless Testbed  .................. 33  
   *Hiroshi Mano*

FPGA-Based Wireless Link Emulator for Wireless Sensor Network ..... 48  
   *Wei Liu, Luc Bienstman, Bart Jooris, Opher Yaron, and Ingrid Moerman*

Implementation and End-to-end Throughput Evaluation of an IEEE 802.11 Compliant Version of the Enhanced-Backpressure Algorithm .... 64  
   *Kostas Choumas, Thanasis Korakis, Iordanis Koutsopoulos, and Leandros Tassiulas*
# Clouds and Networks

**BonFIRE: A Multi-cloud Test Facility for Internet of Services**

<table>
<thead>
<tr>
<th>Experimentation</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alastair C. Hume, Yahya Al-Hazmi, Bartosz Belter, Konrad Campowsky, Luis M. Carril, Gino Carrozzo, Vegard Engen, David García-Pérez, Jordi Jofre Ponsati, Roland Kübert, Yongzheng Liang, Cyril Rohr, and Gregory Van Seghbroeck</td>
<td>81</td>
</tr>
</tbody>
</table>

**ExoGENI: A Multi-domain Infrastructure-as-a-Service Testbed**

| Ilia Baldine, Yufeng Xin, Anirban Mandal, Paul Ruth, Chris Heerman, and Jeff Chase | 97 |

**Experimental Demonstration of Network Virtualization and Resource Flexibility in the COMCON Project**

| Michael Duelli, Sebastian Meier, David Wagner, Thomas Zinner, Matthias Schmid, Marco Hoffmann, and Wolfgang Kiess | 114 |

# Measurements

**A Passive Measurement System for Network Testbeds**

| Charles Thomas, Joel Sommers, Paul Barford, Dongchan Kim, Ananya Das, Roberto Segebre, and Mark Crovella | 130 |

**Monitoring Pairwise Interactions to Discover Stable Wormholes in Highly Unstable Networks**

| Luis C.E. Bona, Elias P. Duarte Jr., and Thiago Garrett | 146 |

**DNEmu: Design and Implementation of Distributed Network Emulation for Smooth Experimentation Control**

| Hajime Tazaki and Hitoshi Asaeda | 162 |

**Implementation and Performance Evaluation of a New Experimental Platform for Medium Access Control Protocols**

| Francisco Vázquez Gallego, Jesús Alonso-Zarate, Danica Gajic, Christian Liss, and Christos Verikoukis | 178 |

# Sensor Networks

**MagicLink: Weaving Multi-site Wireless Sensor Networks for Large-Scale Experiments**

| Xinxin Liu, Li Yu, Di Wang, and Xiaolin Li | 194 |

**Data Filtering and Aggregation in a Localisation WSN Testbed**

| Ivo F.R. Noppen, Desislava C. Dimitrova, and Torsten Braun | 210 |
A Framework for Resource Selection in Internet of Things Testbeds . . . . 224
Michele Nati, Alexander Gluhak, Hamidreza Abangar,
Stefan Meissner, and Rahim Tafazolli

Routing

Automated Deployment and Customization of Routing Overlays
on Planetlab .......................................................... 240
Claudio Daniel Freire, Alina Quereilhac, Thierry Turletti, and
Walid Dabbous

A Real-Time Testbed for Routing Network ......................... 256
Kang Yao, Weiqing Sun, Mansoor Alam, Mingzhe Xu, and
Vijay Devabhaktuni

VF2x: Fast, Efficient Virtual Network Mapping for Real Testbed
Workloads ............................................................. 271
Qin Yin and Timothy Roscoe

Testbeds

How to Build a Better Testbed: Lessons from a Decade of Network
Experiments on Emulab ............................................. 287
Fabien Hermenier and Robert Ricci

Federating Wired and Wireless Test Facilities through Emulab
and OMF: The iLab.t Use Case .................................... 305
Stefan Bouckaert, Pieter Becue, Brecht Vermeulen, Bart Jooris,
Ingrid Moerman, and Piet Demeester

Designing a Federated Testbed as a Distributed System .......... 321
Robert Ricci, Jonathon Duerig, Leigh Stoller, Gary Wong,
Srikanth Chikkulapelly, and Woojin Seok

Experimentation in Heterogeneous European Testbeds through the
Onelab Facility: The Case of PlanetLab Federation with the Wireless
NITOS Testbed ......................................................... 338
Stratos Keranidis, Dimitris Giatsios, Thanasis Korakis,
Iordanis Koutsopoulos, Leandros Tassiulas,
Thierry Rakotoarivelo, and Thierry Parmentelat

Posters

Smart Information Network: A Testbed Architecture for Future
Internet ............................................................... 355
Xiangyang Xue, Yi Li, Xiaoyuan Lu, Xin Wang, and Lingwei Chu
Photonic Services and Their Applications ........................... 358  
*Josef Vojtech, Vladimir Smotlacha, Stanislav Sima, and Pavel Skoda*

An Instrumentation and Measurement Architecture Supporting Multiple Control Monitoring Frameworks ........................... 363  

A Self-organized, Service-Oriented GMPLS Optical Network Testbed ... 365  
*Apostolis Siokis and Kyriakos Vlachos*

A Framework for Multidimensional Measurements on an Experimental WiMAX Testbed ........................... 369  
*Fraida Fund, Chen Dong, Thanasis Korakis, and Shivendra Panwar*

FIBRE Project: Brazil and Europe Unite Forces and Testbeds for the Internet of the Future ...................................... 372  
*Sebastia Sallent, Antonio Abelém, Iara Machado, Leonardo Bergesio, Serge Pádua, Jose Rezende, Siamak Azodolmolky, Marcos Salvador, Leandro Ciuffo, and Leandros Tassiulas*

### Demos

Cross-Testbed Experimentation Using the Planetlab-NITOS Federation ................................................................. 373  
*Nikos Makris, Stratos Keranidis, Dimitris Giatsios, Thanasis Korakis, Iordanis Koutsopoulos, Leandros Tassiulas, Thierry Rakotoarivelo, and Thierry Parmentelat*

OpenFlow and P2P Integrated Testing, Project: OpenLab .......... 377  
*Christos Tranoris and Spyros Denazis*

An Integrated Chassis Manager Card Platform Featuring Multiple Sensor Modules ..................................................... 379  
*Giannis Kazdaridis, Stratos Keranidis, Harris Niavis, Thanasis Korakis, Iordanis Koutsopoulos, and Leandros Tassiulas*

An Experimental Framework for Channel Sensing through USRP/GNU Radios .......................................................... 383  
*Virgílios Passas, Stratos Keranidis, Thanasis Korakis, Iordanis Koutsopoulos, and Leandros Tassiulas*

Integrating FlowVisor Access Control in a Publicly Available OpenFlow Testbed with Slicing Support ........................... 387  
*Dimitris Giatsios, Kostas Choumas, Dimitris Syrivelis, Thanasis Korakis, and Leandros Tassiulas*
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Demonstration of Video over an IEEE 802.11 Compliant Version</td>
<td>390</td>
</tr>
<tr>
<td>of the Enhanced-Backpressure Algorithm</td>
<td></td>
</tr>
<tr>
<td>*Kostas Choumas, Thanasis Korakis, Iordanis Koutsopoulos, and</td>
<td></td>
</tr>
<tr>
<td>Leandros Tassiulas*</td>
<td></td>
</tr>
<tr>
<td>The QUEENS Experiment through TEFIS Platform</td>
<td>394</td>
</tr>
<tr>
<td>*Georgios Aristomenopoulos, Argyris Kaninis,</td>
<td></td>
</tr>
<tr>
<td>Panagiotis Vlahopoulos, Annika Sällström, Farid Benbadis, and</td>
<td></td>
</tr>
<tr>
<td>Symeon Papavassiliou*</td>
<td></td>
</tr>
<tr>
<td>Integrating Sensor Measurements through CM Cards as an OMF Service</td>
<td>397</td>
</tr>
<tr>
<td>*Vasilis Maglogiannis, Dimitris Giatsios, Giannis Kazdaridis,</td>
<td></td>
</tr>
<tr>
<td>Thanasis Korakis, Iordanis Koutsopoulos, and Leandros Tassiulas*</td>
<td></td>
</tr>
<tr>
<td>Demonstrating an Information-Centric Network in an International</td>
<td>400</td>
</tr>
<tr>
<td>Testbed</td>
<td></td>
</tr>
<tr>
<td>*George Parisis, Ben Tagger, Dirk Trossen, Dimitris Syrivelis,</td>
<td></td>
</tr>
<tr>
<td>Paris Flegkas, Leandros Tassiulas, Charilaos Stais, Christos Tsilopoulos, and George Xylomenos*</td>
<td></td>
</tr>
<tr>
<td>Demonstration of a Vehicle-to-Infrastructure (V2I) Communication</td>
<td>403</td>
</tr>
<tr>
<td>Network Featuring Heterogeneous Sensors and Delay Tolerant Network</td>
<td></td>
</tr>
<tr>
<td>Capabilities</td>
<td></td>
</tr>
<tr>
<td>*Donatos Stavropoulos, Giannis Kazdaridis, Thanasis Korakis,</td>
<td></td>
</tr>
<tr>
<td>Dimitrios Katsaros, and Leandros Tassiulas*</td>
<td></td>
</tr>
<tr>
<td>A Semantic Interface for OpenLab Network Measurement Infrastructures</td>
<td>406</td>
</tr>
<tr>
<td><em>Jorge E. López de Vergara, Víctor Acero, Mario Poyato, and Javier Aracil</em></td>
<td></td>
</tr>
<tr>
<td>A Demonstration of a Relaying Selection Scheme for Maximizing</td>
<td>408</td>
</tr>
<tr>
<td>a Diamond Network’s Throughput</td>
<td></td>
</tr>
<tr>
<td>*Apostolos Apostolaras, Kostas Choumas, Ilias Syrigos, Giannis</td>
<td></td>
</tr>
<tr>
<td>Kazdaridis, Thanasis Korakis, Iordanis Koutsopoulos, Antonios</td>
<td></td>
</tr>
<tr>
<td>Argyriou, and Leandros Tassiulas*</td>
<td></td>
</tr>
<tr>
<td>A Demonstration of Fast Failure Recovery in Software Defined</td>
<td>411</td>
</tr>
<tr>
<td>Networking</td>
<td></td>
</tr>
<tr>
<td>*Sachin Sharma, Dimitri Staessens, Didier Colle, Mario Pickavet,</td>
<td></td>
</tr>
<tr>
<td>and Piet Demeester*</td>
<td></td>
</tr>
<tr>
<td>Controllable Packet Prioritization on PlanetLab Using NEPI</td>
<td>415</td>
</tr>
<tr>
<td>*Alina Quereilhac, Claudio Daniel Freire, Thierry Turletti, and</td>
<td></td>
</tr>
<tr>
<td>Walid Dabbous*</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Testing of LTE Configurations and Applications</td>
<td>417</td>
</tr>
<tr>
<td>Francisco Javier Rivas, Almudena Díaz Zayas, and Pedro Merino Gomez</td>
<td></td>
</tr>
<tr>
<td>TaaSOR – Testbed-as-a-Service Ontology Repository</td>
<td>419</td>
</tr>
<tr>
<td>Milorad Tosic, Ivan Seskar, and Filip Jelenkovic</td>
<td></td>
</tr>
<tr>
<td>Enabling Sensing and Mobility on Wireless Testbeds</td>
<td>421</td>
</tr>
<tr>
<td>Harris Niavis, Giannis Kazdaridis, Thanasis Korakis, and Leandros Tassiulas</td>
<td></td>
</tr>
<tr>
<td>Remote Control of Robots for Setting Up Mobility Scenarios during Wireless Experiments in the IBBT w-iLab.t</td>
<td>425</td>
</tr>
<tr>
<td>Pieter Becue, Bart Jooris, Vincent Sercu, Stefan Bouckaert, Ingrid Moerman, and Piet Demeester</td>
<td></td>
</tr>
</tbody>
</table>

**Author Index** ........................................................................................................... 427