Jorge Sá Silva Bhaskar Krishnamachari Fernando Boavida (Eds.)

Wireless Sensor Networks

7th European Conference, EWSN 2010 Coimbra, Portugal, February 17-19, 2010 Proceedings



Volume Editors

Jorge Sá Silva

University of Coimbra, Department of Informatics Engineering Polo II, Pinhal de Marrocos, 3030-290 Coimbra, Portugal

E-mail: sasilva@dei.uc.pt

Bhaskar Krishnamachari

University of Southern California

Department of Electrical Engineering - Systems

3740 McClintock Avenue, EEB 300, Los Angeles, CA 90089, USA

E-mail: bkrishna@usc.edu

Fernando Boavida

University of Coimbra, Department of Informatics Engineering Polo II, Pinhal de Marrocos, 3030-290, Coimbra, Portugal

E-mail: boavida@uc.pt

Library of Congress Control Number: 2010920237

CR Subject Classification (1998): C.2.4, C.2, F.2, D.1.3, D.2, E.1, H.4, C.3

LNCS Sublibrary: SL 5 – Computer Communication Networks and Telecommunications

ISSN 0302-9743

ISBN-10 3-642-11916-6 Springer Berlin Heidelberg New York ISBN-13 978-3-642-11916-3 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.com

© Springer-Verlag Berlin Heidelberg 2010 Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India Printed on acid-free paper SPIN: 12995295 06/3180 5 4 3 2 1 0

Preface

It is our great pleasure to present the proceedings of the European Conference on Wireless Sensor Networks 2010 (EWSN 2010).

As the field of wireless sensor networks matures, new design concepts, experimental and theoretical findings, and applications have continued to emerge at a rapid pace. As one of the leading international conferences in this area, EWSN has played a substantial role in the dissemination of innovative research ideas from researchers all over the globe.

EWSN 2010 was organized by the University of Coimbra, Portugal, during February 17–19, 2010 and it was the seventh meeting in this series. Previous events were held in Berlin (Germany) in 2004, Istanbul (Turkey) in 2005, Zurich (Switzerland) in 2006, Delft (The Netherlands) in 2007, and Cork (Ireland) in 2009.

A high-quality selection of papers made up EWSN 2010. Based on the reviews and the recommendations from the four live TPC discussions, we selected a total of 21 papers from 109 submissions (19.26% acceptance rate) for EWSN 2010. Topics of interest included hardware design and implementation, operating systems and software, middleware and macroprogramming, communication and network protocols, information and signal processing, fundamental theoretical limits and algorithms, prototypes, field experiments, testbeds, novel applications, including urban sensing, security and fault-tolerance.

Putting together EWSN 2010 was a team effort. We would like to thank the Program Committee members, the reviewers, our sponsors, all authors, and the Organizing Committee for their respective contributions.

We believe the conference program was interesting and that it provided participants with a very valuable opportunity to share ideas with other researchers and practitioners strongly involved in wireless sensor networks.

February 2010

Bhaskar Krishnamachari Fernando Boavida Jorge Sá Silva

Organization

General Co-chairs

Jorge Sá Silva University of Coimbra, Portugal Fernando Boavida University of Coimbra, Portugal

TPC Co-chairs

Bhaskar Krishnamachari University of Southern California, USA

Jorge Sá Silva University of Coimbra, Portugal

Program Committee

Adam Dunkels SICS, Sweden

Adam Wolitz Technical University of Berlin, Germany Alex Dimakis University of Southern California, USA

Alexander Pflaum Fraunhofer Institute, Germany Andreas Terzis Johns Hopkins University, USA

Andreas Willig Technical University of Berlin, Germany

Attila Vidacs Budapest University of Technology and Economics,

Hungary

Bjorn Pehrson KTH, Sweden

Chen Avin Ben-Gurion University of the Negev, Israel

Cláudio Geyer FRGS University, Brazil

Cormac Sreenan University College Cork, Ireland Edmundo Monteiro University of Coimbra, Portugal

Eduardo Nakamura FUCAPI, Brazil

Hannes Frey University of Paderborn, Germany Holger Karl University of Paderborn, Germany

Jan Beutel ETH Zurich, Switzerland
Jaudelice Oliveira Drexel University, USA
Jie Gao Stony Brook, USA
Joe Polastre Sentilla, USA

Kamin Whitehouse University of Virginia, USA Kasun De Zoysa University of Colombo, Sri Lanka

Koen Langendoen Delft University of Technology, The Netherlands

Lars Wolf TU Braunschweig, Germany Lin Zhang Tsinghua University, China

Luca Mottola SICS, Sweden

Manuel Ricardo INESC Porto, Portugal

Marimuthu Palaniswami University of Melbourne, Australia Mário Alves Polytechnic Institute of Porto, Portugal

VIII Organization

Martin Haenggi Notre Dame, USA

Matthias Hollick Universidad Carlos III de Madrid, Spain

Matt Welsh Harvard University, USA
Michele Zorzi University of Padova, Italy
Neeli Prasad Aalborg University, Denmark
Ozlem Durmaz-Incel Bogazici University, Turkey

Paul Havinga University of Twente, The Netherlands

Pedro Marron University of Bonn and Fraunhofer IAIS, Germany Rolland Vida Budapest University of Technology and Economics,

Hungary

Rui Rocha IT, Portugal

S. Mukhopadhyay Massey University, New Zealand

Sanjay Jha UNSW, Australia

Suman Nath Microsoft Research, USA
Torsten Braun University of Bern, Switzerland
Utz Roedig Lancaster University, UK
V.S. Anil Kumar VirginiaTech, USA

Wendi Heinzelman University of Rochester, USA

Yu Chen State University of New York – Binghamton, USA

Tutorial Co-chairs

Andreas Terzis Johns Hopkins University, USA

Joel Rodrigues University of Beira Interior IT, Portugal

Poster and Demo Co-chairs

Paulo Pinto UNL, Portugal

Slaven Marusic University of Melbourne, Australia

Publicity Co-chairs

Fernando Velez IT, Portugal Pei Zhang CMU, USA

Takahiro Hara Osaka University, Japan

Sponsorships Co-chairs

Marília Curado University of Coimbra, Portugal Vasos Vassiliou University of Cyprus, Cyprus

Publication Chair

Pedro Furtado University of Coimbra, Portugal

Local Arrangements Chair

Paulo Simões University of Coimbra, Portugal

Local Arrangements Committee

Alberto Cardoso University of Coimbra, Portugal André Rodrigues University of Coimbra, Portugal Jorge Granjal University of Coimbra, Portugal Laura Peralta University of Madeira, Portugal Milan Simek University of Brno, Czech Republic University of Coimbra, Portugal Paulo Gil University of Coimbra, Portugal Ricardo Silva Vasco Pereira University of Coimbra, Portugal

Sponsors

Gold: CONET

Silver: Eneida, Fundação Luso-Americana, Libelium

Standard: Galp

Table of Contents

Localization, Synchronization and Compression	
Radio Interferometric Angle of Arrival Estimation	1
Phoenix: An Epidemic Approach to Time Reconstruction	17
Trimming the Tree: Tailoring Adaptive Huffman Coding to Wireless Sensor Networks	33
Networking - I	
Querying Dynamic Wireless Sensor Networks with Non-revisiting Random Walks	49
TARF: A Trust-Aware Routing Framework for Wireless Sensor Networks	65
Low-Overhead Dynamic Multi-channel MAC for Wireless Sensor Networks	81
Exploiting Overlapping Channels for Minimum Power Configuration in Real-Time Sensor Networks	97
New Directions	
Privacy-Preserving Reconstruction of Multidimensional Data Maps in Vehicular Participatory Sensing	114
Gathering Sensor Data in Home Networks with IPFIX	131

Sensing for Stride Information of Sprinters	147
Programming & Architecture	
Wiselib: A Generic Algorithm Library for Heterogeneous Sensor Networks	162
Selective Reprogramming of Mobile Sensor Networks through Social Community Detection	178
Improving Sensornet Performance by Separating System Configuration from System Logic	194
Virtualising Testbeds to Support Large-Scale Reconfigurable Experimental Facilities	210
Link Reliability	
Mitigating the Effects of RF Interference through RSSI-Based Error Recovery	224
F-LQE: A Fuzzy Link Quality Estimator for Wireless Sensor Networks	240
On the Mechanisms and Effects of Calibrating RSSI Measurements for 802.15.4 Radios	256
Making Sensornet MAC Protocols Robust against Interference	272

Networking – II	
MaxMAC: A Maximally Traffic-Adaptive MAC Protocol for Wireless Sensor Networks	289
Energy-Aware Sparse Approximation Technique (EAST) for Rechargeable Wireless Sensor Networks	306
An Adaptive Strategy for Energy-Efficient Data Collection in Sparse Wireless Sensor Networks	322
Author Index	339