

Guide to Wireless Sensor Networks

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Sudip Misra • Isaac Woungang
Subhas Chandra Misra
Editors

Guide to Wireless Sensor Networks

 Springer

Editors

Sudip Misra
School of Information Technology
Indian Institute of Technology
Kharagpur, India

Subhas Chandra Misra
Department of Industrial & Management
Engineering
Indian Institute of Technology
Kanpur, India

Isaac Woungang
Department of Computer Science
Ryerson University
Toronto, Canada

Series Editor

Professor A.J. Sammes, BSc, MPhil, PhD, FBCS, CEng
Centre for Forensic Computing
Cranfield University
DCMT, Shrivenham
Swindon SN6 8LA
UK

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*Dedicated to the newborns: Tultuli (Subhas's
daughter) and Babai (Sudip's son)
and Isaac's grand ma: Maria Happi*

Preface

Overview and Goals

Wireless communication technologies are undergoing rapid advancements. The last few years have experienced a steep growth in research in the area of wireless sensor networks (WSNs). In WSNs, communication takes place with the help of spatially distributed autonomous sensor nodes equipped to sense specific information. WSNs, especially the ones that have gained much popularity in the recent years, are, typically, ad hoc in nature and they inherit many characteristics/features of wireless ad hoc networks such as the ability for infrastructure-less setup, minimal or no reliance on network planning, and the ability of the nodes to self-organize and self-configure without the involvement of a centralized network manager, router, access point, or a switch. These features help to set up WSNs fast in situations where there is no existing network setup or in times when setting up a fixed infrastructure network is considered infeasible, for example, in times of emergency or during relief operations. WSNs find a variety of applications in both the military and the civilian population worldwide such as in cases of enemy intrusion in the battlefield, object tracking, habitat monitoring, patient monitoring, fire detection, and so on.

Even though sensor networks have emerged to be attractive and they hold great promises for our future, there are several challenges that need to be addressed. Some of the well-known challenges are attributed to issues relating to coverage and deployment, scalability, quality-of-service, size, computational power, energy efficiency, and security.

This handbook attempts to provide a comprehensive guide on fundamental concepts, new ideas, and results in the area of WSNs. This book has been prepared keeping in mind that it needs to prove itself to be a valuable resource dealing with both the important core and the specialized issues in this area. We have attempted to offer a wide coverage of topics. We hope that it will be a valuable reference for students, instructors, researchers, and industry practitioners. We believe that this is particularly an attractive feature of this book, as the very limited

selection of books available on WSNs we are aware of are written primarily for academicians/researchers. We have attempted to make this book useful for both the academicians and the practitioners alike.

Organization and Features

The book is broadly divided into 27 chapters. Chapter 1 is dedicated to the energy efficiency issues in information processing in WSNs, which is probably and definitely arguably one of the challenges of great concern amongst researchers/practitioners working with sensor networks. Chapters 2 and 3 discuss the issues of topology management and coverage in these networks. Chapters 4–7 relate to the issues of routing, data centrality, and cooperation. Chapters 8 and 9 are dedicated to transport control issues including flow-control and congestion-control issues. As sensor network environments are often characterized by noise and error prone-ness, we have included a separate chapter, Chapter 10, relating to the issue of fault tolerance in these networks. Chapter 11 discusses the self-organizing and self-healing behavior/characteristics desirable of sensor networks. Chapter 12 focuses on the challenges concerning offering quality-of-service guarantees in sensor networks. As sensor nodes are operated by specialized operating systems, we have included a separate chapter, Chapter 13, on this topic. Chapters 14–18 relate to discussions about issues concerning medium access control, scheduling, and resource allocation. Chapters 19–21 concern security issues in sensor networks – this is another set of chapters, which would definitely attract many readers, as successfully enabling security in most types of emerging networks and definitely, sensor networks, is considered very challenging. The last few chapters, Chapters 22–27, are relatively specialized and they cover such topics as multimedia sensor networks, middleware for sensor networks, and biologically inspired communication in sensor networks.

We list below some of the important features of this book, which, we believe, would make this book a valuable resource for our readers:

- Most of the chapters of the book are authored by prominent academicians/researchers/practitioners in WSNs who have been working with these topics for several years and have thorough understanding of the concepts.
- The authors of this book are distributed in a large number of countries and most of them are affiliated with institutions of worldwide repute. This gives this book an international flavor. The readers of this book can get absorbed by perspectives, suggestions, experiences, and issues projected forward by authors from different countries.
- Almost all the chapters in this book have a distinct section providing *directions for future research*, which particularly targets researchers working in these areas. We believe that this section in each chapter should provide insight to the researchers about some of the current research issues.

- The authors of each chapter have also attempted to the extent possible to provide a comprehensive bibliography, which should greatly help the researchers and readers interested further to dig into the topic.
- Almost all chapters of this book have a separate section outlining *thoughts for practitioners*. We believe that this section in every chapter will be particularly useful for industry practitioners working directly with the practical aspects behind enabling these technologies in the field.
- Most of the chapters provide a list of important terminologies and their brief definitions.
- Most of the chapters also provide a set of questions at the end that can help in assessing the understanding of the readers.
- In order to make the book useful for pedagogical purposes, almost all chapters of the book also have a corresponding set of presentation slides. The slides can be obtained as a supplementary resource by contacting the publisher, Springer.

We have made attempts, in all possible way we could, to make the different chapters of the book look as much coherent and synchronized as possible. However, it cannot be denied that as the chapters were written by different authors, it was not fully possible to fully achieve this task. We believe that this is a limitation of most edited books of this sort.

Target Audience

The book is written by primarily targeting the student community. This includes the students of all levels – those getting introduced to these areas, those having an intermediate level of knowledge of the topics, and those who are already knowledgeable about many of the topics. In order to keep up with this goal, we have attempted to design the overall structure and content of the book in such a manner that makes it useful at all learning levels. To aid in the learning process, almost all chapters have a set of questions at the end of the chapter. Also, in order that teachers can use this book for classroom teaching, the book also comes with presentation slides and sample solutions to exercise questions, which are available as supplementary resources.

The secondary audience for this book is the research community, whether they are working in the academia or in the industry. To meet the specific needs to this audience group, most chapters of the book also have a section in which attempts have been made to provide directions for future research.

Finally, we have also taken into consideration the needs to those readers, typically from the industries, who have quest for getting insight into the practical significance of the topics, i.e., how the spectrum of knowledge and ideas are relevant for real-life sensor networks.

Supplementary Resources

As mentioned earlier, the book comes with the following supplementary resources:

- Solution manual, having sample solutions to most questions provided at the end of the chapters
- Presentation slides, which can be used for classroom instruction by teachers

Teachers can contact the publisher, Springer, in order to get access to these resources.

Acknowledgments

We are extremely thankful to the roughly 74 authors of the 27 chapters of this book, who have worked very hard to bring this unique resource forward for help of the student, researcher, and practitioner community. The authors were very much interactive at all stages of preparation of the book from initial development of concept to finalization. We feel it is contextual to mention that as the individual chapters of this book are written by different authors, the responsibility of the contents of each of the chapters lies with the concerned authors.

We are also very much thankful to our colleagues in the Springer publishing and marketing teams, in particular, Mr. Wayne Wheeler and Ms. Catherine Brett, who tirelessly worked with us and guided us in the publication process. Special thanks also go to them for taking special interest in publishing this book, considering the current worldwide market needs for such a book.

Finally, we would like to thank our parents, Prof. J.C. Misra, Mrs. Shorasi Misra, Mr. John Sime, Mrs. Christine Seupa, our wives Satamita, Sulagna, and Clarisse, and our children, Babai, Tultuli, Clyde, Lenny, and Kylian, for the continuous support and encouragement they offered during this project.

Kharagpur, India
Toronto, Canada
Kanpur, India

Sudip Misra
Isaac Woungang
Subhas C. Misra

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Contributors

Nael B. Abu-Ghazaleh Department of Computer Science, Watson School of Engineering and Applied Sciences, Binghamton University, T12, Engineering Building, Binghamton, NY 13902, USA

Dharma P. Agrawal OBR Center of Distributed and Mobile Computing, Department of Computer Science, University of Cincinnati, Cincinnati, OH 45221-0030, USA

Özgür B. Akan Department of Electrical and Electronics Engineering, Middle East Technical University, Ankara 06531, Turkey

Barış Atakan Department of Electrical and Electronics Engineering, Middle East Technical University, Ankara 06531, Turkey

Can Basaran Department of Computer Science, Thomas J. Watson School of Engineering and Applied Science, State University of New York at Binghamton, P.O. Box 6000, Binghamton, NY 13902-6000, USA

Doina Bein Applied Research Laboratory, Information Science and Technology Division, The Pennsylvania State University, University Park, PA 16802, USA

Raffaele Bruno Institute for Informatics and Telematics (IIT), Italian National Research Council (CNR), Via G. Moruzzi 1, 56124 Pisa, Italy

J.T. Cain Department of Electrical and Computer Engineering, University of Pittsburgh RFID Center of Excellence, 348 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA 15261, USA

Yu Chen ARES/INRIA, Lyon INSA, Villeurbanne 69100, France

Liang Cheng Laboratory of Networking Group (LONGLAB), Department of Computer Science and Engineering, Lehigh University, 19 Memorial Drive West, Bethlehem, PA 18015, USA

Marco Conti Institute for Informatics and Telematics (IIT), Italian National Research Council (CNR), Via G. Moruzzi 1, 56124 Pisa, Italy

Luiz Henrique Andrade Correia Department of Computer Science, Campus Universitário – Caixa Postal 3037, 37200-000 Lavras –, Federal University of Lavras, Brazil

Robin Doss School of Information Technology, Deakin University, Burwood, VIC 3125, Australia

Aldri Luiz dos Santos Department of Informatics, Federal University of Paraná, 81531-990 Curitiba, PR, Brazil

Meng Joo Er School of Electrical and Electronic Engineering, Nanyang Technological University, Block S1-B1C-90, 50 Nanyang Avenue, Singapore 639798, Republic of Singapore

Xiaoming Fan Electrical and Computer Engineering, Ryerson University, 350 Victoria Street, Toronto, ON, Canada M5B 2K3
and

Institute of Computer Science, Computer Systems and Telematics (CST), Freie Universität Berlin, Takustr. 9, 14195 Berlin, Germany

Eric Fleury Ecole Normale Supérieure de Lyon, 46, allée d'Italie, 69364 Lyon Cedex 07, France

Hannes Frey Department of Computer Science, University of Paderborn, Warburger Str. 100, 33098 Paderborn, Germany

Lisa Frye Department of Computer Science, Kutztown University, Lytle 267, Kutztown, PA 19530, USA
and

Laboratory of Networking Group (LONGLAB), Department of Computer Science and Engineering, Lehigh University, 19 Memorial Drive West, Bethlehem, PA 18015, USA

Cheng Fu Intelligent Systems Centre, Nanyang Technological University, Research Techno Plaza, BorderX Block, Level 7, 50 Nanyang Drive, Singapore 637553, Republic of Singapore

Jie Gao 1415 Computer Science Building, Stony Brook University, Stony Brook, NY 11794, USA

Mesut Güneş Institute of Computer Science, Computer Systems and Telematics (CST), Distributed embedded Systems (DeS), Freie Universität Berlin, Takustr. 9, 14195 Berlin, Germany

Peter J. Hawrylak Department of Electrical and Computer Engineering, University of Pittsburgh RFID Center of Excellence, 3700 O'Hara Street, 348 Benedum Hall, Pittsburgh, PA 15261, USA

I-Hong Hou Department of Computer Science, University of Illinois at Urbana-Champaign, 201 N. Goodwin Ave., 3111SC, Urbana, IL 61801, USA

Jennifer C. Hou Deceased

Abdul-Halim Jallad Surrey Space Centre, Department of Electronic Engineering, University of Surrey, Guildford, Surrey GU2 7XH, UK

Jung Hyun Jun OBR Center of Distributed and Mobile Computing, Department of Computer Science, University of Cincinnati, Cincinnati, OH 45221-0030, USA

Kyoung-Don Kang Department of Computer Science, Thomas J. Watson School of Engineering and Applied Science, State University of New York at Binghamton, P.O. Box 6000, Binghamton, NY 13902-6000, USA

Yu-Kwong Kwok Department of Electrical and Computer Engineering, Colorado State University, Fort Collins, CO 80526-1373, USA

Yee Wei Law Department of Electrical and Electronic Engineering, The University of Melbourne, Parkville, VIC 3052, Australia

Ivan Lee School of Computer and Information Science, University of South Australia, Mawson Lakes, SA 5095, Australia

Gang Li School of Information Technology, Deakin University, Burwood, VIC 3125, Australia

Minghui Li Intelligent Systems Centre, Nanyang Technological University, The 7th Storey Research Techno Plaza, 50 Nanyang Drive, Singapore 637553, Republic of Singapore

Hock Beng Lim Intelligent Systems Centre, Nanyang Technological University, Research Techno Plaza, BorderX Block, Level 7, 50 Nanyang Drive, Singapore 637553, Republic of Singapore

Xiao-Hui Lin Department of Communication Engineering, Shenzhen University, Guangdong, China

Hai Liu Department of Computer Science, Hong Kong Baptist University, Kowloon Tong, Kowloon, Hong Kong

Chris Y.T. Ma Department of Computer Science, Purdue University, 305 N. University Street, West Lafayette, IN 47906, USA

Di Ma Intelligent Systems Centre, Nanyang Technological University, Research Techno Plaza, BorderX Block, Level 7, 50 Nanyang Drive, Singapore 637553, Republic of Singapore

Daniel Fernandes Macedo Laboratoire d'Informatique Paris VI, Université Pierre et Marie Curie, 104 Avenue du Président Kennedy, 75016 Paris, France

Marlin H. Mickle Department of Electrical and Computer Engineering, University of Pittsburgh RFID Center of Excellence, 3700 O'Hara Street, 348 Benedum Hall, Pittsburgh, PA 15261, USA

Mohamed Moubarak Computer Science Department, American University of Beirut, P.O. Box 11-0236, Riad El Solh, Beirut 1107 2020, Lebanon

Vikram P. Munishwar Department of Computer Science, Watson School of Engineering and Applied Sciences, Binghamton University, Binghamton, NY 13902, USA

Vinayak Naik Department of Computer Science and Automation, Indian Institute of Science, Bangalore 560012, India

Amiya Nayak School of Information Technology and Engineering, University of Ottawa, Ottawa, ON, Canada K1N 6N5

José Marcos Silva Nogueira Department of Computer Science, Federal University of Minas Gerais, UFMG-ICEX-DCC, Caixa Postal 702, 30123-970 Belo Horizonte, MG, Brazil

Marimuthu Palaniswami Department of Electrical and Electronic Engineering, The University of Melbourne, Parkville, VIC 3052, Australia

Raphael Chung-Wei Phan Electronic and Electrical Engineering, Loughborough University, Leicestershire LE11 3TU, UK

Antonio Pinizzotto Institute for Informatics and Telematics (IIT), Italian National Research Council (CNR), Via G. Moruzzi 1, 56124 Pisa, Italy

Nageswara S.V. Rao Oak Ridge National Laboratory, MS 6016, Bldg 5600, Oak Ridge, TN 37831-6016, USA

Stefan Rührup Department of Computer Science, University of Freiburg, Georges-Koehler-Allee 51, 79110 Freiburg im Breisgau, Germany

Eric Sabbah Department of Computer Science, Thomas J. Watson School of Engineering and Applied Science, State University of New York at Binghamton, P.O. Box 6000, Binghamton, NY 13902-6000, USA

Jochen H. Schiller Institute of Computer Science, Computer Systems and Telematics (CST), Freie Universität Berlin, Takustr. 9, 14195 Berlin, Germany

Wolfgang Schott Zurich Research Laboratory, IBM Research GmbH, Säumerstrasse 4, CH-8803 Rüschlikon, Switzerland

Mallikarjun Shankar Oak Ridge National Laboratory, 1 Bethel Valley Rd., MS 6085, Oak Ridge, TN 37831-6085, USA

William Shaw Electrical and Computer Engineering, Ryerson University, 350 Victoria Street, Toronto, ON, Canada M5B 2K3

Ivan Stojmenović School of Information Technology and Engineering, University of Ottawa, 800 King Edward, Ottawa, ON, Canada K1N 6N5

Kirsten Terfloth Institute of Computer Science, Computer Systems and Telematics (CST), Freie Universität Berlin, Takustr. 9. 14195 Berlin, Germany

Sameer S. Tilak San Diego Supercomputer Center, California Institute for Telecommunications and Information Technology, University of California at San Diego, MC 0505, 9500 Gilman Drive, La Jolla, CA 92093-0505, USA

Tuna Tuğcu Department of Computer Engineering, Boğaziçi University, Bebek-Istanbul 34342, Turkey

Tanya Vladimirova Surrey Space Centre, Department of Electronic Engineering, University of Surrey, Guildford, Surrey GU2 7XH, UK

Bang Wang Intelligent Systems Centre, Nanyang Technological University, Research Techno Plaza, BorderX Block, Level 7, 50 Nanyang Drive, Singapore 637553, Republic of Singapore

Hui Wang Department of Communication Engineering, Shenzhen University, Guangdong, China

Mohamed K. Watfa Computer Science Department, American University of Beirut, P.O. Box 11-0236, Riad El Solh, Beirut 1107 2020, Lebanon

Bin Xie OBR Center of Distributed and Mobile Computing, Department of Computer Science, University of Cincinnati, Cincinnati, OH 45221-0030, USA

Yong Yang Department of Computer Science, University of Illinois at Urbana-Champaign, 201 N. Goodwin Ave., 3111SC, Urbana, IL 61801, USA

David K.Y. Yau Department of Computer Science, Purdue University, 305 N. University Street, West Lafayette, IN 47906, USA

Honghai Zhang 143 W Farrell Ave., Apt. A3, Ewing, NJ 08618, USA

Hongwei Zhang Department of Computer Science, Wayne State University, 431 State Hall, 5143 Cass Ave., Detroit, MI 48202, USA