This is an author produced version of Guest Editorial Special Issue on Green Communications, Computing, and Systems.

White Rose Research Online URL for this paper: http://eprints.whiterose.ac.uk/123403/

Article:

https://doi.org/10.1109/JSYST.2017.2674538

(c) 2017, IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.
Special Issue on Green Communications, Computing, and Systems

The convergence of computing and communications, a recognized phenomenon since 1996 (“The Convergence of Communications and Computing: What are the Implications Today?,” PROCEEDINGS OF THE IEEE, 1996), has accelerated in recent years. Computing technologies are used extensively in network systems, such as cloud computing and grid computing, and the Internet is the most well-known and widely used network infrastructure for computing. Networked software and hardware applications, especially wireless and mobile ones, have been made remarkable and fast increasing impacts on society development and human lives. They touch a great number of the human population in the world through ubiquitous mobile phones and devices. Computing and communications are indispensable components in many diverse systems. All these systems have energy issues. Their increasing spread, particularly with the emergence of the Internet of Things, is a great challenge to a world seeking to reduce its reliance on fossil fuels and address global climate changes. At the same time, although energy concerns are one of the dominant “green” topics, the green issues could be more generally defined as those making the world and the components of man-made systems both sustainable and friendly in an environmental, economic, social, and/or technical sense (“Big Data Meet Green Challenges: Greening Big Data,” IEEE SYSTEMS JOURNAL, 2016). In this sense, the word “green,” includes not only the sustainability objectives but also the “most positive and friendly” characteristics concerning human environments and societies. This Special Issue aims to be one among solid efforts in promoting green communications, computing, and systems. Green communications (J. Wu et al., Green Communications: Theoretical Fundamentals, Algorithms, and Applications, CRC Press, 2012) and green computing (Harnessing Green IT: Principles and Practices, Wiley, 2012) are highly overlapping research areas due to their strong convergence. Green wireless communications are one of the dominant areas within green communications (“Green wireless communications: From concept to reality,” IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, 2012). Additionally, with focuses on energy and computing issues, one relevant research domain is energy informatics (Energy Informatics, Green ePress, 2011). We stress that green communications, computing, and systems cover many relevant topics on energy efficiency and management, resource efficiency and management, sustainability, and environmental protection.

This Special Issue started the dissemination of the Call for Papers in the middle of 2014, received 63 high-quality submissions, and accepted 22 papers after rigorous peer-review processes based on expert peer reviewers. The review process for the third and fourth accepted papers in the list below was handled independently by the Editor-in-Chief. The paper “Cross-Layer Energy Minimization for Underwater ALOHA Networks” by Koseoglu et al. investigates the crosslayer energy minimization problem in underwater ALOHA networks considering the unique transmission properties of the underwater medium. The paper “Improving the Energy Efficiency of Broadband
Copper Access Networks: Review and Performance Analysis” by Guenach et al. reviews the main techniques that can be applied to improve the energy efficiency of broadband copper access networks. The paper “Energy-Efficient Precoded Coordinated MultiPoint Transmission With Pricing Power Game Mechanism” by Fu et al. generalizes the noncooperative pricing game mechanism with pricing across both frequency and space in the scenario of multiuser multiple-input–multiple-output-based coordinated multiple-point transmissions. The paper “Network Connectivity Proxy: Architecture, Implementation and Performance Analysis” by Bolla et al. extends the knowledge about the concept of network connectivity proxy (NCP) by defining an extended set of tasks that the NCP can carry out, via introducing a suitable communication interface to control NCP operation, and designing, implementing, and evaluating a functional prototype. The paper “PoweRock: Power Modeling and Flexible Dynamic Power Management for Many-Core Architectures” by Lai et al. proposes a novel flexible dynamic power management approach based on a profile-guided dynamic-voltage/frequency-scaling scheme to meet the different goals. The paper “Demand Response in Data Centers Through Energy Efficient Scheduling and Simple Incentivization” by Paul et al. presents the formulation and solution to the optimal server provisioning problem for server provisioning at different tiers, based on a discrete-time model, then proposes a simple and effective mechanism to facilitate more renewable integration into the grid through providing monetary incentives on deadline deferral. The paper “Distributed Energy Consumption Management in Green Content-Centric Networks via Dual Decomposition” by Fang et al. studies the tradeoff between energy consumption and quality of service in content-centric networking by switching off the redundant network content routers and links via a mixed-integer linear programming model and proposes a centralized solution via spanning tree heuristic, and then proposes a fully distributed energy optimization algorithm that is proposed based on the dual decomposition. The paper “Energy-Aware Mapping and Live Migration of Virtual Networks” by Rodriguez et al. introduces a set of new algorithms for the mapping of virtual networks on network substrates designed to reduce network energy consumption, and further proposes two new algorithms for the migration of virtual routers and links. The paper “A Game-Theoretic Analysis of Energy Efficiency and Performance for Cloud Computing in Communication Networks” by Lin et al. adopts a game-theoretic approach to data traffic management to obtain a distributed and energy-efficient solution. The paper “Green Link Weights for Disruption-Free EnergyAware Traffic Engineering” by Okonor et al. provides a framework for disruption-free energy-aware traffic engineering to leverage on selective link sleeping and wake-up operations in a disruption-free manner. The paper “Reducing Greenhouse Gas Emissions With Power Source Aware Multi-Domain Multi-Layer Networks” by Schoendienst and Vokkarane introduces a hierarchical grooming approach to collect, multiplex, and groom traffic at those energy efficient nodes to reduce carbon emissions. The paper “Priority Scheduling for Heterogeneous Workloads: Tradeoff Between Evictions and Response Time” by C. avdar et al. presents a system model with a slot-based priority scheduler that captures the execution progress, evictions, and response times when executing complex workloads.
on heterogeneous systems, and proposes a workload-aware slot configuration and task assignment methodology incorporated with slot-based priority scheduling to improve class-based response time and resource efficiency. The paper “Energy Minimization With Network Coding via Latin Hypercubes” by Kocaoglu and Akan studies the best mapping between the input and output symbols at the network coding node that minimizes the average codeword energy using Latin squares, called the minimum energy network code (MENC), and then investigates the MENC for in-N networks using the Latin hypercubes and proposes a low-energy network code to reduce the average energy with network coding. The paper “Energy-Saving Transmission for Green Macrocell-Small Cell Systems: A System-Level Perspective” by Chung proposes an efficient energy-saving transmission algorithm to minimize power consumption for transceivers in both macrocell base stations and small cell base stations in cellular systems with a green deployment policy. The paper “Energy Efficiency Improvement of Coded OFDM Systems Based on PAPR Reduction” by Yoshizawa and Ochiai investigates how much improvement in terms of the power efficiency by such PAPR reduction techniques can be achieved in coded OFDM systems. The paper “Reducing the Energy Footprint of Cellular Networks Thanks to Delay-Tolerant Users” by Gamboa et al. proposes two delay-tolerant-user-aware sleep-mode strategies in cellular networks. The paper “Metrics on Energy Efficiency for Cognitive Green Equipment Based on FPGA Platform” by Wu et al. introduces some useful metrics for a cognitive management architecture for a field-programmable gate array implementation. The paper “Energy Saving Through Traffic Profiling in SelfOptimizing Optical Networks” by Pederzolli et al. proposes a novel method to reduce the energy consumed by dynamically adjusting the number of active optical carriers to support the short-term load of the optical transport network with a small and controllable margin. The paper “Semantic Systems and Visual Tools to Support Environmental Communication” by Scharl et al. investigates the potential of semantic technologies to address these environmental concerns, presents visualization techniques to explore the lexical, geospatial, and relational context of topics, as well as the entities referenced in these repositories. The paper “Server Consolidation Techniques in Virtualized Data Centers: A Survey” by Varasteh and Goudarzi presents a survey and taxonomy for server consolidation techniques in cloud data centers with the focus on the parameters and algorithmic approaches used to consolidate virtual machines onto physical machines. The paper “A Two-Way Street: Green Big Data Processing for a Greener Smart Grid” by Asad and Chaudhry describes the role of the big data enterprise in envisioning the smart grid via dissecting the big data enterprise into six vital planes impacting the energy footprints of data centers. In the paper “An Energy-efficient Architecture for the Internet of Things (IoT)” by Kaur and Sood, a novel energy-efficient architecture for IoT is proposed with three layers, namely sensing and control, information processing, and presentation, which allows the system to predict the sleep interval of sensors based upon their remaining battery level, their previous usage history, and the quality of information required for a particular application.
ACKNOWLEDGMENT

We would like to thank the great support from V. Piuri, Editor-in-Chief of IEEE SYSTEMS JOURNAL, for his solid encouragement and suggestions, and the other IEEE publication staff. We would also like to thank the members of the IEEE Technical Committee on Green Communications and Computing for the great support to this Special Issue.

JINSONG WU, Guest Editor Universidad de Chile Santiago 1270038, Chile
wujs@ieee.org

RICHARD T. WATSON, Guest Editor University of Georgia Athens, GA 30602 USA
rickwatson@mac.com

RAFFAELE BOLLA, Guest Editor University of Genoa Genova 16126, Italy
raffaele.bolla@unige.it

ATHANASSIOS MANIKAS, Guest Editor Imperial College London London SW7 2AZ, U.K.
a.manikas@imperial.ac.uk

MOUNIR HAMDI, Guest Editor Hamad Bin Khalifa University Doha, Qatar
mhamdi@qf.org.qa

JAAFAR ELMIRGHANI, Guest Editor The University of Leeds Leeds LS2 9JT, U.K.
j.m.h.elmirghani@leeds.ac.uk

Jinsong Wu (S’99–M’07–SM’11) is currently an Associate Professor with the Department of Electrical Engineering, Universidad de Chile, Santiago, Chile. He was the leading editor and a coauthor of Green Communications: Theoretical Fundamentals, Algorithms, and Applications (CRC 2012). Prof. Wu is the founder and founding Chair of the Technical Committee on Green Communications and Computing (TCGCC) of the IEEE Communications Society, which was established in 2011 as an official IEEE Technical Subcommittee and elevated as TCGCC in 2013. He is also the cofounder and founding Vice-Chair of the Technical Committee on Big Data (TCBD), which was established in January 2015 as an official IEEE Technical Subcommittee and elevated as TCBD in December 2016. He has been elected Vice Chair–Technical Activities, IEEE Environmental Engineering Initiative, a pan-IEEE effort under the IEEE Technical Activities Board (TAB). He has been the Steering Committee Member and IEEE Communications Society Representative in IEEE Environmental Engineering Initiative since 2016. He is the founder and Series Editor on Green Communication and Computing Networks ofIEEE Communications Magazine. He is the Series Editor of the IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS Series on Green Communications and Networking, an Area Editor of the IEEE TRANSACTIONS ON GREEN COMMUNICATIONS AND NETWORKING, an Editor of the IEEE COMMUNICATIONS SURVEYS AND TUTORIALS, an Associate Editor of IEEE SYSTEMS JOURNAL, an Associate Editor of IEEE ACCESS, an Associate Editor of
the Special Section on Big Data for Green Communications and Computing in IEEE ACCESS, and the Guest Editor of the Special Issue on Green Communications in Elsevier Computer Networks. He was the Symposium Co-Chair and Track Vice-Chair on Green Communication Systems and Networks of the Selected Areas in Communications Symposium, IEEE GLOBECOM 2012. He was the leading General Chair of the 2013 IEEE International Conference on Green Computing and Communications. He was Technical Program Committee Chair of the IEEE Online Conference on Green Communications in 2012 and 2013, respectively. He was the Track Co-Chair on Green Communications and Networks of the IEEE Vehicular Technology Conference in Fall 2014 and Fall 2017. He was the Proposer and Chair of the Technical Panels on Green Communications and Computing in the IEEE INFOCOM 2012, ICC 2012, and Globecom 2012.

Richard T. Watson is a Regents Professor and J. Rex Fuqua Distinguished Chair for Internet Strategy with the Terry College of Business, University of Georgia, Athens, GA, USA. He is the current Research Director for the Advanced Practices Council of the Society of Information Management and a former President of the Association for Information Systems. As a Visiting Researcher with Viktoria Swedish ICT, he is involved in establishing and applying maritime informatics to the European shipping industry. He is an Honorary Visiting Professor with Xi’an Jiaotong University. Prof. Watson was the recipient of the Association for Information Systems’ LEO Award in 2011, which is given for exceptional lifetime achievement in information systems.

Raffaele Bolla is currently a Full Professor with the Department of Electrical, Electronics and Telecommunication Engineering, and Naval Architecture (DITEN), University of Genoa, Genova, Italy, in telecommunication networks. He is also the reference person for the international relationships of the Polytechnic School (Engineering and Architecture Faculties) with Genoa University, Genova. He is the founder and currently leader of the Telecommunication Networks and Telematics Laboratory, DITEN, a structure jointly supported by the University of Genoa and National Inter-University Consortium for the Telecommunications (CNIT). He has been a Principal Investigator/Local Responsible for DITEN and CNIT (directly or by means of TNT-Lab staff members) of many important research projects and contracts with both public institutions (European Union, Italian Ministry, Regional Entities) and private companies (Telecom Italia, Ericsson, Alcatel-Lucent, Selex Communication, Intel, etc.) in the telecommunication field. He is also heavily involved in TLC standardization activities with ETSI, ITU-T, and IEEE, especially for what concerns the general theme of energy efficiency and environmental sustainability of ICT. He has authored or coauthored more than 200 scientific publications in international journals, books, and conference proceedings. The primary goal of his current activities is the development of theoretical and applicative research in the field of the technologies for the “Future Internet,” with a specific focus on green networking, software-defined network and
network function virtualization, advanced management system for next-generation networks, network analytics mechanisms, and fog-networking techniques and architecture.

Athanassios Manikas has been with the Department of Electrical and Electronic Engineering, Imperial College London, London, U.K., since 1988, where he holds the Chair of Communications and Array Signal Processing. He has held a number of research consultancies for the EU, industry, and government organizations. He is leading a strong group of researchers with Imperial College and has successfully supervised more than 45 Ph.D.s and more than 200 Masters project students. He has published an extensive set of journal and conference papers in the areas of wireless communications and array signal processing and is the author of the monograph “Differential Geometry in Array Processing.” His main research interests include green and space-time wireless communications, antenna arrays, array signal processing, beamforming, localization, uncertainties, mathematical modeling, analysis and algorithmic design, radar signal processing, MIMO radar, wireless sensor networks, 5G+, and physical layers. He is a Fellow of the Institution of Engineering and Technology, a Fellow of the Institute of Mathematics and its Applications, and a Distinguished Lecturer of the IEEE Communications Society. He is also the Vice-Chair of the IEEE COMSOC TAOS Technical Committee. He is on various Editorial Boards and has had various technical chairs at international conferences including the TPC Chair of the IEEE ICC 2015, London, U.K.

Mounir Hamdi (S’89–M’90–SM’06–F’11) received the M.S. and Ph.D. degrees in electrical engineering from the University of Pittsburgh, Pittsburgh, PA, USA, in 1987 and 1991, respectively. He was a Chair Professor with the Hong Kong University of Science and Technology (HKUST), and the Head of the Department of Computer Science and Engineering. He was a founding member of HKUST. From 1999 to 2000, he was a Visiting Professor with Stanford University, Stanford, CA, USA, and the Swiss Federal Institute of Technology, Lausanne, Switzerland. He is the founding Dean of the College of Science and Engineering, Hamad Bin Khalifa University, Doha, Qatar. In addition, he has frequently consulted for companies and governmental organizations in the USA, Europe, and Asia. His research focuses on high-speed wired/wireless networking in which he has authored or co-authored more than 300 research publications. His contributions include design and analysis of high-speed packet switching. Prof. Hamdi has been on the Editorial Board of various prestigious journals and magazines including the IEEE TRANSACTIONS ON COMMUNICATIONS, IEEE Communication Magazine, Computer Networks, Wireless Communications and Mobile Computing, and Parallel Computing, as well as a Guest Editor for IEEE Communications Magazine, the Guest Editor-in-Chief of two special issues of the IEEE JOURNAL ON SELECTED AREAS OF COMMUNICATIONS, and a Guest Editor of the Optical Networks Magazine. He has chaired more than 20
international conferences and workshops. He was the Chair of the IEEE Communications Society Technical Committee on Transmissions, Access and Optical Systems, and the Vice-Chair of the Optical Networking Technical Committee, as well as a Member of the ComSoc Technical Activities Council. He is also a frequent keynote speaker at international conferences and forums. He was the recipient of the Best Paper Award of the IEEE International Conference on Communications in 2009, IEEE Globecom in 2011, and the IEEE International Conference on Information and Networking in 1998. He also supervised the Best Ph.D. Paper Award amongst all universities in Hong Kong. He was the recipient of the Best Ten Lecturers Award of HKUST.

Jaafar Elmirghani (SM’08) received the Ph.D. degree in optical communications from the University of Huddersfield, Huddersfield, U.K., in 1994, and the D.Sc. degree in communication systems and networks from The University of Leeds, Leeds, U.K., in 2014. He is a Full Professor and Chair in Communication Networks and Systems and the Director with the Institute of Integrated Information Systems, The University of Leeds. He coauthored Photonic Switching Technology: Systems and Networks (Wiley, 1988) and has authored or coauthored more than 450 papers. Prof. Elmirghani is a Fellow of the IET, a Chartered Engineer, and a Fellow of the Institute of Physics. He was the Chairman of the IEEE Comsoc Transmission Access and Optical Systems Technical Committee and was also the Chairman of the IEEE Comsoc Signal Processing and Communications Electronics Technical Committee, and an Editor of IEEE Communications Magazine. He was the founding Chair of the Advanced Signal Processing for Communication Symposium, which started at the IEEE GLOBECOM in 1999. He was also the founding Chair of the first IEEE ICC/GLOBECOM Optical Symposium at GLOBECOM 2000 and the Future Photonic Network Technologies, Architectures and Protocols Symposium. He was the founding Chair of the first Green Track at ICC/GLOBECOM at GLOBECOM in 2011, and is the Chair of the IEEE Green ICT Initiative within the IEEE Technical Activities Board Future Directions Committee. He was the recipient of the IEEE Communications Society Hal Sobol Award, the IEEE Comsoc Chapter Achievement Award for excellence in chapter activities in 2005, the IEEE Communications Society Signal Processing and Communication Electronics Outstanding Service Award in 2009, a Best Paper Award at the IEEE ICC in 2013, the IEEE Comsoc Transmission Access and Optical Systems outstanding Service award in 2015 in recognition of “Leadership and Contributions to the Area of Green Communications,” the GreenTouch 1000× Award in 2015, the Edison Award in 2016, and the 2016 Premium Award for best paper in IET Optoelectronics. He is currently an Editor of IET Optoelectronics, the Journal of Optical Communications, IEEE COMMUNICATIONS SURVEYS AND TUTORIALS, and the IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS Series on Green Communications and Networking. He was the Co-Chair of the GreenTouch Wired, Core and Access Networks Working Group. He was an IEEE Comsoc Distinguished Lecturer 2013–2016.