GUEST EDITORIAL PREFACE

First Special Issue on Green Networking and Computing

Josip Lorincz, FESB, University of Split, Split, Croatia

Jinsong Wu, Bell Laboratories, Shanghai, China

Linjia Liu, Department of Electrical Engineering and Computer Science, University of Kansas, USA

It is widely accepted that the world is facing more and more sustainability and environmental challenges. In order to achieve the global objective of sustainability, the information and communication technology (ICT) industries needs to implement innovative schemes and mechanisms to reduce the overall energy-consumption. Towards this end, novel green communications and computing strategies and technologies are needed to combat the relevant challenges, ensure the network scalability in the future, and support more energy efficiencies. This first special issue is a collective effort to show some state-of-art relevant results, approaches, and views from a number of experts in the field of green communications and computing. The purpose of this special issue is to provide some systematic views on the topic of green networking and computing and to trigger relevant discussions in the field.

In the first article, entitled "*Energy consumption effects of WiFi off-loading access in 3G or LTE public wireless networks*", by L-F Pau, the questions of the best mix between Long Term Evolution (LTE) cellular and Wireless-Fidelity (WiFi) off-load base stations is addressed from the energy/emissions perspective. Paper gives characterization of the WiFi off-loading mechanisms and describes the model and approaches used to analyze the WiFi off-load energy consumption effects. In addition, the energy consumption linked to the WiFi off-loading by backhaul coverage and by small mesh coverage is analyzed. Author in the paper give the answers on next research questions: to which extent should WiFi offloading take place in a public cellular network from energy consumption point of view and what are the trade-offs of taking lesser WiFi equipment costs into consideration? In addition, when WiFi

offloading is used, author explains how to take user led service needs into account and how to offer a tool for industry to assess energy costs or measure impact on "green" telecommunications tariffs and profits.

The second article of this special issue, "*Improving Cellular Network Energy-Efficiency through Dynamic Adaptation of Network Resources*" by Lorincz, gives an overview of research results obtained by the author in the area of energy efficient management of network resources according to space and time variations of traffic. In the article, based on real measurements, it is shown how daily and weekly traffic variations and transmitted power influence base stations' instantaneous power consumption. Also, the impact of base stations' transmit power on network energy efficiency, expressed through the most prominent energy metrics, is discussed. In addition, an article gives insight into how dynamic management of base stations' on/off activity and transmitted power can improve the network energy efficiency of mobile operators. For a set of simulated network instances similar to the real ones, it is shown that the proposed optimization and management approach offers significant monthly energy savings while preserving coverage and meeting capacity constraints.

The third article of the special issue on green networking and computing, "*The TREND Meter: Monitoring the Energy Consumption of Networked Devices*" by Chiaraviglio, Bruschi, Cianfrani, Ortiz, and Koutitas, details a tool developed in the frame of the European project TREND (Towards Real Energy Efficient Network Design) named the TREND meter. The tool enables monitoring of the power consumption and the utilization of networked devices. The architecture of the TREND meter is composed of three main units: a device back-end for collecting the measurements, a server back-end for collecting and storing the information from all the devices, and a server

front-end to display the information on a web site. The main issues addressed while designing the tool architecture are the heterogeneity of devices and measurements, security, user friendliness, and ease of customization. In the article, the authors provide graphed energy consumption and load information obtained by collecting measurements from a variety of systems such as personal computers, campus subnets, campus routers, software routers, and data centers. The results obtained confirm that current systems waste a considerable amount of power during the periods of low traffic (e.g. during the night and weekends). In addition, the measurements show that for some systems a correlation between power consumption and traffic intensity exists, while for others traffic variation has a negligible influence on power consumption.

In the last article accepted for publication in this special issue, "*Efficient Forwarding with Power Saving and Load Balancing in Wireless Sensor Networks*", by Idoudi, a new asynchronous power-saving mechanism for Wireless Sensor Networks (WSNs) has been developed. The asynchronous approach considers the residual energy of a node as the main factor when organizing the node activity. The proposed mechanism is based on two protocols: the Lightweight Balanced Power Saving Protocol (LBPS) and the Simple Greedy Routing Protocol (SGRP). LBPS is a Media Access Control (MAC) mechanism that combines the simplicity of the asynchronous protocols and the balance provided by synchronous ones. SGRP is a geographic routing protocol based on minimum local computation and no overhead. Therefore, the mechanism provides an adaptive duty cycle and a minimum routing overhead to achieve load balancing and energy savings by WSN nodes. The mechanism is tested by means of simulation and the obtained results are compared with other, already known prominent mechanisms. Extensive simulations showed

the effectiveness of the proposed approach in terms of residual energy, energy consumption balancing, and packet delivery ratio.

We hope that readers of this first special issue will find the articles informative and will enjoy reading this feature topic devoted to the exciting, fast-evolving field of green networking and computing. Finally, we would like to thank all the authors who submitted articles to this special issue and the reviewers for their comments and valuable feedback on the submitted articles.

Josip Lorincz,
Jinsong Wu
Linjia Liu
Guest Editors
IJBDCN

Josip Lorincz received the B. Sc. (M. S. equivalent) degree in electrical engineering from University of Split, FESB, Croatia in 2002. In 2003 he joined Department of electronics in FESB – Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Croatia. He was visiting researcher at Advanced Network Technologies Laboratory (ANTLab) of the Politecnico di Milano, DEI, Milan, Italy. In July 2010 he obtained Ph. D. degree in tele-communications engineering and computer science from the University of Split, FESB, Croatia. He is co-chair of Symposium on Green Networking and Computing organized in the frame of IEEE International Conference on Software, Telecommunications and Computer Networks (Soft-COM). He serves as the technical program committee member for many international scientific conferences. His current research interest include energy-efficient wireless and wired networks, optimization in telecommunications, advanced design, management and analyses of computer heterogeneous networks, and performance evolution of routing protocols. He is a member of IEEE, ACM and Mathematical Optimization Society. Since year 2004, he owns Cisco CCNA, CCAI, and BCMSN certificates.

Jinsong Wu is the Founder and Founding Chair of Technical Subcommittee on Green Communications and Computing (TSCGCC), IEEE Communications Society, which was officially approved in December 2011. He was the Vice-Chair of Track on Green Communication Systems and Networks and Symposium Chair in the Selected Areas in Communications Symposium, IEEE GLOBECOM 2012. He is Technical Program Committee Chair in the 2012/2013 IEEE Online Conference on Green Communications. He is General Chair in 2013 IEEE International Conference on Green Computing and Communications. He is General Chair in IEEE GLOBECOM 2013 International Workshop on Cloud Computing Systems, Networks, and Applications. He was the Chair/Moderator of the Technical Panels on Green Communications and Computing in the IEEE INFOCOM 2012, ICC 2012, and Globecom 2012. He is the leading Editor of the book of Green Communications: Theoretical Fundamentals, Algorithms, and Applications*, published by CRC Press in Sept 2012. He obtained Ph.D. degree in electrical engineering from Queen's University, Kingston, Canada. Since 2010, he has worked as Research Scientist in Bell Laboratories, Shanghai, China. He is an Associate Editor for* IEEE Communications Surveys & Tutorials*, Associate Editor for* IEEE Systems Journal*, Editor for* KSII Transactionson Internet and Information Systems*, Editor for* Infocommunications Journal. *He currently is an IEEE Senior Member.*

Lingjia Liu received the Ph.D. degree at Texas A&M University in Electrical and Computer Engineering, the B.S. degree with highest honor at Shanghai Jiao Tong University in Electronic Engineering. He is currently working as an Assistant Professor in the Electrical Engineering and Computer Science Department at the University of Kansas (KU). Prior to joining the EECS at KU, he spent more than three years in Samsung Research America – Dallas (SRA-D) leading Samsung's work on downlink multi-user MIMO, Coordinated multipoint (CoMP) transmission, and Heterogeneous Networks for 3GPP LTE/LTE-Advanced standards where he has more than 10 essential intellectual property rights (IPRs). His general research interests lie in the areas of wireless communication systems including delay-sensitive communications, energy-efficient communications,multi-user MIMO systems,coordinated multipoint transmissions,and heterogeneous networks. His research is currently funded by National Science Foundation, Samsung Research America – Dallas, U.S. Air Force Research Laboratory, and University of Kansas Center for Research Inc. Lingjia Liu is a recipient of the Texas Telecommunications Engineering Consortium (TxTEC) Fellowship from the Department of Electrical and Computer Engineering at Texas A&M University in 2003 - 2004. He received the Global Samsung Best Paper Award in 2008 and 2010 respectively. He is the best paper finalist for the ICC 2012 Wireless Communication Symposium (5/508). He has also been selected by the National Engineers Week Foundation Diversity Council as New Faces of Engineering 2011 and was recognized during the 2011 National Asian American Engineers of The Year Awards Banquet in Seattle. Lingjia Liu served as the Vice President of the Dallas Fort-Worth Chapter of the Chinese Institute Engineers – USA (CIE/USA - DFW) from 2009 to 2011. He is currently serving as Technical Program Committee (TPC) co-Chairs of various international conferences. He is also serving as an Editor for IEEE Transactions on Wireless Communications*, and as Associate Editors for* EURASIP Journal on Wireless Communications and Networking *as well as* Wiley's International Journal on Communication Systems*.*