Guest Editorial
Green Communications and Networking Series

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IT is well-known that the information and communication technologies are responsible from about 2% to 4% of all of the Carbon footprint generated by human activity. This corresponds to about 25% of all car emissions and is approximately equal to all airplane emissions in the world, see [1] and its references. A substantial amount of research is currently targeted to remedy this situation. In recognition of this fact, the IEEE Communications Society has decided to publish a SERIES ON GREEN COMMUNICATIONS AND NETWORKING as three issues of the IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS. This first issue of the Series has 39 papers, covering a wide selection of topics. These topics can be characterized in six categories.

The first category is optimization, resource allocation, and scheduling. Six papers are in this category. Mao *et al.* discuss an energy efficiency approach for cellular networks with hybrid energy supplies using Lyapunov optimization. Bedeer *et al.* take fairness as well as energy efficiency into account for resource allocation in amplify-and-forward cooperative OFDMA networks. Debele *et al.* study the Resource-on-Demand technique for dense wireless local area networks. Kwak *et al.* discuss energy minimization in mobile cloud systems, specifically in terms of dynamic resource and task allocation. Lin and Dong propose a specific approach for real-time storage management with renewable integration. The last paper in this category is by Zhou *et al.* and it looks at the demand response approach for the smart grid.

The second category consists of papers with novel and broad approaches. There are four papers in this category. The first of these is by Varan and Yener. In this paper, the sources in the network have the ability to wirelessly power the relays that also have their own data to send to the destination. The goal of the paper is to achieve signal and energy cooperation in wireless networks. The paper concludes that it is possible to reach an equilibrium which maximizes the total utility of the network and allows the destination to choose how much data to receive from each node. Chen and Li study the technique of speed scaling, used in computer communication systems to reduce energy consumption with the goal of ensuring its use does not take away from other considerations. In this paper, they study load balancing against speed scaling. Hafeez and Elmirghani present a new licensed shared access spectrum-sharing scheme as an energy-efficient way to increase the spectral utility of a network. Their results show that the spectral utility of the city of Leeds, U.K. can be improved by more than 12×, and the energy efficiency by 16× through their proposed scheme. The final paper in this category is by Krikidis. It considers cooperative networks and attacks the problem of relay selection when the network has energy storage.

The topic of energy harvesting has recently become a very active research area. Since it relates to energy efficiency, this series received a number of high-quality papers on this subject. This subject determines our third category. There are eight papers in this category. In the first, Arafa and Ulukus develop optimal policies for wireless networks employing energy harvesting, specifically from the viewpoint of the effects of decoding costs. Biason and Zorzi study joint policies for transmission and energy transfer when finite batteries are employed in energy harvesting. Ku *et al.* consider cooperative communications and carry out an energy harvesting gain and diversity analysis. Orhan and Erkip analyze two-hop communication networks employing energy harvesting. Ashraphijuo *et al.* study the capacity of an energy-harvesting communication link. Chan *et al.* carry out modeling of adaptive duty cycling in sensor networks with energy harvesting. Ju *et al.* determine the maximum transmission rate of power splitting-based relaying and time switching-based relaying (PSR/TSR) protocols in energy-harvesting decode-and-forward relay networks. Xiao *et al.* study dynamic energy trading for energy harvesting employing a stochastic energy- trading game approach.

Ten papers constitute the category of networking and protocols, our fourth category. Lahetkangas *et al.* consider networks with MIMO links and develop a route discovery protocol for energy efficiency. Bolla *et al.* provide experimental evaluation of the transmission control protocol (TCP) energy consumption. Polverini *et al.* study per-flow green-routing solutions using a tunneling approach and compare their performance with that of the Internet protocol (IP). Yu studies QoS-aware packet scheduling in high-speed networks from an energy efficiency viewpoint. Zhang *et al.* employ game theoretical principles to carry out an optimization for green network routing. Omidvar *et al.* also study energy-efficient routing by pursuing a redundancy elimination approach. Llorca *et al.* develop a method of energy-efficient dynamic content distribution. Luo *et al.* study green cognitive communications where energy-consuming processes such as spectrum sensing are minimized. Two papers are on optical networking. Schrenk *et al.* study passive reconfigurable optical add-drop multiplexer (ROADM) flexibility

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in optical access with spectral and spatial reconfigurability. Zhao *et al.* consider IP over wavelength division multiplexing (WDM) and attempt to achieve energy-minimized design and operation.

An important area of networking for today's applications is data centers. This is a particularly important area for energy efficiency since data centers are known to consume a great deal of energy. This subject makes up our fifth category. This category has four papers in it. In the first paper, Arjona Aroca *et al.* characterize energy consumption in data centers based on measurements. Fu *et al.* provide energy-efficient heuristics in server farms that employ processor sharing. Tran *et al.* consider colocation data centers and, specifically for emergency demand response applications, provide a number of heuristics. In the fourth paper, Zhang *et al.* also look at colocation data centers and develop online cost-saving algorithms.

The sixth and last category is on specific applications of energy efficiency in communications and networking. Seven papers are in this category. The first paper is by Xu *et al.* It investigates beamforming with partial channel state information in the light of energy efficiency considerations. We *et al.* consider 60-GHz dual-hop indoor wireless systems and answer the question whether full-duplex or half-duplex amplify-and-forward relaying is more energy-efficient. Along the same theme of full-duplex wireless, Maso *et al.* study energy recycling in full-duplex radios. Sleep modes are an important way to achieve energy efficiency. The paper by Herreria-Alonso *et al.* propose an adaptive discontinuous reception (DRX) scheme to improve energy efficiency in LTE networks with a bounded delay constraint. Yang *et al.* consider backscatter communication systems and study wireless energy transfer for them using multiple antennas. Collotta and Pau develop an energy management approach for smart homes, specifically using low-energy Bluetooth. Finally, Du *et al.* look at the communication problem with sensors in a water distribution network and, using compressive sensing, develop an energy-efficient activation scheme for them.

The papers submitted to the JSAC SERIES ON GREEN COMMUNICATIONS AND NETWORKING are handled by an Editorial Board. At the time of this writing, the Editorial Board consists of the following highly capable and hard-working individuals, listed in alphabetical order. I would like to offer my strongest appreciation and thanks to them and to hundreds of anonymous, as much capable and hard-working, reviewers for putting together this first issue and the upcoming issues, on behalf of our community.

Editorial Board: Albert Banchs (Universidad Carlos III de Madrid), Emil Bjornson (Linkoping University), Roberto Bruschi (University of Genoa), Claude Chaudet (Telecom ParisTech), Shuguang Cui (Texas A&M University), Jaafar Elmirghani (University of Leeds), Fabrizio Granelli (University of Trento), Pulkit Grover (Carnegie Mellon University), Deniz Gunduz (Imperial College London), M. Cenk Gursoy (Syracuse University), Kaibin Huang (University of Hong Kong), Daniel Kilper (University of Arizona), Bhaskar Krishnamachari (University of Southern California), Victor Leung (University of British Columbia), Vincenzo Mancuso (IMDEA), Michela Meo (Politecnico di Torino), Paolo Monti (KTH), Zhisheng Niu (Tsinghua University), Raghu Raghavendra (University of Southern California), Dario Rossi (Telecom ParisTech), Luca Sanguinetti (University of Pisa), Nirmala Shenoy (Rochester Institute of Technology), Himal Suraweera (University of Peradeniya), Antonia Tulino (Bell Labs), Sennur Ulukus (University of Maryland), Rahul Vaze (TIFR Mumbai), Jinsong Wu (Universidad de Chile), Guanding Yu (Zhejiang University), Richard Yu (Carleton University), and Rui Zhang (National University of Singapore).

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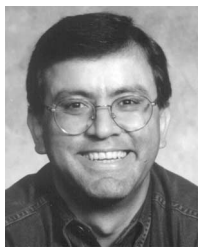
[1] K. Davaslioglu and E. Ayanoglu, "Quantifying potential energy efficiency gain in green cellular wireless networks," *IEEE Commun. Surv. Tuts.*, vol. 16, no. 4, pp. 2065–2091, Fourth Quart. 2014.



Ender Ayanoglu (S'82–M'85–SM'90–F'98) received the Ph.D. degree in electrical engineering from Stanford University, Stanford, CA, USA, in 1986. He was with the Communications Systems Research Laboratory, Holmdel, NJ, USA, part of AT&T Bell Laboratories until 1996, and from 1996 to 1999, he was with Bell Laboratories, Lucent Technologies. From 1999 to 2002, he was a Systems Architect with Cisco Systems, Inc., San Jose, CA. Since 2002, he has been a Professor with the Department of Electrical Engineering and Computer Science, University of California, Irvine, CA, where he served as the Director of the Center for Pervasive Communications and Computing and held the Conexant-Broadcom Endowed Chair from 2002 to 2010. From 2000 to 2001, he served as the Founding Chair of the IEEE-ISTO Broadband Wireless Internet Forum (BWIF), an industry standards organization which developed and built a broadband wireless system employing orthogonal frequency division multiplexing (OFDM), and a medium access control (MAC) algorithm that provides quality-of-service (QoS) guarantees. This system is the precursor of today's fourth generation (4G) cellular wireless systems such as WiMAX, LTE, and LTE-advanced. From 1993 to 2014, he was an Editor, and since January 2014, a Senior Editor of the IEEE TRANSACTIONS ON COMMUNICATIONS. He served as the Editor-in-Chief of the IEEE TRANSACTIONS ON COMMUNICATIONS from 2004 to 2008. As of December 2014, he is serving as the Editor-in-Chief of the IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS—SERIES ON GREEN COMMUNICATIONS AND NETWORKING. From 1990 to 2002, he served on the Executive Committee of the IEEE Communications Society Communication Theory Committee, and from 1999 to 2001, he was its Chair. He was the recipient of the IEEE Communications Society Stephen O. Rice Prize Paper Award in 1995 and the IEEE Communications Society Best Tutorial Paper Award in 1997 and was also the recipient of the IEEE Communications Society Communication Theory Technical Committee Outstanding Service Award in 2014.