

Editorial
IEEE Communications Surveys & Tutorials
Special Issue on Energy and Smart Grid

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The next generation electric grid, also known as smart grid, is expected to be scalable, reliable, and secure, and to enhance efficient energy consumption and deployment of renewable and distributed energy generation. The modern communications and networking technologies will play a vital role in the future smart grid by supporting two-way energy and information flow and enabling efficient monitoring, control, and optimization of different grid functionalities and smart power devices. The emerging field of smart grid has introduced several new challenges for the communications and networking research communities. It has also created new multi-disciplinary research opportunities and potentials for collaborations with industries.

Examples of smart grid technologies and applications include: smart grid communications, demand response, integration of renewable energy resources, wide area measurement and monitoring systems, smart metering infrastructure, and transportation electrification.

The aim of this special issue was to collect from academic and industrial players, tutorials and surveys related to the latest smart grid and energy related technologies and architectures. Contributions on major developments and updates on smart grid systems are considered.

We received a total of 15 submissions from which 5 were finally accepted for this special issue. The papers span from smart grid communications to building energy efficiency, smart metering, information management, and co-simulation of power and communication systems.

In the first paper, Husheng Li *et al.* provide a survey on communications in cyber physical system (CPS) and a tutorial of a framework for the design of communication infrastructure in CPS. The title of their paper is “**Communication Infrastructure Design in Cyber Physical Systems with Applications in Smart Grids: A Hybrid System Framework**”. The studied framework is a hybrid system that features the co-existence of discrete and continuous system states. The discrete system state is the mode of the communication infrastructure while the continuous system state is the state of the physical dynamics (i.e., the power grid).

The second paper is authored by Jianli Pan *et al.* and entitled “**A Survey of Energy Efficiency in Buildings and Microgrids using Networking Technologies**”. The authors provide a broad survey on the latest developments in intelligent buildings and their vision of microgrids formed by such buildings. They draw an overall picture of the current research and potential future applications. Additionally, a series of key issues and trends that can potentially motivate and impact the adoption and development of the intelligent building and microgrid technologies in the near future are discussed in detail.

The third paper, by Sören Finster *et al.*, is entitled “**Privacy-aware Smart Metering: A Survey**”. It is about the privacy challenges in advanced metering infrastructure. The authors divide the privacy problem in smart grids into a billing problem and a metering problem. Accordingly, they identify generic approaches to address these problems. For example, different privacy options such as billing via a trusted third party, billing using a trusted platform, and billing secured via cryptography are surveyed.

The fourth paper, authored by Hao Liang *et al.* and entitled “**Stochastic Information Management in Smart Grid**”, makes the argument that due to the expected deep penetration of renewable energy sources, energy storage devices, demand side management tools, and electric vehicles in the future smart grid, there exist significant technical challenges on power system planning and operation with respect to stochastic information management. Thus, the authors provide a literature survey on the stochastic information management schemes proposed for the smart grid. Furthermore, component-level modeling is used to characterize the stochastic nature of different data sources.

Finally, the fifth paper, authored by Kevin Mets *et al.* and entitled “**Combining power and communication network simulation for cost-effective smart grid analysis**”, focuses on co-simulation of power systems and communication networks. The motivations and requirements for such co-simulations are discussed. Additionally, the authors survey various existing simulation tools such as OMNeT++, ns-2, ns-3, Nessi, OPNET, OpenDSS, PSCAD, DigSilent, Siemens PSS, EMTP, PowerWorld, Cymdist, EuroStag, Homer, ObjectStab, and GridLab-D.

As guest editors, we would like to thank all the authors for their submissions and contributions to this feature topic. We would also like to express our appreciation to all reviewers who have provided quality and timely reviews. Furthermore, this special issue would not have happened without the constant support of Prof Ekram Hossain, the Editor in Chief.

We hope that this feature issue appeals to both the academic and industrial readership, and inspires future work in the emerging area of smart grid and energy systems technologies.

The Editors, April 2014.

Biographies:



Hamed Mohsenian-Rad is an Assistant Professor of Electrical Engineering at the University of California at Riverside. He received his Ph.D. degree in Electrical and Computer Engineering from the University of British Columbia - Canada in 2008 and his M.Sc. and B.Sc. degrees in Electrical Engineering from Sharif University of Technology – Iran and Amir-Kabir University of Technology – Iran in 2004 and 2002, respectively. Dr. Mohsenian-Rad is the recipient of the NSF CAREER Award 2012, the Best paper Award from the IEEE Power and Energy Society General Meeting 2013, and the Best Paper Award from the IEEE International Conference on Smart Grid Communications 2012.

Dr. Mohsenian-Rad's research interests include analysis, design, and optimization of smart infrastructures with applications in smart grid, power systems, data centers, and communications networks. He serves as Editor for the IEEE Transactions on Smart Grid, the IEEE Communications Letters, and the IEEE Communications Surveys and Tutorials.



Fabrizio Granelli is IEEE ComSoc Distinguished Lecturer for the period 2012-15, and Associate Professor at the Dept. of Information Engineering and Computer Science (DISI) of the University of Trento (Italy). From 2008, he is deputy head of the academic council in Information Engineering. He received the «Laurea» (M.Sc.) degree in Electronic Engineering and the Ph.D. in Telecommunications Engineering from the University of Genoa, Italy, in 1997 and 2001, respectively. In August 2004, August 2010 and April 2013, he was visiting professor at the State University of Campinas (Brasil). He is author or co-author of over 140 papers with topics related to networking, with focus on performance modeling, wireless communications and networks, cognitive radios and networks, green networking and smart grid communications.

Dr. Granelli was guest-editor of ACM Journal on Mobile Networks and Applications, ACM Transactions on Modeling and Computer Simulation, and Hindawi Journal of Computer Systems, Networks and Communications. He is Founder and General Vice-Chair of the First International Conference on Wireless Internet (WICON'05) and General Chair of the 11th and 15th IEEE Workshop on Computer-Aided Modeling, Analysis, and Design of Communication Links and Networks. He is TPC Co-Chair of IEEE GLOBECOM Symposium on "Communications QoS, Reliability and Performance Modeling" in the years 2007, 2008, 2009 and 2012. He was officer (Secretary 2005-2006, Vice-Chair 2007-2008, Chair 2009-2010) of the IEEE ComSoc Technical Committee on Communication Systems Integration & Modeling, and Associate Editor of IEEE Communications Letters (2007-2011).



Kui Ren is an associate professor of computer science and engineering at State University of New York at Buffalo. In the past, he has been with Illinois Institute of Technology. He received his PhD degree from Worcester Polytechnic Institute and BS and MS degrees from Zhejiang University. Kui's research interests include Cloud Security, Wireless Security, and Smartphone-enabled Crowdsourcing Systems. His research has been supported by NSF, DoE, AFRL, and Amazon. He is a recipient of NSF CAREER Award in 2011 and Sigma Xi/IIT Research Excellence Award in 2012. Kui also received the Best Paper Award of IEEE ICNP 2011.

Kui serves as an associate editor for IEEE Transactions on Information Forensics and Security, IEEE Wireless Communications, IEEE Internet of Things Journal, IEEE Transactions on Smart Grid, IEEE Communications Surveys and Tutorials, Elsevier Pervasive and Mobile Computing, and Journal of Communications and Networks. Kui is also a TPC area chair for

IEEE INFOCOM 2015. Kui is a senior member of IEEE, a member of ACM, a distinguished lecturer of IEE VTS, and a past board member of Internet Privacy Task Force, State of Illinois.



Chris Develder is currently an associate professor with the research group IBCN of the Dept. of Information Technology (INTEC) at Ghent University - iMinds, Ghent, Belgium. He received the M.Sc. degree in computer science engineering and a Ph.D. in electrical engineering from Ghent University (Ghent, Belgium), in July 1999 and December 2003 respectively. From Jan. 2004 to Aug. 2005, he worked for OPNET Technologies, on (optical) network design and planning. In Sep. 2005, he re-joined INTEC as a post-doctoral researcher, and as a post-doctoral fellow of the FWO since Oct. 2006. In Oct. 2007 he obtained a part-time, and since Feb. 2010 a fulltime professorship at Ghent University.

He has stayed as a research visitor at UC Davis (Jul.-Oct. 2007), CA, USA and Columbia University, NY, USA (2013-14). He was and is involved in national and European research projects (e.g., IST David, IST Phosphorus, IST E-Photon One, BONE, IST Alpha, FP7 Geysers, FP7 Increase, FP7 C-DAX). Chris's research interests include dimensioning, modeling and optimizing optical (grid/cloud) networks and their control and management, smart grids, as well as information retrieval and extraction. He regularly serves as reviewer/TPC member for international journals and conferences (IEEE/OSA JLT, IEEE/OSA JOCN, IEEE/ACM Trans. Networking, Computer Networks, IEEE Network, IEEE JSAC, IEEE Commun. Mag.; IEEE Globecom, IEEE ICC, IEEE SmartGridComm, ECOC, ACM SIGIR, etc.). He is Senior Member of IEEE and Member of ACM.

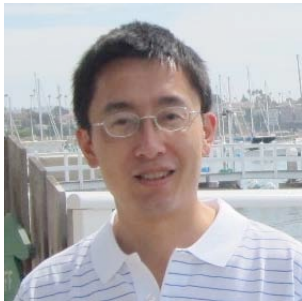


Lijun Chen is an Assistant Professor of Telecommunications at University of Colorado at Boulder. He received a B.S. from University of Science & Technology of China, M.S. from Institute of Theoretical Physics, Chinese Academy of Sciences and from University of Maryland at College Park, and Ph.D. from California Institute of Technology. He was a recipient of the Best Paper Award at the IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS) in 2007. His current research interests are in communication networks, power networks as large-scale cyber-physical systems, sparse sampling and parsimonious solutions, and optimization, game theory and their engineering application."



Tao Jiang is currently a chair professor in the Department of Electronics and Information Engineering, Huazhong University of Science and Technology, Wuhan, P. R. China. He received the B.S. and M.S. degrees in applied geophysics from China University of Geosciences, Wuhan, P. R. China, in 1997 and 2000, respectively, and the Ph.D. degree in information and communication engineering from Huazhong University of Science and Technology, Wuhan, P. R. China, in June 2004. From Aug. 2004 to Dec. 2007, he worked in some universities, such as Brunel University and University of Michigan-Dearborn, respectively.

He has authored or co-authored over 100 technical papers in major journals and conferences and six books/chapters in the areas of communications and networks. He served or is serving as symposium technical program committee membership of some major IEEE conferences, including INFOCOM, GLOBECOM, and ICC, etc.. He is invited to serve as TPC Symposium Chair for the IEEE GLOBECOM 2013 and IEEE WCNC 2013. He is served or serving as associate editor of some technical journals in communications and networks, including in IEEE Communications Surveys and Tutorials, IEEE Transactions on Vehicular Technology, and IEEE Internet of Things Journal, etc.. He is a recipient of the NSFC for Distinguished Young Scholars Award. He is a senior member of IEEE.



Xue Liu is an Associate Professor in the School of Computer Science and a William Dawson Scholar at McGill University. He received his Ph.D. in Computer Science from the University of Illinois at Urbana-Champaign. He has also worked as the Samuel R. Thompson Associate Professor in the University of Nebraska-Lincoln and HP Labs in Palo Alto, California. His research interests are in computer and communication networks, real-time and embedded systems, distributed systems, cyber-physical systems, green computing, and smart energies.

He has published more than 150 research papers in major peer-reviewed international journals and conference proceedings in these areas. His research received the Year 2008 Best Paper Award from the IEEE Transactions on Industrial Informatics, and the First Place Best Paper Award from the ACM Conference on Wireless Network Security 2011 (WiSec 2011). Dr. Liu's research has been reported by news media including the New York Times, Computer World, The Register, Huffington Post, CBC, NewScientist, MIT Technology Review's Blog, etc. He is a recipient of the Tomlinson Scientist Award from McGill University. He serves on the editorial board of IEEE Transactions of Parallel and Distributed Systems, IEEE Transactions on Vehicular Technology, and IEEE Communications Surveys and Tutorials.