Guest Editorial: Special Section on Demand Response Applications of Cloud Computing Technologies

João P. S. Catalão, *Senior Member, IEEE*, Young-Jin Kim, *Senior Member, IEEE*, Jamshid Aghaei, *Senior Member, IEEE*, Joel J. P. C. Rodrigues, *Fellow, IEEE*, and Miadreza Shafie-Khah, *Senior Member, IEEE*

THE use of distributed energy resources for self-generation and self-consumption along with Information and Communications Technologies and the Internet of Things is rapidly increasing the ability of the consumers and prosumers to actively engage with the electric energy system. Sustained consumer and prosumer engagement in demand response programs has been identified as a key factor in future electric energy systems, especially with a high penetration of renewable energy sources.

This engagement has allowed demand-side resources to play a larger role in energy and reserve markets, whether by generating, storing or participating in demand response programs through increased flexibility, towards the consumer-driven energy transition.

However, in real life, there is still a long way to go until demand response solutions take off and become entirely integrated into the daily life of the consumers, thus utilizing their full potential. Stronger engagement of consumers and prosumers is needed, as well as more flexibility services for system operation, benefiting Smart Grid developments.

New technological solutions are crucial to make demand response implementation as automated and user-friendly as possible, without taking away the sense of control from end-users. The opportunities resulting from digitalization with advanced and secure platforms should be explored, implementing a cloud-based optimization.

Hence, in this Special Section, we aimed to publish original research papers, visionary reviews, and practical test results on the theory, applications, algorithms, and technologies, as well as case studies associated with demand response applications of cloud computing technologies.

In response to the call for papers for this Special Section, 52 submissions were received and thoroughly reviewed, out of which 10 high-quality manuscripts were accepted (from USA, Australia, China, India, Greece, Germany and Norway) and included in this Special Section.

In the first article, "Self-Sufficient Participation in Cloud-Based Demand Response" by Sehloff *et al*., the authors propose a unification of the problems of system reliability and individual resilience for critical loads through a cloud-based framework for control and optimization relying on centralized decision-making and distributed emergency control.

In the second article, "Optimal Energy Trading with Demand Responses in Cloud Computing Enabled Virtual Power Plant in Smart Grids" by Chung *et al*., the authors propose a computational architecture combining energy trading and demand response based on cloud computing for managing virtual power plants in smart grids.

In the third article, "Optimal Incentive Strategy in Cloud-Edge Integrated Demand Response Framework for Residential Air Conditioning Loads" by Jia *et al*., the authors propose an edge-cloud integrated demand response framework to achieve an effect-predictable residential demand response without harming users' benefits.

In the fourth article, "Demand Response Control of Smart Buildings Integrated with Security Interconnection" by Hu *et al*., the authors propose demand response active power control for smart buildings based on a cloud platform for security interconnection with power grids.

- *João P. S. Catalão is with the Faculty of Engineering, University of Porto (FEUP), 4099-002 Porto, Portugal, and also with INESC TEC, 4200-465 Porto, Portugal. E-mail: catalao@fe.up.pt.*
- *Young-Jin Kim is with the Pohang University of Science and Technology (POSTECH), Pohang-si, Gyeongsangbuk-do 37673, South Korea. E-mail: powersys@postech.ac.kr.*
- *Jamshid Aghaei is with the Lappeenranta University of Technology, 53850 Lappeenranta, Finland. E-mail: jamshid.aghaei@lut.fi.*
- *Joel J. P. C. Rodrigues is with the Federal University of Piauí, Teresina, Piauí 64049-550, Brazil, and with the Instituto de Telecomunicações, 3810-193 Aveiro, Portugal, and also with the SENAC Faculty of Ceará, Fortaleza, Ceará 60160-194, Brazil. E-mail: joeljr@ieee.org.*
- *Miadreza Shafie-Khah is with the University of Vaasa, 65200 Vaasa, Finland. E-mail: mshafiek@uwasa.fi.*

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In the fifth article, "A Hybrid Cloud and Edge Control Strategy for Demand Responses Using Deep Reinforcement Learning and Transfer Learning" by Tao *et al.*, the authors propose a hybrid cloud and edge control strategy for battery energy storage system and heating, ventilation, and air conditioning systems based on deep reinforcement learning.

In the sixth article, "Cloud Computing Based Demand Response Management using Deep Reinforcement Learning" by Song *et al.*, the authors propose cloud computing based demand response using aggregated water heaters based on deep reinforcement learning.

In the seventh article, "Demand Response as a Service: Clearing Multiple Distribution-Level Markets" by Tsaousoglou *et al.*, the authors propose a distributed demand response market clearing algorithm based on Lagrangian decomposition, combined with an optimal cloud resource allocation algorithm for assigning the required computation power.

In the eighth article, "Evolutionary Game Based Demand Response Bidding Strategy for End-users Using Q-Learning and Compound Differential Evolution" by Ding *et al.*, the authors propose a cloud-computing-based architecture for demand response bidding and an evolutionary game model based on user participation in demand response.

In the ninth article, "Dynamic Price-Enabled Strategic Energy Management Scheme in Cloud-Enabled Smart Grid" by Mondal *et al.*, the authors propose a dynamic cooperation enforcing pricing scheme for a cloud-enabled smart grid using a single-leader-multiple-followers Stackelberg game.

Finally, in the tenth article, "Cloud-Edge Interoperability for Demand Response-Enabled Fast Frequency Response Service Provision" by Bachoumis *et al.*, the authors propose a cloud-edge architecture for fast frequency response service provision in a local energy market architecture incorporating network operational constraints.

The Guest Editorial Board would like to thank the authors for their innovative and valuable contributions, and the reviewers for their prompt and comprehensive feedback and suggestions.

Special thanks go to Prof. Yuanyuan Yang, EiC of the IEEE TRANSACTIONS ON CLOUD COMPUTING, and also to Prof. Dipti Srinivasan and Prof. Bikash Pal, for their leadership, guidance and constant support. We hope that you find this Special Section interesting and useful, serving also as a reference for future work in the field. Thank you very much.

João P. S. Catalão (Senior Member, IEEE) received the MSc degree from the Instituto Superior Técnico (IST), Lisbon, Portugal, in 2003, and the PhD and Habilitation for full professor ("Agregação") degrees from the University of Beira Interior (UBI), Covilha, Portugal, in 2007 and 2013, respectively. He is currently a professor with the Faculty of Engineering, University of Porto (FEUP), Porto, Portugal, and research coordinator with INESC TEC. He was the Primary Coordinator of the EU-funded FP7 project SiNGULAR ("Smart and Sustainable Insular Electricity Grids Under Large-Scale Renewable Integration"), a 5.2-million-euro project involving 11 industry partners. He has authored or coauthored more than 925 publications, including 440 international journal papers (more than 140 IEEE Transactions/Journal papers), 440 international conference proceedings papers (vast majority co-sponsored by IEEE), four books and 41 book chapters, with an h-index of 70, an i10-index of 365, and more than 20000 citations (according to Google Scholar), having supervised more than 90 postdocs, PhD, and MSc students. His research interests include power systemoperations and planning, distributed renewable generation, power system economics and electricity markets, demand response, and smart grid. He was the general chair of SEST 2019, technically sponsored by IEEE PES and IEEE IES, and the general co-chair of SEST 2020, technically sponsored by IEEE PES, IEEE IES, and IEEE IAS. He is the editor of the books entitled *Electric Power Systems: Advanced Forecasting Techniques and Optimal Generation Scheduling* and *Smart and Sustainable Power Systems: Operations, Planning and Economics of Insular Electricity Grids* (Boca Raton, FL, USA: CRC Press, 2012 and 2015, respectively). He is the senior editor of the *IEEE Transactions on Smart Grid*, Promotion and Outreach (senior) editor of the *IEEE Open Access Journal of Power and Energy*, an associate editor for the *IEEE Transactions on Power Systems*, *IEEE Power Engineering Letters*, *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, *IEEE Transactions on Neural Networks and Learning Systems*, *IEEE Transactions on Industrial Informatics*, *IEEE Transactions on Intelligent Transportation Systems*, *IEEE Transactions on Vehicular Technology*, *IEEE Transactions on Cloud Computing*, *IEEE Transactions on Industry Applications*, *IEEE Systems Journal*, and *IEEE Access*. He was the recipient of 2011 Scientific Merit Award UBI-FE/Santander Universities, 2012 Scientific Award UTL/Santander Totta, 2016–2019 (four years in a row) FEUP Diplomas of Scientific Recognition, 2017 Best INESC-ID Researcher Award, and 2018 Scientific Award ULisboa/Santander Universities, and five best paper awards at IEEE conferences. He is a Top Scientist in the Guide*2*Research Ranking, which lists only scientists having h-index equal or greater than 40.

Young-Jin Kim (Senior Member, IEEE) received the BS and MS degrees in electrical engineering from Seoul National University in 2007 and 2010, respectively, and the PhD degree in electrical engineering from the Massachusetts Institute of Technology in 2015. He was with Korea Electric Power Corporation as a Power Transmission and distribution system engineer from 2007 to 2011. He was also a visiting scholar with the Catalonia Institute for Energy Research in 2014, and a postdoctoral researcher with the Center for Energy, Environmental, and Economic Systems Analysis, Energy Systems Division, Argonne National Laboratory, from 2015 to 2016. He joined the faculty of the Pohang University of Science and Technology (POSTECH), where he is currently an associate professor with the Department of Electrical Engineering. He was the recipient of the Best Reviewer for *IEEE Transactions on Smart Grid* in 2019. He is the editor for the *IEEE Transactions on Smart Grid*, and an associate editor for the *IEEE Systems Journal* and *IEEE Access*. His research interests include distributed generators, renewable energy resources, and smart buildings.

Jamshid Aghaei (Senior Member, IEEE) received the BSc degree in electrical engineering from the Power and Water Institute of Technology, Tehran, Iran, in 2003, and the MSc and PhD degrees from the Iran University of Science and Technology, Tehran, Iran, in 2005 and 2009, respectively. He is currently a full professor with the Lappeenranta University of Technology, Lappeenranta, Finland. His research interests include renewable energy systems, smart grids, electricity markets, power system operation, optimization, and planning. He is an associate editor for the *IEEE Transactions on Smart Grid*, *IEEE Transactions on Cloud Computing*, *IEEE Systems Journal*, *IEEE Access*, *IEEE Open Access Journal of Power and Energy*, *IET Renewable Power Generation*, and *IET Smart Grid*, and a subject editor of the *IET Generation Transmission and Distribution*. He was the guest editor for the Special Section on Industrial and Commercial Demand Response of the *IEEE Transactions on Industrial Informatics*, published in November 2018, and the Special Issue on Demand Side Management and Market Design for Renewable Energy Support and Integration of the *IET Renewable Power Generation*, published in April 2019. He was considered one of the outstanding reviewers of the *IEEE Transactions on Sustainable Energy* in 2017.

Joel J. P. C. Rodrigues (Fellow, IEEE) is currently a professor with the Federal University of Piauí, Brazil. He is also a senior researcher with the Instituto de Telecomunicações, Portugal, and with the SENAC Faculty of Ceará, Brazil. He is the leader of the Next Generation Networks and Applications Research Group (CNPq). He has authored or coauthored more than 1000 articles in refereed international journals and conferences, three books, one ITU-T recommendation, and holds two patents. He is a member of the Internet Society and a senior member ACM. He is a member representative of the IEEE Communications Society on the IEEE Biometrics Council. He was the recipient of several Outstanding Leadership and Outstanding Service awards by the IEEE Communications Society and several best papers awards. He was on a Technical Activities Committee Chair with the IEEE ComSoc Latin America Region Board. He is a past-chair of the IEEE ComSoc Technical Committee on eHealth and IEEE ComSoc Technical Committee on Communications Software. He is a general chair and TPC Chair of many international conferences, including the IEEE ICC, IEEE GLOBECOM, IEEE HEALTHCOM, and IEEE LatinCom. He is the president of the Scientific Council with ParkUrbis—Covilhã Science and Technology Park. He is the editor-in-chief of the *International Journal on E-Health and Medical Communications*. He is the editorial board member of several high-reputed journals (*IEEE IoT Journal*, and *IEEE Open Journal of the Communications Society*). He was the director of Conference Development—the IEEE ComSoc Board of Governors. He is an IEEE distinguished lecturer. His research interests include IoT and sensor networks, e-health, vehicular communications, mobile, and ubiquitous computing. He is a fellow of the AAIA.

Miadreza Shafie-khah (Senior Member, IEEE) received the MSc and first PhD degree in electrical engineering from Tarbiat Modares University, Tehran, Iran, the second PhD degree in electromechanical engineering and first postdoc from the University of Beira Interior (UBI), Covilha, Portugal, and the second postdoc from the University of Salerno, Salerno, Italy. His research interests include electricity market, demand response, electric vehicles, and forecasting. He is currently an associate professor with the University of Vaasa, Vaasa, Finland. He is an editor of the *IEEE Transactions on Sustainable Energy*, and *IEEE Open Access Journal of Power and Energy (OAJPE)* and an associate editor for the *IEEE Systems Journal*, *IEEE Access*, *IET Renewable Power Generation*, and the guest editor-in-chief of *IEEE OAJPE*, *IEEE Transactions on Cloud Computing*, and more than 14 special issues. He was considered one of the Outstanding Reviewers of the *IEEE Transactions on Sustainable Energy* in 2014 and 2017, one of the Best Reviewers of the *IEEE Transactions on Smart Grid* in 2016 and 2017, and one of the Outstanding Reviewers of the *IEEE Transactions on Power Systems*, in 2017 and 2018, and IEEE OAJPE, in 2020. He is also the volume editor of the book Blockchain-based Smart Grids, Elsevier, 2020. He is a Top Scientist in the Guide*2*-Research Ranking in computer science and electronics, and he was the recipient of five best paper awards at IEEE conferences.