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

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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 Plants 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.
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 Tsaeosoglu 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.
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