Rising demands in energy due to increasing automation and expanding cities have put an enormous amount of stress on the power grid system over the past decades. There is growing awareness among governments that the current power grid will be insufficient to support our energy needs in the coming years. In the past decades, there have been several initiatives by both governments and organizations to improve the power grid system to manage the energy supply and demand efficiently. Efforts have also been made to build intelligence into the power grid system to adapt and react to different situations. On the demand side of things, the advanced metering infrastructure allows the implementation of demand side management whereby consumers can adapt their energy usage according to the load of the power grid or the price of energy.

Although significant progress has been made in smart grid technologies over the past few years, substantial problems still remain. First and foremost, to enable a true smart grid, a suitable communication architecture needs to be put in place to enable real-time bidirectional communication between the different parts of the grid. Additionally, suitable algorithms are required to support demand side management to efficiently balance the supply and demand of the system.

With increasing interest from both the academic and industrial communities, we planned this special issue to keep the communities up to date about the developments in communication technologies in the smart grid. The response to the call for papers was excellent, with 29 submissions. All the papers were reviewed by at least three experts in the area. Unfortunately, we can only accept seven articles for publication due to the lack of space. The selected articles will bring the readers up to speed with some of the architectures and demand response schemes smart grids can use.

The first article, “Cognitive-Radio-Based Hierarchical Communications Infrastructure for Smart Grid” by Yu et al., presents a cognitive-radio-based communications architecture for the smart grid. They propose solutions to address dynamic spectrum access problems in different geographical networks. They also identify some challenges cognitive-radio-based deployments will face.

The second article, “Challenges in Demand Load Control for the Smart Grid” by Koutsopoulos et al., gives a taxonomy of methods for demand load control. They elaborate on two of these methods that minimize grid operational costs. The article concludes with some open challenges in demand load management.

In the third article, “Communication Systems for Grid Integration of Renewable Energy Resources” by Yu et al., the authors review some of the communication technologies available for grid integration of renewable energy resources. They introduce some of the communication technologies currently in use in a real energy project and also state some of the research challenges faced. Communication technologies used in photovoltaic power systems are also touched on.

Zaballos et al. propose, in “Heterogeneous Communication Architecture for the Smart Grid” a heterogeneous communications paradigm based on power line communications and wireless networks, which is closely related to the framework of the International Telecommunication Union (ITU) ubiquitous sensor network architecture and uses the ITU next-generation network model.

In “Reliable Overlay Topology Design for the Smart Microgrid Network” by Erol-Kantarci et al., the microgrid concept is reviewed, and the authors propose an overlay topology design scheme that aims to minimize the import of power from the power grid.

“Iknow When to Act: An Optimal Stopping Method for Demand Response in Smart Grids” by Iwayemi et al. addresses the problem of smart grid demand response by formulating it as an optimal stopping problem. This approach aims to balance electricity expense and waiting time.

Last but not least, “SG-NEWS: An Early Warning System for Smart Grid Machine-to-Machine Communications...”
Network” by Fadlullah et al. looks at the problem of possible malicious attacks on smart meters, and how an early warning system can help circumvent the attacks. The authors discuss the guidelines for such a system, and how their proposed scheme can predict attacks.

This special issue would not have been possible without the support of all the authors with their contributions, and the reviewers. We would also like to thank the Editor-in-Chief, Professor Thomas Chen, for his help and support in the publication process.

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