

Chapter 10

Internet of Things Technologies for Smart Grid

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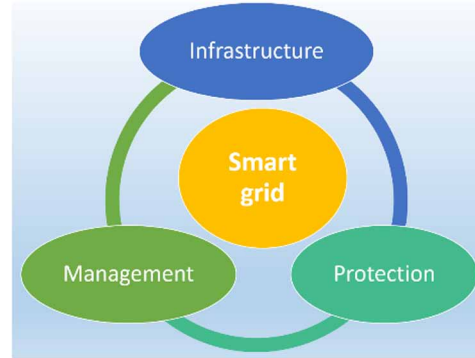
ABSTRACT

Smart grid is a new revolution in the energy sector in which the aging utility grid will be replaced with a grid that supports two-way communication between customers and the utility company. There are two popular smart-grid reference architectures. NIST (National Institute for Standards and Technology) has drafted a reference architecture in which seven domains and actors have been identified. The second reference architecture is elaborated by ETSI (European Telecommunications Standards Institute), which is an extension of the NIST model where a new domain named distributed energy resources has been added. This chapter aims at identifying the use of IoT and IoT-enabled technologies in the design of a secure smart grid using the ETSI reference model. Based on the discussion and analysis in the chapter, the authors offer two collaborative and development frameworks. One framework draws parallels' between IoT and smart grids and the second one between smart grids and edge computing. These frameworks can be used to broaden collaboration between the stakeholders and identify research gaps.

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Figure 1. Smart grid ingredients proposed

Source: Fang, Misra, Xue, & Yang, 2012



INTRODUCTION

Smart grid is a new paradigm that aims at making the legacy utility grid, efficient, green, reliable and secure. The term was coined in 2007 by the US congress in a bid to modernize the US power grid system (Energy Independence and Security Act of 2007, 2007). As stated in the 2007 Act on energy Independence and Security, a smart grid should have the following ten features: (1) Wide-scale deployment of ICT (Information and communication technologies) to shape-up performance, reliability, and trustworthiness of the utility grid, (2) dynamic optimization of grid operations and resources, (3) integration of effective renewable energy resources, (4) endorsement of advanced demand response scheme, (5) amalgamation of smart technologies for controlling and monitoring the grid operations, (6) consolidation of intelligent appliances, (7) integration of cutting-edge electricity storage and peak-abatement technologies, (8) purveying consumers with timeous information and control options, (9) development of standards for communication and interoperability of appliances and equipment, and (10) battling barriers and obstacles that prevent the adoption of smart grid technologies, practices, and services.

The legacy grid has been built using outdated technologies which cannot address existing shortcomings. Further, the current grid suffers from the interoperability issues among systems and devices which makes the need for a better and efficient grid a hard mission. For instance, the report published by NIST has identified more than 70 gaps in the current grid standards that need to be addressed (National Institute of Standards and Technology, 2014). During recent years, discernible efforts have been put forward to establish a smart grid with the characteristics stated heretofore. A good survey that summarizes the research effort on the permissive technologies for the smart grid until the year 2011 is reported in (Fang, Misra, Xue, & Yang, 2012). The authors reviewed advances in the following three axes: infrastructure, management, and protection. Finally, the researchers digested the omnifarious projects, legislations, programs, standards and trials worldwide in the area of smart grid. Figure 1 elaborates the three essential ingredients in a smart grid.

Communication is a key enabling technology for the smart grid infrastructure. It is believed that the smart grid will integrate multifarious communication technologies like cellular communication, fiber-optic, short-range communication, wireless mesh networks, power-line communication, and satellite communication. The assorted deployment of communication technologies in the smart grid is attributed to factors like the application requirements, the geographic locations, environments, legislations, cost,

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