Chapter 66
Privacy Preservation in Smart Grid Environment

Muhammad Aminu Lawal
King Abdulaziz University, Saudi Arabia

Syed Raheel Hassan
King Abdulaziz University, Saudi Arabia

ABSTRACT

Smart grids are conceived to ensure smarter generation, transmission, distribution, and consumption of electricity. It integrates the traditional electricity grid with information and communication technology. This enables a two-way communication among the smart grid entities, which translates to exchange of information about fine-grained user energy consumption between the smart grid entities. However, the flow of user energy consumption data may lead to the violation of user privacy. Inference on such data can expose the daily habits and types of appliances of users. Thus, several privacy preservation schemes have been proposed in the literature to ensure the privacy and security requirements of smart grid users. This chapter provides a review of some privacy preservation schemes. The schemes operational procedure, strengths, and weaknesses are discussed. A taxonomy, comparison table, and comparative analysis are also presented. The comparative analysis gives an insight on open research issues in privacy preservation schemes.

INTRODUCTION

The integration of information and communication technology (ICT) and traditional electricity grid gives rise to what is referred to as smart grid. The notion of smartness comes from the ability of a two-way communication among the smart grid entities. This allows for better management through effective monitoring and controlling of energy generation and consumption. Overall, the smart grid is envisioned to achieve the following objectives (Şimşek, Okay, Mert, & Özdemir, 2018):

- Integration of green/renewable power sources into the existing energy distribution.

- Billing through effective control and observation of measurements.
- Load balancing of energy consumption.
- Bi-directional communication among stakeholders.
- Enhancing resistance against attacks from malicious users.
- Autonomous management to increase reliability.
- Optimal use of assets to increase efficiency.

Despite the benefits of the smart grid, the two-way communication paves way for collection of fine grain information of user consumption through the smart meter. This introduces a major challenge of privacy violation because the information collected can be used to infer user habits, types of appliances, total energy consumption as shown in figure 1. This fine-grained information can be obtained through the use of "Non-intrusive Appliance Load Monitoring" (NALM) technique (Hart, 1992). Hence privacy preservation is very vital in the smart grid environment. Several schemes have been proposed in the literature to ensure user security and privacy preservation in smart grid. The relationship between privacy preservation and security is very close, hence effective privacy preservation is nearly difficult without security. However, this chapter focuses on privacy preservation in smart grid environment.

Figure 1. Energy consumption information inference
(Efthymiou & Kalogridis, 2010)
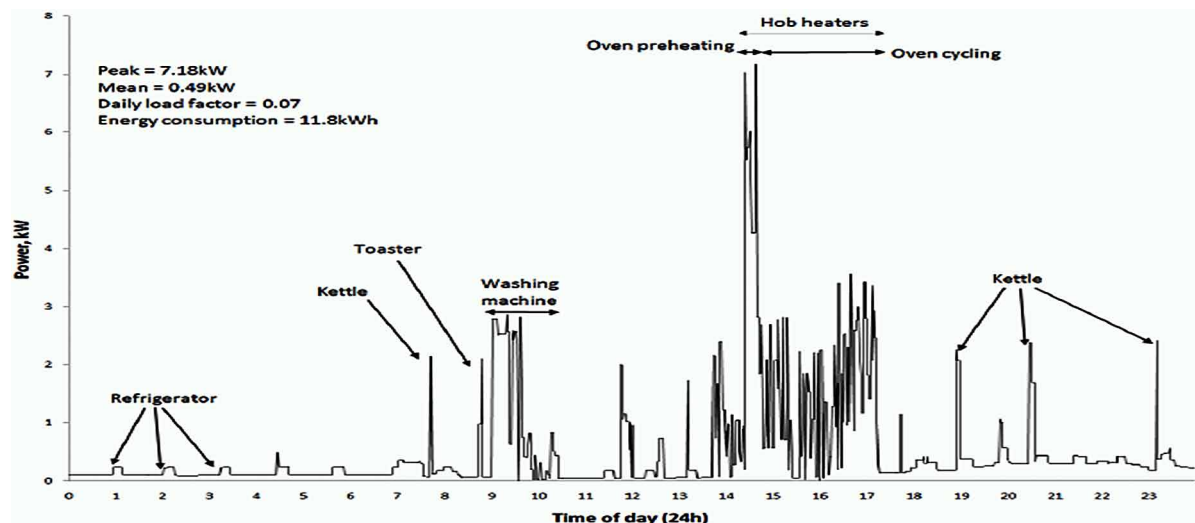
This chapter intends to discuss the background of smart grid and privacy with a review of some privacy preservation schemes in smart grids. The operational procedure, strength and weakness of each scheme is highlighted. In addition, a taxonomy and comparative table based on types and techniques employed in the schemes are presented at the end of the chapter.

The rest of the chapter is organised as follows: section 2 discusses the background of smart grid and privacy in smart grid, section 3 presents the review of the privacy preservation schemes, taxonomy, comparison table, and the comparative analysis. Finally, section 4 concludes the chapter.

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