Chapter 3
Privacy Preserving in Smart Cities Using Various Computing Technologies

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ABSTRACT

IoT has influenced our daily lives through various applications. The high possibility of sensing and publishing sensitive data in the smart environment leads to significant issues: (1) privacy-preserving and (2) real-time services. Privacy is a complex and a subjective notion as its understanding and perception differ among individuals, hence the observation that current studies lack addressing these challenges. This chapter proposes a new privacy-preserving method for IoT devices in the smart city by leveraging ontology, a data model, at the edge of the network. Based on the simulation results using Protege and Visual Studio on a synthetic dataset, the authors find that the solution provides privacy at real-time while addressing heterogeneity issue so that many IoT devices can afford it. Thus, the proposed solution can be widely used for smart cities.

INTRODUCTION

The Deployment of low-cost smart devices are widespread use of high-speed wireless networks (Gheisari, M., & Esnaashari, M. 2018) have led to the rapid development of Internet of Things (IoT). IoT embraces countless physical objects embedded with Radio Frequency Identification (RFID) tags, sensors and actuators that have not been involved in the traditional Internet and enables their interaction and cooperation through both traditional as well as IoT-specific communication protocols, Gartner estimates that around 20.4 billion 'things' will be connected by the year 2020. These pervasive and heterogeneous devices that interact with the physical and digital worlds have the potential to significantly enhance the quality of life

for individuals interacting with the IoT. With smart home and wearable devices, users obtain seamless and customized services from digital housekeepers, doctors and fitness instructors. Smart building and smart city applications provide an increased awareness of the surroundings and offer greater convenience and benefits to the users.

Information privacy (Patil, H. K., & Chen, T. M. 2013) is a broad and complex notion as its understanding and perception differ among individuals and its enforcement requires efforts from both legislation and technologies . Privacy laws help to enforce compliance and accountability of privacy protection and make privacy protection a necessity for every service provider. Privacy enhancing technologies on the other hand support the underlying principles guided by privacy laws that enable privacy protection strategies to be implemented in engineering. In this paper, we study the privacy protection problem in IoT through a comprehensive review by jointly considering three key dimensions, namely the state-of-the-art principles of privacy laws, architectures for the IoT system and representative privacy enhancing technologies. Based on an extensive analysis along these three dimensions, we show that IoT privacy protection requires significant support from both privacy enhancing technologies (PETs) and their enforcement through privacy legislation. We analyze how legal principles can be supported through a careful implementation of various privacy enhancing technologies at various layers of a layered IoT architecture model to meet the privacy requirements of the individuals interacting with IoT systems. Our study is focused on providing a broader understanding of the state-of-the-art principles in privacy legislation associated with the design of relevant privacy enhancing technologies (PETs) and on demonstrating how privacy legislation maps to privacy principles which in turn drives the design of necessary privacy enhancing technologies to be employed in the IoT architecture stack.

Privacy

Privacy is a complex and a subjective notion as its understanding and perception differ among individuals. In this section, we review the definitions of privacy in the past, introduce the privacy laws and analyze the state-of-the-art privacy legislation. We then introduce the privacy-by-design strategies that facilitate the design of privacy-preserving systems satisfying the legal principles.

Defination

The notion of media privacy had come into being with the technical and social development, the notion of privacy successively shifted to territorial, communication, and privacy (1940s)+. Finally, in the 1960s, it was the rise of electronic data processing that brought into being the notion of information privacy (or data privacy) that has achieved lasting prominence until now. In 1890, Warren and Brandeis defined privacy as 'the right to be let alone' in their famous article 'The Right to Privacy'. After that, many privacy definitions have been emerging unceasingly, but the one proposed by Alan Westin in his book 'Privacy and Freedom' has become the base of several modern data privacy principles and law. Westin defined privacy as 'the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others', which mainly emphasized the control of the data subjects over their data. The authors in argued that Westin's definition was too general for the IoT area and they proposed a more focused one that defines the IoT privacy as the threefold guarantee including 'awareness of privacy risks imposed by smart things and services surrounding the data subject; individual control over the collection and processing of personal information

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