Chapter 85
Privacy Protection for Data-Driven Smart Manufacturing Systems

Kok-Seng Wong
Soongsil University, South Korea

Myung Ho Kim
Soongsil University, South Korea

ABSTRACT

The Industrial Internet of Things (IIoT) is a new industrial ecosystem that combines intelligent and autonomous machines, advanced predictive analytics, and machine-human collaboration to improve productivity, efficiency and reliability. The integration of industry and IoT creates various attack surfaces and new opportunities for data breaches. In the IIoT context, it will often be the case that data is considered sensitive. This is because data will encapsulate various aspects of industrial operation, including highly sensitive information about products, business strategies, and companies. The transition to more open network architectures and data sharing of IoT poses challenges in manufacturing and industrial markets. The loss of sensitive information can lead to significant business loss and cause reputational damage. In this paper, the authors discuss emerging issues that are related to IIoT data sharing, investigate possible technological solutions to hide sensitive information and discuss some privacy management techniques in smart manufacturing systems.

1. INTRODUCTION

The Internet of Things (IoT) paradigm is rapidly gaining ground in the scenarios of modern wireless-telecommunication technologies. The basic idea of this concept is the utilization and extension of the benefits of the Internet, such as always-on, data-sharing, and remote-access capabilities. To achieve this, billions of sensors and smart devices interact with each other, and cooperate with other smart objects to create new services (Perera, Liu, Jayawardena, & Chen, 2014). Motivated by the explosion of smart and cloud-enabled devices, many IoT applications are now widely accepted, and are becoming the core business focus for many organizations.

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The IoT revolution is having great impact on existing industries, such as manufacturing, energy, automotive, and healthcare. To stay competitive, companies are increasingly relying on IoT technology to maximize the efficiency and quality of their products and services. Manufacturing companies are now identifying new growth opportunities by adding digital services and innovation strategies to their product assortment. The significance of the Internet in business model innovation has increased steadily since the 1990s (Fleisch, Weinberger, & Wortmann, 2015). Each new Internet wave has given rise to new digital business model patterns, and the biggest breakthroughs to date have been made in digital industries.

The IoT provides seamless integration of physical and digital worlds through networked sensors, machine learning, and big data. One of the most exciting possibilities is in industrial applications, known as the Industrial Internet of Things (Industrial IoT). The Industrial IoT has been heralded as a way to improve operational efficiency, and reduce overall maintenance cost. According to the World Economic Forum (O'Halloran & Kvochko, 2015), "As the Industrial Internet gains broader adoption, businesses will shift from products to outcome-based services, where they compete on their ability to deliver measurable results to customers. Such outcomes may range from guaranteed machine uptimes on factory floors, to actual amounts of energy savings in commercial buildings, to guaranteed crop yields from a specific parcel of farmland. Delivering such outcomes will require new levels of collaboration across an ecosystem of business partners, bringing together players that combine their products and services to meet customer needs. Software platforms have emerged to better facilitate data capture, aggregation and exchange across the ecosystem."

The communication and interaction capabilities can be extended to devices or things used for factory and city automation, renewable energy resources (Twidell & Weir, 2015), intelligent transportation systems (ITS), and vehicular communications (Wang, Fan, Hsu, Sun, & Yang, 2014; S. Wang, Lei, Zhang, Hsu, & Yang, 2016).

1.1. The Fourth Industrial Revolution

The integration of IoT and industrial is closely related to the 4th Industrial Revolution, better known as Industry 4.0 (Drath & Horch, 2014), which is the German strategic initiative to take up a pioneering role in industrial IT (Schwab, 2016).

The Industrial IoT is one of the major revolutionary technologies that have lately become significant trends (Da Xu, He, & Li, 2014; Perera et al., 2014). This technology will drastically change the manner of industrial production, user-machine interaction, and machine-to-machine communication. For example, sensors that monitor weather and traffic conditions help logistics managers perform real-time traffic analysis to avoid traffic congestion, i.e., the Internet of Vehicles (Wang et al., 2014). Some airplane manufacturers, such as Airbus and Boeing, have begun to build networked sensors into airplane bodies, in order to collect continuous flight data during the entire route of the flight. The collected data will be used by the airlines to improve their proactive maintenance activities.

The market associated with the Industrial IoT has seen tremendous growth over the past few years. As estimated by Gartner (Gartner, 2013), the incremental revenue generated by the IoT could reach $309 billion per year by 2020. However, the implementation of industrial IoT technology is limited, due to the interoperability challenges of device connectivity and interoperability, security and privacy concerns, and convergence between technologies (Chang, Srirama, & Mass, 2015).

There are four Industry 4.0 design principles to support companies in identifying and implementing Industry 4.0 scenarios (Hermann, Pentek, & Otto, 2016):