Chapter 3
Radio Frequency Identification and Mobile Ad-Hoc Network: Theories and Applications

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ABSTRACT

This chapter explains the components of Radio Frequency Identification (RFID); the aspects of RFID; the barriers to RFID utilization; the privacy and security issues of RFID; the RFID applications in supply chain management; the RFID applications in the health care industry; the RFID applications in modern business; the Near Field Communication (NFC) in mobile devices; the overview of Mobile Ad-Hoc Network (MANET); the security concern of MANET; and the advanced issues of MANET in the digital age. RFID and MANET become the growing components of Information and Communication Technology (ICT) applications and can be effectively utilized in global operations. The chapter argues that RFID and MANET have the potential to increase the efficiency of operations in various industries, improve asset visibility and traceability, decrease reliance on manual processes, reduce operation costs, and provide useful data for business analytics.

INTRODUCTION

The number of applications for radio frequency identification (RFID) systems is rapidly growing (Cui, Wang, Zhao, & Chen, 2016). Many professions, businesses, and industries have integrated the RFID technology into their procedures and it has resulted in the great advances in the accuracy of data, operational efficiencies, logistics enhancements, and other process improvements (Pang, Morgan-Morris, & Howell, 2010). RFID technology is utilized in various fields (e.g., manufacturing, retail, logistics, transportation, inventory control, health care, and business). For many companies, RFID suggests not only a new alternative to the existing tracking methods, but also a method to a wide range of previously cost-prohibitive internal control and supply chain coordination innovations (Bendoly, Citurs, & Konsynski, 2007).

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Because of its low cost and ease of deployment, RFID technology offers the great potential for all applications that require identification (Akgün, Bayrak, & Çağlayan, 2015). As RFID can quickly identify an object without requiring physical contact, it provides efficient identification for the verification of individual objects (Chen & Wu, 2014). RFID systems rely on the significant technology of the remote and automatic identification with the small and low-cost radio frequency elements to securely complete radio frequency communications among all entities (Cheng, Liu, Chang, & Chang, 2013). RFID is a small electronic device that transmits and receives several types of data using electromagnetic radiations (Sarwar & Shah, 2015) and constitutes an important part of what has become known as the Internet of Things (IoT) that is the accessible and interconnected machine (Rekleitis, Rizomiliotis, & Gritzalis, 2014).

Mobile ad-hoc network (MANET) is recognized as one of the most important emerging wireless communication scenarios (Yang, 2010) and is a collection of communication devices or nodes that wish to communicate without any fixed infrastructure (Singh, 2016). MANET plays an important role in supporting visions toward the creation of the world of ubiquitous computing where computation is integrated into the environment, rather than having computers that are the distinct objects (Sim, Chin, & Tan, 2007). MANET is prone to confront a lot of challenges in designing a proper quality of service (QoS) model where transmission reliability has an important contribution (Das & Chaudhuri, 2017). Providing QoS assurances in MANET is difficult due to node mobility, contention for channel access, a lack of centralized coordination, and the unreliable nature of the wireless channel (Hanzo & Tafazolli, 2011).

MANET is dynamic in the sense that each node is free to join and leave the network in a non-deterministic way (Trivedi, Arora, Kapoor, & Sanyal, 2009). In MANET, the nodes need to cooperate each other to establish the multi-hop routes (Chand, 2007) for the out-of-range wireless communication (Wang, Zhang, & Naït-Abdesselam, 2015) and for maintaining the routes to other nodes in the network (Cornetta, Touhafi, Santos, & Vázquez, 2011). To minimize communication interference, the selected path may not be the shortest path or may increase the number of hops in the routing path (Zadin & Fevens, 2015). In MANET, messages hop from node to node until they reach their destination, which requires each node to be more intelligent than the conventional terminals found in other wireless networks, such as mobile networks (Fleury, Qadri, Altaf, & Ghanbari, 2011). Every node has the ability to handle the congestion in its queues during traffic overflow (Natsheh, 2009).

This chapter aims to bridge the gap in the literature on the thorough literature consolidation of RFID and MANET. The extensive literature of RFID and MANET provides a contribution to practitioners and researchers by explaining the theories and applications of RFID and MANET in order to maximize the technological impact of RFID and MANET in the digital age.

BACKGROUND

RFID is fundamentally based on the study of electromagnetic waves and radio, pioneered in the 19th century work of Faraday, Maxwell, and Marconi. The idea of using radio frequencies to reflect waves from objects dates back as far as 1886 to experiments conducted by Hertz (Wyld, 2008). RFID has been around since World War II when radio waves were used to identify the friendly aircrafts (Brown, 2011). In the 1970s, New York Port Authority introduced the RFID device used for toll collection. The development of RFID technology has been in progress for more than 50 years, and the wide variety of RFID products will become increasingly diverse with the advanced technology (Ouyang, Hou, Pang, Wang, & Xiong, 2008). Many nations have developed and implemented RFID-based automated systems in various public services (Hossain & Quaddus, 2014).