Chapter 6
Multi-Agent Based Formal Verification of Data in RFID Middleware

Muhammad Tarmizi Lockman
Universiti Teknologi Malaysia, Malaysia

Ali Selamat
Universiti Teknologi Malaysia, Malaysia

ABSTRACT
As the load of traffic increases in RFID middleware, RFID system can no longer manage the RFID tags. Because of the incapability of the RFID system to handle vast amount of RFID tags, there are possibilities that the data cannot be processed efficiently in the RFID middleware. Implementation of agent technology is useful for verification and validation in RFID system architecture because intelligent agent is autonomous and has the capability to define specific verification process to increase efficiency and trustworthiness of the data in RFID middleware. Therefore, in this research, the authors have implemented the multi-agent based verification of data in RFID middleware. The results of the implementation have been encouraging based on the investigation and verification done on the simulation platform. As a result, the verification of RFID middleware system architecture is clearly understood and has been successfully implemented in RFID system.

1. INTRODUCTION
Radio frequency identification (RFID) is a technology that can identify and detect something. RFID tag can be applied by embedding it into an item, animal, or a person for identification and tracking. It works with automatic identification method that retrieves data using RFID tags or transponders. Many of business activities and operations have been using a conventional system to manage their assets. This can affect their performance and quality of services (QOS). In
fact, with the rapid growth of business operation and management, RFID has taken advantages to introduce the fast and cost saving tools for asset management and solve the identification problem. Thus, we could reduce the processing time and human involvement in the conventional system by implementing detection and product management using RFID. Therefore, in this chapter, we propose an integration of agent based verification in RFID middleware using formal method for processing the data and modeling the verification in order to meet the system specification and requirement. Figure 1 shows the RFID building block as presented in the RFID certification textbooks (Harold et al., 2007; Klaus, 2003; Weinstein, 2005; Selamat and Lockman, 2009). The RFID building block shows how the reader can read tag information in the radio communication interface. This environment can be a part of RFID system (Harold et al., 2007).

In recent years, RFID middleware has again attracted great attention due to its technology advancements, security concern and competitive business environment. There is a research that has been done using agent based for RFID middleware (Cui and Chae, 2007). It uses agent to design the load balancing system. Software agent is a technology that provides autonomous, flexible and dynamic computational entities in solving problems (Timothy and Scott, 2000; Yan et al. 2004). This is because according to (Gerhard, 2000), agents work in a goal oriented environment in which they have the ability to sense, communicate and achieve the given task at a specific time. Therefore, by applying agents in the RFID system specifically in the RFID middleware architecture, it will manage to enhance the performance of RFID data verification.

In this research, an agent technology is applied in the extended design of RFID System that has the potential to increase the performance of system management processes. The goal of this research is to investigate the capability of agent to check and verify the RFID middleware architecture especially on the communication protocols in data transaction which includes the format of the RFID data and the reliability of the data transfer. The structure of the chapter is as follows. In Section 2, we describe the related works and the overview of RFID middleware, RFID application and multi-agent. Next, Section 3 presents the taxonomy of RFID system, followed by Section 4 that explains how multiple agents are interconnected with each other. Then, Section 5 explains the formal verification approach that is

Figure 1. RFID building block
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