Chapter 6
Design and Implementation of an Event-Based RFID Middleware

Angelo Cucinotta
University of Messina, Italy

Antonino Longo Minnolo
University of Messina, Italy

Antonio Puliafito
University of Messina, Italy

ABSTRACT

The downward trend in the cost of RFID technology is producing a strong impact on the industrial world that is using such powerful technology in order to rethink and optimize most of the existing business processes. In this sense, the chipless technology is playing a key role to facilitate the adoption of RFID in enterprises. All this implies the use of solutions that simplify the adoption of the continuously evolving RFID technology and allow keeping a high-level vision versus the specific technical details. In brief, it is mandatory to abstract the technological level and makes transparent the physical devices to the application level. The widespread use of the RFID technology also produces a large volume of data from many objects scattered everywhere, that have to be managed. In these complex scenarios, the RFID middleware represents an ideal solution that favors the technology integration, reducing costs for application development and introducing real benefits to the business processes. In this chapter, the authors describe the main features of our event-based RFID middleware and its powerful architecture. Their middleware is able to assure an effective process of technological abstraction, switching from a vision linked to the specific issues of interfacing devices (chipless tags, readers, sensor networks, GPS, WiFi, etc.) to the management of the event generated by each device. In brief, “event-based” means to integrate the management logic of different devices.

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INTRODUCTION

A very important innovation is the possibility for the user to customize the event-response of the system and to adapt its behavior to changing working conditions. An example of the adoption of chipless RFID for document flow management is presented with emphasis on the technological solutions adopted and on the derived benefits. RFID is a very promising wireless technology that will strongly impact on everyday life in several fields such as retail, supply chain management, document management, access control, healthcare and so on. In general, RFID identifies a plethora of heterogeneous location and identification technologies ranging from wireless identification tags to sensors networks and GPS. One of the main opportunities for RFID is the tagging of all things to create a global network of physical objects, the so-called Internet of Things (IoT). To accomplish this result it is necessary to count on very inexpensive tag, and some printed and chipless RFID technologies have demonstrated the potential to achieve this goal. Recent statistics show how the potential of RFID technology is influencing the commercial interests. For example, in the next ten years we will see a rapid gain of the market and in particular of the printed and chipless RFID tags.

The chipless tag is a particular RFID tag that does not contain a silicon chip. It represents a new frontier of RFID technology and at the same time an opportunity that could open a new scenarios as it could be printed directly on the products and packaging for less than 0.1 cents each. Also, chipless tags are smaller and less obtrusive than RF chips and can be easily embedded in products like a paper sheet. In addition, the readers for chipless tags are similar in size and cost to barcode readers. In the near future a progressive replacement of the 2D barcode with chipless tags could be hypothesized because they offer several advantages. Besides the known advantages such as the identification of the object without the requirement to be in line-of-sight or the possibility to hide the RFID tag inside a container (envelope, paper, etc.), the low cost of the chipless tags has to be considered.

The Internet of Things and the broad diffusion of many different RFID technologies for tagging a wide range of objects such as consumer products in supply chains or in other applications (theft deterrence, counterfeit detection, etc.), will produce very complex scenarios and a big amount of data that have to be managed. In order to take advantage from the potential of each technology, to properly manage a big amount of data and then to obtain more effective solutions and services, effort has to be devoted to develop a middleware layer that glues technical hardware aspects and software services. For instance, mobility, identification and localisation are very important issues, as from the position of a user or of an object several implications may arise such as the capability to provide targeted services, optimize paths, increase safety, etc.

In this chapter we intend to present our work in the creation of an “Event-based” RFID Middleware for the automatic identification of objects in several heterogeneous contexts. This middleware provides an effective abstraction of the technological level, facilitating the integration process with company IT systems, reducing costs and improving the effectiveness of business processes. In order to achieve such goals, it was built using a modular and flexible software architecture based on the state-of-the-art technologies such as SOA–Service Oriented Architecture (WS, REST, HTTP), Enterprise Service Bus (XMPP, JMS) and Multichannel Communication (Jabber, VoIP, SMS, MMS).

Our work resulted in the creation of a commercially available product, known as the WhereX© middleware. This product was realized in the Wireless RFID Laboratory of University of Messina and commercialized by Inquadro s.r.l., a spin-off company of the University of Messina. We will present our design choices and implementation details and describe a real case that will enable to