

RFID: From Concepts to Concrete Implementation

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Abstract—Technologies of identification by radio frequencies (RFID) and their standardization with the Electronic Product Code (EPC) architecture experience a fast development. After briefly introducing the common terminology of the RFID field and a short presentation of its current standards, this paper presents one possible application domain: the tracking of objects.

In this context, the distributed software architecture of a J2EE based assets tracking application, called RFIDLocator, is further described. RFIDLocator allows to trace electronically labeled objects within a predefined area (e.g. a building, a campus, a site, ...). Indeed, when tagged objects are moved, the monitoring information system is automatically informed thanks to readers deployed in their environment.

As the number of assets can increase dramatically, this kind of application has high requirements for scalability and reliability which are supported through the use of solid object oriented software systems (Enterprise Java Beans technology along with an implementation of the Event Manager standard). Some critical remarks about this emerging technology, the important questions it raises and the barriers it has to overcome to be fully accepted conclude this paper.

I. INTRODUCTION

More than any other discipline, computer science jumps from one technology to another. Some will die early, some will remain longer. During the last years, the increasing use of Radio Frequency as a means of identifying objects, placed this technology close to the latter category. According to many experts [1], RFID (or Radio Frequency Identification) matured and is in the process of becoming one of our everyday-life partners.

In this fast evolving context, the first goal of this paper is to provide a brief overview of the field's "state of the art". Thus, the second section begins with a short history of Auto-ID technologies and an introduction to the common terminology of this domain. Then it offers an overview of the standards forming the "Internet of Things", a vision shared by many computer scientists where the objects surrounding us would all be part of a global infrastructure: the EPC (Electronic Product Code) Network. Finally, the second section is concluded with the presentation of some interesting applications.

The third section describes a concrete application where the use of RFID and EPC presents a great benefit: the tracking of assets within a predefined area (e.g. a building, a campus, a site, ...).

The implementation of the described application presents many challenging issues requiring the knowledge of advanced object-oriented technologies and best practices. Indeed, different

hardware devices (e.g. RFID readers, RFID transponders, servers) have to be interconnected, specific middleware has to be used (e.g. Sun Java System RFID Software) and enterprise software products have to be deployed (e.g. J2EE application servers).

Section 4 describes the technological choices and the adopted software architecture for the RFIDLocator, a fully functional prototype respecting all the related current standards and satisfying high requirements for scalability, robustness and reliability.

Finally, the conclusion summarizes the main achievements of this project and provides insight into the barriers RFID still has to overcome as well as its possible future.

II. RFID OVERVIEW

A. Short history

Radio Frequency Identification (RFID) is part of the more general Automatic Identification systems (also known as Auto-ID systems). Auto-ID systems are not new. However, these systems are becoming more and more popular in many business areas. In short, the term Auto-ID groups the technologies helping computer to identify objects, animals or people in use since the seventies. Automatic Identification procedures were developed in order to create means of providing information about objects in transit. Figure 3 offers an overview of existing Auto-ID technologies.

Barcodes. Technically speaking, the barcode comprises a field of bars and empty spaces, vertically printed on a sticker or a product label. The sequence (bars, gaps) as well as the width of the sticks are converted into an ASCII sequence using optical lasers and a complex set of mirrors. Barcodes are a worldwide available and popular mean of identifying objects since the late seventies. There is a simple reason for this long-lasting success: barcodes have been made of paper and ink which makes these tags cheaper than any other Auto-ID system. Many barcodes standards were published, with the most popular among them certainly being the EAN (European Article Number) code which is nothing but an extension of

In the rest of the paper, the word object is used and is to be taken in its general meaning, ranging from non-living objects to animals or human beings.

²On June 26th 1974 in Ohio, USA the first product using barcodes, a 10-pack of Juicy Fruit chewing gum, is scanned at the check-out counter [2].

On this figure, OCR stands for Optical Character Recognition.

ASCII is the acronym of American Standard Code for Information Interchange.

