Chapter 1

Introduction

RFID (*Radio Frequency Identification*) systems use electromagnetic waves to transmit, at distance, energy and data to devices that perform a scheduled process of information contained in these exchanges. The origin of RFID technologies, dates back to the invention of RADAR, where, during the Second World War, fighter pilots cleverly maneuvered their planes to be remotely identified by friendly radar operators, who distinguished them from their foes (*Identify Friend or Foe*).

However, the RFID technology received a boost in the early 1970s. The very first RFID devices were simple resonant analog circuits. Then, advances in microelectronics allowed the integration of increasingly complex digital functions. The initial applications were designed to track and monitor dangerous materials in sensitive areas (usually military or nuclear). In the late 1970s, applications of these devices also included the civilian doman, typically the monitoring of animals, vehicles and automated production lines [DOB 07].

Usual tracking technologies such as barcodes, invented in 1970 by an IBM engineer, have shown their limitations for applications in an altered environment, such as animal tracking or in the engine assembly lines. Indeed, the barcode must pass through a scanning window to be scanned by a mobile reader without obstacles or of dirt traces which degrade or block the reading operation. This is why RFID technologies are being developed to replace barcodes in identification functions, so as to make it possible to read or write information at a distance using electromagnetic waves.

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RFID technologies and contactless smart cards consist of one or more electronic tags connected to one or more antennae or terminals that radiate an electromagnetic field through their antennae. These devices communicate by RF (Radio Frequency) or UHF (Ultra High Frequency) channels. Some RFID applications and contactless smart cards require embedded energy sources to facilitate the data exchange between the tags and the terminal readers. Other more common RFID technologies and contactless smart cards perform remote energy transmission to enable data exchange.

Depending on the frequencies used, the transmitted energy necessary for operations can be stored in a geometric volume, site of an electromagnetic induction effect (as in the case of low frequencies or radio frequencies), or propagated (as in the case of Ultra High Frequency).

The deployment of RFID technologies presupposes that a number of electrical electronic, mechanical and material parameters have been controlled [ELR 04].

Indeed, given the nature of energy and data transmissions between the devices of the RFID system, the geometric space in which the energy transmission and data exchanges are performed may reveal communication failures between tags and terminals. In particular, the phenomena of echo due to reflection and absorption signals (as in the case of UHF) must be controlled. The coupling intensity in the near field (as in case of LF or HF frequencies) can degrade the signal to noise ratio or, in other cases, lead to very high impedance mismatch at the power stage level and cause a malfunction of the baseband station [BAR 05]. The antenna orientation of RFID tag/terminal pairs in correlation with the energy and data propagation should be minimized and the writing and reading distance should be optimized by taking into account the complete front-end architecture (stages of power, reception and power control). These issues (operational zones and antenna configurations) mainly relate to physical and electrical properties.

Regarding electronic aspects, the anti-collision processing should allow us to establish data exchange between all the RFID tags in the operating zone of the terminal(s) under the conditions predefined by RFID system specifications and ISO standards. The processing time of transmission, which should be secured by cryptographic algorithms, should be optimized (in terms of bandwidth and data rates), so that the processing time is compatible with the high flux of expected transactions.

Finally, the interoperability between different RFID systems, their robustness (in terms of electrical features) and their compatibility with ISO standards must be guaranteed. The mechanical parameters (connections between chips and antennas) and materials (from a point of view of electric behaviors) are all very important in this context.

By nature of their capture and data processing abilities, the RFID technology is well suited for automation of the complete supply chain, with better utilization flexibility and operation under varying environmental constraints, even when the object is in movement and occupies various positions. RFID technologies follow the unprecedented development of international trade exchanges. These technologies make it possible to save money by avoiding logistical and human errors and by limiting fraud, irrespective of their origin [ROU 05].

Information system architectures that aggregate data from RFID systems are based on normative networks, which define international ISO standards, or the coalition of managers and assignees such as EPCglobal Inc. which implements EPC (Electronic Product Code) codes. These codes are allocated to objects for identification at a worldwide level, while providing an interconnection service to servers dedicated to identification and localization of objects by the Internet.

Today, due to the joint progress of micro-electronics, microcomputer and telecommunications, RFID systems are not only reserved for automatic identification, but have also spread to other areas such as secure access to buildings, to networks or the completion of secured transactions between remote electronic devices.

1.1. Bibliography

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