

The RFID Reference Model

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Abstract: The term “RFID technology” refers to a vast field of applications. When people talk about RFID technology they might talk about logistical applications, e.g., identification of pallets, about animal identification systems, or also about smart objects finding their destined way within logistic applications. When an application field is so wide [Ka07, In06] it is obvious that publications are accordingly dispersed. Therefore it is difficult to classify findings of other authors and to realise which of these findings are relevant for someone’s own business or research field. The RFID Reference Model was developed to solve this problem. A comprehensive list of RFID applications has been clustered to eight RFID Application Fields to structure discussion and analyses of RFID technology.

1 Description of the RFID Reference Model

As part of our work within the CE RFID¹ initiative we have developed this model. As first step a list of RFID applications has been created and discussed with various RFID experts. The idea was to create a list of RFID use cases that is as comprehensive as possible. In the next step these use cases have been merged to eight RFID Application Fields. Table 1 shows the resulting Application Fields (A.-H.). The Application Fields A. to C. can be described as mainly “Object Tagging Applications”. Whereas the Application Fields D. to H. describe applications with “Reference or Potential Reference” to individuals.

RFID technology is already an important topic in the field of agricultural production and food industries [CG06]. Examples of use cases can be mainly identified in the Application Fields A. – D., e.g., logistical tracking and tracing of goods (A.), monitoring of production processes in the food industry (B.), quality assurance and anti-counterfeiting of products (C.), or tagging of animals (D.).

¹ CE RFID: „Coordinating European Efforts for Promoting the European RFID Value Chain”, a coordination action project funded by the European Commission within the Sixth Framework Programme. CE RFID aims at improving the market conditions for RFID technology and at strengthening the technology development in Europe. More information: www.rfid-in-action.eu

	RFID Application Fields	Description
Mainly Object Tagging	A. Logistical Tracking & Tracing	Solely identification and location of goods and returnable assets (e.g., pallets or containers)
	B. Production, Monitoring and Maintenance	Smart systems in combination with RFID-Technology to support production, monitoring, and maintenance of goods and processes
	C. Product Safety, Quality and Information	Applications to ensure quality (e.g., sensors to monitor temperature) and product safety (e.g., fight against counterfeiting)
Tagging with Reference or Potential Reference to Individuals	D. Access Control and Tracking & Tracing of Individuals	Single function tags for identification and authorisation applications for entry control and ticketing
	E. Loyalty, Membership and Payment	Smart Card based identification and authorisation systems for multifunctional applications (e.g., loyalty, payment, and banking systems)
	F. eHealth Care	Systems for hospital administration and smart systems to support and monitor health status
	G. Sport, Leisure and Household	Sports applications, rental systems (e.g., cars or books), smart home
	H. Public Services	Systems mandated by law or to fulfill public duties (e.g., ID-Cards, Health Insurance Cards, Road Tolling Systems)

Table 1: RFID Application Fields

2 Subcategories of the RFID Reference Model

Different applications within the RFID Application Fields are called Subcategories (see table 2). Examples of Subcategories within the RFID Application Field “A. Logistical Tracking & Tracing” are “In-house Logistics”, “Open Logistics”, or “Postal Applications”. These examples show that for instance regulatory challenges, open questions, and relevant stakeholders for these Subcategories differ accordingly.

Subcategories	RFID Application Field	
AA. - Inhouse Logistics AB. - Closed Loop Logistics AC. - Open Logistics AD. - Postal Applications AE. - Dangerous Goods Logistics AF. - Manufacturing Logistics	A. Logistical Tracking & Tracing	Mainly Object Tagging
BA. - Archive Systems BB. - Asset Management (incl. Environmental Monitoring) BC. - Facility Management BD. - Vehicles BE. - Airplanes BF. - Automation / Process Control BG. - Food and Consumer Goods	B. Production, Monitoring and Maintenance	
CA. - Fast Moving Consumer Goods CB. - Electronic Goods CC. - Textile Goods CD. - Fresh/Perishable Foods CE. - Pharmaceutical CF. - Customer Information Systems	C. Product Safety, Quality and Information	
DA. - Ticketing DB. - Access Control Systems DC. - Animal Tracking DD. - Personal Tracking	D. Access Control and Tracking & Tracing of Individuals	Tagging with Reference or Potential Reference to Individuals
EA. - Loyalty Cards EB. - Membership Cards EC. - Contactless Banking Cards ED. - Payment and Advertising via mobile phones	E. Loyalty, Membership and Payment	
FA. - Assistance for the Disabled FB. - Hospital Management FC. - Implants FD. - Medical Monitoring FE. - Smart Implants	F. eHealth Care	
GA. - Sports Applications GB. - Rental Systems GC. - Smart Games GD. - Smart Home	G. Sports, Leisure and Household	
HA. - Public Service Maintenance HB. - Road Tolling Systems HC. - Banknotes HD. - ID Cards and Passports HE. - Health Insurance Cards	H. Public Services	

Table 2: Matrix structure listing RFID applications

The RFID Application Fields and Subcategories are listed on the horizontal axis of the matrix. By using this model research questions can be answered for all Subcategories separately (e.g., frequencies used in each subcategory, existence of data standards, research needed concerning specific topics, etc.). The University of Freiburg's Institute of Computer Science and Social Studies for instance has used the RFID Reference Model as framework for a survey on the current status and future plans regarding the implementation of RFID in SMEs. For further information please go to: http://www.telematik.uni-freiburg.de/event/ece2005_rfid.php

By classifying Subcategories into the RFID Application Fields the intention was to minimise differences within Application Fields and maximise differences between different Application Fields. Amongst others, the following have been the most important aspects to differentiate between Subcategories:

- Need /existence of standards
- Potential reference of tag data to people
- Potential number of participants of RFID systems
- System complexity
- Technological requirements (e.g., memory chips – processor chips – smart systems)

Both the Reference Model as an Excel Sheet and an accompanying Word document, describing all Subcategories in detail and giving examples, can be downloaded at www.rfid-in-action.eu/rfid-referencemodel and can be used for scientific and industrial purposes. Links to studies using the RFID Reference Model will also be published on this website to realise network effects between users of the RFID Reference Model. Therefore users of the model are asked to send a copy of their publication, a summary of results, or a web-link to their publication to the authors of the RFID Reference Model (E-Mail address: rfid-referencemodel@rfid-in-action.eu).

References

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