Current issues in RFID standardisation

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Introduction

According to professional journals, Internet information services and consultants, RFID (Radio Frequency Identification) seems to be "the new technology hype" which "will revolutionise business performance across supply chains" (Accenture). While low-frequency RFID has been used in some areas in the industrial world for more than a decade (source), the recent decision by Wal-Mart and the U.S. Department of Defence (DoD) to mandate to all its suppliers the adoption of ultra-high frequency RFID as a logistics and inventory management tool by January 2005 (Brewin, 2003) is driving a widespread interest in RFID technology throughout other industry areas and in academia.

The supporters of the technology argue that RFID significantly reduces costs, increases the transparency and hence improve the visibility of the entire supply chain, leading one step further towards the achievement of the truly integrated and virtual supply chain. In contrast, the critics draw the attention on the huge technical challenges such as integration with the existing IT infrastructure and the even more substantial organisational changes required by the adoption of RFID such as the changes in the business processes, let alone the high costs of the RFID tags that hamper the implementation and use of RFID. Another major obstacle for the widespread adoption of RFID are RFID standards. In a global business environment, the lack of interoperability between systems based on RFID technology in different parts of the world deter users to make large investments in a technology that has to be used on a global basis.

This paper seeks to provide an overview of the current situation of RFID standardisation issues, with a particular focus on the different, and often competing, interests of the actors involved in the two standard life cycle stages: standard creation and standard use. The analysis is based on extensive documentation (company information, newspaper articles) and interviews with experts involved in RFID standardisation, as well as representatives of companies involved in RFID development and use.

After a brief section describing the RFID technology and identifying a number of issues related to the development and use of the technology, the following two sections analyse the two RFID standardisation stages: standard creation and standard use in order to unveil the challenges surrounding the standardisation issue. The conclusions summarise the observed phenomena and identify areas of further research.

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Background

Technology

RFID is defined as a method of identifying unique items using radio waves (http://www.rfidjournal.com). RFID technology allows the automatic collection of product, place, time and transaction data quickly and easily without human intervention. An RFID system includes a reader (or interrogator), a transponder (or a tag), and their associated antennas. The reader transmits the radio signal, through its antenna, that the transponder receives via its own antenna. The transponder converse with the reader to verify and exchange the data. Once the reader receives and eventually verifies the data, it sends it to a computer for processing and management. This process is illustrated in the figure below:

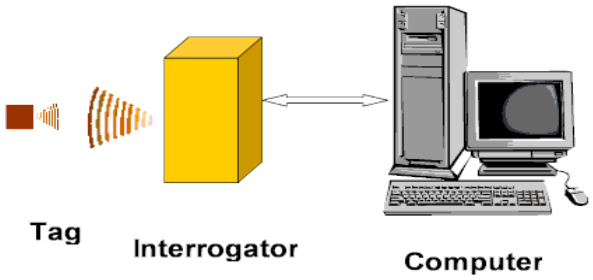

Figure 1. RFID system

RFID readers are automatic locks, fixed or mobile hand held scanners. They are usually connected to a computer and serve the same purpose as a barcode scanner. The transponder, also called tag, smart card or smart label, consists of a chip containing a processor and a receiver, and an antenna to broadcast and receive data via radio frequency. Dependent on the installation size of the antenna and the air interface protocol, the coverage reaches up to several meters. In contrast with the barcode, the transponder can be read without direct visibility and is contact-free. Additionally, transponders can store more information and are safer in terms of staining or abrasion. A huge advantage of RFID is the parallel data collection: a RFID reader can read up to 200 tags. Active and passive transponders are available. The antenna connected to the RFID reader activated the RFID tag and transfers data by emitting wireless pulses.

Issues

The issues surrounding RFID technologies can be categorised in five main categories:

1. The RFID market is congested, with a massive amount of diverse players such as chip makers, transponder manufacturers, system integrators or consultancies, all of whom offer different, and generally proprietary, products and services. Available systems consist of different frequency ranges, transfer modes, etc. For a potential customer, it is difficult to acknowledge the distinct benefits and disadvantages of these different RFID solutions.
2. Currently RFID technologies cannot offer a so-called “killer application” which is an off the shelf standard solution . A selection of different RFID systems has to be done

by the users depending on the organizational specific process and technological requirements.

3. Due to the fragmented market (a variety of individual RFID products and services), the total costs of RFID implementation are not transparent. Apart from the fact that transponder prices range from 50 Eurocent to 80 Eurocent, the exact price calculation as part of a cost-benefit analysis is difficult because of the number of unknown variable. A RFID implementation cost analysis has to take into consideration not only the investment in the transponders and readers, but also the other cost drivers, such as peripheral systems, software and integration effort.
4. The discussion in the media regarding RFID implementations often is driven by high promises in terms of what can be expected as benefits, that is cost reduction and improved visibility of the supply chain. If these expectations are not fulfilled, potential customers defect from the "RFID vision". Additionally, there are a number of privacy and health issues concerning the wide spread adoption of RFID.
5. RFID technologies require a huge effort in terms of standardisation. RFID standards are a major issue in securing the high investments in RFID technology on different levels (e.g. interface protocol, data structure, etc.). Not only different standards co-exist in parallel, but also different actors with sometimes divergent interests influence the standardisation life cycle.

This paper addresses the last of these issues – the challenges surrounding the standardisation of RFID technologies. The standardisation life cycle is conceptualised as formed of two different, yet deeply interrelated stages: standard creation and standard use. The next section discusses the existing approaches to RFID standard creation, and focuses on two competing initiatives, the EPC Global approach and the ISO process. EPC Global is a commercially driven initiative dominated by the large end users, in particular retailers. In contrast, ISO adopts a more global (cross industry) perspective following a generic approach to standards. The implications that RFID standardisation has for the user organisations are discussed in the second part of the paper.

RFID standards creation

There are two competing initiatives in the RFID standardisation arena: ISO and EPC Global. Additionally, there are also a number of special interest groups including industry specific such as the American Trucking Association in the transport industry, the NFC forum in the in consumer electronics, mobile devices and computer industry or the Automotive Industry Action Group in the automotive industry that seek to influence RFID standards development. This section will compare the two major approaches to RFID standardisation, unveiling the underlying conflict that shape the RFID standards creation process, and consequently, the future development of the technology.

The ISO approach

RFID standards first come to scene during the early 1990s, when the (newly created) CEN TC225 committee on bar coding focused the attention on automatic ID techniques in general. During the early 1990s, the standardisation activity on automatic ID techniques was mainly carried out in Europe within the CEN standard body (TC225 committee),, with little involvement from the US. However, during the 1995, a joint ISO IEC JTC1 committee – the SC31 – was set up for standardisation of automatic identification techniques generally drawing from the earlier work on RFID standards within CEN. Another influence on the

RFID work within ISO was the work on the GTag initiative for RFID standardisation of asset tracking and logistics which was launched by UCC and EAN in 2000 along with input from international companies including Philips Semiconductors, Intermec, and Gemplus.

The members of the SC31 committees are the representatives of the national standard bodies such as the BSI IST34 committee on bar coding in UK, including the same people who tend to participate in CEN TC225. They represent either internal consultants within large corporations, or external consultants which are representing different companies. Their work on the committees is primarily voluntary. As a result, three different levels of representativeness (and thus interests) can be identified in the ISO process: the individual, the organisational, and the national level.

RFID ISO standards cover 4 different areas: technology (e.g. ISO 18000 series including the air interface standards, which are developed within the SC31 committee), data content (e.g. ISO 15418), conformance and performance (e.g. ISO 18046), and application standards (e.g. ISO 10374). The ISO standards are defined at a very high level, focusing on the interface rather than on the data which is transported. As a result, ISO standards are generic, being able to be supported by any system and in any context, irrespective of the data that is being carried.

The EPC Global approach

In parallel with the ISO standardisation efforts, MIT and UCC together with a number of industrial partners including Procter & Gamble, Gilette and Wal-Mart set up the Auto-ID consortium in 1999 to research RFID technologies and standards. The members included end users, primarily from consumer packaged goods, large retailers and solution providers, including hardware and software providers and consultants. The Auto-ID members included large retailers such as Wal-Mart, Gilette, Coca Cola, Unilever, Tesco, Carrefour and Ahold (http://archive.epcglobalinc.org/aboutthecenter_oursponsors.asp).

As the membership of Auto-ID became larger and more diverse, and with the increasing need for global ”legitimate” standards, the members recognized the need for the creation of a formal standard body that would take over the standardisation and commercialisation work within Auto-ID. A new entity was created in October 2003, the EPC Global as a joint venture between UCC and EAN. Whereas Auto-ID would continue to research RFID technologies, EPC Global focuses on standardisation activities, as well as their commercialisation.

In contrast with ISO RFID standards which are generic standards, EPC standards are specific. EPC standards describe the tag and the air interface depending on the data being carried. EPC standards prescribe the physical implementation of the tags and readers, rather then specifying their generic characteristics. The standards are also much more limited in their scope, for example where the ISO standards for air interface cover all the frequency range, EPC operates only within the UHF between 860-930MHz with one standard for 13.56MHz (http://www.infomax-usa.com/rfid.htm). The EPC standard activities, although taking advantage of the resources of the parent organisations in terms of expertise as well as potential users, is separate from the generic EAN UCC standardisation process. Such distinction is required due to the difference in the nature of standards and the need for a fast standard development process.

ISO vs. EPC

The table below compare the two standard settings in terms of their organisational characteristics (membership, procedures), and their approaches to RFID standardisation:

Table 1. ISO vs. EPC

Characteristics	ISO	EPC
Membership	Driven by RFID manufacturers	Driven by large users (retailers and their large suppliers)
Resources	volunteers internal consultants from large companies external consultants that represent different smaller companies + national standard bodies	Full time people Academics (MIT) UCC – is a trade association funded by industry members (worked on bar codes)
Process	"Formal" standard body, characterised by openness, transparency, due process => slow, bureaucratic process	"Standard consortia", driven by the interests of its members => fast process
Approach	High level, generic approach, focusing not on the data itself, but on how to access it: ❑ the technical building blocks, not the applications ❑ air interface ❑ high level data access techniques, data object definitions Case level identification	Specific, focuses on the data itself: ❑ data carrier, data access and product mark-up language ❑ similar with the bar code system (central to EPC is the GTIN) => It can identify a specific item
Air interface	Cover the entire range of frequencies	Only UHV
Chips	Bigger, smarter, active chips => more expensive	Smaller chips => cheap enough to make economic sense for the package good industry

Whereas ISO can claim that it reflects the global requirements into a legitimate process (equal footing and consensus based), EPC focuses on speed and emphasises the broad support it receives from the industry community. The ISO and EPC processes can be seen as complementary. However, for both EPC supporters and for ISO the need for a single, global standard is impetuous. The benefits coming from standardization would be lost if in different parts of the globe, multinationals would have to invest in different technologies for RFID.

RFID standards use

Today, RFID is used to track and identify parts/goods moving through shop floors or warehouses in order to get accurate data. Technologically, RFID has the potential to simplify the process of tracking parts, without any line of sight and with multiple tags that can be detected simultaneously. As such, RFID systems are a useful tool in improving the visibility in the supply chain, hence reducing time and costs. One major user of RFID technology is the retailing industry to track inventory and gather information at the point of sale about customers shopping behaviour. Among the early adopters is also the automotive industry which uses RFID technologies during manufacturing processes to track parts in the supply chain. Claimed benefits of RFID standardised technology include improved supply chain efficiency, for example significantly lower transport and operating cost, reduced capital, or the stop of misplaced packaging during transport when moved between suppliers, or the reduction in the incidence of fraud.

The actors involved in the use of RFID standards are component manufacturers, technology vendors, consultants, end user companies. Whereas technology vendors proclaim RFID as a huge market opportunity to sell their technology and promise huge benefits, the exact distribution of this benefits is not clear. Apart from unclear benefits, there are other factors that deter a widespread adoption of RFID technologies. For example, the standardised RFID technology seems not to be mature enough to satisfy the user requirements, or integration with existing IT system. Additionally, as usually in the case of IS implementation, the challenges associated with internal organisational change required by the change in the business processes due to RFID use create massive problems. Under these conditions, the users care less about standards and more about the practical cost-benefit analysis of the technology.

The table below summarises the major concerns that the four categories of users included in our study have voiced regarding RFID standardisation.

Table 2. RFID standardisation and RFID users

Standardisation issues	**RFID component provider (Philips)**	**RFID system vendor (SAP and Oracle)**	**RFID consultants (Egs and nexolab)**	**RFID end user (auto industry)**
Importance	(Very) important	Indirectly important, because of its relevance to customers	important	important
Perception (reasons why standards are considered important)	Significant in areas where company is market leader	Dual approach: standards and participation in standard setting is important to collaborate towards a common accepted standard to address customers needs, - but otherwise work to impose their product as a de facto standard - as their focus is on the application side, the hardware concerns their partners	There is a lack of commonly agreed standards which hampers RFID market diffusion, especially for external use (as currently most RFID project concern internal deployment) Standardisation is crucial for the deployment of RFID in inter-organizational relationships, but not so much for the internal use of RFID	The only concerns is that the technology (embedding the standards) has to work (anywhere)
Standardisation bodies	ISO	both	EPC global	none
Areas of standardisation considered relevant	Air frequencies ICs	Reader Air frequencies (indirect relevance, as the vendors focus on applications, not hardware)	Tag Reader Air frequencies	Applications Reader Data
Participation ▪ Extent ▪ Reasons	▪ Depending on the importance of application ▪ Exercise influence in	▪ limited involvement, but visible member ▪ gain awareness, study the (potential) market, influence the standards	▪ active involvement ▪ awareness	none

	market areas where double development is expensive			

Standards are considered important by all four categories of actors for the reasons discussed at the beginning of this paper: the global diffusion of RFID technologies at low costs is not possible in the absence of common, global standards that prescribe the major components of the RFID system: the reader, the tag and the air interface. In addition to these generic components, the different actors are interested in specific areas of standardisation that directly affect their businesses: the chip manufacturer is interested in IC standardisation, whereas the user is concerned about data standards. The lack of direct interest of the vendors is justified by the fact that their businesses consist in providing the RFID applications to customers, whereas the hardware is provided by their partners. Consequently, their interest in RFID standardisation (tags, readers and interfaces) is only indirect, to the extent that it affects their customers' willingness to adopt their products embedding RFID applications.

The perceptions of RFID standardisation differ across the actors: the manufactures addresses only standards in areas where they position themselves as market leaders. Their interests concern data access, and not the data itself. Naturally, such interests determine their participation in ISO rather than EPC. The major reasons for participation are development cost reductions: lack of involvement would lead to duplication of efforts which is not only costly but it also increases the danger of higher competition.

The consultants working with large end users will naturally be involved in EPC which is a user driven consortium, however interestingly the particular user involved in our study is not involved in neither of the settings. The reason is the perceived retailing industry focus of the EPC, which means that users from other industry do not perceive EPC as being able to address their specific industry needs and requirements. A consequence of this might be either a proliferation of industry specific RFID standardisation efforts within industry specific standard consortia such as AIAG and ATA, or the enlargement of the EPC to include working groups addressing specific industry needs (for example EPC has already created a specific group for health care and life sciences).

RFID system vendors are involved in both ISO and EPC and the major driver is, according to them, the need for direct collaboration between companies involved in RFID development to address customer needs for interoperability. Additionally, participation is justified by a need to be aware of what is going on in the market, to identify (and therefore address) potential future trends, to keep an eye on competitors, and also to influence the development process to address their specific needs.

Finally, RFID technologies are not used as a common place technology to support every day business. In most of situations today, RFID is implemented internally, which means that standardisation is not high on the agenda. The major current concern for end users is that the technology *"just has to work"*. Until the basic technological issues surrounding RFID development are not solved, standardisation will be only a remote concern for end users.

However, driven by the large retailers mandate, RFID, at least in the retailing industry, became a must, and pushes standardisation to a more prominent role.

Conclusion

The RFID standards realm thus include two distinct and yet overlapping standardisation efforts – the ISO RFID standardisation which and the EPC Global. However, for both EPC supporters and for ISO the need for a single, global standard is impetuous. The benefits coming from standardization would be lost if in different parts of the globe, multinationals would have to invest in different technologies for RFID.

Today, from a user point of view, the implementation of RFID is in its infancy despite all the promising announcements of RFID technology vendors and consultancies predicting a boost in sales figures for RFID technology and related services. From the interview data gathered, this seems to be the case for about 5 years now. Due to market and cost pressures, some industries are more advanced than others, e.g. retail and the automotive sector.

Although organisations are well aware of the benefits RFID provides, a couple of questions remain still unanswered. As the barcode has a huge installed base, potential RFID users are on one hand aware of the benefits RFID can provide, but on the other hand complain about the lack of a concrete business cases. Apart from the question of cost and a respective investment in RFID systems (for example RFID tags are far more expensive than barcodes), the technology still shows weaknesses, e.g. antenna breakdown, small coverage and a lack of standardisation in the convergence of air interface protocols, performance and data structure. As most of the applications are only in use to support internal processes, the ROI of RFID in an internal so-called “closed-loop scenario” is mostly negative.

The RFID market/arena is populated by different actors with different interests in and approaches to the technology. Standardisation and/or the involvement in standard setting bodies depends on the role an actor takes up in the RFID game. There is definitely a gap between the development of RFID standards and their implementation. Whereas RFID vendors participate in EPC as well as in ISO, end users are primarily interested in the fact if a RFID solution fits their business requirements and work. Additionally, it appears that from the users perspective industry specific standard consortia should play a more significant role in RFID standardisation, otherwise the industry faces the danger that they voices will not be heard in the IT vendor dominated RFID standard bodies such as EPC.

Reference list

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