RF identification Future Outlook

Sub Group 2 - Application

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Table of Contents

Version History

Release reference	Distribution	Version Date	Purpose?
Version 1.0, draft	All, RFID in Europe Members & also non - Members	02/11/2012	Initial draft template to gather contributions
Version 1.1, draft	All, RFID in Europe Members & also non - Members	16/11/2012	Updated draft reflecting changes to the milestones in plan
Version 1.2, draft	Contributors	09/01/2013	Consolidated contributions
Version 1.3, Published	Public	08/02/2013	Final Document Format

Related Documents

Title	Version	Version date	Author
RF identification Future Outlook - Project Definition	1.0, Published Draft	02/11/2012	Trevor Peirce
RF identification Future Outlook - Sub Group 1 Technical	1.3, Published	08/02/2013	Trevor Peirce
RF identification Future Outlook - Sub Group 3 Public Policy	1.2, Published Draft	13/12/2012	Trevor Peirce
RFID in Europe - RF identification future outlook - Conf call 14 Nov.	0.1, Published Draft	16/11/2012	Trevor Peirce

Introduction

RFID in Europe[1] engages in promoting the European adoption of RFID, related technologies and solutions. RFID in Europe offers a technology neutral and independent European network which is free to join, offering all stakeholders an accessible trusted source of information to build widespread confidence in RFID use.

Today an apparent gap exists which is considered by a number of RFID in Europe group members to be possibly influencing European demand. The void referred to is the lack of a documented vision as to how the broad domain of RF identification (RFID, NFC, IoT, etc.) may look like in the future. Without such a reference many stakeholders including policy makers, potential and existing technology end users and others lack any kind of reference collective vision as to the future direction of RF identification. This initiative aims to stimulate investment confidence, whether that is within R&D or within application deployment.

The selection of RF identification as the initiative title fulfils two principle motivations. Firstly it is to encourage the broadest consideration of aspects directly influencing RFID, related technologies and applications. Secondly to convey to the end reader an initial engaging message that the document offers a comprehensive vision as to how RFID, related technologies and solutions may evolve in the future and the factors affecting such a future.

Future outlooks in general depict a vision which may be inaccurate in scale, timing and direction. Nevertheless an important value of a future outlook is from the grouping together of ideas of how the future might look in order to bring together interested parties who share a common vision, bringing greater chance of successfully achieving their vision through fostering collaboration. It also allows a wider shared consideration of the influencing factors to minimize potential 'blind-spots' slowing or diminishing progress. The dialogue which this project encourages can contribute to overcoming unnecessary divisions in opinions through shared understanding, promoting harmonization beyond certain irreconcilable economic interests.

All deliverables of this initiative are owned by RFID in Europe. RFID in Europe will not be held responsible for the content of the final published document, but will make every effort to ensure that the document is readable and interesting through the participation of content providers. It is planned that the final document will be made available to all members of RFID in Europe contributing content to this project. The published document will be in English, although through RFID in Europe's network opportunities for translations into local European languages will be supported and encouraged.

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[1] RFID in Europe AISBL is a not-for-profit organization established in 2012. RFID in Europe's principle goal is to promote the adoption of Radio Frequency Identification and related technology solutions enabling small and medium sized organizations throughout Europe to gain competitive advantage through their best use. RFID in Europe connects with European end-users, operators, solution providers, universities, research establishments, non-government and government organizations and all other European stakeholders through own initiatives and promotion of national projects via our international network. RFID in Europe is an extension of a European Commission FP7 Thematic Network called RACE networkRFID initiated in 2009. http://www.rfidineurope.eu/

Sub Group 2 Scope:

All RF identification is in scope. There is no intention to place unnecessary boundaries on the breadth of knowledge of contributors, nor their interests. RF identification is an extremely broad area and it is acknowledge that the final report may not have sufficient contributions across all areas.

There are two target horizons, one of between 3-5 years (2016-2018) and a second between 5-10 years (2018-2023).

1. Technologies convergence & evolutions (hardware & software)
2. **Applications developments and changes to requirements**
3. **Services and Turn-Key solutions evolutions**
4. **Market sizes, legacy and new and likely impacts upon growth**
5. **Technology and Solution Supply-base market outlook**
6. Radio spectrum opportunities and challenges
7. IPR, IPR ownerships and influences upon adoption
8. Health & Safety studies anticipated outcomes and effects upon adoption
9. Privacy and Security
10. Standards and the future role of standards organizations in RF identification
11. Interoperability
12. Testing and compliance
13. R&D
14. European Government Policies and Governance

SUB GROUP 1 & **SUB GROUP 2** & SUB GROUP 3

Sub Group 2 Preliminary Considerations:

2. Applications developments and changes to requirements

Despite past efforts most RF identification within the RFID space involves tailored devices and solutions by customer or sector vertical application type. Look to animal RFID, library RFID, apparel RFID, healthcare RFID, automotive RFID to name but a few for examples in abundance. Middleware and software solutions are also frequently customized in order to meet application requirements or optimize solutions, sometimes through parameter settings but too often by hard code changes.

How will applications change and how will this affect RF identification requirements (hardware/software) and adoption patterns? Will there be changes to what needs identifying with item level developing to include both component assemblies and individual parts? What information will future applications need? What information will be shared, by whom and for what reasons? Will the push for 'Big Data' influence RF identification applications and how?

3. Services and Turn-Key solutions evolutions

Commoditizing RF identification devices and applications has been the objective of several past initiatives yet the complexities imposed by application requirements have meant that in most cases this has not been possible. Service providers, independent operators and turn-key solution providers

provide arguably the next best thing bringing valued knowledge and experience and assurances of continuity in service of the overall application.

Will turn-key solutions or managed services dominate future market adoption, how and where? How will the turn-key market and managed services sector evolve in the breadth of offerings? What will most influence user selection of turn-key solutions or managed services?

4. Market sizes, legacy and new and likely impacts upon growth

Adoption of RF identification has been progressive over a period of more than 20 years already. What aspects will influence future market sizes? Will legacy RF identification hinder the progression of new RF identification technologies? What are the key areas for future growth and what challenges need to be overcome to access these? Is there lingering legacy from over-hype and frustrated pilot experiences of the past? What will determine growth in hardware? What will impact growth in middleware and software?

5. Technology and Solution Supply-base market outlook

The RF identification technology and solution supply-base market has seen a great many changes through mostly business acquisitions of 'start-ups' or larger take-overs. There have in comparison been few IPOs no doubt influenced since 2008 by the global financial crisis and its impact upon equity markets but also possibly by missed forecast sales due to adoption lag and competition. Venture Capital has played a vital role in funding investments in RF identification device manufacturing and testing capabilities, standards development processes and, marketing.

What effects on the technology and solution supply-base are predicted and what will influence these changes? How will this affect end user choices? Will there be greater consolidation and what effects will this have upon the market? Will there be an increase in start-up activities, in which areas and why?

Contributions:

Sections key:
2. Applications developments and changes to requirements
3. Services and Turn-Key solutions evolutions
4. Market sizes, legacy and new and likely impacts upon growth
5. Technology and Solution Supply-base market outlook

Contribution Text
We expect application specific customization including tailoring basic RFID hardware and software, to be more the rule than the exception in the future, as RFID tags will move from just being an Identifier to being used as a data carrier, capturing and providing information through-out the tag's life cycle. As Energy harvesting is maturing we will even see passive RFID tags capturing data from various sensors in sensor network implementations.

Embedded RFID tags will turn products into intelligent ("Smart") products, which holds information regarding the product and captures data on the usage of the product. When the product is connected directly or through a reading device (ie. Smart Phone) the 'Internet of Things' vision is ready to take off.

As illustration you can think of an industrial cleaning machine used by a service provider at a Hospital. An RFID tag embedded in the machine is capturing data from its usage and can then provide documentation for the service provider towards its customer – the Hospital. The manufacturer of the machine can through the capturing of information regarding usage provide a platform for more intelligent service and maintenance on the machines as well as providing actual usage data back to new Product Development.

Contributor Name	Section	Future Horizon
Henrik Granau	2. Applications developments and changes to requirements	2016-2018

Contribution Text

Introduction:

RFID data collection will have become a standard ERP system function. There will be a need to determine standards for such system integration. Focus will move to more general integration structure, which would allow real time data exchange.

Explanations:

In pursue for information about an object (e.g. product or similar) – during its creation or movement through the world – management systems will inevitably have to find a way to change information without additional human interaction. Spread and development of RFID technology creates demand for such inter-system communication mechanism. We already have technical possibilities for such data interchange, so now the only questions are standards, agreements and security. There have already been attempts to create such systems, but the lack of need for such systems in addition to high requirements for personal, limited the possibilities and spread of such systems.

Contributor Name	Section	Future Horizon
"DS projektai" - Gintaras Naudziunas	2. Applications developments and changes to requirements	2018-2023

Contribution Text

Applications will continue to develop in their diversity across all forms of RFID. Of all passive RFIDs there will be an unprecedented leap forward in consumer/public facing HF proximity applications for various reasons.

Mobile applications will develop particularly fast with the focus upon embedded readers, both UHF and HF. With greater and greater numbers of smart phones having embedded NFC(+ HF RFID) readers/emulators. The 'avoid the double-click' convenience will open a wealth of application opportunities which consumer/public facing sectors will be attracted to. This will give weight to the established early drive towards dual-frequency/protocol tags although costs and tag placement conflicts will hinder deployments, with some electing a twin tag initial approach.

Anticipated supply market consolidation may bring some challenges short-term. The prospects longer term from this consolidation really depend upon the acquiring organizations' abilities and willingness to bring the combined advantages of the accumulation of IPR to bear in enriching the capabilities of innovative new products.

Contributor Name	Section	Future Horizon
Trevor Peirce	2. Applications developments and changes to requirements	2016-2018

Contribution Text

Services and Turnkey solutions will continue to be a growing Market as companies in general are concentrating on having only core competencies internally and sourcing everything else. As RFID technology will be an integrated part of the IT infrastructure, it is expected that the general IT infrastructure service providers will integrate RFID into their offerings. Of course there will also be opportunities in the Market for new players having key competencies in RFID technology.

Contributor Name	Section	Future Horizon
Henrik Granau	3. Services and Turn-Key solutions evolutions	2016-2018

Contribution Text

New services and turnkey solutions will have different paths. Turn-key solutions will probably largely find favour with SMEs while larger end users may choose to manage their RFID applications through multiple OEMs (possibly led by one principle OEM) as they traditionally do with many other technologies.

SMEs may seek both turnkey solutions and supporting maintenance services. The outsourcing of service support for hardware and application software may be an area where even large enterprises see opportunities in diminishing the expense of maintaining in-house expert teams.

Establishing an RFID application and maintaining it are distinctly different challenges and this applies equally when considering the sustained interoperability of hardware components through to software upgrades and interfaces. Turnkey maintenance solutions may become increasingly popular as RFID becomes a more relied upon or critical part of processes.

There will also be likely demand for services supporting RFID application enhancements and upgrades. Expanded uses, improved security, exploitation of new features and standards, changes to processes, modifications or new legislation may individually or collectively drive the creation of new services.

Contributor Name	Section	Future Horizon
Trevor Peirce	3. Services and Turn-Key solutions evolutions	2016-2018

Contribution Text

Smart phones, Smart GRID, Smart Cities, welfare technology – as we have seen it in general IT, there will on the Hardware side be more dedicated vendors, and as users and application developers get an improved understanding of what RFID technology can/can't, and how it is used, Hardware will (as with Local Area Networks) just become a commodity bought, implemented and serviced by one or more vendor companies.

The so called 'frustrated pilot experiences' of the past was primarily unrealistic an unmanaged expectations from replacing barcodes with RFID tags in Supply Chain Management. Retailers in Fast Moving Consumer Goods segments was the target for opportunistic, unprofessional vendors who was focusing entirely on the technologies and not in building the business case for the customer.

Most organisations which will implement RFID technology in the future have only just learned, or are about to learn, about RFID technology and its potential – they have no frustrating experiences.

RFID vendors today are in general better in setting the expectations right and much more focus is on actual business problems when building the business case in the early phases of a project.

In the commodities part of the Market the prices are expected to decrease further as volumes are growing and production costs are falling.

On the tailored devices with small volumes, which we expect will be a growing segment, it is expected that the Market will allow for significant margins, hence we expect to see a number of business successes in vendor companies with strong domaine knowledge, focusing on application specific RFID solutions.

Contributor Name	Section		Future Horizon
Henrik Granau	4.	Market sizes, legacy and new and likely impacts upon growth	2016-2018

Contribution Text

RFID market predictions of the early 2000's were too optimistic in their estimates of market sizes and rates of adoption; nevertheless the RFID market has grown and will continue to grow. The pace of consolidation of the RFID hardware and RFID solution provider market through take-overs and to a lesser extent mergers will be driven firstly by tough market conditions with oversupply, when 'good-deals' are likely. Secondly, towards the end of 2017/8 the motivations to M&A will likely be replaced by factors associated with anticipation of or signs of fast growth in ICT investment appetite and early adopter hardware renewals aligned with a general impending upswing in market confidence.

New markets are critical to both RFIDs evolution and market growth. Mobile together with Near Field Communications (NFC) provides two of the most widely talked-about and visible technology elements offering short to mid-term major market potential. The opportunity to access mobile or mobile Web applications neither without a 'double-click' nor without users searching and selecting bar-code reading phone camera related applications is a considerable advance in consumer convenience. All forms of traditional retail and public services can be automated from capturing shop shelf pricing, scanning of individual items to validate their authenticity through to contactless payment at the check-out. Evidence of public appetite for such RFID accessed convenience can be seen through the public transport adoption of contactless RFID based solutions from Beijing to London and even Brussels. Future evolutions of electronic personal identification (which are also HF/NFC) will extend the possibilities for authentication of items and also individuals through mobile applications opening a wealth of new services.

Mobile and UHF are also sighted as offering huge potential too, but the consumer market with a growing NFC presence is likely to have the most significant influence given that UHF and mobile faces significant persistent technical and other adoption challenges when it comes to low cost embedded mobile devices such as mobile phones. Towards the 2016-18 near horizon it will be very interesting to see how some consumer facing organizations approach the challenges of having one technology for up-stream supply chain processes (UHF) and another (HF) for interaction with their customers. Dual-tagging will see increasing traction with either dual frequency tag technology or possibly a migration to NFC/HF being the longer term future depending upon market pressure, IPR issues, technological and process related challenges and, associated privacy and

security obligations.

Mobile Network Operators (MNOs) and mobile phone producers will undoubtedly play a major role in determining the speed of progression of mobile whether NFC and/or UHF. The acquisitions of some leading industrial mobile hand-held terminal manufacturers by mobile phone manufacturers will likely have a significant influence. The gradual maturity of Bring Your Own Device (BOYD) may undermine the market for industrial terminals. The development and adoption of security measures will provide reassurances about the necessary divides between work and private use of smart phones and become an NFC/Cloud application norm. Robustness of mobile devices will not need to evolve much due to the care that users generally take to avoid damaging their personal property eliminating the enterprise barriers to such low cost technology. Also when devices do get broken now need to go further than the high street to get a replacement, what could be easier or cheaper.

One thing is clear the market multiplication barriers of application silos will persist without a fundamental maturity of a number of technical aspects not least an efficient spectrum use allowing a more universal RFID platform and progression towards a much smaller number of efficient multi-purpose tag designs.

Fulfilment platforms will be prevented from gaining much benefit from RFID while transport load efficiency and speed of handling dictate a wide variety of product consolidations e.g. mixed pallet, sandwich pallet, etc.. If the future swings towards fulfilment costs dominated by labour then perhaps UHF RFID will have greater opportunities to yield benefits as load efficiencies will be less of a priority allowing less consolidation providing low cost UHF RFID tags more chances to perform reliably.

One of the challenges to achieving the predictions has undoubtedly been performance and hence value. While it is more convenient and easier to talk about costs the value proposition is critical to growth. Another challenge has been the high costs of the sales cycle. Yet another is the business transformation often needed to gain value from RFID.

The principle challenges to fulfilling the fullest traditionally targeted RFID market potential is for RFID to progress towards a more robust performance which is less process specific, item specific or sector specific. Standards have done little to resolve the considerable fragmentation of solutions which undermine identification level interoperability and tag manufacturing scale efficiencies. There have been multiple diverse reasons for this. Looking to the future it is perhaps only supply market consolidation which offers an opportunity to evolve established or legacy application solutions towards something less specialized in order to open new markets. Similarities exist with the evolution of bar codes with the challenges presented by RFID being somewhat greater due to its greater complexity. Development of new application domains will remain a significant challenge.

Increasing security capabilities will become increasingly important as applications achieve broader global penetrations. Identifiers (embedded and user assigned) and address protection whether within RFID systems or IS and communication systems will become an increasing priority. While an evolution towards more secure identifier and addressing structures and number management processes would be the most cost effective approach the weight of legacy is likely to mean resorting to a series of band-aid style fixes which likely negatively impact cost, performance and interoperability.

Social media, big data, IoT will all provide a growing influence upon the public and government attitudes to RFID. Western media, government and certain industry sectors will increase their efforts to sensitize the public to personal identity, freedom and behavioural influences. (See Future Outlook - Public Policy for more detail).

Contributor Name	Section	Future Horizon
Trevor Peirce	4. Market sizes, legacy and new and likely impacts upon growth 5. Technology and Solution Supply-base market outlook	2016-2018

Contribution Text

Introduction:

Part of RFID equipment control will be transferred to hardware level. This will let operational systems control RFID hardware modules from various manufacturers.

Explanations:

At the moment hardware on hand is incompatible with each other and this is a big problem for ERP and RFID equipment integration. In the future, RFID market will demand from RFID equipment manufacturers to find standards for RFID hardware control and the initiative for this will come from ERP developers. This primary initiative may come from governmental organizations, but only as additional requirements from ERP system realization.

RFID software developers will have a possibility to choose whether they will use operational systems to control their RFID equipment or to control it directly. This will let ERP system developers to create modules which will cover standard data collection functionality. In turn, this will separate standard RFID solution implementers from non-standard solution creators, who need higher qualification.

When ERP developers will have more say in RFID technology development, certain RFID hardware testing in work places standards will have to evolve. Taking into account that ERP developers will not have to spend so much resources to raise their personal qualification in RFID technology, there will have to appear some personal certification systems and some recommended methodology for tests and test result analysis.

Contributor Name	Section	Future Horizon
"DS projektai" - Gintaras Naudziunas	5. Technology and Solution Supply-base market outlook	2016-2018

Contribution Text

The unmanaged and unrealistic market expectations in the past caused vendor companies and Venture Capitalists to invest significantly without having a deeper understanding on the technology and its limitations. Even traditional large IT companies and consultancy organisations invested too much too early, because they didn't want to get in too late and miss the huge opportunities.

Many Venture Capitalists are still following the RFID market with great interest, but they have learned as well; to focus on the business case for the customers!

We expect to see a growing number of successful RFID implementations delivering significant value for money, in Healthcare, Pharmaceutical, Asset Management, anti-counterfeiting etc. and this to lead further investments in both hardware, middleware, software, consulting, education and other services.

This will probably mean a significant number of start-up's and Venture Market investing primarily in picking niche players, which can later be sold to traditional large players in the IT Market .

Contributor Name	Section	Future Horizon
Henrik Granau	5. Technology and Solution Supply-base market outlook	2016-2018

Contribution Text

When RFID technology meets Social Media Networks and Cloud Computing

A variety of future applications of RFID can exploit social media potential to offer new and exciting applications to consumers which can be as a result utilised by many organisations and businesses.

A consumer can have an RFID card or wristband and enter any activity centre while utilising the tracking ability of the RFID technology. For example, when an individual visits an entertainment park, he can pass through RFID gates and automatically any future activities can be tracked by the RFID readers/stands which are placed inside the area. At the same time the visitor can share any experiences with friends through social

media. The customers of the park can update their status by utilising the RFID wristbands across the reader-places inside the park. They can even invite any friends and receive any recommendations from them in a real time basis.

An interesting example is an application utilised in a well known resort in United States of America. In particular, the snowboarders have an RFID identity card and while skiing their activities can be tracked. The software developed for this reason captures all their activities, benchmarks their performances and rewards the best performances. The resort visitor can then take a look at his performance on the specific day or in the long-term.

In addition, another area where RFID can collaborate with social media networks is in the apparel industry. Consumers can enter a changing room which has already all their Facebook and automatically upload any photos they share them with friends. Any friends can this outfit in a real time basis. At the advantage of this application and offer customer just "likes" a particular outfit offer for example discounts only to those experiences through a social media network. and with an RFID identity card other networks account data can take inside the fitting room and give them recommendations for same time companies can take incentives (e.g. discounts), when a inside a store. An organisation can who have shared their real-time

Apart from the consumers, these applications can have a significant impact on the companies too. These examples of applications give access to a huge amount of data. Therefore, the question would be: "How will the companies utilise all this data and information?". The majority of the firms based on the state of the art, invests in RFID platforms and software and spend high amounts of money to accommodate any RFID applications. With cloud computing, any data are saved on a network. An organisation needs only to log into a Web-based service which includes all the related programmes. With access from any device, companies can lower the investment cost and have access to the RFID real time data from their work, their laptop when they are abroad or even their smart mobile phone. Any member of the organisation can have access to this data from any device. For this reason a Cloud-Computing architecture which utilises the real time data captured from RFID technology should be built by companies for more scalable and smooth RFID systems applications.

The following figure shows the integration of three main technologies: (1) RFID Technology (2) Cloud Computing and (3) Social Media. The cloud Computing enabled architecture includes three layers, based on the literature. In this figure the cloud computing layers are integrated with the required ones for RFID technology in order to exploit any data coming from Social Media Networks. First, there is the infrastructure layer which includes the servers, virtual machines, and the hardware for the RFID infrastructure operations (e.g. RFID gates, RFID readers, RFID tags). The second which is the platform layer contains parameters such as the database which stores all the data captured in a real time basis from RFID as well as the static data based on the Social Network databases. It includes also the cloud runtime and the queues that occur during queries from several clients. The third layer contains all the applications which can be combined with the Social Media Networks and offers insightful integrations of the data and services to consumers and businesses.
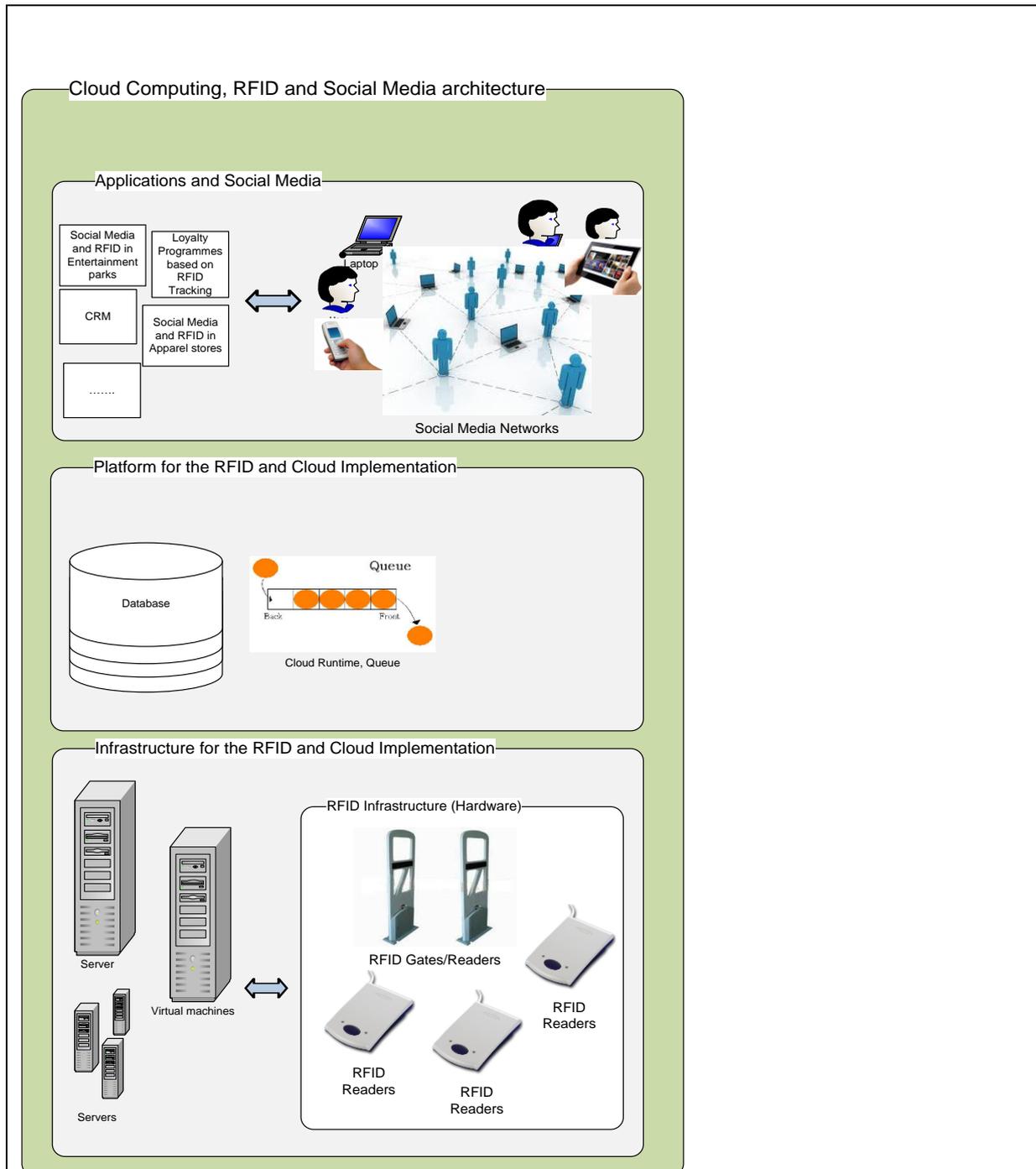
Figure 1 When RFID meets Social Media and Cloud Computing

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Contributor Name	Section	Future Horizon
Andriana Dimakopoulou, AUEB	2. Services and Turn-Key solutions evolutions	2016-2018

Contribution Text

Introduction

The Internet of Things (IoT) is deeply connected with Radio Frequency Identification (RFID). When retailers started their first RFID approaches in 2004, people dreamed of huge benefits. Some have been realized, some not. The first approaches were set up on item or case level tagging, which is the most difficult task in retail because of the vast varieties of objects, followed up by the reading performance problems. Secondly they tried to force their suppliers to tag shipments with RFID and integrate a full EDI-System. This approach failed because of the high investment cost on the supplier side and technical constrains.

Look into the future

From a logistics point of view the 'thing' in a retail supply chain is not really the item itself or the goods. It is the transport item where it is distributed with. The transport item is the major object in the whole retail process from production plant over distribution centers, right into the store. Every process uses different transport items, but there is hardly no process without one. In the future, in context of sustainability, Returnable Transport Items (RTI) becomes more and more important in logistics. These assets vary from simple plastic boxes up to refrigerated containers which may have values up to 600 EUR.

RFID is a technology which will provide a major contribution for more efficient logistic processes of returnable transport items. In the future nearly every RTI will be tagged with a global standardized RFID-Label. They are used to gain a very high transparency over the whole supply chain, including redistribution processes, by making them smart with autoID-technologies. Transport items like pallets, boxes, etc. will become more than a simple carrier of goods. They will become in additional a carrier of standardized information about their material flow. The basic principle is the use of RTI as major information carrier over the supply chain including redistribution. By considering the complete cycle synergies become visible, like automatic control (self-control), transport optimization and real time transparency.

In addition new software architectures will support RFID and RFID-Standards like EPCIS. EPCIS Repositories will be rentable out of the cloud. Supply chain data will be shared in a cloud network between companies like it is currently done in personal platforms like Facebook. RFID-Hardware adoption will get more and more standardized and easy to implement with cloud interfaces instead of local middleware software.

The Solution

With the aim to develop a very practical solution for customers, a new RFID infrastructure will have three outstanding characteristics that distinguish it from the today's market:

1. Hybrid AutoID processes allow a customer-oriented usage of technologies. Hybrid stands for every AutoID-technology that is able to read a unique ID which is in a combined printed label with clear-text, a 1D- and/or 2Dbarcode and a UHF Gen2 RFID transponder. With this combined hybrid identifier, customers are able to use a high variety of hardware starting with simple terminals, or apps, over barcode scanners (1D/2D), up to RFID Handhelds or Gates and of course UHF Gen2 compatible RTLS (Real-time location systems).

2. Cloud-based Repository allows one language for all supply chain partners. The so called Masterdata can be individually extended by every partner, but the system itself ensures the consistency over the supply chain. Hardware devices which generate the 'events' are connected to the rules-data in real-time, which represents a working Internet of Things showcase.

3. Common standards and RTIs are the must-have enablers for cross-company processes with the described system. It follows rigorously the EPC-standard (Electronic Product Code) by GS1. By using EPCIS (EPC Information System) the events and interfaces are clearly described and the complete system is easy adoptable for common ERP or WMS systems. The RTIs are marked with a unique defined EPC, which is readable by every AutoID-system which understands EPC.

Contributor Name	Section	Future Horizon
Alexander Hille, Fraunhofer - IML	2. Services and Turn-Key solutions evolutions	2016-2018