Aktiv in der Initiative
Ideen erfolgreich machen
Partner für Innovation

RFID – A Driving Force for Innovation

Imprint

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Photographs
IBM Deutschland, METRO Group, Corbis, Getty Images, zefa

Status: May 2005

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A word of greeting

Dear Readers,

Anyone who claims to act in entrepreneurial spirit must be willing to tread new ground. The fact that IBM is one of the top technology companies in the world today is due to our lasting commitment to this principle. It all began with pioneering spirit and the courage to innovate. Back in 1896 the founder of our company, Herman Hollerith, invented the punch card machine and thus laid the foundations for our success. All of a sudden, statistics could be processed in a tenth of the time and at a third of the cost.

Market requirements have always been the driving force behind everything we do. All companies and public institutions are expected to provide the maximum degree of customer orientation. At the same time – today even more so than a hundred years ago – time and costs are the crucial competitive factors. Radio Frequency Identification is a modern technology that helps companies meet growing demands. It permits the contact-free transfer of data and enhances both the efficiency and transparency of processes. We at IBM realized this back in 1992 and designed the first RFID systems in our research and development department. Since then the technology has undergone rapid development. Today, we are working flat out on the development of holistic IT solutions, based on which companies can exploit the potential of RFID on the market. It is already apparent that this basic technology is the inspiration behind a wealth of creative ideas.

This brochure is intended as an introduction to RFID as a driving innovative force and covers the introduction of RFID in the METRO Group – the third-largest trading and retailing company in the world. The initial results are impressive: the manufacturing industry, the trading and retailing sector and consumers all benefit equally from the potential of this new technology. Thanks to RFID, the companies involved operate more efficiently, while at the same time offering their customers a range of novel services in the stores. The close collaboration between the METRO Group and IBM has contributed significantly to the success of the project. Together we have developed new ideas quickly and turned them into marketable products and applications. Proof enough that strategic partnerships can revolutionize processes and thus promote innovations. Our country needs more initiatives like this!

Johann Weihen
Chairman of the Management Board
IBM Deutschland GmbH

A word of greeting

Dear Readers,

In Germany technological progress is synonymous with securing the country's economic future. Only with innovative products and services is it possible to create jobs and safeguard our country's international competitiveness. Today the use of new technologies is also one of the most important competitive factors in trading and retailing, enabling companies to improve both the efficiency of their processes and the service they offer to customers.

Radio Frequency Identification (RFID) plays a special role here. The METRO Group recognized the potential of this technology at an early stage: in November 2004 we were one of the first trading and retailing companies in the world to begin the gradual introduction of RFID along our supply chain. Nowadays, however, no company can hope to establish a technology like this on its own. This is why we are delighted to have won over renowned partners such as IBM to join us in pushing ahead with innovations in the trading and retailing sector. They are collaborating with us on the METRO Group Future Store Initiative. We founded this platform in April 2003 in order to test and further develop forward-looking technical systems in practice.

We seek a dialogue with the various interest groups. High-ranking politicians have already visited our RFID Innovation Center in Neuss, a unique information and development forum, as well as the Future Store in Rheinberg, in order to become acquainted with the benefits and limits of the technology. Together with other visionary companies, leading research institutes and committed politicians, we will continue to turn ideas into marketable solutions in the future.

In all of this we believe it is important to keep our customers, partners and the general public informed about any developments. In the form of this brochure, we would therefore like to present both the RFID technology and the impressive results of our partnership with IBM. We also want to show how RFID can help to make Germany a location that stands for inventiveness and innovation.

Zygmunt Mierdorf
Member of the Management Board
METRO Group

Introduction

Joining forces to boost innovation

The modernization of Germany as a business location is a task that faces the whole of society and requires equal commitment not only from trade and industry but also from research, unions and politics. Because progress is only possible in a climate that both demands and encourages innovations. It was against this background that, in January 2004, Federal Chancellor Gerhard Schröder set in motion the most comprehensive and ambitious progress initiative in the history of the Federal Republic of Germany under the defining title "Partners for Innovation." A coalition of companies, associations and institutions was established that now numbers around 200 members. Its goal is to secure Germany a leading position among the world's foremost technological economies. Promising ideas are to be turned into marketable products in the quickest possible time. This not only calls for the continued improvement of business conditions in Germany. More than anything else, it is essential to capture people's imagination with innovations (see chapter Germany moving into the future).

RFID – one of twelve top issues

In the organization model, the partners work together in 13 closely networked teams – the so-called "Impetus Groups." Each of these groups proposes various projects. By the end of 2004, the initiative presented twelve top issues which it believes hold particular promise for the future. One of these issues is Radio Frequency Identification (RFID), a technology permitting the contact-free transfer of data. The "Partners for Innovation" are convinced that the procedure will revolutionize logistics and merchandise management within the next few years. This is why two of the teams – the Impetus Group for Mobility and Logistics and the Impetus Group for Services – are working on the issue simultaneously. IBM Deutschland makes intensive contributions to the Services team, focusing on four issues.

Future demand will grow

Even today, RFID is being deployed with great success in many areas of life – in the leisure sector, in public libraries or the car industry, for instance (see chapter Key technology RFID). The technology makes it possible to access relevant information at any time and independently of location. For consumers, it means a high degree of security as well as extra service and convenience in the above-mentioned areas. But RFID is also an interesting proposal for manufacturers of technological components and IT service providers. For even now, it is apparent that there will be a growing demand for the relevant hardware and software over the next few years. Worldwide standards for the technology guarantee investment security. Larger order volumes are leading to a drop in prices for system components. At the same time, new areas of application are being developed as costs for initial investments gradually decrease.

Emerging services

The Impetus Group for Services is concentrating its efforts on how to boost the introduction of the technology on the market. In addition, it is committed to ensuring the ongoing development of the technology, and it therefore investigates what innovative products and services will be possible with integrated RFID usage.

It might provide valuable solutions for the tracing of consumer goods, quality assurance for food products or "on-demand" production of goods. In the long term, comprehensive usage of RFID may well give rise to an "Internet of things" – the interlinking of the physical and digital worlds. The Impetus Group describes possible services that could result in the long term. It would for instance be feasible to request products directly by touching the relevant pictures or posters. One thing is certain: the "Internet of things" will give rise to new services, so that each and every one of us has access to information "on demand" – at any time and from any location.

Keeping consumers informed

In order for RFID to be accepted and establish itself on the market in the long term, it is important to provide consumers and users with comprehensive information about the technology and its applications. This calls for more transparent processes and open communication on the part of companies. The customer must be informed as to where and when personal data is recorded and processed. This brochure is therefore also intended to familiarize readers with RFID and instigate a dialogue.

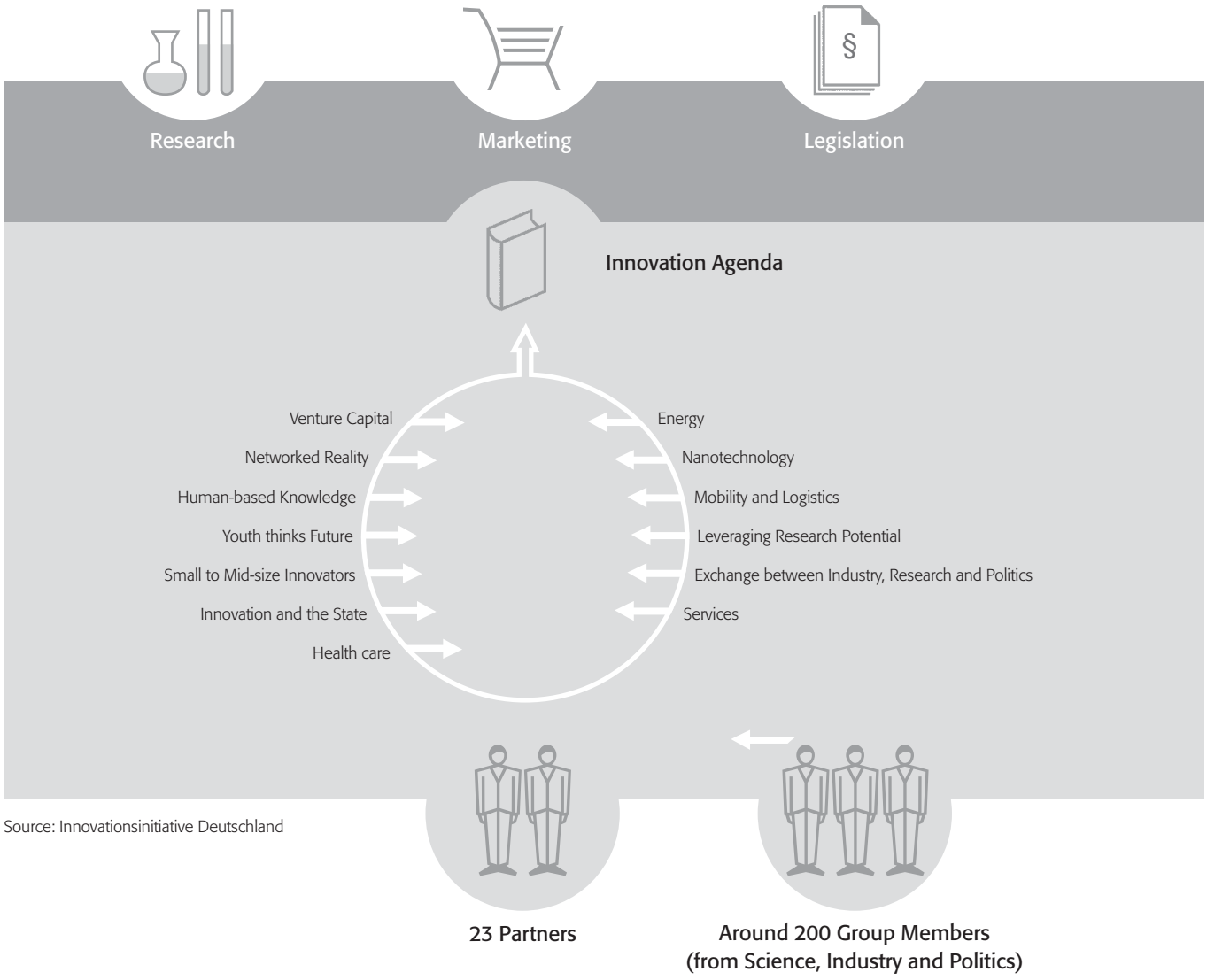
Application of the technology takes place in line with the European data protection regulations and the data protection laws of the Federal Republic of Germany (see chapter Data protection and IT security). Usage of RFID does not therefore require any new action or regulation. In cases where the technology is used in the area of internal production, in logistics or in warehouse management, no personal data is involved anyway. For all other areas of application, the same applies to RFID as to all other communication and information technologies: personal data may only be gathered, processed or stored if the customer has given his prior written consent. International standardization organizations such as EPCglobal not only establish the technological framework for the use of RFID, they are also developing guidelines for data protection. In research projects and on committees, IT developers and users are working continuously to ensure optimal data security.

Boosting the modernization process

If the products and services are to correspond to users' needs, the developers in the research institutes and IT companies must collaborate closely with businesses that use the technologies. IBM has always adhered to this principle. One example of a successful strategic partnership is the METRO Group Future Store Initiative (see chapter Partnership for progress in trade and retail). This unique undertaking is a collaboration of the METRO Group with IBM, Intel, SAP and T-Systems as well as partner companies from the IT sector, the consumer goods industry and the service sector. Its goal is to boost the national and international modernization process and promote innovations in trade and retail.

Many other companies and associations have also founded working groups and initiatives to encourage the usage and ongoing development of RFID (see chapter Promoting innovation throug networking). There is political support for this commitment as well: various German ministries have classified relevant projects as worthy of sponsorship. For even today, it is already apparent that the technology is the basis for generating new jobs and developing new service products. The politicians' task is to create the appropriate economic conditions. The authors of this brochure have outlined the greatest challenges and possible next steps (see chapter Possible issues for political focus).

An overview of the "Partners for Innovation" initiative



Source: Innovationsinitiative Deutschland

Germany moving into the future

Germany already plays a leading role in technological development in Europe. The country enjoys an extraordinarily high density of companies that generate innovative business ideas, with six of the 20 enterprises that register the most patents based in Germany. In terms of investment in research and development as well, an important indicator of innovative impetus, German businesses lead: R&D accounted for 2.5 percent of the gross domestic product in 2002 – more than in most OECD and EU countries. Further advantages that characterize the Federal Republic are its many reputed research institutes and its highly specialized industry suppliers.

Mid-size enterprises play a key role in information technology. They continue to make up the backbone of the German economy: roughly 3.3 million small to mid-size companies employ more than 23 million people – two thirds of all job holders. Businesses of this size have especially great potential for rapidly transforming technological visions into marketable products and creating future jobs.

A technology for today and tomorrow

Innovations are new ideas successfully realized. They flourish where inventiveness and industry know-how meet. New technologies act as a catalyst for innovation in the manufacturing and service sectors. Radio Frequency Identification (RFID) is a prime example. Although the technology was developed as early as the 1940s, only in conjunction with integrated information systems has it begun to realize its full potential for industry and service applications. Germany currently plays a leading role in the development and deployment of RFID in the service sector. RFID is poised to raise the overall level of innovation and to contribute to the competitive strength of the German economy.

RFID is a source of considerable economic potential, with opportunities not only in the service sector, but also for applications in a wide range of business areas. The technology allows data transfer without physical contact. Information of all kinds can thus be processed, regardless of spatial distance, timeframe and volume. The Federal Ministry of Economic Affairs and Employment has made this technology one of its main priorities. The Ministry has judged various RFID projects involving respected research institutes and leading IT companies worthy of its support.

In the trade sector, for instance, RFID can help optimize service for the consumer. Improved processes and warehouse management ensure that customers always find the desired products on the store shelf. Product safety can also be further optimized. Consumers are given access to extensive data on ingredients and production methods. RFID facilitates a range of services that meet the needs of our increasingly mobile society. At some point in the future, for example, the consumer will be able to let the Smart Fridge write a shopping list and then transfer it electronically to the supermarket. A high level of service is also important in view of Germany's demographic changes. The technologies make shopping more convenient for older customers, the main reason being that employees are afforded more time to offer service and information – because they are freed from routine tasks. In addition, further qualified employment opportunities are created for people with specialized know-how. RFID is not only of interest to large companies: the technology also presents an opportunity for mid-size businesses. They too can utilize RFID to optimize processes and reduce costs, thus securing competitive advantages at an early stage.

Forecasts for the further development of the RFID market are promising. For example, the business consultancy Frost & Sullivan expects the international RFID sector to grow at an average rate of 32 percent up to 2010. In this manner, the technology will not only create a framework for further advances, it will also contribute to the innovative capacity of the European single market. A study conducted by PricewaterhouseCoopers even regards support of RFID-based Smart Chip technology as a step toward meeting the goals of the Lisbon Accord.


NESCAFÉ
GOLD

Key technology RFID

What is RFID?

The abbreviation RFID stands for Radio Frequency Identification. It is a technology that permits the contact-free transfer of data via radio signal. The heart of the RFID technology used today is an RFID transponder, a tiny computer chip that also contains an antenna. For the most part, the consumer goods industry uses RFID transponders integrated into extremely thin labels. They are e.g. attached to logistic units such as pallets or cartons.

Some form of number code is generally stored on the transponder. It encrypts information which is recorded in a database for access by authorized users. International organizations such as EPCglobal are working to establish uniform worldwide standards for this number code. The aim of these efforts is to standardize the form of encryption and syntax employed by all users of RFID technology to record information. Through this uniformity, data exchange is to be simplified. EPCglobal seeks to promote the so-called Electronic Product Code (EPC). Among other data, this code contains the European Article Number (EAN), which appears on packaging in the form of a barcode, and a nine-digit serial number.

By means of the EPC, every logistic unit fitted with an RFID transponder is assigned an unmistakable identity. The code can be registered by an RFID reader without visual contact. For this purpose, the device creates an electromagnetic field that is received by the RFID transponder's antenna. The transponder then transmits the EPC to the reader. Depending on the frequency range, the data can be read at a distance of a few centimeters or up to several meters. With the aid of special application software, information such as price, weight, best-before date, the date of manufacture or the product manufacturer can be assigned to the code.

There are both active and passive RFID transponders. Passive transponders do not have their own energy source – they are activated by the radio frequency field emitted by the antenna of the RFID reader. These chips are intended for deployment in the consumer goods industry and trade sector. In contrast, active transponders have their own power supply. Data stored on active transponders can be read at a much greater distance. Many toll systems, for example, function on this principle.

Where is RFID used?

Today RFID has already entered many areas of public life. In individual market segments, companies and public institutions have been benefiting from the advantages of the technology for decades.

Industry

Car manufacturers use RFID technology in their vehicles' immobilizers: the car owner's key is equipped with an RFID transponder. The antenna of the RFID reader is built into the ignition lock and connected to the vehicle's engine electronics. When the driver approaches his car, the door is unlocked and the electronics are released. If the driver removes the key from the lock and moves away, the car's entire electronic system is deactivated. Unlike mechanical and electronic alternatives for securing the vehicle, the immobilizer can no longer be activated by simply short-circuiting or severing individual cables.

The pharmaceutical industry uses RFID to tag medicines. According to an estimate by the World Health Organization (WHO), between five and eight percent of all medicines traded worldwide are forgeries. Thanks to RFID, patients can be protected from such plagiarisms that can be life-threatening. In addition, RFID technology can help ensure that all types of medication prescribed to the patient are compatible with each other.

Public institutions

Libraries and museums rely on RFID to offer their visitors greater convenience: library users can borrow books, films and CDs fitted with RFID transponders independently, conveniently and fast. Carrying the selected media, they simply walk by an RFID reader that recognizes all RFID transponders simultaneously. Waiting times at the counter are a thing of the past. In addition, libraries benefit from the improved safeguarding of their lending media since no books can be removed without being noticed.

In museums visitors can use a small computer, a so-called Personal Digital Assistant (PDA), to access background information about exhibits that have been fitted with RFID transponders. The curators of the exhibition for their part receive data on which information is most often called up. This makes it easy to identify the exhibits that are of particular interest to the public and enables the organizers to tailor the exhibition to visitors' requirements.

Science

Biologists use RFID to investigate the behavior of bees. Tiny chips attached to the creatures' backs use radio signals to provide information on the activities of the insects. As soon as a bee leaves the hive with its RFID transponder, it is registered by a reading device. This process is repeated at the feeding place and again when the bee returns to the hive. Thus, with the aid of RFID, it is possible to investigate the activities of an entire bee colony.

Genetic researchers have also discovered the benefits of RFID: they use RFID transponders to monitor the growth of genetically modified trees. The system is far superior to the marking methods used in the past because the transponders can no longer be removed by unauthorized persons. After some time they are completely surrounded by tree bark and thus protected from environmental influences. The transponders continue to be fully functional and readable.

Areas of application for RFID – an overview

Who		Where	Benefits	Additional Information
Public Institutions	Libraries	Lending system	• Theft protection • Faster lending procedure	www.buechereien.wien.at
	Museums	Exhibits	• Visitors can use a Personal Digital Assistant (PDA) to call up information	www.naturhistoriskmuseum.dk
	Military	Control of supplies	• Visibility, efficiency	www.darpa.mil
Science	Universities	Behavioral biology	• Observation of bee colonies	www.uni-wuerzburg.de
		Genetic research	• Growth monitoring of genetically modified trees	www.cfr.washington.edu
Industry	Car industry	Immobilizers	• Theft protection	www.bmw.de
	Air traffic	Baggage handling at airports	• Security	www.fraport.de
	Pharmaceutical industry	Product tagging	• Tracing of medicines • Protection from product piracy	www.aventis.de
Leisure	FIFA World Cup 2006	Tickets	• Increased security in stadiums • Curbing of black market trade	www.fifaworldcup.yahoo.com
	Winter sports	Ski passes	• More convenient checks at lift stations	www.seilbahn.net
	Marathons	Participants' shoes	• Exact recording of times • Prevention of cheating	www.vienna-marathon.com

Source: IBM/METRO AG 2005

Leisure

Thanks to RFID, skiers no longer have to get their passes out of their ski suits at the entrance to the lift station. Readers register the passes fitted with RFID transponders without the need for contact and allow the skier to pass through the turnstile.

Tickets for the World Cup 2006 in Germany will also be equipped with RFID. The organizers intend to use the personalized tickets to stop black market trading and improve security in the stadiums. Security is one particular field where users from various sectors are hoping to benefit from a wide range of other RFID applications.

Why is the trade and retail sector counting on RFID?

The entire consumer goods sector has been undergoing a far-reaching process of change for several years. Altered customer expectations as well as economic and political conditions call for a high degree of flexibility and innovation. The use of new technologies for process optimization is a crucial competitive factor. For this reason, the trade sector and consumer goods industry have been exploring the potential of the technology applied to their processes for a number of years. With the help of RFID, they aim to improve efficiency and product safety, while at the same time raising the level of customer satisfaction. That is why experts believe that RFID will change trading and retailing processes just as fundamentally as the introduction of the barcode did in the 1970s.

From the producer to the point of sale

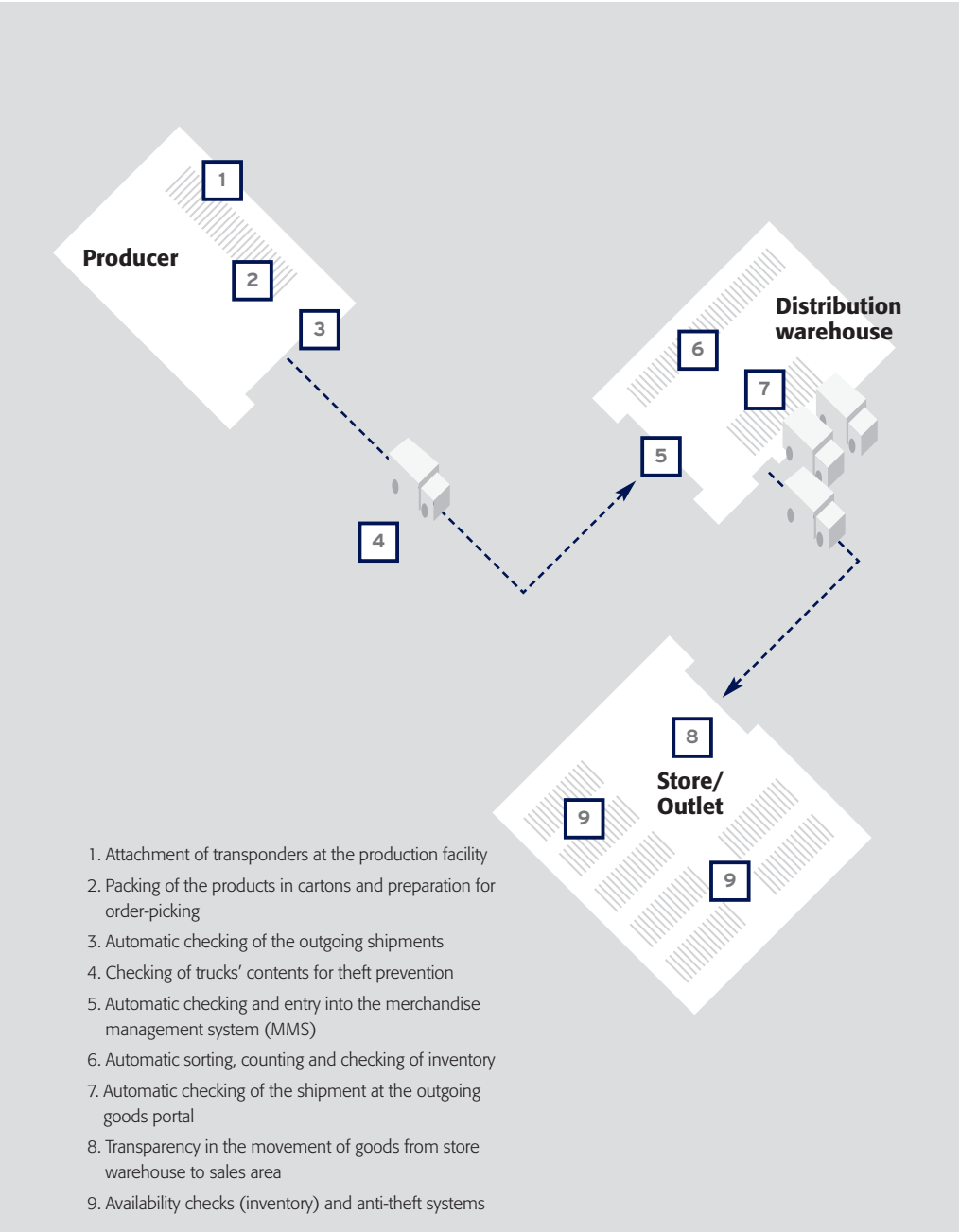
Up until now the trading and retailing sector has been using RFID in segments of the supply chain, i.e. in logistics and inventory management in the stores and outlets. Before a product is offered for sale on a store shelf it has traveled a long way: from producer to distribution warehouse and on to the retail outlet. In future RFID will facilitate automatic monitoring and documentation of the flow of goods and bookkeeping entries along the entire supply chain.

Cartons and pallets are equipped with RFID transponders at the manufacturing facility. An RFID reader installed at the outgoing goods portal checks the logistic units and transfers the data to the merchandise management systems of the producer and the retailing company. Within seconds, the packed goods are thus compared to the order placed and approved for shipment.

A delivery truck transports the merchandise to a distribution warehouse. Here again, RFID readers accelerate the incoming and outgoing of goods. They scan the information stored on the transponders affixed to the cartons and pallets. The logistic units are thus effortlessly sorted according to their respective destinations and loaded onto trucks. In the warehouses, the forklifts as well as high shelves are equipped with RFID technology. This facilitates correct placement of the cartons and pallets. Once the merchandise has been prepared for shipping, further checks are conducted at the outgoing goods portal, automatically and without contact. The distribution center then transfers the data electronically to the merchandise management systems of the retail outlets.

During unloading of the truck at the incoming goods portal of the supermarket or department store, an RFID reader registers the cartons and pallets. The merchandise management system compares the data collected to goods ordered. Here as well, forklifts and high shelves equipped with RFID technology help staff ensure that the merchandise is sorted into its intended place. Employees are thus able to quickly and precisely locate the pallets and cartons at all times. As soon as the logistic units are brought into the sales area, RFID readers again scan the EPCs stored on the transponders. The merchandise management system immediately records the movement of the goods.

Vision for the future: RFID – from the producer to the point of sale



1. Attachment of transponders at the production facility
2. Packing of the products in cartons and preparation for order-picking
3. Automatic checking of the outgoing shipments
4. Checking of trucks' contents for theft prevention
5. Automatic checking and entry into the merchandise management system (MMS)
6. Automatic sorting, counting and checking of inventory
7. Automatic checking of the shipment at the outgoing goods portal
8. Transparency in the movement of goods from store warehouse to sales area
9. Availability checks (inventory) and anti-theft systems

Source: IBM/METRO AG 2005

Experts anticipate that the usage of RFID transponders on individual product packages will not achieve total coverage until the middle of the next decade. Since deployment of the technology is regarded as growing at an exceptionally fast pace in trading and retailing, this sector is used as a model below to illustrate the benefits of RFID for all involved. The opportunities that arise here are easily translated to applications in other economic sectors. The benefits that have been realized at this stage result from deployment of RFID transponders on logistic units. In addition, the technology holds further potential for the future, when transponders are deployed on retail units – i.e. directly on merchandise offered for sale to consumers in stores and outlets.

Benefits for the customer

Customer needs are the decisive factor when it comes to new concepts in the trading and retailing sector. With the aid of RFID technology the industry is far better equipped to meet these changing requirements.

Benefits today:

- Improved availability of goods in stores and department stores. RFID technology enables retailers to conduct real-time checks on stocks of merchandise equipped with transponders.

- The merchandise management system signals in advance when stocks of a certain product are running low. The responsible employee places an order at an early stage, and the customer almost never faces an empty shelf.

- The system automatically recognizes which pallets and packages are about to reach their best-before date: staff can order new goods in time so that fresh, high-quality groceries are always available to the customer.

Benefits for the future:
In future, the use of RFID technology at product level will result in the following benefits for the sector:

- Product safety will increase: via Information Terminals, customers will be able to trace the various manufacturing stages of grocery products. When buying eggs, for instance, they could call up precise information on the laying date, the laying company, how the chickens are kept and what they have been fed.

- Exchange procedures will be more convenient: the customer will be able to exchange goods or claim on a guaranty without having to show the sales receipt. Product data such as the date of sale is stored in the merchandise management system of the supermarket or outlet.

- People who suffer from allergies will enjoy improved quality of life: by means of a mobile telephone equipped with an RFID reader, which recognizes the Electronic Product Code of a product, the customer accesses product data warning of any ingredients that might cause an allergic reaction.

Benefits for the trade and retail sector

With the aid of RFID, processes in the trade and retail sector will become more efficient. The new technology means that the entire supply chain is easier to monitor – from the production site all the way to the sales floor.

Benefits today:
- It is possible to ascertain at any time which point of the supply chain the goods have currently reached. This increases transparency and enhances product safety.

- Staff benefit from fast, straightforward incoming and outgoing goods processes.

- Staff is always up-to-date on stocks and the location of goods in the warehouse. Staff can restock shelves in good time and reorder goods according to requirements. Reliable stock control means that average inventory levels can be reduced efficiently.

- Increased availability of goods improves customer service and customer loyalty. In the long term, this will lead to an increase in sales and higher market shares.

Benefits for the future:
In future, the use of RFID technology at product level will result in the following benefits for the trading sector:

- Products spoil less often because their best-before dates are checked automatically.

- Product loss is reduced because RFID transponders also support anti-theft systems.

- The time-consuming process of counting merchandise becomes superfluous. The merchandise management system automatically monitors stock levels, allowing staff to take inventory on a constant basis.

Benefits for the consumer goods industry

RFID simplifies and accelerates merchandise management for companies from the consumer goods industry.

Benefits today:

- Based on RFID technology, processes can be fully automated and conducted simultaneously: picked goods are reconciled to the order and released for transport. At the same time, outgoing goods are booked in the merchandise management system of the manufacturing company, and the retailer receives an electronic dispatch note.

- Stocks of goods in the warehouses and supermarkets can be called up at any time. This way, consumer goods manufacturers can plan their production capacities in line with requirements, avoid supply bottlenecks and reduce the number of incorrect deliveries to supermarkets and outlets.

- Thanks to optimized inventory management at the retail outlets, out-of-stock situations in the supermarkets and outlets are avoided. There is a decline in the amount of sales lost due to stock deficiencies.

Benefits for the future:

- RFID provides protection against forgeries and plagiarism because it permits the seamless documentation of entire production and supply channels. This applies both to complete deliveries and – in future – to individual high-value products.

Leading international companies in the trading and retailing sector, such as the METRO Group, the American retail group Wal-Mart and British retailer Tesco, have recognized the potential of RFID and already started to introduce the technology. These three companies together account for almost half of global sales in food retail.

Introduction of RFID technology in the trading and retailing sector

METRO Group	Wal-Mart	Tesco
November 2004: RFID-tagging of the pallets of approx. 20 partners in the consumer goods sector.	**January 2005:** The 100 biggest suppliers fit pallets and cartons for three warehouses in Texas with RFID transponders.	**November 2004:** Labeling of cartons with RFID, continued in February 2005.
Planned to start in January 2006: Step-by-step expansion of supplier portfolio and involvement of further stores and outlets.	**Planned by the end of 2005:** Use of RFID technology in 12 warehouses and 600 stores.	**Planned by January 2007:** Labeling of all deliveries along the entire process chain with RFID.

Quelle: IBM/METRO AG 2005

In international committees and standardization organizations, they have committed themselves to the rapid and comprehensive introduction of RFID throughout the entire sector. According to appraisals by the Boston Consulting Group, the market force of these pioneering companies will in itself ensure that usage of RFID in the trading and retailing sector will soon develop a strong momentum.

A technology opens up new perspectives

Considering the manifold benefits of RFID, deployment of the technology is inevitable in diverse sectors within the short term. This holds especially for applications in which

- a higher level of automation results in more efficient processes;
- data must be handled with great precision;
- information is exchanged automatically;
- utmost security is called for;
- the physical parameters of the environment favor deployment of the technology;
- convenience plays an important role for the customer.

Beyond the current areas of deployment described, in the near future RFID implementation will be launched in a number of other sectors. The technology will be utilized to streamline processes in the following areas within the next three to five years:

- In the consumer goods industry, to ensure traceability of food products in compliance with EU Directive 178/2002
- In the pharmaceuticals industry, to positively identify medications
- In the manufacturing sector, e.g. to trace components and additives
- In the security service sector, to improve authorized access control and thus better protect private citizens, companies and public buildings

Visions for greater convenience and safety

In the long term, once its potential for boosting efficiency has been largely realized, RFID will give rise to entirely new services and areas of application. Then the truly revolutionary aspect of the technology will come into being: RFID forms the basis for the much-quoted "Internet of things." Outfitted with transponders, objects are able to communicate with each other. This creates a connection between the physical world and the digital world. Intelligent merchandise, for example, knows its way through the supply chain: information stored on transponders enables products to autonomously control conveyor systems or other machinery.

The four scenarios below illustrate visions for a distant future. They are all based on the premise that consumers will one day be equipped with intelligent mobile telephones. As early as 2004, Nokia became the first manufacturer to introduce RFID readers for cell phones.

Scenario I

The pharmaceutical industry makes increased use of RFID to protect consumers from plagiarized and counterfeit products. For this purpose, RFID transponders are affixed to the packaging of medication. Mobile telephones equipped with RFID readers are able to scan the data stored on the transponders. The ingredients of the preparation are then compared via Internet with a strictly confidential list of components that might cause a reaction, accessible to the patient and his physician exclusively. Dangerous interactions with other medication or possible allergic reactions are identified immediately. Protection of the consumer's health is significantly improved. The customer has the option of deactivating the transponder before leaving the pharmacy.

Scenario II

RFID has the potential to optimize the customer service of public transport systems in future. The customer holds a cell phone with an integrated RFID reader up to the schedule at the bus stop. The display of the phone informs him that the next bus to his destination will arrive on time in seven minutes. On arrival, the customer passes his cell phone over the schedule for the bus in the opposite direction. Before catching the bus back home, the customer uses his phone to send a request for information, and learns that the bus is running late. He can take his time before returning to the bus stop.

Scenario III

For the marketing and advertising industry too, RFID opens up new channels for addressing consumers. An outdoor poster with an integrated RFID transponder, for instance, could enable users of RFID cell phones to access information on the advertised products, movies or concerts at the push of a button. A further possibility: transmission of Internet addresses, where the user could order electronic tickets for admission. The charges would appear on the user's mobile telephone bill.

Scenario IV

Retailers can leverage RFID to offer their customers better service than ever before. With the help of an RFID-equipped cell phone, a customer could scan the products he wishes to restock at home and then send the list of items electronically to a supermarket near his workplace. A store employee assorts the purchases for him and places them in a refrigerated locker, to which the customer has access even after working hours. After a long day at work, the customer quickly picks up milk and cereal for breakfast the next morning. He saves time and shops at his convenience, regardless of opening hours.

Beyond these scenarios, RFID holds a great deal of promise in conjunction with sensor technology, which could potentially close the gap between the digital and real worlds. Supported by RFID, traffic telematics can optimize the flow of traffic, for instance. But Friedemann Mattern at the Institute for Information Systems of the

Swiss Federal Institute of Technology (ETH) in Zurich has even more spectacular visions: he proposes that objects could learn to "speak" to blind people, by transmitting information to a blind person's white cane. The cane then converts the data into speech. In Mattern's world, furnishings and appliances can even communicate among each other. A carpet with an integrated transponder, for example, is able to "tell" a vacuum cleaner equipped with an RFID reader precisely when it was last cleaned as well as which areas are heavily soiled and might require shampooing.

The next development stage

The examples presented in these scenarios reflect a typical development cycle for a service-oriented innovation. RFID not only boosts efficiency in the processes looked at here. In the second phase of its deployment, the technology optimizes data collection, product quality and overall service performance – and thus ensures greater customer satisfaction. At the same time, it opens up new horizons for application in other sectors. In the third and final development phase, RFID paired with sensor networks will create a new generation of services and entirely new business models. Once machines are able to tell us what their operating capacities are, when they require maintenance and what problems could arise in the near future, it will be possible to market more than just products: companies will be able to sell all-encompassing services. A similar course has been observed with the computer hard drive, developed by IBM in 1956. It allowed far greater efficiency in storing, administrating and accessing data than ever before. IBM was thus responsible for a milestone in the computer industry. The invention of the hard drive acted as a catalyst for further innovation, providing a basis for services such as external backups. In comparison, RFID has an even greater potential to become a basis technology for the dynamically growing service sector – and a driving force for the German economy.

Privacy and Data security

Data protection – in the best interest of consumers

In future people will profit from RFID in many areas of their lives. However, acceptance of the technology throughout society is a prerequisite for its wide-scale application to the benefit of all concerned. In order to learn to trust a new technology, consumers must first develop an understanding of how it functions and what benefits it offers them. The developers and users of the technology have a responsibility to inform the public and at the same time to take people's concerns and worries seriously. In this regard, protection of consumers' privacy and personal data is of great significance.

RFID and privacy in retail

By means of RFID, it is possible to collect data stored on transponders within an extremely short time. Since, in contrast to conventional scanning processes, the data transfer takes place without physical or optical contact, fears have been raised that consumers could unknowingly and unwillingly reveal personal data. However, this concern is unfounded regarding RFID in retail. Privacy regulations are irrelevant to deployment of the technology in this sector.

RFID transponders on logistic units

The issue of privacy does not apply to the application of the technology in retail, as RFID implementation is currently limited to the supply chain, i.e. logistics and warehouse management. The consumer does not come into contact with RFID during shopping, with the exception of a few pilot projects conducted by the industry.

RFID transponders on products

For the near future it will remain economically unfeasible to deploy RFID transponders at the individual product level for the majority of companies in the consumer goods industry. Today only a handful of retailers and manufacturers affix RFID transponders to selected products in the context of pilot projects. These involve predominantly high-end consumer goods – e.g. television sets – and designer products. In all cases, the application of the technology is in full compliance with privacy regulations. The Electronic Product Code (EPC) stored on the transponder records product- and process-related information exclusively. No personal information regarding the customer is stored on the transponder, nor is such data collected by means of RFID. Notably, retailers do not use RFID to create customer profiles. The customer cannot be identified via the EPC, and thus remains anonymous as defined by data protection laws.

In any case, to collect all information stored on the transponders using large numbers of RFID readers, then processing it in data management systems is neither technically nor economically feasible for retailers. Experts estimate that to employ RFID technology for all transactions of a single company such as the METRO Group, nine terabytes of data – the storage capacity of 13,000 CD-ROMs – would have to be processed per second. Customers can profit from practically all advantages of RFID technology, e.g. optimized product traceability, without submitting personal data. In trade and industry, the EPC enables companies to determine the precise location of a certain pallet at all times as it moves along the supply chain. Should it be necessary, faulty products can be quickly and reliably withdrawn from store shelves. This ensures the consumer optimum product safety.

The consumer decides for himself

In the public discussion, the deployment of transponder technology is often associated with customer cards. However, RFID implementation is strictly separated from customer data collection in the context of so-called Customer Relationship Management programs. Privacy laws in effect include special regulations to safeguard personal information in terms of collection, processing and use. The transponders are not used to store personal data, but rather encrypted product and process information only. Personal data can become relevant only in the payment process and in conjunction with customer cards, e.g. when a customer takes advantage of a discount. The same data protection legislation applies to this process as to the familiar process of scanning conventional barcodes or customer card usage. It is of no significance whether the price information required for a rebate is accessed via EPC or

barcode technology. Data protection is safeguarded by various general and sectorspecific laws. In Germany, the regulations applicable to the use of customer cards in retail are contained mainly in the federal data protection laws (BDSG), that implement EU Directive 95/46/EC. This applies regardless of the technology employed. The German BDSG laws contain legislation that safeguards the interests of the customer wherever RFID is deployed. They give ample consideration to the concerns associated with RFID. In particular, the following holds:

- In accordance to Section 4 of BDSG, collection, processing and storage of data are admissible only with prior **written consent of the consumer** or with legal authorization in cases that require data collection and processing in order to fulfill a contract or to safeguard justified interests of the company, provided the customer has no overriding legitimate interest (Section 28, Paragraph 1, BDSG).

- BDSG requires that **transparency be maintained in data collection**. The consumer must be notified as to which data are collected for what purpose and in what manner they will be used (Section 4 BDSG, regarding informed consent; Section 33 BDSG).

- The consumer has the inalienable right to **withdraw his consent** at any time and to demand the erasure of his data.

Retailers are required to adhere to these regulations. Consumers wishing to participate in customer loyalty programs give express consent to the collection of their data in the context of shopping and taking advantage of discounts.

RFID and privacy in other areas

In everyday life, the consumer already encounters RFID systems that refer to personal data. For example, ski lift passes and membership cards in wellness clubs often function on this principle. In these cases too, federal data protection laws entrenched in EU Directive 95/46/EC guarantee ample security.

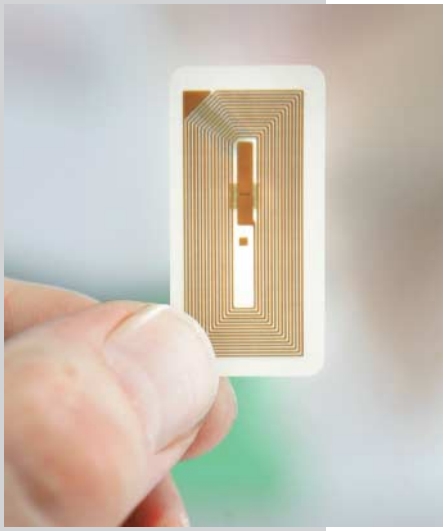
Guidelines for optimum data protection

Over and above the legal requirements, members of EPCglobal, the international organization dedicated to standardization, have made a voluntary commitment to uphold certain principles in communications with consumers.

The following is a summary of the consumer protection guidelines of EPCglobal:

- **Consumer education**
  Consumers will have the opportunity easily to obtain accurate information about EPC and its applications, as well as information about advances in the technology. Companies using EPC tags at the consumer level will cooperate in appropriate ways to familiarise consumers with the EPC logo and to help consumers understand the technology and its benefits. EPCglobal would also act as a forum for both companies and consumers to learn of and address any uses of EPC technology in a manner inconsistent with these guidelines.

- **Consumer notice**
  Consumers will be given clear notice of the presence of EPC on products or their packaging. This notice will be given through the use of an EPC logo or identifier on the products or packaging.

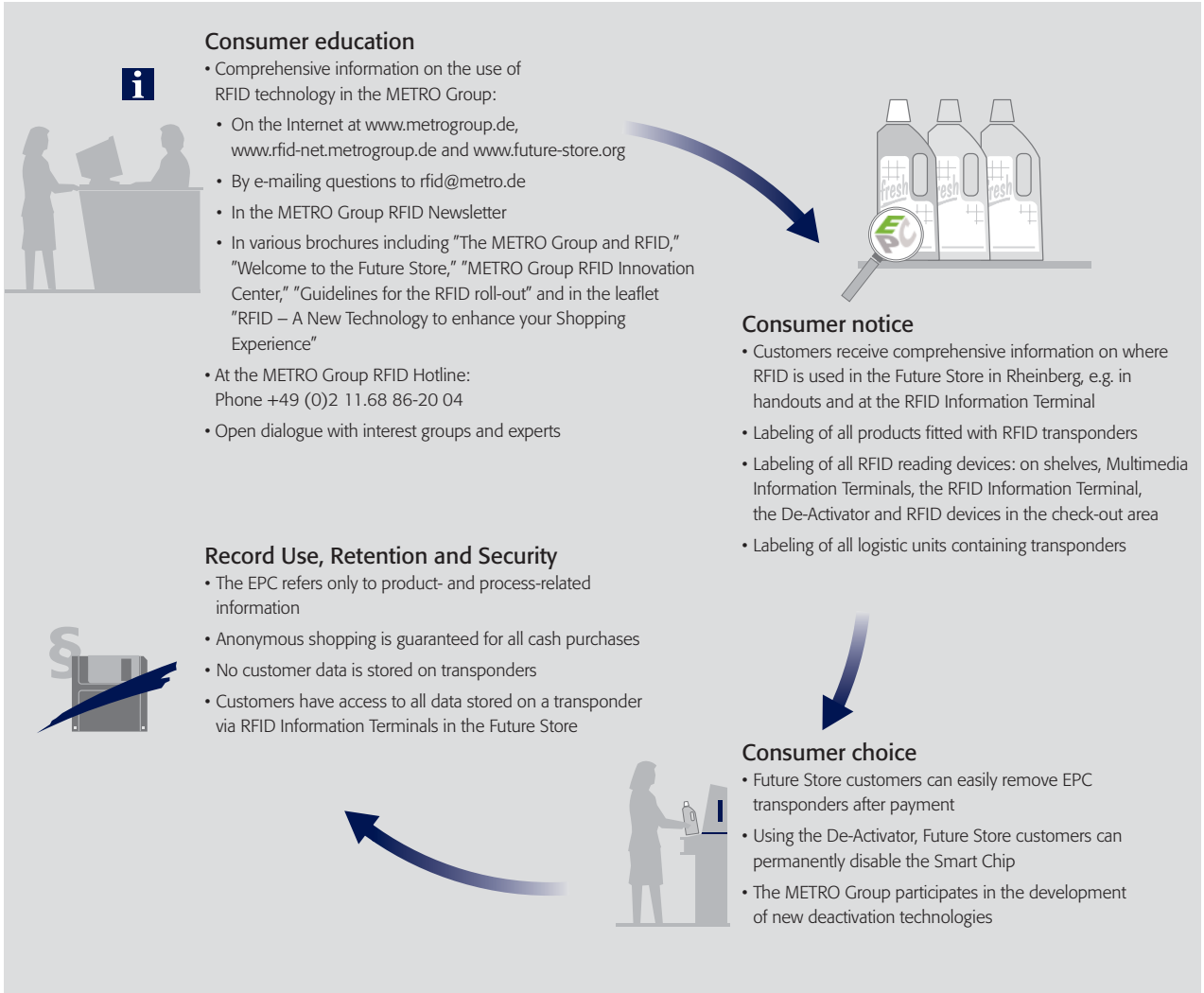


- **Consumer choice**
  Consumers will be informed of the choices that are available to discard or remove or in the future disable EPC tags from the products they acquire. It is anticipated that for most products, the EPC tags would be part of disposable packaging or would be otherwise discardable. EPCglobal, among other supporters of the technology, is committed to finding additional efficient, cost effective and reliable alternatives to further enable customer choice.

- **Record use, retention and security**
  The Electronic Product Code does not contain, collect or store any personally identifiable information. As with conventional barcode technology, data which is associated with EPC will be collected, used, maintained, stored and protected by the EPCglobal member companies in compliance with applicable laws. Companies will publish, in compliance with all applicable laws, information on their policies regarding the retention, use and protection of any personally identifiable information associated with EPC use.

These regulations form the basis for an open dialogue with consumers and ensure transparency in RFID deployment. The voluntary commitment is intended to help consumers, retailers and consumer goods manufacturers take full advantage of the opportunities presented by RFID technology. EPCglobal will continue to expand and modify its guidelines, keeping pace with the ongoing development of the Electronic Product Code. The METRO Group is one of the first trade and retail companies worldwide to implement the EPCglobal guidelines.

EPCglobal guidelines in the METRO Group



Source: METRO AG 2005

Data security – technical solutions

In order to exploit the full innovative potential of RFID, data has to be protected from unauthorized access. This applies to information on goods or merchandise as well as to coded personal data used for example in access permits for a company's site or premises. It is essential to recognize what kind of manipulation is feasible and develop effective countermeasures before the technology is implemented. According to experts, adequate possibilities for blocking access to information by non-authorized third parties already exist.

It is generally true to say that the security requirements for IT systems grow in relation to the protection-worthiness of the information they manage. The higher the requirements, the more complex the technical solution must be. This in turn means higher costs for the operator. Companies decide what organizational effort and financial outlay are appropriate for protecting their IT systems depending on their field of activity and the type of data concerned. Independently of these considerations, users of the technologies are legally bound to observe the strict privacy laws that have been put in place to safeguard consumers' welfare. Yet in the opinion of many trade and retail companies, the Electronic Product Codes (EPCs) used on pallets or boxes do not necessarily require such protection, as the number code merely refers to process and product information which, in isolation, is of no value to third parties.

Prerequisites for the security of IT systems

The security of RFID systems and the data stored in them is generally based on the following prerequisites:

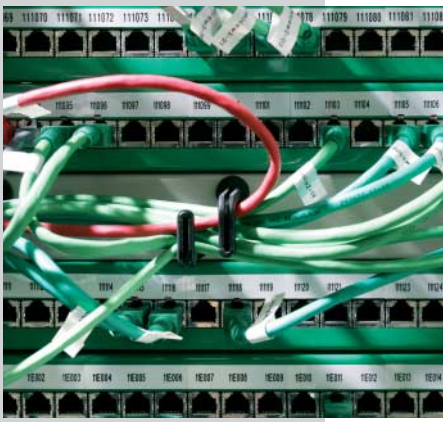
- The RFID transponder carries an unequivocal and unique identification number which can either be the standardized Electronic Product Code or a different type of bit pattern. The latter can be interpreted in such a way as to yield a combination of numbers or letters.

- While activated, the transponder is allocated to a single object only. This means that the information stored on the chip cannot simultaneously serve as a reference for various items.

- Only authorized readers obtain access to the data stored on the RFID transponder.

- There are authorization procedures to protect communication between readers and the IT system from interception, manipulation of the data during transport or false identities.

- Security software must be used to protect the readers and the IT system from manipulation of the operation code by hackers.

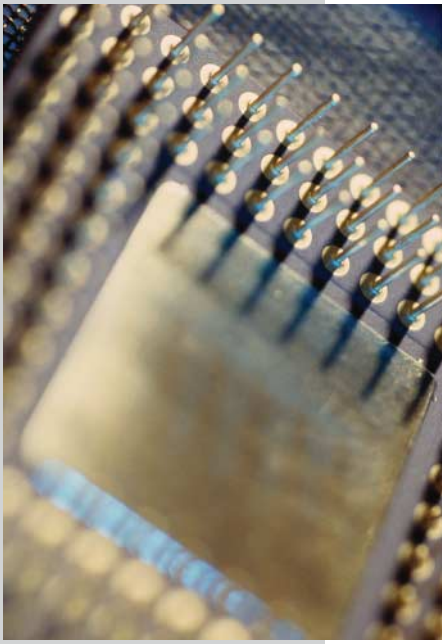


- Users' access codes and passwords must be safeguarded against unauthorized access.

- Special security concepts grant access to the data in the RFID system exclusively to persons with a "need-to-know" status.

Technical weak points and their solutions

The essential elements of an RFID system infrastructure are the transponders, the readers and the supporting IT system. It is possible to prevent conceivable potential threats to hard- and software by taking technical precautions. This conclusion is drawn in two studies conducted by the Federal Office for Information Security (BSI) in collaboration with the Institute for Futures Studies and Technology Assessment (IZT) and by the Swiss Federal Laboratories for Materials Testing and Research (Empa). Furthermore, it would require an extremely high level of technical and business know-how on the part of unauthorized persons to counterfeit transponders, manipulate communications between transponder and reader or obtain access to the IT systems. Nevertheless, the following section presents some of the weak points that are currently the subject of public debate and the corresponding technical security precautions.



Security of the RFID transponders

As a rule, the transponders store number codes relating to information about objects and processes in a database. If a person without authorized access were to succeed in altering the data on RFID transponders, false information could be passed to the reader. This kind of **data manipulation of RFID transponders** can be prevented by using write-protected chips, so-called read-only transponders. In addition, further security is provided by chips that only release data when they receive the right password from a reader. Detectors are now also available on the market for localizing unauthorized read-write devices that attempt to access the chip.

Besides the possibility of manipulating data content, **replication of an RFID transponder's identity** is also feasible. This would first require the forger to capture its data content. He would then use this information either to feign the identity of the original transponder ("emulation") or duplicate the transponder ("cloning"). Here automatic security checks by the IT system offer effective protection: they detect false transponder identities by comparing the identification number with the data stored in the IT system. It involves following the data traces the transponder has left behind on its way through the supply chain. This process detects all identities that occur more than once. If the same number code stored on a transponder suddenly appears twice, there is in all probability some inconsistency.

Far less effort is required to **remove an RFID transponder from one object** and attach it to another – in the same way as price labels can be swapped. This would give an object a new identity. Faking the delivery of a shipment is one possible scenario, as is the false labeling of products, resulting in a lower retail price. To prevent this type of manipulation, manufacturers are working on the integration of transponders into the packaging or directly into the product (say, a notebook computer) during production. And product developers are working on a special sealing function: any attempt to remove the RFID label will damage it and render it useless. In the case of active RFID transponders such as those used in container logistics, an alarm function is feasible: a sensor recognizes that the transponder has been manipulated and auto-saves this information, then transmitting it to an RFID reader within its range.

Security of communications between reader and transponder

Special RFID readers are used to register the number codes on the transponders. Skeptics describe scenarios in which non-authorized persons **intercept and decode radio waves,** thus gaining access to information. However, in the case of passive RFID systems, this is very difficult if attempted from a distance, because the transponder's return signal to the reader is far weaker than the signal transmitted by the reader itself. Furthermore, a secure RFID system requires a reader to prove its reading authorization to the respective RFID transponder by means of a special password or coding system. This makes it impossible for unauthorized third parties either to capture the data stored on the transponders or enter false data into the IT system.

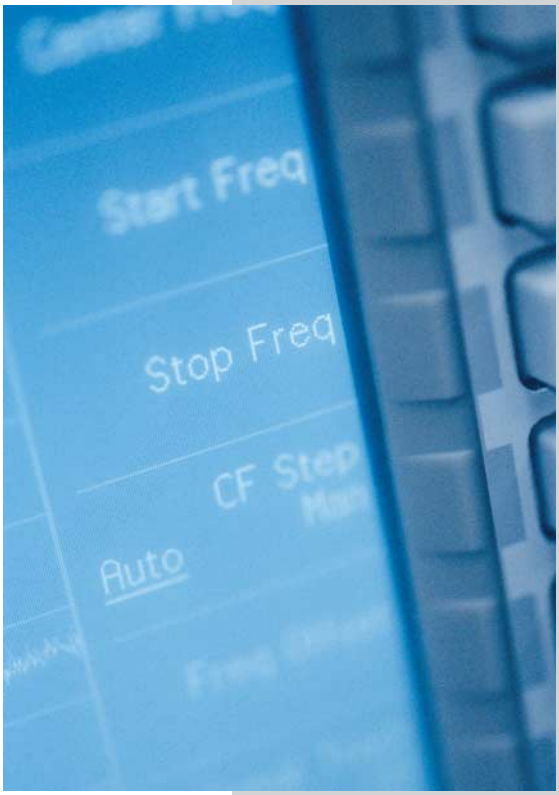
In general, experts advise against storing any protection-worthy or valuable information on a simple RFID transponder, apart from the identification number. The number code alone is of little use to anyone who reads it without permission, as the data allocated to the number code is stored in the IT system and cannot be read without authorization. In the case of RFID applications that store relevant contents on the transponders themselves, coded transmission is both possible and advisable.

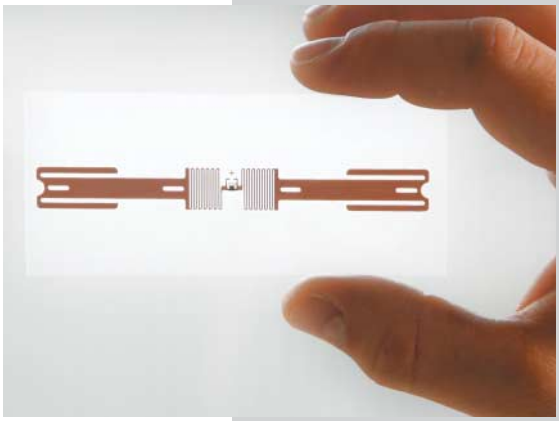
Powerful **jamming transmitters and blocker tags** can interfere with the communication between transponders and readers. However, the current German telecommunications laws declare their operation illegal and a punishable offence. Jamming transmitters and blocker tags can be tracked down using permanently installed field detectors or by making manual spot measurements. In addition, the use of a so-called Frequency-hopping Spread Spectrum (FHSS) is feasible for future transponder generations. In this procedure the frequency band on which the devices operate is varied according to a pattern known only to the reader and transponder, making it even more difficult to disrupt communication between them.

Security of the IT systems

In theory, hackers might attempt to gain access to the IT system that manages the data allocated to the number code. However, attempts to gain unauthorized access to the IT system are not specific to RFID. In order to prevent the input of manipulated information or software, database systems must be capable of automatically detecting any security infringement occurring in data communication. Particular caution is called for when the readers and servers are installed in a warehouse or at some other easily accessible location. In general, the common IT security procedures, such as firewalls and authentication technologies, provide enough security to prevent unauthorized access.

The examples described illustrate that all necessary countermeasures for combating intrusion into RFID systems are already available. Nevertheless, RFID technology is constantly progressing. This is why IT experts from organizations like IBM are collaborating continuously with researchers and users to improve the efficiency and security standards of RFID.





Worldwide standards

Industry and commerce have recognized the potential of RFID. Internationally valid standards are crucial for ensuring the long-term success of the technology and safeguarding companies' investments. It was in order to establish such standards that the international organization EPCglobal was founded in 2003. In Germany, EPCglobal is represented by GS1 Germany (formerly known as Centrale für Coorganisation, CCG). Among EPCglobal's members are trade and retail companies, consumer goods manufacturers, logistics service providers, pharmaceutical and drug manufacturers, IT companies such as IBM and scientific institutions. Their goals is not only to deal with issues relating to data protection and data security, but also to develop technical specifications for the hard- and software used in RFID systems and establish them on a global scale.

Technical standards for data security

In December 2004, for instance, EPCglobal approved a new standard for RFID transponders in the ultrahigh frequency (UHF) range, the "EPC Generation 2." Just as the previous generation, the new standard covers details on the structure and format of the Electronic Product Code (EPC) as well as specifications for communication with RFID readers. For the first time, these stipulations can now be implemented internationally. Additional functions improve the security and reliability of the technology. The new specifications apply to passive transponders whose 96-bit EPC tagging is stored in the WORM section (Write Once, Read Many).

The size of any additional storage capacity depends on the manufacturer. It can be used to increase the transponder's functionality, for instance to implement the so-called kill function, which permits permanent deletion of the number codes stored. It is now also possible for readers to target individual transponders for communication – yet another step towards greater security.

Partnership for progress in trade and retail

Modern technologies such as RFID can only establish themselves on the market if they correspond to users' needs. It is therefore essential for developers in the research institutes and IT companies to collaborate closely with the companies that actually use the technology. IBM has always adhered to this principle.

Technologies for a new era

IBM is a strategic partner of the METRO Group Future Store Initiative. This unique undertaking is a collaboration of the METRO Group with IBM, Intel, SAP and T-Systems as well as some 50 other partner companies from the IT sector, the consumer goods industry and the service sector. Its goal is to boost the national and international modernization process and promote innovations in trade and retail.

The initiative sees itself as a platform for technical and process-related developments in the sector. Within the scope of the METRO Group Future Store Initiative, for instance at the Future Store in Rheinberg or the RFID Innovation Center in Neuss, the technologies and technical systems of tomorrow are already being tested in practice and developed further. The collaboration yields benefit-oriented solutions that imply advantages not only for the trade and retail sector but also for its customers. The long-term goal is to create uniform global standards for both the trade and retail sector and the consumer goods industry.

The supermarket of the future

Besides other technologies, the METRO Group and its partners have also been testing RFID technology in a pilot project in some areas of the Future Store in Rheinberg since April 2003. In the supermarket of the future, RFID readers at the incoming and outgoing goods gates register pallets and boxes that have been equipped with transponders at the distribution warehouse in Essen. On the sales floor, the Future Store features so-called Smart Shelves fitted with RFID readers. They alert staff when products equipped with RFID transponders are in the wrong place, stocks are running low or the best-before dates are about to expire. This ensures that consumers always find fresh, high-quality food on the shelves. Three products in the Future Store are currently equipped with RFID transponders.

IBM Deutschland has developed an overall system for the Future Store in Rheinberg that networks a series of very different technological components – such as RFID, control of merchandise management and the cash registers – with one another. All RFID-based devices and applications with their different technological specifications communicate via a central node in the system, enabling staff to view the latest stock and sales information on all terminals in the store at any time. Never before has a flexible all-round solution like the one currently being tested by the METRO Group Future Store Initiative been implemented with such consistency, including integration into the sales floor.

Impressive results
A comprehensive analysis of the technologies tested in the Future Store is providing resoundingly positive results: out-of-stock situations have fallen by up to 14 percent while product losses have been reduced by up to 18 percent. In addition, a savings potential of 17 percent was identified in relation to warehouse organization and the handling of incoming goods.

Together with fashion producer Gerry Weber, Kaufhof Warenhaus AG, a sales division of the METRO Group, instigated a pilot scheme from July to November 2003 for testing RFID in the clothing industry. It emerged that the application of reusable RFID labels has definite advantages for both the retailer and the clothing manufacturer: warehouse and stock management are optimized and efficiency increases all along the supply chain.

RFID roll-out at the METRO Group

These positive experiences have convinced the METRO Group of the technology's potential. In November 2004 the METRO Group became one of the world's first trade and retail companies to begin gradually introducing RFID technology along its entire supply chain. IBM is making an important contribution as RFID system integrator and software provider.

In the current phase of the technology's introduction, selected suppliers of the trade and retail company are equipping their logistic units (pallets, packages and hanger-goods shipments) with RFID transponders. Retail units (cartons and subcartons) will follow in a second phase beginning at the end of 2005.

One of the METRO Group's most important objectives in using the RFID technology is to improve the availability of goods in supermarkets and department stores. The first interim balance is positive: by February 2005, more than 20 industry partners had integrated RFID into their day-to-day workflow. All pallets they deliver to selected Metro Cash & Carry, Real and Kaufhof warehouses are now fitted with RFID transponders. Manufacturers were able to save time in order-picking and loading goods on trucks. The handling of incoming goods in the group's warehouses and stores was accelerated considerably, and stock-outs occurred less frequently. In addition, the technology provides greater data security because order and delivery data are automatically reconciled when incoming goods are received.

METRO Group RFID Innovation Center as a work platform

In July 2004 the METRO Group opened the RFID Innovation Center in Neuss to offer extensive support to participating industry partners during the roll-out. At the Center, the METRO Group sales divisions and their suppliers can experience the new technology first-hand on more than 40 systems and test its application. As one of the METRO Group's premium partners, IBM has made an important contribution to this accomplishment. The RFID Innovation Center also serves as a training and communication venue.

Implementation of EPCglobal guidelines

Up until now the METRO Group has mainly been using RFID in logistics and merchandise management. Only selected products at the Future Store are being fitted with RFID transponders for test purposes. Experts assume that it will take another 10 to 15 years before the majority of trade and retail companies attach the transponders to individual products. Nevertheless, as a member of EPCglobal, the METRO Group has declared its support for the responsible handling of RFID from the start. Together with its partners in the consumer goods industry, it has committed itself to observing the EPCglobal guidelines. In fact, in the interest of its customers, the METRO Group even voluntarily exceeds the scope of EPCglobal stipulations.

Promoting innovation through networking

Politics, industry and commerce, as well as scientific research institutes, have long recognized the economic significance of modern technologies, as demonstrated at European level by the Lisbon Accord of 2000. It was in this document that the European Council outlined its goal of turning Europe into "the most competitive and dynamic knowledge-based economy in the world." One of the major measures foreseen by the Growth and Employment Initiative, which was established in February 2005 to build on the Lisbon strategy, is a considerable increase in research and development budgets, with the particular objective of promoting information and communication technology (ICT). In 2004, the Dutch Ministry of Economic Affairs commissioned a study of the sector entitled "Rethinking the European ICT Agenda." The study mentions RFID as a potential "breakthrough technology" and places particular emphasis on the Smart Chip. Financial support provided by the European Commission is evidence that it is fully aware of the significance of RFID. Additional funding for RFID projects has been announced as part of the Information Society Technologies Program (IST).

Partners for Innovation in Germany

At a national level, the government of the Federal Republic of Germany instigated the "Partners for Innovation" initiative in 2004. It consists of ten "Impetus Groups" that identify topic areas and pioneering activities and recommend measures for promoting exemplary innovations. A project office coordinates the results from the individual teams. The steering committee defines the strategic orientation of the initiative and also interfaces the various German ministries that are already turning their attention to RFID. The Ministry of Economic Affairs and Employment considers these technologies to be of particular relevance for the future and has classified various projects as worthy of sponsorship. Last year, for instance, it supported an investigation by the Rewe Group entitled "Usage possibilities for transponder technology in medium-sized consumer goods-oriented companies, with special emphasis on retail." This entailed equipping beverage crates with radio chips, permitting the precise tracking of the route taken by the goods. Improved tracking will result in greater food safety and simplifies the return of empties.

The Federal Ministry of Education and Research is another political institution to commission studies on RFID. On the ministry's behalf, the Bremen-based Institute of Industrial Technology and Applied Work Science (BIBA) is testing ways to optimize logistics and the recycling of packaging with the help of RFID systems. The goal is to make the relevant procedures more economical, thus increasing the recycling quota and saving resources.

Dr. Wolf-Dieter Lukas, Assistant Secretary of the Federal Ministry of Education and Research (BMBF)

« After an announcement in late 2004, the BMBF selected eleven of the more than 50 project proposals it received in response. The chosen projects focus on the development of new transponder chips, such as polymer ICs (plastic-based memory components) as well as the development of new surface mount technologies – with the aim of reducing the cost of Smart Chips and increasing label functions, for instance by integrated sensors or displays. The range of applications includes freight traffic, the trade and retail sector, production logistics and even the health sector. New solutions will for instance be developed for tracing temperature-sensitive food and pharmaceutical products. Another project involves labels with integrated tilt and acceleration sensors to increase the safety of sensitive or dangerous transports. »

Werner Wilke, Managing Director of VDI/VDE Innovation + Technik GmbH

« VDI/VDE Innovation + Technik GmbH has been appointed Project Executor for Microsystems Technology by the Federal Ministry of Education and Research. In this function it is responsible for the state-funded project "Smart label applications in logistics". It is part of this initiative to include the issues of data and consumer protection into the development of systems that come into close contact with customers. On the whole, I am convinced that RFID will provide an innovative boost to many different sectors. The systems offer great potential for optimizing production and distribution processes in sectors such as trade and retail, logistics or the car and electronics industry. German companies are well positioned to benefit from such developments – especially the medium-sized firms that play a major role in this area. Our future goals will be to achieve standardization and master the technological challenges on the way to the next generation of Smart Labels. »

A study of the "Risks and opportunities of using Radio Frequency Identification systems" was commissioned by the German Federal Ministry of the Interior and drawn up by the Federal Office for Information Technology Security (BSI) in collaboration with the Institute for Futures Studies and Technology Assessment (IZT)

and the Swiss Federal Laboratories for Materials Testing and Research (Empa). The aim of the study is to inform the interested public about the new technology. It explains how RFID functions, illustrates the fields of application and investigates possible weak points.

International exchange on RFID

The commitment of individual companies is promoting the usage and continued development of RFID. The research lab of IBM, for instance, is working with IBM On Demand Innovation Services (ODIS) on an RFID-based solution that improves the protection of international container transport from acts of terrorism and smuggling. IBM ODIS is a team of specialists that translates the latest research results into pilot projects. In this particular project, every single container is given a profile containing detailed freight information on the goods contained, the container's route, as well as environmental conditions such as temperature and moisture. The data is stored on a control element permanently attached to the container, a so-called "Tamper Resistant Embedded Controller" (TREC). Its various sensors continuously measure all relevant data. This data is then transferred to a database that forms the back-end of a portal allowing authorized users access to all the information relating to the entire supply chain. It is thus possible to trace the route of each and every container from its country of origin all the way to its destination – a huge security advantage. The system does not only minimize risks. It can also help participating companies to improve processes, increase quality and reduce costs.

Pioneering research

There are a handful of research institutes throughout the world dedicated to exploring the potential of RFID technology for applications in industry and commerce as well as various areas of public life. The Auto-ID Center, a scientific organization at the Massachusetts Institute of Technology (MIT) in Boston, was one of the pioneers in this field. As early as 1999, the Auto-ID Center developed the Electronic Product Code (EPC), collaborating closely with numerous industry partners and universities such as Cambridge in Great Britain and St. Gallen University in Switzerland. Once the Electronic Product Code was ready for the market, it was a question of translating the research results into practice – on a global level. It was for this reason that, in 2003, the American Uniform Code Council (UCC) and EAN International founded EPCglobal. The Auto-ID Center ceased its activities after the founding of the organization. Today EPCglobal is supported by research conducted at the newly created Auto-ID Labs. These are located at the Massachusetts Institute of Technology (MIT), the University of Cambridge, the University of Adelaide, Keio University (Tokyo), Fudan University (Shanghai) and St. Gallen University.

Standardization is an important issue in many sectors of the industry. The two aviation companies Boeing and Airbus, for instance, have been collaborating on the definition of standards for their industry sector since 2004 in their "Spec2000" initiative. The initiative is concerned with e-business specifications for supply chains in aviation, placing special emphasis on data formats for RFID and barcode technologies. Spec2000 is organized by the Air Transport Association (ATA) in the USA.

Similar endeavors are being made in the car industry. The members of the Automotive Industry Action Group (AIAG), which includes car companies like

DaimlerChrysler, General Motors, Toyota and Volvo Trucks, have recently defined a data format for the unambiguous identification of car tires using RFID technology. Some manufacturers of RFID transponders have already launched products based on the new "Tire and Wheel Label RFID Standard" AIAG B-11. Such transponders must be able to withstand the severe conditions of the tire manufacturing process.

In Europe, the Dortmund-based Fraunhofer Institute of Material Flow and Logistics (IML) is a leader in the field of RFID applications within the process chain. Together with the University of Dortmund, the IML created the city's "Open-ID Center," a platform for the exchange of information between technology providers and users. The initiative investigates the technology's potential for use in company-wide material flows, focusing on four projects that are prime examples of the future use of RFID: management of reusable containers, tracking and tracing using intelligent containers, control of material flows with autonomous, self-controlled logistic objects and creating an ASP platform that integrates all levels of information.

Prof. Dr. Michael ten Hompel, Director of the Fraunhofer Institute for Material Flow and Logistics (IML)

« Germany has become a world leader in logistics technology. According to the German Engineering Federation (VDMA), the industry's exports total around 7.7 billion euros – only slightly less than the combined exports of the USA and Japan. If we are to maintain this status in the future, we need the support of both politics and industry. Many medium-sized companies operate in this sector. There will be a host of new firms offering RFID-based services and new products. The technology is a real opportunity for small and mid-sized business – and for German industry as a whole. »

Associations are forming specialist units

In January 2005, the German Association of IT Consulting Companies (VDEB) founded a specialist RFID team to present sample projects and develop criteria intended to help member companies integrate the technology into their own applications and day-to-day business. The group is supported by representatives from the Universities of Bremen, Dortmund and Cologne, and by the Aachen-based Electronic Commerce Competence Center. The Baden-Württemberg Ministry of the Interior advises this group on issues relating to data protection. In February, the Information Technology Society of the German Association for Electrical, Electronic and Information Technology (VDE) also formed a team of specialists that is to play an active role in standardization processes and promote an exchange between technology providers and their customers.

Organizations in Great Britain

Great Britain best illustrates the fact that other European countries as well are seeking to create networks for innovative companies. A study by the British Department of Trade and Industry (DTI) identified RFID as an important field of technology. In response, the DTI and regional sponsors founded the National RFID Centre in West Yorkshire in autumn 2004. Its tasks include coordinating the establishment of further regional RFID centers and organizing numerous conferences and seminars to provide information about RFID to interested parties. Another important aspect is consulting for companies, provided by an RFID specialist.

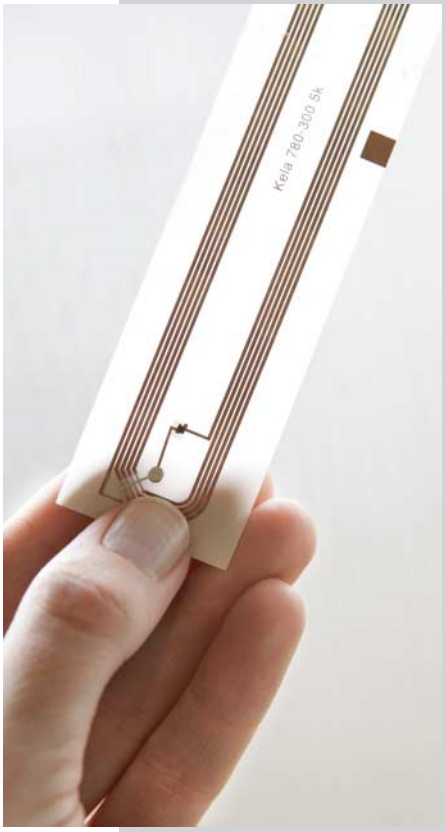
Heinz Paul Bonn, Vice President of the German Association for Information Technology, Telecommunications and New Media (BITKOM)

« Thanks to RFID, even medium-sized companies can finally benefit from the advantages of efficient information logistics. And the fact that RFID enhances the scope of business management software represents a major chance for the German IT industry! Germany has a leading position when it comes to RFID implementation expertise, research and development. That's why we should support this superb, innovative technology in every way, instead of allowing unfounded fears and overzealous regulation to obstruct its use. »

In Switzerland too, RFID is the subject of intense investigation. The University of St. Gallen and the Swiss Federal Institute of Technology in Zurich are jointly responsible for one of the Auto-ID Labs that form part of EPCglobal's international research network. Its goal is to further the development of RFID. In January 2005, a group was formed to collaborate with industry partners on ways of using RFID to make products forgery-proof.

Joining forces for progress

All these initiatives show that RFID is in fact attracting a great deal of attention on an international level. German industry has realized this at an early stage and has played an important role in pushing ahead with the technology. In order to continue providing impetus for international research, it is now essential to gain even more experience of the technology in practice – and, at the end of the day, translate innovations into economic growth. This will only succeed if all those involved pull together and join in the deep-level networking crucial to success. Meanwhile, the idea of networking is already being put into practice on a small scale: in all the initiatives presented, the exchange of know-how plays a major role. The next task will be to achieve a higher level of specialization in some fields of application and an even better coordination of activities, both in Germany and at international level. In this way all groups involved will be able to share their particular experience and expertise and contribute to stepping up the speed of innovation.



Possible issues for political focus

The political world has realized the significance of Radio Frequency Identification for German industry and commerce. Rapid action is now crucial in order for companies to master the learning process quickly. But what concrete political measures are necessary to promote the further development and application of RFID? Four different starting points show different approaches to increasing the speed at which visions are translated into tangible results.

Firm political commitment

If the technology is to develop its full potential, an information exchange must take place and the public be made aware of possibilities and benefits. Hands-on experience of RFID in everyday situations is also essential. This is already happening in various areas of public life: tickets for the Football World Cup in 2006, for instance, will be fitted with RFID transponders. This will mean quicker admission into the stadium for fans, whereas forged tickets can be more easily identified and their buyers refused admission. An effective way to put a stop to black market trade; at the same time, stadiums will become safer. In December 2004, the European Parliament decided to integrate RFID transponders into passports. This will make it possible to store biometric data such as digitized facial profiles or finger prints on the passport – another example of how the technology will increase public safety. The German government is planning to introduce the new documents as early as this autumn. Another possible application is to make use of the savings potential of RFID to ease the burden on state funds. Solutions of this kind have already been successfully deployed in other countries, for instance by the US Department of Defense, that uses RFID for supply chain optimization.

Less regulation, more standardization

All parties wishing to utilize radio frequencies for an RFID application in Germany must fulfill the requirements of the Regulatory Authority for Telecommunications and Posts (RegTP). This is an area in which politicians could take action to introduce a simpler and more flexible procedure. RFID technology is undergoing continuous further development, constantly placing new demands on frequency ranges and transmission capacities. For this reason, it would be helpful to make special permission more readily available to users during this development phase. In the United States, licensing is already far more liberal than in Germany, where competitive pressure is unnecessarily intensified by overregulation. Besides, it is Germany's own interest to promote global standardization: firstly, because the technology can then be used by business partners from any nation; secondly, because these standards are the only way to ensure investment security for German companies wishing to exploit the full potential of the technology.

Promoting research and development

Although some areas of application have been defined, further research is required if the technology's promise is to be realized to the full. German research institutes are among the best in the world in terms of user-related RFID research. It is vital to maintain this leading position. Continuous state funding for RFID projects by the Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Economic Affairs and Employment (BMWA) is making an important contribution to this endeavor. Experts estimate that it will take at least another 15 years of intense research to gradually develop further fields of application for RFID. In the medium term, researchers see interesting possibilities for using the technology in the transport and logistics sectors, the pharmaceutical industry, aviation and aerospace travel. In these fields RFID would guarantee more efficient and transparent processes, forgery protection and higher service levels for consumers.

Better opportunities for medium-sized firms

Using RFID is not only an option for major companies. If the technology is to gain acceptance, it is vital for small and medium-sized companies to adopt it as well. They should therefore receive special political encouragement to back innovations – in order to create new jobs and strengthen Germany's industrial and commercial position. Many small and medium-sized firms need security not only in relation to the standards used but also for their investments. They also require expert advice and comprehensive information for the integration of the new technology into their work processes. Politicians could establish a system that supports courageous entrepreneurs by making a commitment to standardize competitive conditions. Making it easier for medium-sized companies to get inexpensive loans would be a step in the right direction: firms need sufficient financial means if they are to invest in forward-looking technologies. Once investment incentives and a legal framework to safeguard usage of the technology are available, small and medium-sized businesses will be willing to implement RFID even sooner.

For a leading role in Europe

RFID does not only mean a host of new challenges. Companies and individuals will also benefit from rapid distribution of the technology, as it not only increases consumer protection and product safety but improves service quality as well. By enabling innovations in various areas, RFID technology will contribute to boosting the economy, creating jobs and establishing Europe as one of the leading technology regions in the long term. But this calls for a joint commitment from politicians, industry, commerce and society in general in the years to come.

Further information

Links

AIM
www.rfid.org
The Association for Automatic Identification and Mobility (AIM) is committed to promoting widespread usage of automatic identification technologies and presents new developments in RFID on a specially created Internet site.

Auto-ID Labs
www.autoidlabs.org
A federation of six research institutes that develop new applications for global trading and retailing.

EICAR
www.eicar.org/rfid
The RFID taskforce of the European Institute of Computer Anti-virus Research (EICAR) has set itself the task of objectifying the debate surrounding the new technology. It also develops application scenarios for the new technology, taking into account such diverse fields as organization, legislation and psychology.

EPCglobal
www.epcglobalinc.org
Committed to the worldwide standardization of the Electronic Product Code (EPC).

www.epcglobal.de
The German website of EPCglobal provides downloads of current guidelines and approved standards.

METRO Group
www.metrogroup.de
The METRO Group is one of the first trading and retailing companies in the world to gradually introduce RFID along the entire supply chain. On the site's Press pages, a special feature provides comprehensive information on the new technology.

RFID Journal
www.rfidjournal.com
An independent US magazine dedicated to news on all aspects of RFID. Subscribers are given access to numerous additional articles.

The RFID Gazette
www.rfidgazette.org
A collection of reports on RFID from various websites, updated daily. A weekly e-mail newsletter service is available.

Studies

RFID-Technologie. Neuer Innovationsmotor für Logistik und Industrie? (RFID Technology. The new innovation driver for logistics and industry?)
www.boozallen.de/content/downloads/5h_rfid.pdf
Joint study by management and technology consultants Booz Allen Hamilton and the University of St. Gallen. Automotive and logistic companies evaluate RFID.

Making Waves – RFID Adoption in Returnable Packaging

www.logicacmg.com/pdf/RFID_study.pdf

According to this study by Dutch consulting firm LogicaCMG, RFID will replace the barcode in the long term.

High Performance Enabled Through RFID/EPC

www.accenture.com/xdoc/en/services/rfid/insights/rfid_insights_epc.pdf

The majority of consumer goods manufacturers have already realized that Radio Frequency Identification will play a major role in future – as this survey from the US consultancy Accenture proves.

Risiken und Chancen des Einsatzes von RFID-Systemen (Risks and opportunities of using RFID systems)

www.bsi.bund.de/fachthem/rfid/RIKCHA.pdf

This study by the Federal Office for Information Security (BSI) explains how RFID functions, illustrates potential and real fields of application and investigates the technology's weak points.

Application scenarios

RFID solution for supply chain management and in-store operations

www.ibm.com/industries/wireless/doc/content/solution/946146104.html

The scenario shows how RFID can be used in the supply chain to increase productivity and save costs.

RFID solution for asset tracking and inventory management

www.ibm.com/industries/wireless/doc/content/solution/1025230304.html

This solution demonstrates how RFID can aid planning and optimization both in production processes and along the supply chain.

RFID Solution for Chemical and Petroleum

www.ibm.com/industries/wireless/doc/content/solution/1147014104.html

This application scenario illustrates how laboratory planning and quality control can be improved.

RFID Solution for the Midmarket

www.ibm.com/industries/wireless/doc/content/solution/1203595104.html

The solution supports companies in their efforts to investigate how RFID technology can be used to benefit their own business and their partners.

The shopping experience of the future

www.future-store.org

In collaboration with partner companies, the METRO Group has developed a "supermarket of the future" in Rheinberg where RFID is tested in real-life conditions. Under the heading "RFID Net," the site also offers downloads of the METRO Group's regular newsletter on RFID.

Literature

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RFID and Beyond. Growing Your Business Through Real World Awareness
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Christian Muszynski studied telecommunications and technical computer science in Mannheim, Germany, and San Jose in California. He works for IBM Deutschland GmbH as an IT architect specializing in RFID. For the last six years he has been responsible for the formulation and execution of innovative applications in the field of wireless data transfer technologies. He has been involved with the Future Store Initiative of the METRO Group since 2003, accompanying the introduction of RFID in the trade and retail group from the RFID pilot project all the way to the group-wide roll-out.

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Christoph Weiss studied business information technology at the University of Cooperative Education in Stuttgart. He has been working as an IT specialist at IBM for five years now and is responsible for the formulation and execution of embedded IT solutions, with special emphasis on sensor networks and RFID.

Dr. Gerd Wolfram

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Dr. Gerd Wolfram joined the MGI METRO Group Information Technology GmbH in 1996. For the last three years Dr. Wolfram, who holds a doctorate in business management, has been in charge of the Future Store Initiative, the METRO Group's program for supporting the modernization process in the trade and retail sector. It was under his leadership that the METRO Group founded the RFID Innovation Center in Neuss as an information and development platform. Dr. Wolfram is active on various national and international committees dedicated to the standardization of logistic and merchandise management processes in the trade and retail sector.

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