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About The Potential Of RFID Technology For Distributing Free And Paid Content On Mobile Devices In Retail Business

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ABSTRACT

The attention on Radio Frequency Identification (RFID), Mobile Business and Mobile Content has recently attracted in various industry sectors, the media and in academic research. This article focuses on the convergence of RFID technologies and mobile devices and presents applications in the retail business. Based on related literature and existing models and technologies, a business framework and service architecture is derived which describes new ways of distributing product information through the convergence of RFID technology and mobile devices in the retail business, as well as identifying the key players involved in this. The presented framework creates a new connection between content and mobile business and is exemplified by a cell phone prototype containing a RFID reader. The article outlines applications of the business framework and service architecture in product advertisement, Mobile Business and Paid Mobile Content which involve connecting physical products with virtual product information made available through integrating RFID technologies and mobile devices.

Keywords

Mobile Business, Mobile Content, RFID Technology, Retail Business

INTRODUCTION

For several years there has been debate on Radio Frequency Identification (RFID) technologies from a technological point of view. Several case studies with a business perspective also exist for the retail segment, describing and predicting a fundamental transformation of the supply chain due to RFID technologies. Shopping has become more individualised and more comfortable (Loebbecke 2005a). RFID technologies make it easier for consumers to compare products and to utilise product information for their purchasing decisions. According to Loebbecke (2005a) customers have become sophisticated and have gained a clear understanding of value, generated from vast information resources. Delivering this value is an enormous challenge for retailers (Loebbecke 2005a).

The basic idea of RFID is storing and remotely retrieving data using devices called RFID tags or transponders. According Wikipedia.org a RFID tag is a small object that can be attached to or incorporated into a product, animal, or person. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. Passive tags require no internal power source, whereas active tags require a power source (Wikipedia.org 2005). RFID tags are often envisioned as a replacement for barcodes in retail business, having a number of important advantages over the older barcode technology. An RFID tag contains an incredible amount of information. The data contained in the RFID tag can be read by so-called RFID readers. RFID tags ,identify' themselves when they detect a signal from a compatible device (Loebbecke 2005b). As a tag passes through a radio frequency field generated by a compatible reader, it transmits its stored data to the reader, communicating information about the object to which the tag is attached and further content.

Whereas most business case studies on RFID technologies in retail business discuss (Strüker et al. 2004, Loebbecke 2005b, METRO Group 2005a, METRO Group 2005b) RFID readers and content provision devices like personal shopping assistants or information terminals, the customer's personal mobile devices such as cell phones are not considered as content provision devices. Certain cell phone manufacturers such as Nokia, however, have long taken an interest in RFID. At the CTIA Wireless IT & Entertainment Trade Show 2004 Nokia presented an early prototype built in collaboration with VeriSign, who propose a central repository for RFID data that companies can use to relay information about inventory and deliveries to

customers and suppliers. The prototype was based on a Nokia cell phone, with an RFID reader contained in a shell attached to the phone. Nokia's prototype has fundamental implications for the delivering of product information to a mobile device using RFID and can extend the technology "beyond the supply chain and into customer service, merchandizing, marketing and brand management" (ZDNet 2004).

Research Question

Given the subject's relevance the following research questions will be considered in this paper. What are the consequences of the convergence of RFID technology with mobile devices – and the association of physical products with corresponding virtual information and content which thus becomes possible – on the way retail products are sold, on the conception of advertising and on the emergence of new business models for cell phone operators and producers of paid content?

The paper is organised as follows. The following section will give an overview over the literature on consumer choice, mobile business, mobile content and RFID technologies in retail business. Based on a model of object hyperlinking a theoretical business framework and services architecture will be derived. In the last section, business applications derived from the theoretical business framework and services architecture and the implications of these business applications are discussed.

RELATED LITERATURE

Consumer Choice

Many goods and services traded are experience goods, meaning that the buyer only recognises the good's or service's true properties after the purchase, when consuming the good or service. Often these goods are refereed to as credence goods, as the vendor's reputation determines whether the buyer trusts the information on the good or service offered by the vendor. The asymmetric distribution of information for goods with experience and credence properties leads to a classical principle-agent relationship between the buyer and the vendor at the time of purchase – the vendor of the product is better informed about the product's true properties than the consumer (Milgram, Roberts 1992).

Given incomplete information consumers buy goods and services based on different attributes such as price or quality. The information about a good or service can be imperfect for a number of reasons, such as the proliferation of competing brands, the difficulties of exhaustive search or sampling, biases in product evaluation, constant product innovation or consumer mobility (Newmann 1977, Thorelli & Thorelli 1977). Thus, price and quality of a good or service are the dominant attributes for the choice of a brand, a provider or a vendor. Information concerning the quality of a good or a service is more problematic, as it is more difficult to communicate before or at the time of purchase (Tellis, Gaeth 1990). According Tellis und Gaeth (1990) it is important to analyse consumer behaviour and firm strategy in the context of consumer choices under incomplete information.

As discussed in the introduction, RFID technologies have the potential to provide consumers with information about goods and services at the time of purchase, which alleviates the principle-agent problem and has direct influence on consumer choice, as discussed by Newmann (1977), Thorelli and Thorelli (1977) or Tellis and Gaeth (1990). The direct influence of RFID technologies on purchasing and consumption behaviour is explained with a model for RFID technologies in mobile devices which also takes account of the integration of paid content from third party providers. The implications of the integration of paid content from third party providers at the time of purchase using RFID technologies is dealt with in the last section of the article.

Mobile Business and Mobile Content

In recent years, computing has been moving toward creating pervasive and ubiquitous environments. Countless small mobile devices such as cell phones, palm pilots, and personal digital assistants (PDAs) have been developed to provide users with ubiquitous access to information. This section provides a general overview of the value chain in mobile industries and of mobile content, the major driving force for the telecommunications and media industries, as the basis of a general business and service framework of RFID technologies in mobile devices. The value chain concept is used according to the definition given by Timmers (Timmers 1998), which he developed for the analysis and design of business models for electronic markets. Timmers (1998) bases his concept of a value chain on Porter's management approach (Porter 1985, 1998). In analogy to Porter (1998), the value chain determines the architecture of the product, the service and the information flows in Timmer's (1998) concept. Due to this relationship the analysis of a business model can only be carried out by taking account of the value chain. „A systematic approach to identifying architectures for business models can be based on value chain de-construction and re-construction, that is identifying value chain elements, and identifying possible ways of integrating information along the chain" (Timmers 1998).

The value chain that defines the mobile content environment depends upon a wide range of factors. According to the OECD Mobile Content Report (OECD 2005) the underlying value chain for mobile content is long, complex, varies for different types of content and is still developing. The handset or device frequently dictates or constrains an user's access to mobile content (OECD 2005).

As many players in the mobile content value chain originate from mature industry sectors such as wireless telecommunications, media and entertainment and the device industries, the OECD claims that the mobile content industry is experiencing the integration of the very different value chains of these three industries. The differing strength of the individual industries and the integration of different value chains have resulted in the vertical and horizontal integration of value chains in the mobile content industry in recent years. Major industries such as movie studios, record labels and game developers are moving into mobile content, and each is vying for a central position in the value chain. Mobile operators are at the centre of a complex web of value creation for mobile content because of their primary interface with mobile consumers (OECD 2005).

As content becomes digital, more and more of it will be delivered over mobile platforms. The capabilities and bandwidth of the mobile networks are continually being expanded by mobile operators. Greater bandwidth enables the download and sharing of larger, more sophisticated files in an acceptable timeframe for a particular content application via WAP or Web browsers. Next to entertainment, video, music and game content, contents like mobile tourist guides or shopping guides for consumers are further examples of new innovative mobile content business models.

Not only paid mobile content, however, is gaining importance in the mobile business, but free mobile content is too. The term mobile marketing has entered the discussion designating services and business models where users are informed about products and services by means of free content or where free on-demand information and content is made available to users of mobile devices. Mobile marketing can be defined as the use of interactive wireless media to provide customers with time and location sensitive, personalised information that promotes goods, services and ideas, thereby generating value for all stakeholders (Dickinger et al. 2004, Bragge et al. 2005). "As mobile devices are very personalized and they allow the interaction with the users virtually any time and anywhere, mobile advertisements must be custom-made and also adaptable to different types of terminals" (Bragge et al. 2005).

The integration of RFID technologies in mobile devices can not only influence the value chain of mobile business models of paid content but also make new kinds of mobile marketing feasible by means of personalised advertising in the sales room and at the moment of decision making. The next section will elaborate the ways in which the value chain is influenced and which possibilities for personalised advertising emerge due to the integration of RFID technologies in mobile devices with the help of a business framework and a service architecture.

RFID Technologies

In a typical RFID system are individual objects e.g. products, animals or passports equipped with a small RFID tag. The tag contains a transponder to receive and send data and a digital memory chip to store rewriteable data (e.g. data about the products, animals or biometrical information of the passport holder) (wikipedia.org 2005a). In a RFID system, the RFID tag will be activated by RFID reader's electromagnetic (U)HFField. As soon as a RFID tag is close to the electromagnetic (U)HFField, electric power is induced in the transponder. This power activates the microchip of the RFID tag. In passive RFID tags the electric power charges also an electrical condenser, which provides permanently power to the microchip. When a RFID tag is activated the tag sends data to the reader. The RFID tag does not send a field, but changes only the electromagnetic field of the RFID reader through so-called "load modulation", by "dissipating" the energy of the field. Therefore a 13.56 MHz RFID tag can be read only in the electromagnetic near field, which has a range of the half wave length Lambda/2, with 13.56 MHz thus maximally 11.1 meters (wikipedia.de 2006). "The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer" (wikipedia.org 2005a).

As mentioned RFID tags can be either passive or active. Is a RFID tag passive, it has no internal power supply His power to transmit a response and send data is induced in the antenna by the incoming radio frequency signal. "Most passive tags signal by backscattering the carrier signal from the reader. This means that the aerial (antenna) has to be designed to both collect electric power from the incoming signal and also to transmit the outbound backscatter signal" (wikipedia.org 2005a). Passive RFID tags without an onboard power supply means that the device can be quite small (2006 the smallest commercial RFID tags are 0.15 mm × 0.15 mm). Active RFID tags contain an internal power source which also generates the outgoing signal. The advantage of active RFID tags are a longer range and larger memories than passive tags, as well as the ability to store additional information sent by the transceiver" (wikipedia.org 2005a).

RFID Technologies in Retail Business

In retail business a RFID tag is best compared to a conventional barcode. A numeric, article-specific code stored in the RFID chip is assigned to each product, also refereed to as an „Electronic Product Code" (EPC). The EPC is a 96-bit tag which contains a number called the Global Trade Identification Number (GTIN). Unlike an UPC number, which only provides information specific to a group of products, the GTIN gives each product its own specific identifying number, giving greater accuracy in tracking (Wikipedia 2005b). As soon as the chip with the "Electronic Product Code" is within range of a RFID reader (>1m) it sends its numeric code to the reader. The reader then matches this code to further information and content about the product or service such as its price, size or weight which the reader either has stored or which it obtains from other data sources.

In keeping with Porter's (Porter 1998:46) value chain concept, RFID technology can be employed all along the value chain of retail stores and offers the retail business efficiency and cost advantages at every step of the value chain as has been shown by a number of studies (Loebbecke 2005b, Kaerkkaeinen 2002, METRO Group 2005c).

- The impact of RFID on the *inbound logistics* of the value chain of the retail business is related to the possibility to monitor incoming and outgoing goods quickly and precisely. RFID allows several processes concerning incoming goods to be automated simultaneously ("merchandise picked for an order is matched with the shipment and approved for transport, while the merchandise planning and control system registers the outgoing goods" METRO Group 2005c) as well as allowing for the automatic monitoring of stocks by retailing and industry partners, making time-consuming, manual scanning obsolete (METRO Group 2005c).

- The *operations* of the retail value chain can be optimised with RFID technology with respect to warehouse management, storage processes, automating goods handling and administrative processes (e.g. correct sorting of merchandise, constant and accurate overview of the location of goods). As there is a growing tendency toward smaller shipments and mixed loads being delivered to stores, requirements for handling efficiency in the supply chain will increase (Fitzek 2003).

- RFID influences *outbound logistics* in retail business in particular with regard to the payment procedure in the store (automatic check-out at the cash desk by reading several articles simultaneously without each item having to be scanned). Automating the check-out process attains cost savings (Hawkes 1994) and improves theft prevention with shelves that report if a large amount of goods is removed from them as well as increasing authenticity control (Ashton 2000).

- RFID has an impact on *marketing* and *sales*, as retailers manage their stocks more efficiently and reliably. Because consumers always find the desired goods on the store shelves, they are not led to purchase alternative products or patronise competitors. Brand loyalty is supported and industry partners do not lose sales (METRO Group 2005c). Personalised advertisement displays and self-check-out increases customer loyalty and promotes sales. Electronic price labelling in stores makes price tags easier to understand and more up-to-date (Loebbecke 2005b).

- The *services* of the retail business value chain are influenced by optimised traceability. Each transponder-equipped object is positively identifiable. Should a recall programme be necessary, RFID enables retailers and manufacturers to conduct it in a targeted, safe and efficient manner (METRO Group 2005c).

In these scenarios, the benefits described are often significant, and a total re-invention of the supply chain way of working is promised by enabling consumer packages to efficiently communicate with their environment. However, an exact description of how the benefits are attainable in practice has often remained vague, and the process and costs of implementing the solution have not been explained (Kaerkkaeinen 2002).

This paper aims to integrate these different research areas about consumer choice, mobile business, mobile content and RFID Technologies with the aim of developing a business framework and service architecture which describes how new forms of product information, personalised advertising and promotion are being created and which new fields of business are emerging for mobile operators thanks to the integration of RFID technology in mobile devices. The business framework and the service architecture focus primarily on the influence of RFID technology on marketing and sales within the value chain of retail business.

THEORETICAL BUSINESS FRAMEWORK AND SERVICE ARCHITECTURE

In this section a generic business framework and service architecture for developing business models and mobile applications is presented. As described in the previous section, RFID technology is at present primarily being discussed with regard to the logistics between producer, supplier and retail store or in connection with in-store product information and is being tested by

individual firms such as METRO, Tesco or Wal-Mart. Figure 1 presents the applications of RFID technology for retail business addressed in the current discussion.
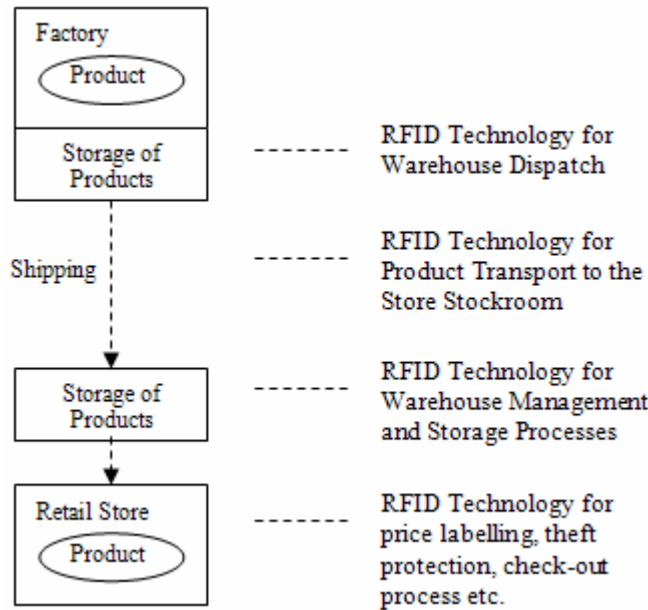

Figure 1: Main applications of RFID technology in retail business logistic processes and value chain

As mentioned in the introduction prototypes of RFID readers integrated into mobile devices like cell phones already exist. The scientific literature discusses this convergence of mobile technologies and RFID technologies and the resulting application possibilities using the terms "websigns" and "object hyperlinking" (Pradhan et al. 2001, Sphorer 1999). According to Pradhan et al. (2001) the key idea of „websigns" is that users would benefit from having access to devices that combine the advantages of wireless technology and ubiquitous computing to provide a transparent link between the physical world around them and the resources available on the Web. Websigns are an alternative way to map e-services using a simple form of augmented reality (Pradhan et al. 2001). To create a hyperlink between a physical entity and a Web resource, Pradhan et al. attach RFID tags to people, places, and things to associate them with an appropriate universal resource identifier, resolving the URI in the network if it is not already an URL. "These hyperlinks rely on commonly available wireless mobile devices to help users automatically access services associated with physical objects. [...] To receive an URL, users point their mobile device in the direction of a RFID tag and receive periodic broadcasts" (Pradhan et al. 2001). Figure 2 illustrates the way "websigns" works.

Within the CoolTown research programs at Hewlett Packard Laboratories Pradhan et al. (2001) have developed an ubiquitous computing "websign" system which can be personalised for individuals, group-targeted for users with specific interests or needs, or made universally available to anyone who wants to use them. To facilitate class-specific filtering, it is possible to categorise websigns by type – for example, restaurants, theatres, or historic sites.

Based on the ubiquitous computing "websign" system, a business framework and service architecture is developed, specifying how RFID technology can be employed in retail stores to communicate and inform customers at the moment of decision making. The business framework and service architecture does not focus on the RFID applications for logistics as in other scientific articles (cf. figure 1) but rather first and foremost on the processes involving marketing and sales in the value chain of retail business. Figure 3 presents the business framework und service architecture.
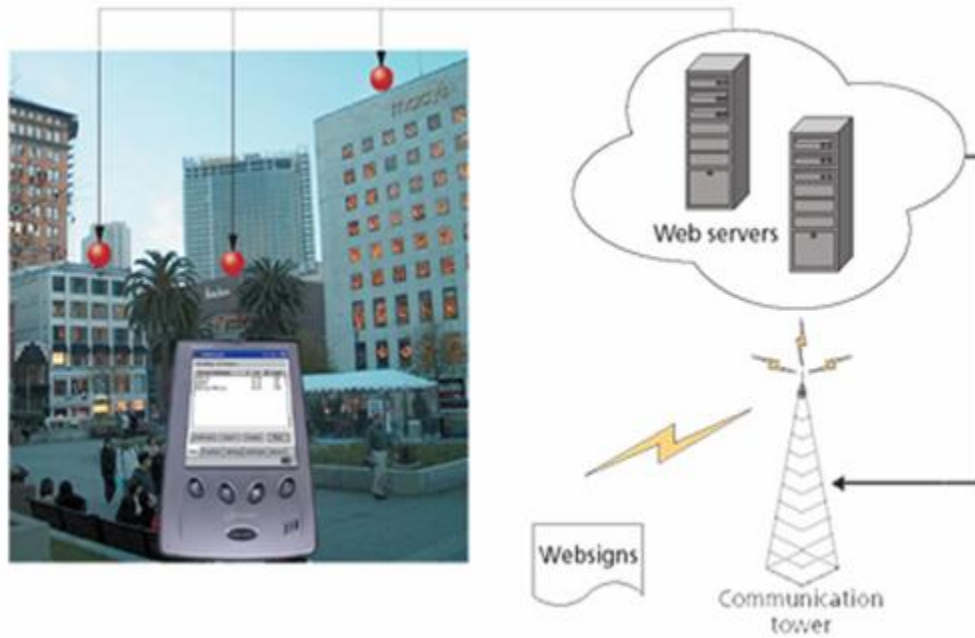
**Figure 2: Example of a "websign": Web servers detecting websigns
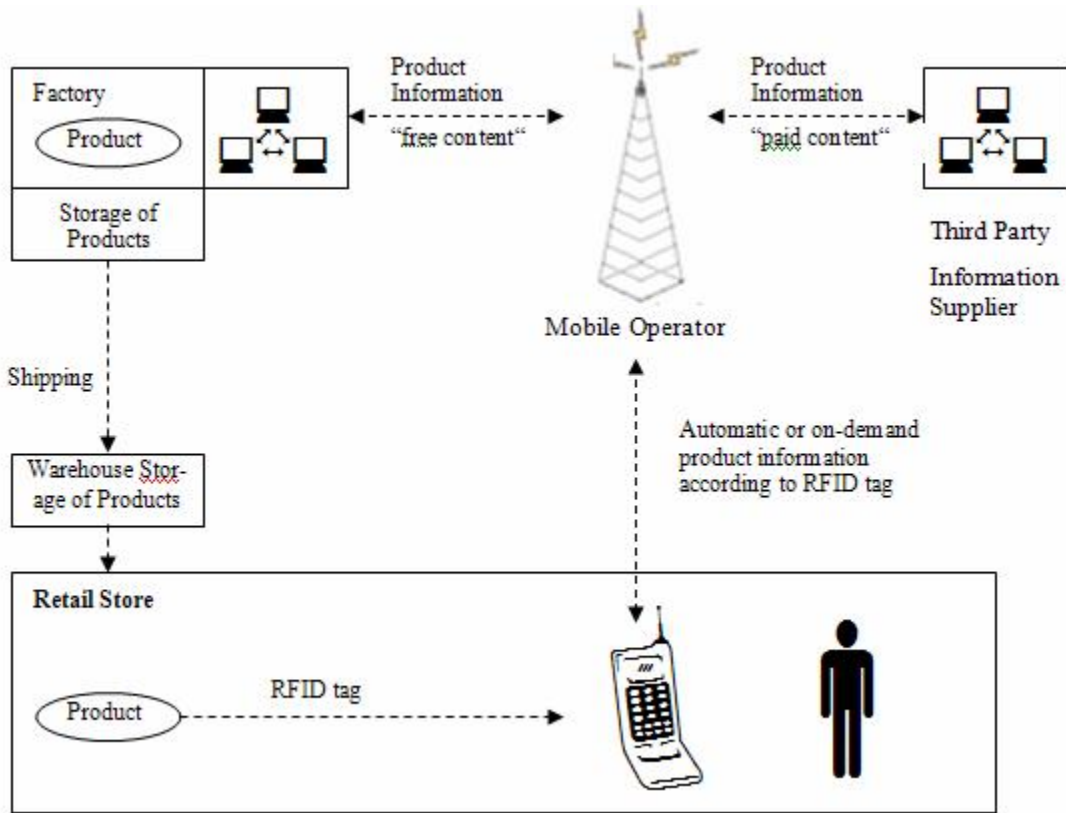with a wireless PDA in an urban environment (Source: Pradhan et al. 2001)**

**Figure 3: Business Framework and Service Architecture to distribute free and
paid content about products on mobile devices through RFID technology in retail business**

Within this business framework and service architecture the customer can be informed about a product at the time of purchase in a retail store (e.g. advertisements) or she can access product information from the product's manufacturer or a third party information supplier (e.g. comparative product test) through a RFID reader in her mobile device (e.g. cell phone). In this business framework the key players in the value chain are not only producers, supplier und retailers of a product as in other RFID frameworks in the retail sector. Rather, mobile operators and third party information suppliers also become key players in the framework.

The key essence of the framework is not logistics of products but information for customers about a product at the moment of decision making. This framework introduces transformations into two aspects of the existing value chain in the retail sector. One concerns product advertising, the other the degree of information a customer has and consumer choice. Furthermore, the technological implementation of this business framework has the potential to change the existing balance of market power. The implications of the business framework for product advertising, customer choice and market power are discussed in the next section.

DISCUSSION AND IMPLICATIONS

The business framework and service architecture which was presented in the last section is a further step in the investigation of the growing complexity and connectivity between three formerly separate interactive spaces – the real world of retail stores, the mobile world and the virtual world.

As described in the context of consumer choice, goods and services are often experience and credence goods, because the true properties of a good or a service do not become apparent until it is consumed. Thus a good or a service is more than a physical object or service, as the product has properties which cannot be recognised without consuming it. For this reason information about the properties and attributes of a product are necessary for the purchasing decision to minimise the buyer's risk. Nowadays such information – e.g. product information provided by the manufacturer, product ratings by other buyers or product tests by independent test institutes – is available on the Internet. The physical object or service which represents the product has a virtual counterpart (Nicolai et al. 2005). With RFID technologies, the product can be digitally augmented if the digital data is attached to it, for example, by sticking a RFID tag or integrating it into an embedded system. "Attaching a digital tag enables the connection of the product to the virtual world by either storing information on the chip itself or storing a link to the Internet which can be used by mobile devices as the premier source of information" (Nicolai et al. 2005).

The connectivity between three formerly separate interactive spaces – the real world of retail stores, the mobile world and the virtual world – which is presented in the business framework and service architecture influences product advertisement as well as the degree of information of the customers at the moment of decision making to buy or not to bay a specific product.

Due to the connection of physical products in real retail stores to information about customers and their purchasing behaviour by means of RFID technologies, the possibilities for product advertising are expanded and the efficiency of advertising measures increases. It has never before been so easy for retailers and producers to place strongly personalised advertising at the place and at (or near) the time of the purchasing decision, taking into account the attributes of the customers and consumer behaviour. „Sellers now have far more information about their customers through personalization technologies. This make it possible for retailers to know the identity of their consumers in "real-time", to access data on past shopping patterns, and to change prices and offerings where appropriate" (Vulkan 2003). Due to this technological convergence, mobile marketing gains further importance. By means of the connection of the real products to offers of digital virtual information about the products with RFID technologies and mobile devices, new forms of customer relationship management become possible for providers, as not only a customer's purchasing history is known but also her purchasing intentions as the access of information can be observed. In principle this opens up the opportunity to engage in the strategies of "push" marketing (tailoring marketing messages to individual customers) and mass customisation (low cost tailoring of the same basic product for individual customers) (Vulkan 2003). Whereas up until now it was only possible for the retailer to advertise a product at the place of purchase (usually depending on the products margins), the producer now can also target the customer at the time and place of purchase. The producer of a product will now gain a part of the hitherto exclusive power of the retailer regarding promotion and advertising at the place of purchase.

The connectivity of a physical product with virtually provided digital information all about the product by means of RFID technologies in mobile devices such as cell phones means the customer can easily and conveniently access information about the product at the time and place of purchase. Products can thus be compared with other products regarding price and other properties at the moment of decision. This possibility to access information at the time and place of purchase results in a much higher degree of information for the customer and for their purchasing decision. A possible hypothesis is that the convergence of RFID technologies with mobile devices will change the demand elasticity of products. From the perspective of consumer choice the possibilities of on-demand information at the time and place of purchase are comparable to the "Shop

Bots" offered on the Internet, which visit many Web sites, interrogate them to find the price and return with the lowest price. It thus becomes unnecessary to compare product prices in different retail stores. „Shop Bots have the potential to reduce consumer search costs to zero" (Vulkan 2003). This leads to the question of whether the convergence of RFID technologies and mobile devices and the easy and convenient access to information on the product and on product comparisons that this makes possible results in a reduction of the prices. As the search costs for price information on electronic markets decrease, the price differences for comparable goods between different vendors should be small (Luo & Chung 2002). However, several empirical studies concerning Shop Bots on the Internet (Bailey 1998, Clemons, Hann, & Hitt 1998, Brynjolfsson & Smith 2000, Lee & Gosain 2000), show that price dispersion (the difference between the lowest and the highest price for same goods on a market) still exists on markets with easily accessible information and easy product comparisons and has not decreased.

Apart from the effect on product advertising and the consumer's degree of information the business framework and service architecture presented in the previous section has an effect on the value chain of mobile operators and paid content producers. In this business framework and service architecture mobile operators connect consumers to the providers of information. Due to the convergence of RFID technologies and mobile services mobile operators not only have access to data about the communication behaviour of their customers but also to data concerning their consumption behaviour and purchasing intentions, seeing as all this can be tracked when information from the producer of a product or third party information is accessed thanks to an RFID tag. For the providers of information mobile operators are the central access channel to a customer, as they are in possession of all the relevant customer information. This opens up the possibility of new business fields for mobile operators such as offering producers or vendors of goods and services personalised advertising and marketing strategies (in the moment of decision making). Through integration of RFID Technologies in mobile devices mobile operators get key competences in market and marketing research.

However, not only mobile operators but also producers of paid content concerning products such as product tests or products comparisons can boost their sales volume thanks to the convergence of RFID technologies and mobile devices. In addition to offering their paid content over the Internet they can now make it easily and conveniently available as mobile content by means of RFID technology. It also makes it possible to increase the mobile operator's sales volume through mobile content, as these new content services, which meet a need of consumers, are billed via the mobile operators. RFID technologies in mobile services thus indirectly represent new applications for the mobile operators' UMTS (3G) technologies.

The RFID readers of the Nokia cell phones 5140 and 5140i (which are attached to the phones) are prototypes which link the proposed framework with real business life. With these cell phones predetermined operations perform automatically by touching an RFID tag-equipped object with the RDIF reader/writers of the phones (Nokia.com 2006). RFID tags links a Nokia phone with the RFID reader "to the initiation of a service, such as calling, messaging, browsing or recording data" (Nokia.com 2006). The Nokia phone's RFID Reader allow consumers to launch services and access phone functions such as dial or send messages by touching an RFID tag. Consumers can automate and initiate tasks, such as browsing service instructions or logging time-stamped data like meter readings (Nokia.com 2006).

The applications for product advertising, product producers, mobile operators or paid content producers considered in connection with the business framework and service architecture, however, are subject to a restriction which will severely limit the realisation of the applications: the privacy issue. The use of RFID technology has engendered considerable controversy and even product boycotts. The aspect which concerns consumer advocacy groups is the globally unambiguous labeling of everyday objects, which thus can be identified anywhere in the world without the owner being aware of this. The convergence of RFID technology and mobile devices would be a big step towards the transparent consumer. To avoid the privacy problems of the described applications of the business framework and service architecture the proposed privacy related guidelines for the use of RFID-based EPC by EPCglobal would have to be adhered to, which require giving consumers clear notice of the presence of EPC and the possibility to turn off the RFID reader functionality in their mobile devices. In addition and thanks to the sales generated by new business fields, mobile operators could leave the choice to the customer, offering the customer lower rates or free mobile services in return for her revealing her consumer behaviour through RFID technology.

A further aspect of the applications of the business framework and service architecture of RFID in mobile devices and retail business that could be criticised could be that RIFD is too expensive a technology, and that it is unlikely that investments in RFID will pay off (Riso 2001, Burnell 1999). The sales revenues from new business fields for mobile operators and the advertising possibilities for producers of products, however, seem to answer to this criticism.

CONCLUSIONS AND FUTURE WORK

This paper discusses the applications emerging from the convergence of RFID technology and mobile devices which are: personalised advertising at the moment of consumers' decision to buy or not to buy a product, a higher degree of information for consumers and new business models for mobile operators and content producers for the distribution of free and paid content. From this perspective the framework presented creates a new connection between content and mobile business.

Beside this the framework presented leads also to a connectivity between three formerly separate interactive spaces – the real world of retail stores, the mobile world and the virtual world. Physical products are linked with virtual information – with their digital counterparts. At the same time the previously virtually-limited interactive frame of the Internet is connected to the real world. "Enhancing a physical product with digital information objects can lead to completely new creations and process chains. [...] Real and virtual worlds emerge into a new expanded interactive space" (Nicolai et al. 2005).

However, the framework presented poses questions which should be the object of further research. These include the question of which types of personalised advertising can be used and how, further how a record of consumer behaviour can be stored without violating privacy issues, thus being available for the development of new products and services or finally how the technology can be implemented without RFID resulting in an information overload for the customer in a retail store.

In the future, companies will be able to utilise the numerous possibilities offered by RFID technologies. The future standards are, however, still being developed and it is difficult to foresee exactly what the future of RFID will bring us. The integration of RFID technologies into mobile telephones promises to make the much discussed concept of "augmented reality" a feasible possibility. The real and virtual worlds will become connected thanks to information and new services with the aim of supporting customers in whatever environments they may be in.

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