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TNO Whitepaper

Managing the masses with contactless payment technologies

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1 Introduction

A contactless payment transaction can be done using few types of devices, the main types being smartcards (such as a credit card), key fobs or mobile phones. The underlying technology is Near Field Communication (NFC) which is a short-range wireless connectivity technology which evolved from a combination of existing contactless identification (such as RFID) and interconnection technologies. Communication between two NFC-compatible devices occurs when they are brought within some centimetres of one another: a simple wave or touch can establish an NFC connection. A contactless device has an embedded computer chip and radio frequency antennae. After you tap/wave your device within the stated range from the reader, the reader securely transmits payment details for confirmation.

Figure 1: Example of a contactless payment transaction

In 2007, hundreds of contactless payment trials are being conducted across Europe varying in focus and size. One of the most common first-time uses is in public transport; a well-known example is the Oyster (smart-)card for the London Transport system.

This whitepaper shares research on contactless payment applications where masses of people have to be dealt with in short time periods. The potential for using contactless payment technology in situations where large numbers of people wish to make use of the same facility in a relatively short time-span is growing. The case is based on omitting cash handling which results in faster and more secure transactions.

The developments of new contactless devices, and the inclusion of NFC technology in new mobile devices, result in a technology push that anticipates large growth potential for contactless transactions.

Last but not least, improvements in security concepts and the emergence of third parties offering services around contactless transactions will all lead to the expected growth.

2 Our modern society: dealing with masses of people

In the western urbanized society we are always surrounded by many other people wishing to make use of the same facilities. These facilities include transport to get to and from work or school, access to large buildings and queuing to pay for lunch at the canteen. Outside of work or school large numbers of people make use of supermarkets or fast food restaurants. In the evenings or weekends hundreds or even thousands of people throng to centres of amusement such as movie theatres or clubs, amusement or theme parks, music or sport events.

A large proportion of each individual's time is spent on waiting to gain entry and, where applicable, pay for the use of the facilities, services or goods. Sometimes the waiting time is only seconds, mostly minutes, but in some cases people will queue for an hour or more to get to where and what they want. The time spent waiting is not productive time and is a main source for customer dissatisfaction and irritation. Not only does the factual waiting time play a role, but also the expected waiting time. The difference between the two contributes directly to the customer's experience around the use of the facilities, the services and to some extend the goods. For customers who are concerned about time, the perception of the time spent waiting is a better predictor of satisfaction than the actual waiting time [3].

Individuals are concerned with waiting times, but so are businesses, especially if there is a case for improved customer satisfaction. However, a financial case can be an even bigger motivator for businesses to look at ways for reducing waiting times. In recent studies McDonald's, the well known fast-food-chain company, estimated that 6 seconds saved on payment will result in 1% extra revenue. Tesco, one of largest UK supermarkets calculated that 1 second saved on payment will result in 10 million pound savings.

Figure 2: Dealing with masses of people

3 Consumer potential for contactless payment services

The potential consumer market for contactless payment services is growing rapidly. Certain groups of consumers are more prone to adopting the use of contactless payment in their daily lives. This paper focuses on three types of potential customers: Frequent users of facilities, Yuppies or Dinky's, and young families.

3.1 Frequent users of facilities

Frequent users of facilities or services is the biggest group in the potential consumer market who could be convinced to start using contactless payment services. Public transport is one of the best frequent use cases: assuming that a person travels the same route to work or school 4 to 5 times per week, at the same pricing tariff and in predictably busy hours; then a daily time saving of even seconds can be perceived as positive. Frequent users of other travelling hubs, such as airports, is another potential market. The benefits of contactless payment can be coupled with frequent use saving schemes (customer loyalty programs) or preferential treatment in the form of contactless access to special facilities (lounges) or quicker access to facilities or services (jumping queues).

Frequent users of sporting events offer another opportunity in the market: Thousands of people wish to enter the same facilities and make use of the same services in a very short time period. Contactless payment services, combined with contactless access management can have a positive effect on the customer's perception of the event. The customer can save time by tapping or waving the device (smartcard or mobile phone) to confirm (pre-)payment (prepayment in the case of year tickets) and then be routed automatically by a gating system to the appropriate seating area based on the team supported. Instead of using a customary contactless payment device such as a smartcard or a mobile phone, the sporting event customer may also be open to using branded sporting club paraphernalia for entry confirmation or access routing such as an armband, jacket or clothing badges with the necessary identifiers and NFC technology built in.

3.2 Yuppies and Dinky's

Another segment of the potential consumer market is so-called yuppies (young urban professionals) and dinky's (double-income-no-kids couples). These groups of consumers have disposable income for expensive leading-edge contactless devices, they have an affinity for using credit cards and are in general open to using new technology, not least because of the aspect of 'coolness' and being trendy. This group is also characterized by busy lifestyles and the potential to save time on mundane everyday transactions is most welcome. Smart cards (credit cards) but even more so mobile phones are seen as a daily life tool in which the convergence of as many aspects of the individual's life is realized: combining communication tools, agenda, personal items like photos and other documents is already commonplace. NFC technology in new devices makes it possible to add other daily life tools like payment (credit card emulation) and access (contactless keys to either physical locations or logical access, such as computer systems). When confronted with situations where masses of people

wish to make use of the same facilities, this group will be prone to using contactless devices (regardless of higher costs) to save time. The situations can include the use of public transport or entertainment such as sporting and music events or clubs and (movie) theatres.

Figure 3: Dinky's

3.3 Young families

The last group in the potential consumer market discussed in this paper is young families. These are typically parents with children at school for whom the parents still have complete financial responsibility. Two of the characteristics of this consumer group are the need to manage expenses and minimize the need to handle small amounts of cash for everyday activities. Using contactless payment services is of interest to this group as devices such as a smartcard or a mobile phone can be issued to the children to gain access to sporting or other club facilities, make small (capped) payments for lunches or other expenses and pay for public transport for week/daily travel. Visiting theme parks or amusement parks is another interesting application: not only can access be quickened (long queues at zoo's and parks are commonplace) but also can small purchases be made independently by the children and is there potential for location tracking (in the case of lost children) based on access points or contactless zone detection throughout the park's facilities.

4 Business potential for contactless payment services

Much research has been done on the benefits of contactless payment in public transport or retail business. The focus of this section is to highlight the potential for contactless payment services for business offering facilities or services of which masses of people make use at the same time.

4.1 Public transport

Some of the key concerns of users of public transport is minimizing waiting times to gain access to the transport services, ease, transparency and speed of payment and maintaining individual space while using the facilities. These concerns are valid for all forms of public transport: city transport systems (bus, tram, underground) as well as national railway and (inter-)national flights. Implementing contactless payment solutions can address all of these concerns to at least some extend: It has been proven in many trials and implementations that time is saved for payment (omitting cash handling) and gaining access (an NFC device can be read much quicker than a magnetic striped device). The consumer has a positive experience with regards to maintaining individual space as queues are minimized. Public transport operators can positively impact the uptake of contactless payment devices by advocating the benefits for the consumer.

4.2 Event facilitators

Sporting or music event facilitators have much to gain from applying contactless payment. Convincing consumers to start using contactless devices will have a positive impact on the payment process: personnel dealing with cash can be reduced, margins for error or fraud can be managed during the transactions and security aspects of dealing with large amounts of cash at large events can be minimized. Not only is the payment aspect of contactless interesting for this segment, but also the possibilities around crowd control, targeted marketing and loyalty schemes. Crowd control entails using zoned access control mechanisms to steer crowds to the assigned seating or standing areas by means of contactless gates (where the contactless device of the consumer acts as a key to a zone). Targeted marketing and loyalty schemes can be introduced as more information can be gathered around the users of the event facilities; this is obviously not possible with cash-paying consumers.

Figure 4: Enabling contactless payments would help

4.3 Amusement and theme parks

Amusement and theme parks have similar benefits than those listed for sporting or music event facilitators. Long queues can be drastically reduced when cash handling is replaced by contactless payment. Branding opportunities exist to issue visitors with a one-day valid armband with identifiers linked to the contactless payment transaction. The armband (or other type of imbedded NFC device) can be worn during the visit and serve as a souvenir at the same time. These armbands can be fitted with NFC technology to help guide and track crowds through the park. Additional benefits include: 1) facilitating bringing members of groups or families who momentarily lost track of each other in touch again, this can also be an interesting application during emergency or evacuation situations. Screens can be implemented throughout the park with NFC scanners which can indicate the other members of a group on a zoned map based on the identifiers imbedded in the armband linked to the initial contactless payment. 2) Early identification of overcrowding upon which can be reacted to improve service. 3) Monitoring exact use of facilities and linking these to profiles based on the initial contactless payment transaction. 4) Optimal use of the facilities can be encouraged by incorporating games based on visiting all zones of the park. The consumer can track progress on zoned maps on screens throughout the park. 5) Scanning the armband again when exiting the park gives an opportunity for loyalty by awarding bonus points based on the use of certain facilities or supplying fun statistics (‘how many times on the rollercoasters’). The potential of application around NFC based services is fascinating but it all starts with gaining identity information which is gathered during the initial contactless payment process.

4.4 Processing expense claims of personnel

Companies can save time in processing personnel expense claims by allowing their employees to make contactless payments linked to a company payment account. The device can be the employee’s access pass (smartcard) or the company mobile phone. Transactions can include parking, lunches, airport facilities and other recurring expenses. Transactions can be disallowed or capped based on the role of the employee, the location of the payment and the time of day (Parking at 22h00 in the evening might

be deemed outside of the payment scope). This is not an application for situations dealing with masses of people at the same time, but the number of transactions eligible for claims in large companies can lead to large financial administration costs. Not only is the process of claiming eliminated which typically involves the employee saving tabs, filling in claim forms, getting manager(s) to sign but also the processing the claim itself including reimbursing the employee.

5 Where are we now with contactless payment technology?

In the previous chapters we considered the business potential of contactless payment transactions for the masses. These new payment services have to be enabled by contactless technology. In this chapter we will analyse the maturity of the available contactless payment technologies on the market. Moreover we address two important drivers of the successes of these technologies: security and ease of use, both impacting on the acceptance by users.

5.1 Development of contactless payment technologies

Contactless payment technologies are those technologies that enable consumers to wave an object such as a card, a key or a device over a reader at a Point of Sale (POS). While waving the payments object the inbuilt chip or antenna communicates with or initiates communication leading to a financial transaction. This payment object can be just a debit or credit card or integrated in a mobile device, a body chip, an armband or a wristwatch. In fact it can be incorporated in everything a human can carry with him [5]. If we plot the contactless payment technologies along the usual product lifecycle we will get the following graph, see Figure below.

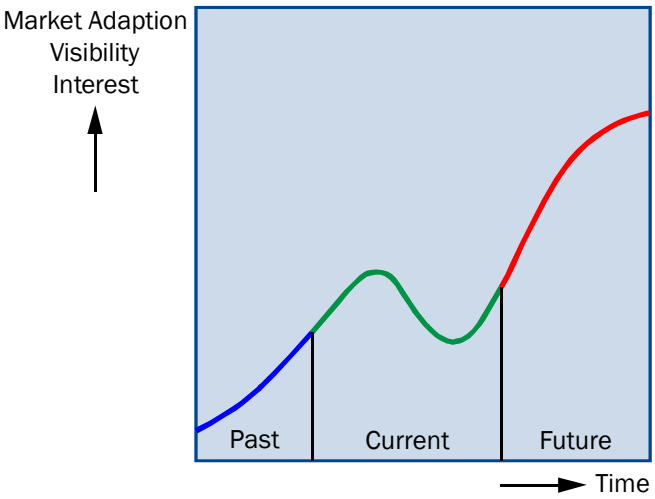

Figure 5: Market adoption, visibility and interest of Contactless Payment technologies

Banks, operators and other companies have started to introduce specific payment solutions. Currently we are in the middle of the graph; the expectation is that we will see significant growth in market adoption, visibility and interest in all business areas in the future. Within the coming years there will be some hype around the technology which will eventually pass. As with any new technology not all payment products will be successful and some users will lose interest. But in the long run contactless payment technologies will definitely be adopted and integrated in our daily lifestyles.

We get a more detailed graph if we plot the available payment technologies and the enabled services against time. The more complex the technology the longer it takes to have a significant penetration of enabled payment service in the market. Hence, when

we evaluate the situation with regards to payment applications for the masses, single company specific payment solutions are currently active on a small scale and small collaborative group solutions are in development – on a regional and national scale. We expect that robust contactless payment solutions for handling large masses of people are likely to appear in the future, and the development of standardisation of the technology will play a significant role. We can also expect that all the different size solutions will co-exist in the future.

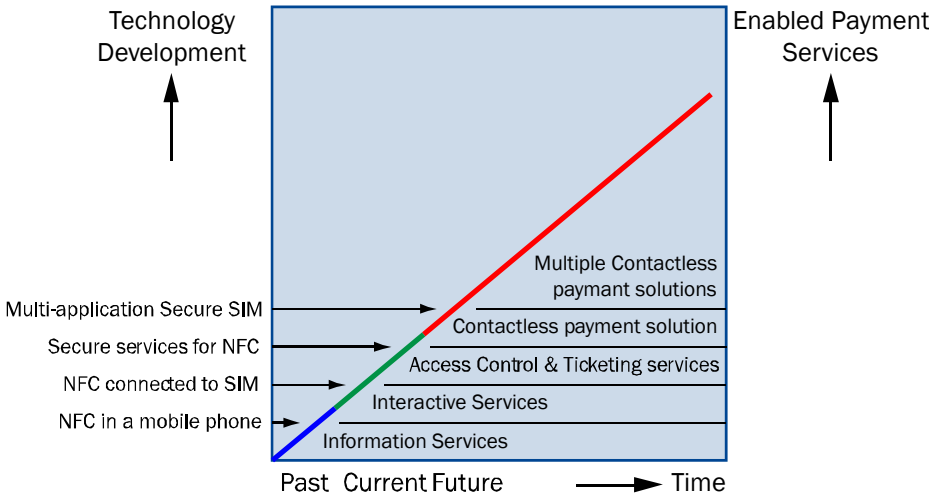

Figure 6: Maturity of payment technology and enabled payment service over time

5.2 Security issues around contactless payment solutions

Using contactless payment technologies in real-life applications requires security issues to be addressed properly, either by implementing countermeasures, or by making sure that specific issues do not impose threats for the applications. Security issues are of particular interest for contactless payment applications for the masses. Here we will summarize some security threats and possible countermeasures. For a more detailed discussion on this important topic we refer to the TNO Whitepaper [6].

Because contactless payment solutions encompass antenna or chip components such as RFID or NFC, the threats associated with using these are inherited by the payment solution. This makes these payment products vulnerable to unauthorised reading of information stored on it., to eavesdropping or to attacks on the back-end system. Moreover, threats are caused by the fact that most NFC devices can support the active communication mode, meaning that all these devices are potentially readers and hence information on NFC devices can be read by others. Similarly, all NFC devices can emulate tags and hence can be programmed to look like any conceivable NFC tag. Other threats may occur because NFC communication is not enforced, NFCs may act as a gateway to attached devices, multiple NFC applications on single devices may interfere and NFC devices may pair unintended. Finally, there is no security standard yet.

In order to assure a proper functioning of contactless payment solutions a whole spectrum of technical countermeasures against the threats mentioned above has been

designed. For example, NFC mobile phones can carry secured chips, the memory capabilities of the payment device can be used for security controls and also the user-interface of the device can be used for requesting user permissions and even passwords for transactions.

Last, but not least, educating end-users about the risks of always having an always-on connection helps to manage the risks of contactless payment devices. When we are dealing with mass applications it is obvious that educating large groups of individuals is not a trivial task.

5.3 Levels of acceptance by end-users

Nowadays consumers are bombarded with new technologies. They feel that these are pushed by the big industries. In particular this holds true for new payment solutions with which some consumers already have experience in earlier unsuccessful trials. Moreover consumers might have the perception that there is no real need for these new contactless payment solutions since they can already easily handle payment on internet, TV and the mobile phone by using the well known credit cards.

When it comes to contactless mobile technology there is at first sight already a difference with all the previous payment methods, one easily must wave or tap with ones mobile. Moreover, it appears that the combination of a payment method with ease-of-use (everyday, everywhere), fastness (speed at check-out) and coolness (innovative technology) leads to growing end-user interest and we can expect to face a steady uptake of contactless payment technology. It is typical for new technologies that security concerns are high, but becoming more familiar with the technology will lead to a higher acceptance level by end-users.

6 Conclusion

The use of contactless payment solutions in industries where masses of people have to be dealt with can be justified by a number of different benefits.

For consumers the tangible benefits can be summarized as saving time, managing expenses and minimizing the risk and hassle of handling cash. The more intangible benefits include the unobtrusiveness of the technology, the coolness or trendiness of using the contactless devices and last but not least the convenience it offers.

For business the benefits are even greater: More satisfied customers by reduced waiting times, maximising people throughput using facilities, optimizing costs through automation as a result of contactless (payment) systems, innovation opportunities and enhanced end-user experience, opportunities for cross and upselling (selling more because of lowering the barriers to the actual action of payment, a wave or tap is easier done than taking out cash or swiping cards), opportunities for customer loyalty and direct marketing activities, the list is almost endless.

However, much of the success of these payment solutions for consumers as well as for businesses will depend on the actual implementation of these services. Choices made by the companies offering contactless payment solutions will have a great impact on the uptake and acceptance of the technology. Finally, as with any new technology, consumer concerns about ease of use and security will have to be addressed actively to promote uptake.

7 Role of TNO

TNO Information and Communication Technology is a unique centre of innovation in the Netherlands that brings together the ICT and Telecom disciplines of TNO. We help companies, government bodies and (semi-)public organisations to realise successful innovations in ICT. Value creation for clients is our priority, and our added value lies in the combination of innovative strength and in-depth knowledge.

Our approach to innovation is integrated and practical. Our research involves more than the technologies themselves. Where necessary, we also focus on user-friendliness, financial aspects, and business processes. We support the implementation process by carrying out technical and market trials. We are also specialists in innovation strategy and policy, and our extensive ICT expertise is a valuable resource that can be used to address issues in the wider community.

We believe that contactless payment technology and its underlying NFC are potentially high impact technologies, both in terms of the possible new applications they bring and regarding the societal issues that may arise from their use. TNO, due to its independent nature, is in the perfect position to address both these issues and strike the right balance.

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