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When technological superiority is not enough: The struggle to impose the SIM card as the NFC Secure Element for mobile payment platforms

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ABSTRACT

Mobile network operators have long played an essential role in the Near Field Communication (NFC) mobile payment ecosystem. In most implementations, the SIM card has been the main technical component to secure payments. Currently, mobile payment providers are increasingly planning to place the Secure Element (SE) for authentication in the handset or cloud, rather than on the SIM card. This paper unveils factors that influence stakeholder preferences for the SE location. To structure the analysis, we use a multi-level framework based on concepts borrowed from multi-sided platform theory. Using interviews with stakeholders, we elicit themes and preferences for each level of the framework (provider, technology, and user). Our findings explain why mobile network operators, despite their superior technology, will likely lose the battle for control in the mobile payment ecosystem.

1. Introduction

Due to growing pressures on profit margins, mobile network operators (MNOs) have been looking for opportunities to diversify their traditional "voice and data" business model. The emergence of NFC (Near Field Communication), a short range, high frequency, and low bandwidth wireless communication technology based on RFID (Ok, Coskun, Ozdenizci, & Aydin, 2013), enables the provisioning of new mobile value-added services. Among them, NFC-enabled mobile payments could become a good candidate for diversification. Mobile payments could increase revenues with the collection of transaction fees. Additionally, the service could lead to more stickiness and therefore reduce customer churn (de Reuver, Verschuur, Nikayin, Cerpa, & Bouwman, 2015). Although mobile payments offer promising business perspectives, technical hurdles need to be solved.

In order to secure NFC payment transactions, the so-called secure element (SE) is a crucial component to authenticate users (Reveilhac & Pasquet, 2009). The SIM card is generally considered a secure location for placing the SE (Chen, Mayes, Lien, & Chiu, 2011). A prominent alternative is the embedded SE, which consists of a hardware module soldered onto the mobile handset (Pourghomi, Abi-Char, & Ghinea, 2015; Reveilhac & Pasquet, 2009). The embedded SE architecture was chosen for the first version of Google Wallet in 2011. Another alternative is to emulate a payment card using a software piece. The SE is stored in the cloud rather than on a hardware module (Pannifer, Clark, & Birch, 2014). Recently, hybrid models emerged. For example, Apple Pay uses an architecture in which the SE is present inside the iOS device. The payment credentials are stored in the cloud. A

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tokenization mechanism is used to secure the transactions.

The alternative SE implementations to the SIM-centric architecture attracted the interest of financial institutions and other payment providers. They have been looking to store the SE on other technologies than the SIM card. Technically-speaking, new mobile payment systems could be launched without the presence and active participation of MNOs. Consequently, the MNO's clout in the mobile payment ecosystem could be significantly undermined.

The aim of this paper is to unveil factors that influence stakeholder's preference for the SE location. This paper explains why the SIM-centric SE model is losing against the embedded and cloud models. We use multi-sided platform theory as an analytical lens (cf., Hagiu, 2014). The value of an SE architecture depends on its simultaneous acceptance by multiple user groups (i.e., consumers and merchants on one side and payment service providers on the other side). Through qualitative interviews with multiple mobile payment stakeholders, we elicit factors on the level of the providers, the technology and the users.

We focus on NFC-enabled mobile payments that use a mobile device (i.e., contactless cards are beyond the scope of this paper). Although the term "mobile payment" is being used for different types of service scenarios, this paper focuses exclusively on mobile proximity payments using NFC. Mobile proximity payments involve performing authentication and authorization, making a payment, initiating accounting and confirming the completed transaction, through a mobile phone at a physical point of sale (POS) terminal (de Reuver et al., 2015). We also focus on post-payments, such as debit/credit cards (i.e., stored value accounts are beyond our scope).

The paper contributes to telecommunication literature on mobile platforms and ecosystems, and specifically the position of MNOs in the mobile payment market. The pivotal and enabling role that MNOs can play in the mobile ecosystem has been a common theme in telecommunications literature, especially in relation to the mobile Internet (Gonçalves & Ballon, 2011; Karippacheril, Nikayin, De Reuver, & Bouwman, 2013; Natsuno, 2003; Peppard & Rylander, 2006; Weber, Haas, & Scuka, 2011; Zhang & Liang, 2011). Yet, there is little research on the reasons why MNOs failed to dominate the mobile payment ecosystem (for more details, refer to the critical review of mobile payment research by Dahlberg, Guo, and Ondrus (2015). Studying the perspective of payment service providers' complements earlier studies on mobile payment acceptance from the perspective of consumers (e.g., Mallat, 2007) and merchants (e.g., Guo & Bouwman, 2015). Our paper contributes to practice by showing how stakeholders such as financial institutions and other payment service providers make decisions on SE architectures. Such understanding is crucial for informed strategizing by stakeholders. This research is timely, as other type of actors such as Google, Apple and Samsung have entered the mobile payment market.

The paper is structured as follows. We provide an introduction on mobile payment (Section 2). Based on desk research and contemporary examples, we describe the different SE technologies (Section 3) followed by a theoretical background on multi-sided platforms (Section 4). Next, the empirical part of the paper introduces the interview method (Section 5) and results (Section 6). A discussion on how the main findings contribute to literature is provided next (Section 7). The paper concludes with key contributions, limitations and outlook to future research (Section 8).

2. NFC-enabled mobile payment

For many years, MNOs have struggled to design mobile proximity payment solutions. A common standard for communication between mobile phones and merchant terminals was lacking. To solve the issue, MNOs invested into proprietary solutions. Different technologies emerged. Unfortunately, none of them became a dominant standard. In Korea, SK Telecom created their own specification of RFID (Radio-frequency identification) technology, requiring heavy investments in both consumer handsets and merchant payment terminals. Similarly, NTT DoCoMo in Japan rolled out a mobile payment platform using the Sony's FeliCa smartcard standard. One advantage was the existing use of this technology for public transit and other prepaid payment schemes. Merchants already possessed the required equipment to accept mobile payments. NTT DoCoMo only had to distribute compatible mobile handsets to their customers. Despite these limited successes, the high investments in technology required prohibited most MNOs in other countries to replicate these experiences (Ondrus, Gannamaneni, & Lyytinen, 2015).

In 2004, Nokia, Philips, and Sony established the NFC Forum. Then, in 2006, the Nokia 6131 was the first NFC-equipped mobile device. Fortunately, all major handset manufacturers now support NFC. Simultaneously, merchants are increasingly equipped with NFC-ready terminals. Financial institutions are rolling out contactless EMV (Europay, MasterCard and Visa) payment cards, which are compatible with NFC. Thus, more than ever, consumers and merchants have NFC-enabled technology in their hands. The diffusion of NFC handsets and terminals remove the main technological barriers that MNOs faced earlier when rolling out mobile proximity payment systems.

The use of contactless payments is growing but remains marginal compared to other payment methods, at the exception of niche markets such as public transportation. Thanks to a gate infrastructure, transit fare collection can be done with a contactless card or an NFC-enabled smartphone. For this specific application area, viable systems have been launched. For instance, there is Octopus in Hong Kong, T-Money in South Korea, EZ-Link in Singapore, and Oyster in London. Similarly to some of the mentioned countries, in the Netherlands, payment for public transportation is now done via dedicated contactless chip cards. In November 2015, Dutch public transportation providers have started a pilot with emulating the chip card through a mobile application, which currently works only on Android phones. Technically, this solution uses the SIM card for storing the SE, requiring users to replace their SIM card with UICC (Universal Integrated Circuit Card) card, and extends existing mobile wallet applications from two of the three major MNOs Vodafone and KPN. Nevertheless, the development of such solution has been impeded by the SIM-card architecture choice. Consumers must buy a specifically certified smartphone and typically swap their current SIM card. Up to now, the onboarding process and technical requirements were the main barriers for mass adoption of mobile payments in public transit scenarios.