Analysis of the Risks of NFC Mobile Payment Systems

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Abstract

Near Field Communication (NFC) mobile payment processing systems have become increasingly prominent over the past few years. As more consumers switch to card-less transactions, perceptions of this colossal paradigm change abound. This research aims to understand consumer perceptions regarding the risks associated with NFC mobile payment processing systems as they become progressively popular. Despite the technical evidence and validation that NFC transactions support a more secure mobile payment process, opinions remain undetermined. Consumer perceptions may support the technical spectators in NFC transactions' safety, but it can also refute it. One credible method to analyze how consumers truly feel about NFC risk was to conduct a simple survey of 100 participants. The survey yielded very informative results, and served as an excellent foundation for additional research, as NFC mobile payment processing systems become more widespread.

Keywords: Mobile Payment Systems, NFC, Digital Commerce, Alternate Payment Methods, Android Pay, Apple Pay.

1. INTRODUCTION

Payment systems are broadly defined as any system used to settle financial transactions through the transfer of monetary value, and includes the institutions, instruments, people, rules, procedures, standards, and technologies that make such an exchange possible (Wikipedia, n.d.). This research paper focuses on the risks of a certain forthcoming technology. Unlike traditional payment systems, Near Field Communications (NFC) focuses on user convenience. Although NFC is still a relatively new phenomenon, its risks are already spurring myriad questions. Even though NFC presents one protocol of many available in payment systems, this research focuses on it due to its unconventional usage techniques and the learning curve users need to attain. Lastly, it is worth noting that although there are many aspects of a communication protocol which could branch into various security issues, this research is only concerned with studying consumer perception relative to risks.

2. EVOLUTION OF PAYMENT SYSTEMS

Payments systems continue to evolve rapidly as newer and more efficient technologies are introduced (Jones Lang LeSalls, 2013). This monumental rise in e-commerce as a business for both consumers and companies only seems to fuel the evolution. According to Nakajima, payment systems will never stop to evolve, because they are the social infrastructures that support all economic activities (Nakajima, 2012). Furthermore, as the financial markets continue to grow and become interdependent, the need for safer and more sophisticated mobile payment processing systems becomes inevitable.

According to BI Intelligence, by 2019, they expect the mobile payments volume to reach $808 billion and think that mobile payments will catch on faster than other research firms suggest (Andrew Meola, 2016).

In the pre e-commerce era (Web 1.0, prior to Y2K), payment systems were largely limited to physical cash, bank checks, and some credit card transactions. But as more financial activity became virtual, the need for card-less systems became imperative. As such, a large portion of merchants accounting for US payment volume will implement mobile payment capability (Andrew Meola, 2016). NFC is a case in point for a payment system which focuses on card-less transactions through the purchasers' mobile devices.

Although NFC and many other payment systems may seem foreign to the everyday consumer, it does not come as an unusual surprise. Payment systems are often considered as "behind-the-scene activities," because the large audience rarely ever considers how they are going to pay (Nakajima, 2012). A payment system may be considered as an underground activity, but its importance requires that users understand at least the surface of its operations. Nonetheless, the adoption of mobile wallets and the behaviors of payments by mobile devices will increase as more consumers use and more retailers offer mobile in-store payments. Furthermore, the competitive pressure that is forming among the companies that offer mobile payments, for example, Apple Pay, Samsung Pay, Google Wallet, and others will drive mobile payment adoption faster as well. This study seeks to explain how the development of information technology has further contributed to the advancement of payment processing, in particular, the NFC protocol.

3. FACTORS TO CONSIDER WITH ONLINE PAYMENT SYSTEMS

This section discusses the different factors that should be well thought-out when online payment systems are evaluated, both from the viewpoints of the merchants and the consumers. This study focuses on factors that include acceptance, physical security, cost, and support, among others.

Consumer Related – Security versus Convenience

When consumers think of NFC mobile payments, they usually visualize waving a smartphone or a smart wearable over a credit card terminal and paying for their purchases. Although this vision is valid, it is far short of the full capabilities that NFC has to offer. There are numerous other functions which NFC makes possible, including potential "risks" such as losing personal information like addresses, phone numbers, etc. (Wolpin, 2012). In actuality, the technical safety of NFC payments is much more robust than that of physical credit cards (Weise, 2014). Since a NFC payment requires smartphones or other mobile devices to be physically placed no more than a few centimeters apart from the card terminal, potential offenders will find it extremely difficult, if not impossible, to be able to intercept payment information. The details of the actual NFC payment processing transactions are discussed further in the following subsection of this paper titled: Physical Security of a Transaction.

Although NFC payments have several built-in safety functions, consumers may still be at risk due to the level of physical security of their smartphones. Some consumers feel that NFC payments can be risky because their payment information is stored on their smartphones (The Green Sheet, 2013). The risks of NFC based mobile payments could be valid in cases of smartphone theft, because many users do not lock their smartphones with a PIN and/or fingerprint recognition software, as often times consider doing so to be lackluster (The Green Sheet, 2013). Additionally, the physical security of users' smartphones may be worsened since many users "protect" their smartphones and NFC based payment systems with easy-to-guess and easily hackable four-digit PINs (The Green Sheet, 2013).

Merchant Related – Cost versus Overhead

NFC mobile payment systems will not require much change from merchants (Zimmerman, 2014). The only financial expense that merchants have to bear would be a payment processing system for their POS that supports NFC. There would be no additional payment processing costs because the NFC purchase would proceed as a regular credit/ debit card purchase. As far as risks are concerned, merchants would have less overhead, because they aren't provided with any card information or customer facts. The entire NFC payment transaction would occur with a unique identification number which initiates the funds transfer. Hence, merchants would have less to worry about, because clerks are never exposed to the customer's credit/ debit card and there are no additional surcharges for paying with

NFC (Zimmerman, 2014). Even though there are significant benefits for merchants that accept NFC based payments, its full potential will not yet be known because there is still only a small fraction of US businesses with NFC enabled technology (Zimmerman, 2014).

Acceptance Related - Consumer Side

Potential risks that may result when the masses use NFC for payments are yet to be determined due to the limited number of mobile devices that support the NFC protocol. Risks that have surfaced to the top still could represent only the tip of the iceberg because there are still only a few devices, particularly smartphones that allow for NFC enabled payments (Riley & Schmidt, 2014). Apple Pay is restricted to only iPhone 6 and later. This prohibits numerous smartphone users from using Apple Pay for NFC payments. Additionally, Samsung users are also severely limited in using Android Pay and Samsung Pay because these applications are only compatible in Samsung Galaxy 6 and later and Note 5 and later. Since there are still many users who are limited to using NFC technology for mobile payments, the true risks of NFC enabled payment systems cannot yet be identified.

Acceptance Related - Merchant Side

An additional reason for NFC enabled payment systems to not be fully analyzed is the lack of merchants who are equipped with NFC payment terminals, more specifically "Contactless Terminals" (Riley & Schmidt, 2014). Several small businesses shy away from implementing contactless terminals solely because of the additional costs of the newer terminals; However, several larger retailers are similarly restrictive due to their previous commitments to competing merchant networks with lower interchange fees, such as the Merchant Customer Exchange (MCX) (Riley & Schmidt, 2014). Since numerous top-tier retailers are already engaged with other networks, adopting newer NFC enabled payments may seem like an extra burden. Hence, analyzing NFC enabled payments' risks becomes less accurate and more generalized.

4. PHYSICAL SECURITY OF A TRANSACTION

Despite the perception that contactless payment systems, like NFC, may seem riskier than physical card swipes, such a perception remains not true (Weise, 2014). NFC enabled payments like Android Pay, Apple Pay, and Samsung Pay are actually more secure than their counterparts. The first misapprehension has to do with the smartphone / mobile device's proximity to the card reader. The distance is typically no more than a few inches (Wolpin, 2012). With such closeness, it becomes extremely difficult for hackers to intercept payment information in between. Additionally, NFC enabled payments usually communicate within a secure channel (NFC.org, n.d.). This communication is then encrypted, and only authorized users or devices are able to decode the transmitted information.

An additional security measure which is used by Apple Pay is tokenization (Blue Pay, 2015). Tokenization refers to the use of "tokens" – that is, the users' credit card and other personal information gets replaced by randomly created IDs or tokens when transacting (Blue Pay, 2015). The receiving merchants only get sent these tokens along with a security code. Once the payment processor decodes the tokens and the security code, they then become obsolete (Blue Pay, 2015). This feature doesn't pass any financial information to the retailer; hence, there is nothing available to be stolen. The fundamental security associated with NFC along with the additional security measures used in popular applications - like Android Pay, Apple Pay, and Samsung Pay - make for a very secure and efficient payment method.

Another issue of potential security concern has to do with interception of the data flowing between the mobile device and the NFC terminal. As such, NFC interception attacks could be possible in situations where a person acts as a middleman between two NFC devices and receives and alters the information as it passes between them. This type of attack is difficult and less common. To prevent it, devices should be in an active-passive pairing. This means one device receives info and the other sends it instead of both devices receiving and passing information (Security Concerns with NFC Technology, n.d.).

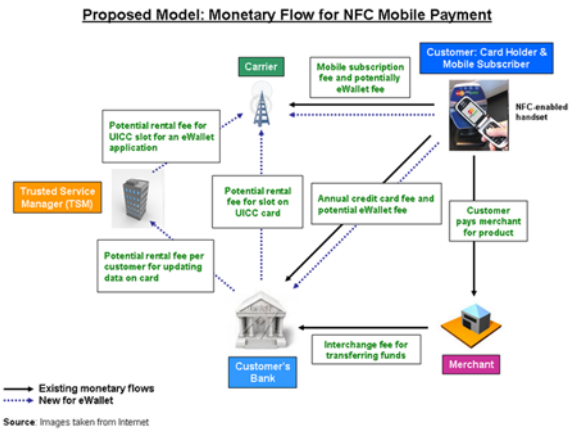

Figure 1: Monetary Flow for NFC Mobile Payment

An NFC- based payment transaction is similar to that of a physical card swipe (Conkling, 2011). As diagramed in Figure 1, a customer makes a payment through a NFC-enabled handset. The payment information is routed to the merchant through its card processor. The credit/debit card processor then accesses the customer's bank account and funds are sent to the merchant less any credit card and interchange fees. Although the process is very similar to a physical card swipe, Figure 1 seems more complicated because there are options to incur additional fees while using a NFC-enabled payment system. However, delving into these options and additional fees is beyond the scope of this research project. Nonetheless, it is fair to assume that there will always be certain issues related to security during the NFC enabled payment process; however, this research is mainly concerned with the study of consumer perception relative to risks, and defers the concerns of additional security issues to further future research.

5. RESEARCH QUESTION

The focal question of this study deals with consumers' perception of the risk or safety level associated with transactions made with NFC technology. The research question for this study is:

"**With the advent of increased mobile-based payment systems, do consumers perceive transactions made with NFC technology as risky?**"

6. METHODOLOGY

Data for this study was obtained from conducting a voluntary paper survey of 100 participants. The participants were common every day purchasers of goods and services at a gas station, in suburban Atlanta, Georgia. The survey was approved by Internal Review Board (IRB) at Georgia Gwinnett College (GGC). A copy of the approved Informed Consent is provided in the Appendix as part of the survey instructions.

Surveys are arguably one of the most efficient and reliable methods to getting honest and credible data for a research paper (Wyse, 2012). There are some very important benefits of a survey, particularly a paper survey. Surveys are fairly inexpensive, because they do not require any "high- tech" equipment, nor any trained professionals. Surveys can yield extensive results when done on a large population and the results are usually fairly accurate. Additionally, surveys are considered dependable, because the respondents are surveyed anonymously and incognito, and the individual answers always remain confidential (Wyse, 2012). And for these reasons, this research focused on acquiring consumer perception through a paper survey.

The survey was purposefully kept very short and simple to ensure maximum responses. The designed survey is only one question that aims to understand how consumers feel about the safety of NFC-based payment systems, and it is completely anonymous. The informed consent was included on top of the survey slip prior to the participants' ability to read the survey question. The Informed Consent also disclosed the benefits and risks of participating in the survey. Once the participant agrees to the informed consent, they are asked to answer the brief question for the survey. The Appendix shows a snapshot of the slip that was used for this survey.

This survey was conducted over a period of four months, starting in January, 2016 and continuing until late April, 2016. There was no particular intensity or frequency to this survey. The survey paper slip was placed near a check-out counter at the gas station. The survey was totally voluntary. There was a goal of at least 100 respondents to minimize effects of outliers, but there was no pre-set maximum for the survey.

Risks and Benefits of the Survey

There were zero to minimal risks to this survey. The respondents were completely anonymous and the survey was voluntary. This allowed for a very low risk factor to those who responded. Additionally, the survey was conducted randomly and without any person directly asking consumers to participate. This allowed potential respondents complete freedom in answering or not answering the survey question and almost completely eliminated any haggling or threats of not completing the survey. Consequently, this survey was very beneficial to the participants and to society as a whole. The survey provided invaluable data about the consumer perception regarding NFC-based payment systems, and allowed for analysis of the data without any additional costs. Although, there were no direct benefits to the participants, the survey result yielded a significant amount of data in terms of consumer knowledge and change adaptability (Katayama & Bennett, 1999). According to many scholarly articles, a survey prior to change implementation helps minimize the adverse effects of change within consumers. With this survey in mind, the participants would be more knowledgeable about NFC-based payment systems as it becomes more prominent.

Additionally, society as a whole would benefit from the results of this survey because it provides credible real-world data from real consumers regarding NFC-based payment systems. This data would serve beneficially towards comparing consumer perception during this research (when NFC-based payment systems and technology are still in their infancy) with the era of NFC-based payments becoming as common as physical credit/ debit cards. Such a comparison could yield valuable data about consumer perception changes, if there are any.

7. DATA ANALYSIS

After surveying 100 participants, the results were varied, but also lacked any clear indication. The extrapolated data portrayed mixed results. On a scale of 1 (Riskiest) to 5 (Safest), the survey of 100 participants yielded the following results:

- Median: 3.0
- Mode: 5
- Average: 3.1
- Sum: 310
- Range: 1 to 5
- Total 1s: 18
- Total 2s: 21
- Total 3s: 17
- Total 4s: 21
- Total 5s: 23

If the hypothesis predicted the perceptions of consumers as risky, the average should have been less than 3.0; yet the actual average was 3.1. This same average would not have strongly supported an opposite hypothesis. Although the average leaned more towards a safer perception, the value wasn't high enough to effectively argue that a hypothesis either wat. Consequently, we decided to analyze the responses to see which answer value was the most common. After analysis, the mode answer value was 5. The responses are depicted in Figure 2.

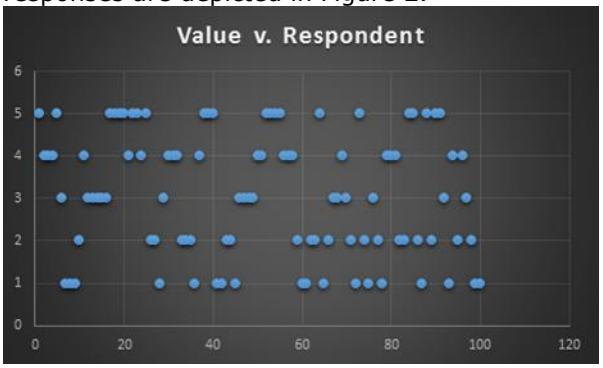

Figure 2: Data Graph- Value v. Respondent

Figure 2 clearly depicts a large cluster of values for a 5 (consumers perceive NFC-based payments as very safe). This analysis was an important decision maker for this survey. Since the average value was almost in the middle, the only way to make a decision was through looking at the mode. Additional measures that were feasible to understand the decision was that the second highest answer value was a tie between 2 and 4. Understanding the 4 further reinforced the conclusion that a hypothesis would be neither validated nor invalidated. However, another fact that supported consumer perception as risky was that the second highest answer value was also a 2. Since the second highest value was an even split between 2 and 4, we decided to evaluate the mode as a decision maker. Another reason why this survey did not yield very clear indicators was the fact that there was a similar distribution for all the possible answer values. Figure 3 graphically portrays this information:

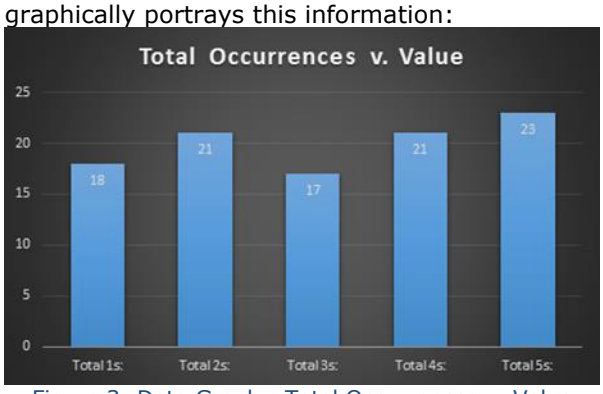

Figure 3: Data Graph - Total Occurrences v. Value

As the graph in Figure 3 shows, the answer values had a similar number of answers by the participants. The number of answers ranged from 17 to 23, which is a small range. This small range further emphasized the notion that there is still a variety of perceptions among consumers with regard to NFC-based payments and their risks. Since NFC-based payments are still in their initial stages, this idea is not extraordinary. The information gained from this survey did not yield very strong conclusions, and it neither validated nor invalidated a hypothesis. However, this survey was not completely of no value. The information garnered is an excellent depiction of the notion that consumers still lack a clear understanding of NFC-based payment systems. This can serve very well with regards to an early study of consumer perceptions relative to risks.

8. FURTHER STUDY NEEDED

As with numerous surveys, the conclusions are not cast in stone, and no survey is perfect. There were several shortfalls to this survey, which require further study and analysis.

First, since this survey was conducted at one identical geographical location, the results do not portray the general public's perceptions relative to risks about NFC-based payment systems. For a more holistic perception, it is important that an identical survey be performed throughout the United States or even throughout the world. Only then can results be conclusive enough to truly understand consumer perceptions.
Second, this survey only determined consumer perception through a quantitative measure, or only through numbers. If the survey is tweaked to include space for qualitative feedback, such as "why consumers perceive NFC-based transactions as risky or safe?" along with a clear description or explanation of NFC safety (ex: physical safety, safety of information, identify theft, etc.), then a more accurate depiction is possible. Because of the lack of resources, these components were not included in the survey.

A third reason that calls for further study before gaining a valuable understanding is the lack of information given to consumers about NFC-based payment systems (Hayashi, 2012). For researchers to gain credible insight into consumer perceptions, consumers need to have a decent understanding of NFC-based payments beyond Android Pay, Apple Pay, and Samsung Pay. Without the respondents having a comprehensive understanding, it becomes very difficult for the results to be detailed. Educating consumers about NFC is not possible via a survey, and would require a large amount time and other resources. However, once consumers have a reasonable understanding of NFC-based payments, results from identical surveys could be invaluable.
The fourth shortfall is that the survey only asks one question. This was intentionally decided in order to maximize participation and minimize that time it takes to complete the survey. Consequently, it was not possible to look for correlations with other relevant variables (for example: previous experience with NFC payments, previous experience with e-commerce in general, general risk propensity, etc.).
Lastly, despite the many shortfalls to this survey, it serves as a very good portrayal of consumer perceptions relative to risks while NFC is still in its infancy stages.

9. CONCLUSION

Consumer perceptions is a widely studied idea in various industries, because of its applicability, and it is no different for NFC-based payment systems. Understanding how consumers feel about NFC-based payment systems before it becomes more prevalent is extremely valuable for both retailers and security-experts, because they can base their decisions on it (Conkling, 2011). Even though the survey was unable to yield strong results regarding consumer perceptions, it served as an excellent tool to gauge consumers' discrepancy regarding NFC-based payment systems. This survey may not yield any immediate benefits, but will serve perfectly as a comparison to future surveys that wish to study consumer perception relative to risks. Conclusively, the varied responses were not able to strongly understand consumer perceptions, but as long as this research aids future researchers, it will have served its purpose.

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Appendices and Annexures

Perception about NFC Payment Systems
A Research Project Survey

Informed Consent: This survey question is used to judge consumers' perceptions about the safety of "Near- Field Communication" payment systems. The risks of participation are minimal, and the survey is completely anonymous and voluntary. Submission of the survey will be taken as agreement to participate. There are no incentives for participating in this survey.

Slip # _____ Date: _____

Q: **On a scale of 1- 5 (1- Riskiest to 5- Safest), how is your perception about the safety of "Near- Field Communication" payment systems like Android Pay, Apple Pay, and Samsung Pay?**

Please circle your response below, and thank you for your participation!
(Riskiest) 1 2 3 4 5 (Safest)

Figure 4- Survey Slip