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Understanding the current state of the NFC payment ecosystem: A graph-based analysis of market players and their relations

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Resumen

El reciente desarrollo de la tecnología Near Field Communication (NFC) ha permitido la aparición de servicios de pago a través de teléfonos celulares. Además, esta innovación tecnológica ha iniciado una evolución continua relativa a las operaciones de pago. Las empresas y los investigadores proyectan que la función predominante de las tarjetas de crédito serán progresivamente sustituidos por dispositivos móviles. En este trabajo se describe en detalle NFC y se realiza un análisis de red basado en gráficos para determinar los participantes y las industrias involucradas en la red, así como las relaciones, incluyendo los conflictos, cooperaciones o alianzas entre los actores.

Palabras clave

NFC, Pagos móviles, Telecomunicaciones, Financiero.

Abstract

The recent development of Near Field Communication (NFC) technology has enabled the emergence of payment services using mobile phones. Furthermore, this technological innovation initiated an ongoing evolution concerning payment transactions. Companies and researchers project that the prevalent function of credit cards will be progressively substituted by mobile devices. In this paper NFC is described in detail and a graphed based network analysis is performed to determine players and industries involved in the network as well as the relations, including conflicts, cooperation, or alliances between these actors.

Keywords

NFC, Mobil Payments, Telecommunication, Financial.

1. Introduction

Traditionally, the mobile telecommunication and financial industries are completely separated, each with their distinct, non-overlapping sectors and markets. The recent development of Near Field Communication (NFC) technology has enabled the emergence of payment services using mobile phones. Furthermore, this technological innovation initiated an ongoing evolution concerning payment transactions. Both involved companies and researchers project that the prevalent function of credit cards will be progressively substituted by mobile devices (Wilcox, 2011). Therefore, this progress creates an interface between these independent industries and inevitably induces competition among industry players.

1.1. Motivation

The first specification of the NFC technology was unveiled to the public in 2006 by the NFC Forum (Katzman, 2006). The technology itself is a set of protocols to enable short-range, contact-less and bi-directional communication between two devices (NFC Forum, 2011a). This organization

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represents a non-profit consortium currently consisting of 150 members and is supported “by leading mobile communications, semiconductor and consumer electronics companies” (NFC Forum, 2011b). They predict NFC to be the next generation payment method and will invest a vast amount of capital to actively support their prediction (Ondrus & Pigneur, 2008; Kharif, 2011). Nevertheless, the technology still has not made its breakthrough within the payment market. This is affirmed by the fact that there is currently only one mobile device, which can be used to accomplish a payment transaction in the USA (Citigroup Inc., 2011).

1.2. Core problem and research questions

From a scientific point of view the usage of NFC as a payment method has only partly been covered in literature. However, much effort has been conducted to analyze security aspects (Haselsteiner & Breitfuss, 2006), (Madlmayr, Langer, Kantner, & Scharinger, 2008). Despite NFC payment systems undoubtedly involving many competing companies and therefore requiring the establishment of new inter-organizational systems, the NFC ecosystem has not been sufficiently studied through an Interorganizational Systems(IOS)-lens.

At the interface between independent industries, the introduction of the NFC technology has exposed a new ecosystem linking different players. In this context, an ecosystem is considered “an economic community supported by a foundation of interacting organizations and individuals“ (Moore, 1993). We use this concept because it gives us a holistic view by including every stakeholder involved in the NFC technology. The recency of the NFC ecosystem leads to the core problem in that it currently consists of unstable, fast-changing relationships between its players. Different competing systems strive to a leading position, while mutually impeding the mass-adoption of NFC as a payment method by customers (Ondrus, Lyytinen, & Pigneur, 2009). Within the ecosystem, alliances were set up, conflicts arose and even competing players cooperate to achieve strategic benefits contributing to a less transparent view.

Therefore the main purposes of this paper is to 1) identify players and industries of the NFC ecosystem, 2) discover and describe relations between these players on various levels and 3) analyze possible incentives of each player to engage in these relations.

1.3. Structure of the paper

After first introducing the topic of this paper, located above in Section 1, we will continue on to briefly explain the basics of NFC as well as the method we will apply in our research, a graphed based analysis, in Section 2. Following that, in Section 3, we will perform a network analysis to determine players and industries involved in the network as well as the relations, including conflicts, cooperations, or alliances between these actors. Finally, we draw conclusions from our research, propose potential future goals of market players, described the limitations of the study, and the market outlook in Section 4.

2. NFC basics and research method

In order to give the reader a common understanding of NFC payment systems, we use this chapter to explain the basics of the NFC technology and to illustrate the payment procedure using NFC during a checkout process. Additionally, we outline the graph-based network analysis method, which is used as the primary instrument to answer out research questions.

2.1. Near Field Communication (NFC)

2.1.1. Technology

On its technological layer, NFC is a set of standardized protocols to enable short-range communication between two devices. Basically, the wireless connection is established by an air-core transformer through the use of magnetic induction using two loop antennas located in the initiator and target devices' near field (NFC Forum, 2011c).

NFC is an extension to the Radio-Frequency Identification (RFID) technology and allows an exchange of data and therefore a bi-directional communication instead of a uni-directional communication. In fact, NFC integrates standards of the RFID technology, but while RFID devices can rely on various incompatible communication protocols, they are strictly declared for NFC devices (NFC Forum, 2011a). On a more precise level, NFC uses two ISO/IEC standards: ISO 14443 in passive mode and ISO/IEC 18092 in active mode.

In active mode, both devices generate an RF field to enable a transfer, for example when two phones are tapped together to exchange contact information. In passive mode, only the initiator generates the field, which activates and powers the target; case in point being the point-of-sale at a retailer (Noor, 2006). By operating within a distance of 20 centimeters at a transfer rate of 106, 212 or 424 kbit/s per second, NFC fills a gap in the diagram provided by Figure 1 in comparison to other wireless technologies (NFC Forum, 2011a).

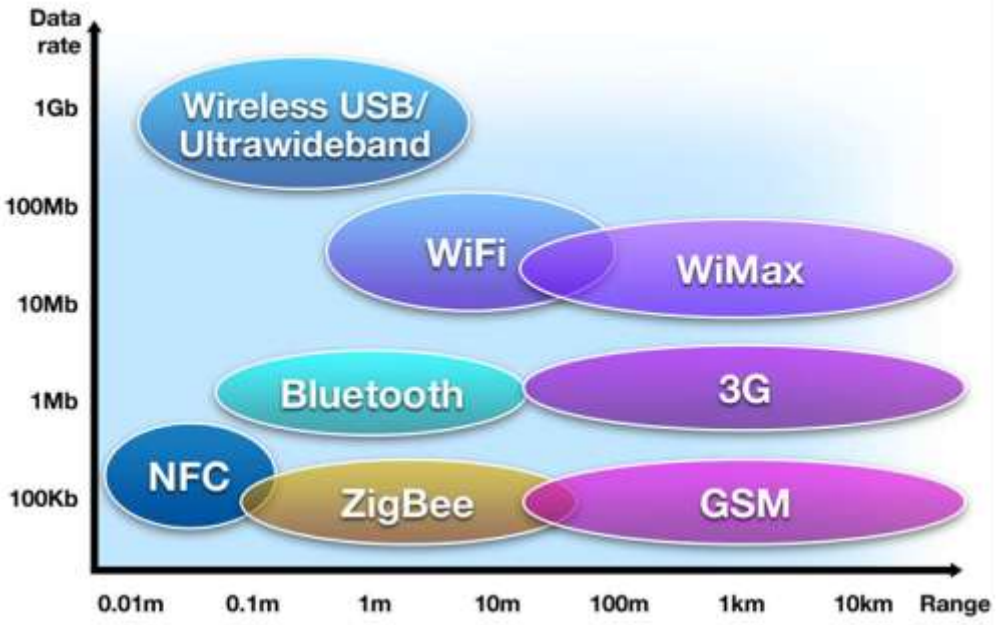
Most security aspects in NFC depends entirely on the software developers who are responsible for the encryption of transmitted data. An example being Google Wallet encrypting the credit card information which is transferred to the retailer.

However, point-of-sale transactions are already secured by the ISO 14443, having already been designed to do so for use with RFID which is used by "major credit card companies" (Nosowitz, 2011).

2.1.2. Payment procedure

In the following section, we illustrate an example of how a typical transaction looks like using Google Wallet. With a NFC-enabled Android phone, such as the Galaxy Nexus S 4G, you proceed to a merchant which accepts CitiBank MasterCard and utilizes PayPass. The payment process is initiated by tapping the phone near the PayPass-terminal. This terminal is generating an RF field which powers the NFC chip inside the phone and establishes a session. During this session,

Google Wallet transfers certain information, such as credit card information, from the phone to the merchant's terminal. This information is then utilized by the merchants system to make a request to the customers MasterCard provider to inquire the availability of credit. The rest of the payment portion remains the same as a regular credit card transaction. Shortly after a successful payment, the customer receives information on his phone about the transaction, e.g. merchant information, time of purchase, transaction value etc. (Google Inc., 2011a).



(Source: NFC Forum, 2011a)

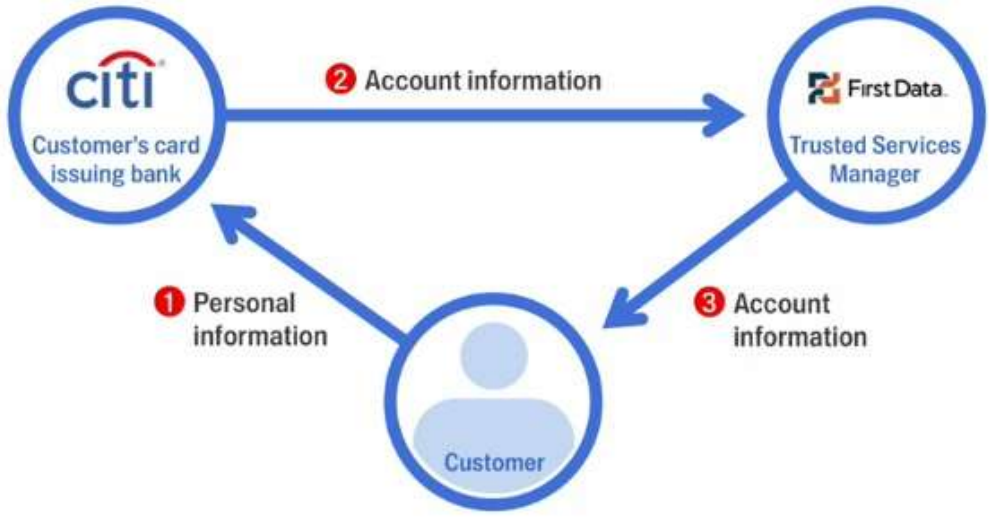
Figure 1. Comparison of wireless technologies

Google Wallet ensures the security of transactions through a few measures. As a first barrier, the phones NFC chip is not active if the screen is off, and thereby protects users from unauthorized connections. Second, even when the phone and the NFC chip are active, there is an additional secure, hardware-based storage, which is not activated by default and thus prevents transactions. There encrypted credit card and other personal information is stored and only trusted programs are given access to it. However, once the data leaves the phone it is up to the retailers to ensure that it stays secure, which is the case with all transactions (Camp, 2011). Finally, in order to open the Google Wallet app to make a payment, a pin code has to be entered by the user to unlock the app. Figure 2 depicts the variety of secure channels, Google sends encrypted data through.

2.2. Graph-based network analysis

As a primary tool to elaborate players, industries and relations within the NFC ecosystem, we utilized a graph-based approach. This is because graph theory provides a profound framework of methods to visualize as well as to analyze complex networks (Newman, 2010). Although its ability to represent complex networks, a plain graph only consists of two element types: nodes and edges, whereas one edge connects two nodes. In the network analysis we conduct in this paper, a

node in the graph corresponds to a player and on a more aggregated level, multiple nodes form an industry.



(Source: Camp, 2011)

Figure 2. Secure communication channels in a Google Wallet transaction

The first step of the analysis is to identify a set of relevant players. We include all NFC-enabled payment systems as starting points, which currently exist in the US market: Google Wallet and ISIS. The official websites of these systems serve as the primary source to collect nodes and therefore have to contain a minimum level of information (at least 3 press releases). We search for references to partner companies within the websites' content, announcements or press releases and intelligently transform relevant companies to nodes in our graph. Therein, we collected nodes using a recursive search covering one level of depth. It is possible to extend the analysis by increasing the level, but is refrained in this paper due to complexity reasons. Finally, the result of this step is a set of unconnected nodes.

To connect these nodes in the second step, we have to identify relationships between the players. Furthermore, this relationship has to be characterized either as a cooperative or conflicting one. As the primary source in this step, we conduct and Internet-based search using Google. The approach is to build search queries, each covering two players, based on the Cartesian product of the players an industry and the players of every other industry. In a single search query, an AND-operator combines the names of two players and a static keyword in order to relate the search to the NFC ecosystem:

(nfc OR "near field communication") [Player 1] [Player 2]

To collect further information, we focused on the first 10 results of each query. The result sets were browsed for information indicating either a cooperative or conflicting relationship. We interpreted a cooperative relationship as an edge within our graph, while leaving two nodes unconnected if a possible conflict was identified (missing edges). The results were consolidated in one table each for edges and missing edges.

3. Network analysis

3.1. Network players and industries

For this research, we focused on the mobile payment in U.S. market, where we identified eight different industries that participate in the NFC payment market. Figure 3 visualizes these industries, their members, and the relations between them in a graph.

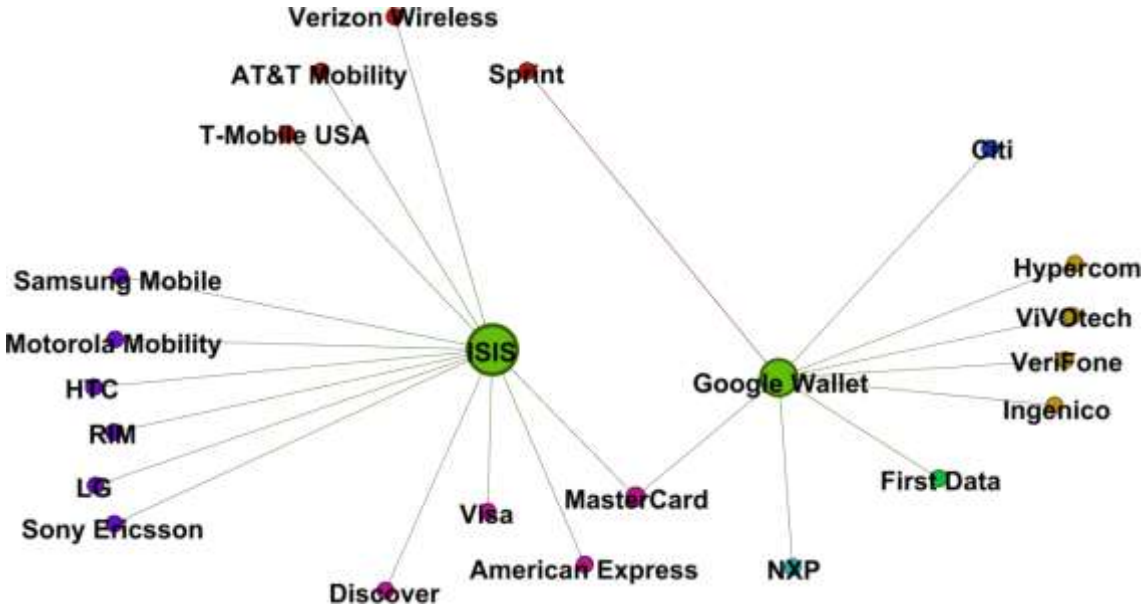


Figure 3. Players in the NFC payment market

NFC Payment Services (Green)

- Google Wallet (Google Inc., 2011a)
- ISIS (ISIS, 2011a)

As a core industry, *Payment Services* is positioned at the center of NFC market. Due to our research approach, the members of this industry connect to every other industry in the market as seen in the graph in Figure 3. Their main objection is to operate the “mobile wallet” and therefore they strive to establish a solid network structure.

Mobile Operators USA (Red)

- Verizon Wireless
- AT&T Mobility

- T-Mobile USA
- Sprint

Mobile Operators are the key industry in this market because they provide the basis for communication and transaction layer.

Handset Manufacturers (Purple)

- Samsung Mobile
- Motorola Mobility
- HTC
- RIM
- LG
- Sony Ericsson

The industry consisting of *Handset Manufacturers* industry is starting to produce more devices integrating NFC chips. As a part of our research, we analyzed statistics about NFC-enabled mobile devices which are offered in December 2011 by all handset manufacturers collaborating with Google Wallet and ISIS. The results are presented in Table 1, which describes the current state of mobile devices in the market, mobile devices supporting NFC and new devices announced to be in the market in the near future. A further step was to build a ratio of the total number of the NFC mobile devices in comparison to the total number of mobile phones. By looking at a ratio of only 3 %, we conclude that the number of devices supporting the technology is still very low. Table 6 even shows that there is only one mobile phone used for testing and is working at the moment with Google Wallet, even though there are more devices with NFC chip in the U.S. market.

Issuing bank (Blue)

- City

Credit Card Networks (Pink)

- Visa
- Master Card
- American Express
- Discover

In the *Payment Industry*, we identified Banks and Credit Card Networks participating in this market. Furthermore, this industry connects Google Wallet and ISIS indirectly.

Merchant processing, point of sale, and Trusted Service Manager (Light green)

- First Data

Semiconductor (Teal)

- NXP

The two industries stated above are working with Google Wallet and provide the NFC chip and the technology to connect credit cards into the virtual wallet.

Point of sale (Yellow)

This industry is the provider of the electronic payment solutions, software, systems and high security electronic payments. They provide for example the terminal at the checkout counter of a retailer.

- VeriFone
- ViVOtech
- Hypercom
- Ingenico

3.2. Network relations

When we analyzed the NFC payment market, we identified two key players: Google Wallet and ISIS; which are specified in Figure 4 and Figure 5.

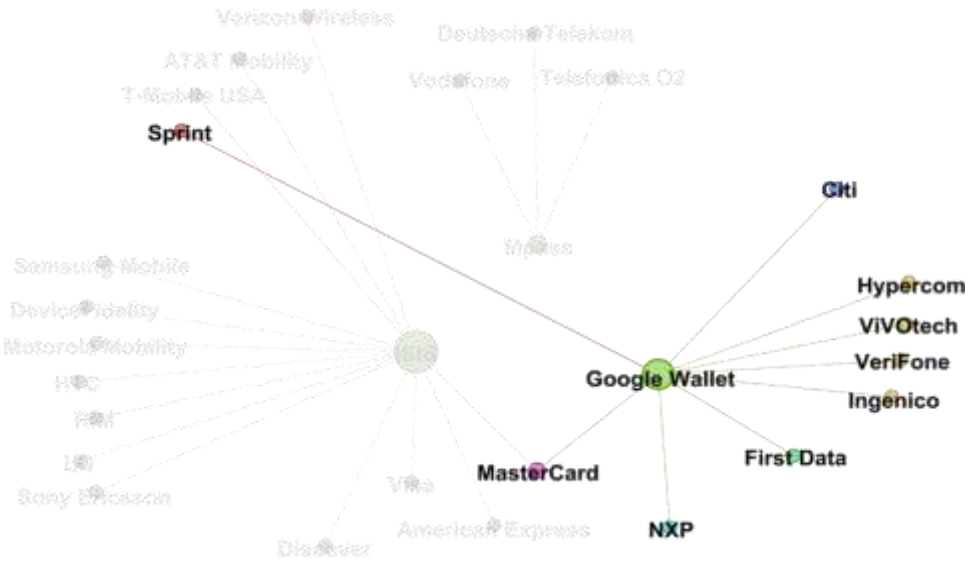


Figure 4. Network players in the NFC payment market (Google perspective)

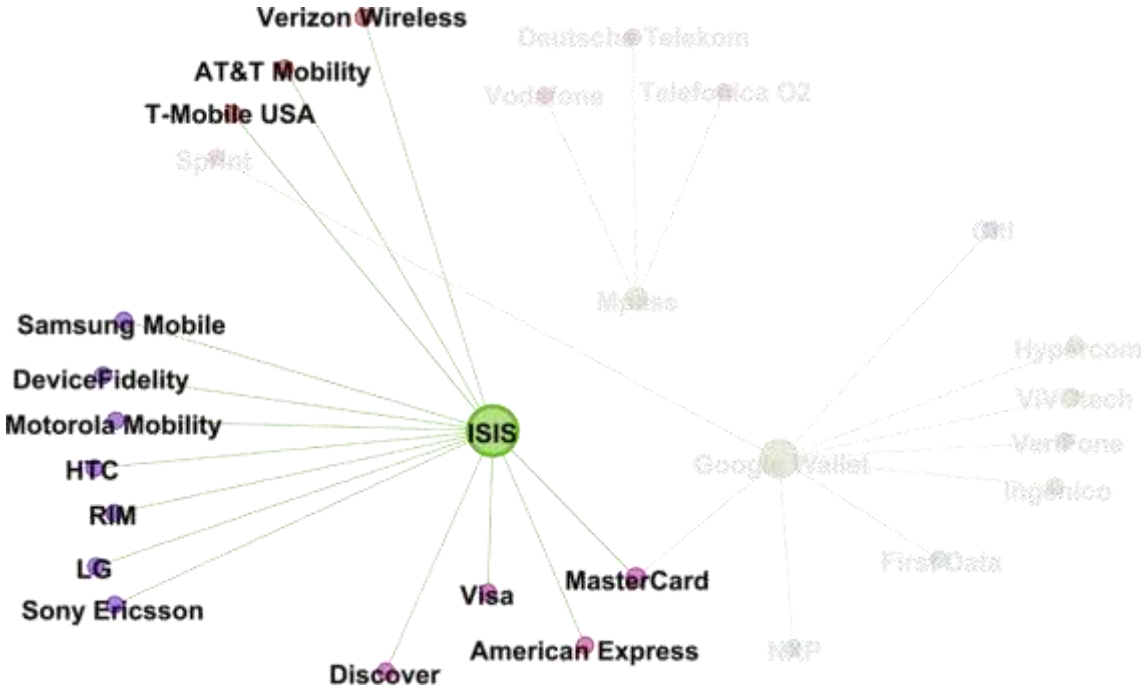


Figure 5. Network players in the NFC payment market (ISIS perspective)

We researched the current NFC market in order to analyze the current state of Google Wallet and ISIS shown in Table 1.

Table 1. Current standing of the NFC payment market. Potential customers were calculated from the customer base of each of the Mobile Operators cooperating. Thus is Google Wallet (Sprint), ISIS (AT&T, T-Mobile, and Verizon).

	Google Wallet	**ISIS**
Potential customers (in million)	51*	223.3**
Launch date of service (actual/announced)	19.09.2011	2012
Involved point of sale payment providers	4	TBA
Amount of NFC-enabled devices	1	TBA

*(Sprint, 2011),

**(AT&T Inc., 2010), (T-Mobile USA, 2011), (Verizon Communications, 2010)

For this analysis, we searched for information at the company's websites and their financial annual reports with the intention of looking at the number of current customers of mobile operators who we named "Potential Customers." In these figures, we see that Google Wallet has only a few, but diverse, types of relations with players of different industry Figure 4. Google Wallet has an advantage at the moment which is being the pioneer in mobile payments by launching its operations in September 2011 Table 1. Another interesting fact that we see in our Figure 5, is that ISIS is creating a very strong structure in the market and has managed to establish agreements with several of the most prominent players in different industries. This suggests that they could be very successful in the future due to the solid network structure they are creating. The biggest threat

currently facing ISIS is that there is no set date for its launch. This can give an advantage to their competitors, allowing them to establish a solid and unchallengeable customer base.

3.2.1. Alliances

The first relation we analyzed between two market players is the alliance. The word itself is used often but the meaning varies from company to company. Therefore, we first tried to define the meaning of alliance and then introduce five different types of alliances identified by Kuglin and Hook. They state that an alliance is a close association of different groups and they identified five types of alliances:

Sales alliance

Two companies agree to go to the market to sell complementary products and services.

Solution-Specific alliance

When two market players agree to develop a shared solution for the market.

Geographic-specific alliance

This alliance occurs when two companies work together in a geographic region to co-brand their products and services.

Investment alliance

A company invests into another company and jointly market their products and services.

Joint venture alliance

Company's come together to found a new company to specific market a new product or service (Kuglin, 2002).

Due to our focus on the payment market, especially ISIS and Google Wallet, there will only be in depth explanations of the types of the alliance structures found in the payment market. The types of the different alliances are listed in Table 2 and Table 3 The classification of the alliances is based on our research of the network relations in Table 4 and Table 5 which can be found in the appendix.

The mobile operators, T-Mobile USA, AT&T and Verizon Wireless, are working together in a Joint Venture alliance. The motivation is to get into the payment market and provide their cellphone customers with an easy payment method. ISIS itself formed sales alliances with different handset providers who will sell their phones with the ISIS NFC technology. These alliances are motivated by the need to provide customers with NFC enabled handsets to be able to use the ISIS payment

services. Additionally ISIS formed Sales alliances with Visa, MasterCard, American Express, and Discover to provide payment processing with credit cards.

Table 2. Alliance types from ISIS to their partners

ISIS					
	Sales agreement	**Shared Solution development**	**Co-brand products in a region**	**Investment and joint market**	**Joint venture**
AT&T	N	N	N	N	Y
T-Mobile USA	N	N	N	N	Y
Verizon	N	N	N	N	Y
Samsung Mobile	Y	N	N	N	N
Device Fidelity	Y	N	N	N	N
Motorola Mobility	Y	N	N	N	N
HTC	Y	N	N	N	N
RIM	Y	N	N	N	N
LG	Y	N	N	N	N
Sony Ericsson	Y	N	N	N	N
Discover	Y	N	N	N	N
Visa	Y	N	N	N	N
American Express	Y	N	N	N	N
MasterCard	Y	N	N	N	N

Google Wallet is a Google run venture whose goal and motivation is to work together with their partners in order to develop a shared solution to provide an open ecosystem for competition with many different players. They have a sales alliance with Citi Bank to provide payment processing to their customers. Additionally, they have a Solution-Specific alliance with MasterCard who provide their PayPass technology and payment processing to Google Wallet. The Solution-Specific alliance with First Data provides Point of Sale technology to the retailers. These three alliances were part of the pilot for Google Wallet. With the intention of showcasing how their technology works for the retailers (First Data), technology for contactless payment (PayPass) and payment processing (Citi, MasterCard). After the pilot phase, they are now trying to populate their ecosystem with new players. Therefore, they are working together with VeriFone, ViVotech, Hypercom and Ingenico Point of Sale providers on a Solution-Specific alliance to integrate even more retailer payment systems. Sprint is a Mobile Operator company who has a Sales alliance with Google in order to provide their customers with the Google Wallet functions on their mobile phones. Additionally, they are collaborating with NXP to provide NFC chips which work together with Google Wallet. This is a Solution-Specific alliance and is motivated in increasing the number of NFC chips which are compatible with Google Wallet.

Table 3. Alliance types from Google Wallet to their partners

Google Wallet					
	Sales agreement	**Shared Solution development**	**Co-brand products in a region**	**Investment and joint market**	**Joint venture**
Citi bank	Y	N	N	N	N
MasterCard	N	Y	N	N	N
FirstData	N	Y	N	N	N
VeriFone	N	Y	N	N	N
ViVotech	N	Y	N	N	N
Hypercom	N	Y	N	N	N
Ingenico	N	Y	N	N	N
Sprint	Y	N	N	N	N
NXP	N	Y	N	N	N

3.2.2. Conflicts

In a situation where a new market is being created that is an "interface of two traditionally separate markets," there arises many different issues which could lead to the new market grinding to a halt even when the technology is ready and there is "high customer interest." This stems from the fact that actors who are coming together in the new market come from positions of dominance in their respective markets, thereby the managers bring the same cognitive frames to the new market where "dominant players are impeded by the dominant position" from their market (Ozcan & Santos, 2010). This could be a prime factor in why we have seen such a slow advance in development of NFC as a form of payment: Players come together in the new market and bring their dominant cognitive frames which stifles cooperation.

Each business manager then tries to "place [their business] in the center of [the] business model" while at the same time stemming competition for this place of prominence from other players. Some examples include mobile operators seeing a chance to "become payment providers by creating financial accounts for their subscribers." This is in direct competition with banks who see NFC payment as an extension of banking service as opposed to a mobile operator service. These are just two examples of the "misaligned interests of key players" who are jockeying with each other to be at the center of the new market (Ozcan & Santos, 2010).

These out-of-sync interests are prominently showcased by one important issue: To whom belongs the final customer? In their respective markets, the businesses involved are considered to be the "point of contact" for all their customers which leads to the conflict of who will be facing the customer in the new market (Ozcan & Santos, 2010). Mobile phone companies would like to place the NFC chip on the SIM card itself, ensuring that all agreements go through them first while banks would prefer the NFC chip to be located within the mobile phone, separate from the SIM card, allowing banks to negotiate directly with cell phone manufacturers (Ozcan & Santos, 2010). This conflict represents a large amount of influence, and therefore profits, within the new market which, when coupled with the desires and cognitive frames of the managers involved from each industry, leads to a massive misalignment of interest. To make this area even more complicated, most cell

phone manufacturers prefer the latter option, since it, for once, allows them a bit of leverage over the mobile phone companies.

3.2.3. Coopetitions

The ISIS network consists of many players who are cooperating with each other within the ISIS network but, at the same time, have conflicting relations and are in competition with each other. In each of the three main industries taking part in the ISIS network: mobile operators, handset manufacturers, and Credit Card networks; every business is in direct competition with each other in their respective markets. E.g., Verizon, T-Mobile, and AT&T as mobile operators; Samsung, LG, and Sony-Ericsson as handset manufacturers; Visa, MasterCard, and Discover Card as credit card networks.

The answer to why these players cooperate with each other is quite simple: this new market gives the opportunity for all players to expand and create new revenue streams where the value of participating with competitors far outweighs the benefits of not cooperating. This is a major reason why any number of businesses enters into coopetitions. Competition between businesses “often takes place close to customers while competitors can cooperate in activities more distant from the customer” (Bengtsson, 2000). In the case of ISIS and the NFC market, different organizations can cooperate in developing the technology and infrastructure that is in the background while still competing “close to customers” in the forefront, such as the quality of service, assortment and style of phones offered, etc. Another reason why competing business will take part in coopetition is that, within such a coopetition, “new products can be developed more cost efficiently, as each actor contributes with its own core competence” (Bengtsson, 2000). This is due to the fact that costs are spread out among each of the organizations. Therefore, coopetition allows each contributing actor the ability to provide more solutions for their customers to choose from than any of the actors could alone (Bengtsson, 2000).

4. Conclusion

4.1. Future goals

Based on our in depth research of the networks ISIS and Google Wallet, we identified different approaches each take to establish their NFC technology. Both are trying to establish NFC payment through network effects. Therefore, they are trying to cooperate with other companies to promote their system. On the one hand, ISIS chooses to incorporate all major players from the handheld industry, credit card networks and is backed by three mobile operators. This gives them access to phones which are compatible with the ISIS NFC application, supply payment transactions through all major credit cards networks and allow the usage of the ISIS NFC application to all customers of the mobile operators. This shows that ISIS strategy is to develop a solution which works from the start with all major players for a huge customer base.

On the other hand, Google Wallet implemented a working system which is already operating but has many restrictions. They have the support of one credit card network, one payment provider,

one mobile operator and a handful of point-of-sale providers. Additionally, there are many retailers who already support Google Wallet. These decisions show that Google developed small but working solutions and is now trying to extend the solutions with new strategic alliances (e.g. Visa) and add new retailers to their network to make it attractive to customers. Beside strategic alliances, Google decided to enter the market of handset provider to be independent from the decisions of the handset industry. Therefore they announced to acquire Motorola Mobility (Michael, 2011).

To draw a conclusion from the different strategies of Google Wallet and ISIS we chose to use the paper from Caillaud and Jullien which claims that a divide and conquer strategy has to be used on markets where a so called 'chicken & egg' problem occurs. The chicken, in our case, would be the retailers who have to install the point of sale and the eggs would be the customers with their NFC enabled handholds (Caillaud & Jullien, 2003). The latter is being pursued by ISIS. They are trying to provide all their customers with NFC enabled handholds and therefore gain enough momentum to drag retailers into their network and become in the dominant player in the NFC payment market. This strategy is contrasted by the one employed by Google Wallet, where they try to cooperate with retailers and provide a working system to the customers and try to gain enough momentum to suck customers and other market players into their network.

4.2. Research limitations

There were a few, but major, limitations to our research and this study. First, there was a distinct lack of high value literature on this topic. This is most likely attributable to the fact that NFC is a relatively new technology that has not achieved wide adoption as of yet. Therefore, we were forced to limit our research of different NFC implementations and chose to only focus on the NFC payment market.

Secondly, we were unable to properly discerning the edges of the NFC markets since we do not have access to the contracts. Thus, we could only review press releases and other similar sources to discover what links, or lack thereof, were there in the market.

Finally, for complexity reasons, we limited the scope of the network analysis to a depth of one only level, one of direct relations between actors only. This allowed us to analyze relations and missing edges while still maintaining enough simplicity to fit within the limitations of space for this study.

4.3. Outlook

If we look into the future of the NFC ecosystem it is clear that it will grow drastically. There are two competitors for the payment market with strategies to acquire a dominant position over the market and therefore establishing NFC as a technology in our daily lives. If this will happen depends on the execution of the strategies. Both players have the potential to achieve their goal to be the dominant player in the NFC payment market. Besides the usage of NFC as a payment service, there are many other business ideas who integrate the NFC technology. During our research there

were several new NFC services announced which shows that NFC is just starting to be integrated into our daily lives.

NFC technology has a nearly infinite potential in becoming integral to our daily lives. Some ideas are that an NFC phone could unlock our home or car, a hotel could transfer a virtual hotel key to our phone, used as an airline ticket, or businesses could use an NFC phone to clock an employee in or out automatically as well as allow them in and out of the building. These are just a few examples of ideas of what an NFC phone could be used for. In summary, an NFC phone could replace nearly everything that would be located in our purses or wallets and make them irrelevant. All can be replaced except for handkerchiefs of course.

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Appendix

Table 4. Missing relations between players in the NFC payment market

Company A	Company B	Description of possible conflict
Samsung	Google Wallet	Samsung joins with Google Wallet rival: ISIS
Motorola Mobility	Google Wallet	Google buys Motorola to add them into the fold. Acquisition is not finished but the edge will change
HTC	Google Wallet	HTC joins with Google Wallet rival: ISIS
RIM	Google Wallet	RIM runs its own NFC pilot in Spain with partner Telefónica. Joins ISIS with other major mobile manufacturers
LG	Google Wallet	LG joins with Google Wallet rival: ISIS
Sony Ericsson	Google Wallet	Sony Ericsson joins with Google Wallet rival: ISIS
T-Mobile	Google Wallet	No information found
AT&T	Google Wallet	No information found
Verizon	Google Wallet	Verizon blocks Google Wallet on its Galaxy Nexus phone
MasterCard	Google Wallet	MasterCard with mFoundry allows banks to create their own NFC wallet
Visa	Google Wallet	Currently does not support Google Wallet but will join in 2012
Discover	Google Wallet	Currently does not support Google Wallet but has plans to do so
American Express	Google Wallet	Currently does not support Google Wallet but has plans to do so
NXP	ISIS	No information but ISIS need to only have handset manufacturers on board who have agreements with NXP
First Data	ISIS	No information found
Citi	ISIS	Citi Bank claims that ISIS is "hampering the development of NFC"
Hypercom	ISIS	No information found
ViVOtech	ISIS	No information found
VeriFone	ISIS	No official connection with ISIS
Ingenico	ISIS	No information found

Table 5. Existing relations between players in the NFC payment market

Company A	Company B	Description of existing relation
Citi	Google Wallet	Backing Google Wallet with payment processing
Hypercom	Google Wallet	Provides Point of Sale with PayPass for Google Wallet
ViVotech	Google Wallet	Provides Point of Sale with PayPass for Google Wallet
VeriFone	Google Wallet	Provides Point of Sale with PayPass for Google Wallet
Ingenico	Google Wallet	Provides Point of Sale with PayPass for Google Wallet
First Data	Google Wallet	Provides secure payment processing at the retailer
NXP	Google Wallet	Provides NFC chips to manufacturers for Google Wallet
MasterCard	Google Wallet	Integrate PayPass into Google Wallet; payment processing
Sprint	Google Wallet	Provides their customers with the Google Wallet app
MasterCard	ISIS	Provides payment processing
American Express	ISIS	Provides payment processing
Discover	ISIS	Provides payment processing
Visa	ISIS	Provides payment processing
Sony Ericsson	ISIS	Integrates ISIS technology into Handsets
LG	ISIS	Integrates ISIS technology into Handsets
RIM	ISIS	Integrates ISIS technology into Handsets
HTC	ISIS	Integrates ISIS technology into Handsets
Motorola Mobility	ISIS	Integrates ISIS technology into Handsets
Samsung Mobile	ISIS	Integrates ISIS technology into Handsets
T-Mobile USA	ISIS	Founded ISIS as a Joint Venture
AT&T Mobility	ISIS	Founded ISIS as a Joint Venture
Verizon Wireless	ISIS	Founded ISIS as a Joint Venture

Table 6. Current State of Mobile Devices, NFC Devices and announced NFC Devices in the US Market

Handset manufacturer	Current # mobile devices available in the market	# of NFC-enabled mobile devices	# of announced NFC-enabled mobile devices[1]	NFC device adoption rate
Samsung Mobile	142[2]	4[3]	2	3%
Motorola Mobility	25[4]	3[5]	2	12%
HTC	50[6]	1[7]	0	2%
RIM	21[8]	2[9]	3	10%
LG	129[10]	0[11]	2	0%
Sony Ericsson	23[12]	0[13]	15	0%
Nokia	10[14]	2[15]	10	20%
TOTAL	400	12	34	3%

[1] (SJB Research, 2011)
[2] (Samsung, 2011a)
[3] (Samsung, 2011b)
[4] (Motorola Mobility Inc., 2011)
[5] (Motorola Mobility Inc., 2011)
[6] (HTC, 2011)
[7] (HTC, 2011)
[8] (Research In Motion Limited, 2011a)
[9] (Research In Motion Limited, 2011b)
[10] (LG Electronics, 2011)
[11] (LG Electronics, 2011)
[12] (Sony Ericsson Mobile Communications, 2011)
[13] (Sony Ericsson Mobile Communications, 2011)
[14] (Nokia, 2011)
[15] (Nokia, 2011)