

Near Field Communication (NFC) Technology: The Future Mobile Money Service for Kenya

LAWRENCE M. MURIIRA^{§§}

*Department of Computer Science and Business Information
Kenya Methodist University*

NIMROD KIBUA

*Mobile Application Developer
Peponet Technology*

Abstract

NFC technology allows two active devices embedded with chips transmit small pieces of data between each other via short range wireless connection and at low speeds depending on the configurations. It is a low friction process because of the close range that two NFC enabled devices can setup a connection. With the launch of wallet NFC payments by Google Wallet, Samsung's *Nexus S/Galaxy II* powered by Android Operating System and NFC features in Nokia's *C9 & 6212 Classic NFC* powered by Symbian Operating System (OS), this will turn the devices running on these platforms into mobile payment systems. Wallet NFC will allow Smartphone users to pay for their transactions and such payment solutions are seen by OS developers, handset makers, banks and telecoms as a money making transaction.

Different modes of mobile payments have been well adopted in many parts of Europe, Asia and African especially Kenya. Users of Smartphone and ordinary mobile phones in Kenya pay for a wide range of services, and digital and hard goods using the three most commonly used modes of mobile payments; the premium SMS based transactional payments, direct mobile billing, and mobile web payments.

The main objective of this research paper was a feasibility study of the common primary modes of mobile payments, that is, premium SMS based transactional payments, direct mobile billing, mobile web payments and most importantly for this paper - the future opportunities of NFC; and how with the adoption of the technology in mobile payment solution may affect the customer, banks and the telecommunication industry in Kenya.

IJCIR Reference Format:

Muriira, M. Lawrence. Near Field Communication (NFC) Technology: The Future Payment Service for Kenya. *International Journal of Computing and ICT Research*, Vol. 6, Issue 1, pp.73--83
<http://www.ijcir.org/volume6-number1/article8.pdf>

1. INTRODUCTION

§§ Author's Address: Lawrence M. Muriira, Department of Computer Science and Business Information, Kenya Methodist University. Nimrod Kibua, Mobile Application Developer, Peponet Technology

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International Journal of Computing and ICT Research, ISSN 1818-1139 (Print), ISSN 1996-1065 (Online), Issue Vol. 6, Issue 1, pp. 73-83, June 2012.

Near Field Communication more commonly known as NFC, a brainchild of Sony and NXP semi conductors, is at the bottom of the wireless totem pole (Brad Molen, 2011).

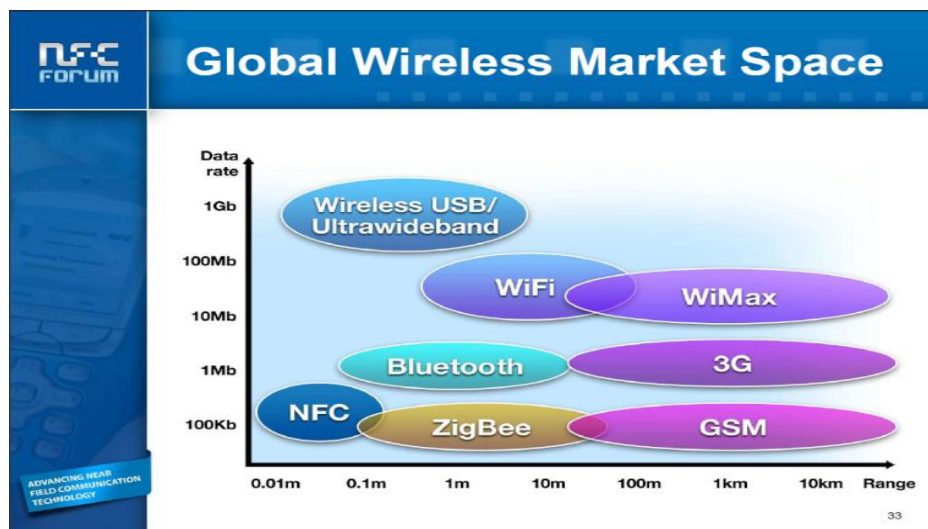


Figure 1: Shows the ranges of global wireless connections in meters and their connection speeds in bites.

In the launch and the demos of *Nexus S* smartphone (manufactured by Samsung) by Google, NFC was defined as a technology that allows two active devices embedded with chips transmit small pieces of data between each other when they are in close proximity of 1CM-4CM via short range wireless connection and at low speeds of 106-414 kbps, depending on the configurations. It is a low friction setup because of the close range that two NFC enabled devices can setup a connection.

Remember RFID (Radio Frequency Identification)? That's the baby that started it all, and it's been around the world since the 1990s. RFID microchips are installed in reader tags that can be found in a number of everyday items, they're found in supermarkets, supply chain equipment, luggage tags, and even "smart" ID badges. There's a RFID chip installed on credit card that, when tapped on the point of sale, will complete your purchase without needing to go the "old-fashioned" route. Since NFC is based on the same technology, it's easy to mistake it for RFID. It takes the same type of chips and bumps it up a notch by adding computing power. That's why putting it on a phone is so critical; NFC not only needs the proper hardware (an antenna and controller) but the right software (OS platform that support the apps) as well (Brad Molen, 2011).

History: A summarized history of RFID, NFC's Parent Technology as presented by Omosola O., Nadja R. and Ievirt G III of the Faculty of Computer Science at Stanford University.

1940-1950

- World War II: Secret development of practical radar by the several nations
- 1940: Term RADAR coined by the US Navy (Radio detection and ranging)
- 1948: Invention of RFID by Harry Stockman in his paper, Communication by Means of Reflected Power, Stockmans vision was before its time — "before the invention of the transistor (1950s), the integrated circuit (late 1950s), and the microprocessor (1970s)

1950-1960

- Research and Development (R&D) exploration of RFID technology

1960-1970

- Development of RFID theory.
- Emergence of RFID applications.
- Late 1960s: first and most widespread use of RFID by the Electronic Article Surveillance (EAS), which was used to prevent shoplifting or book theft from the library

1970-1980

- Flurry of interest into RFID from inventors, companies, academia, and government labs.

- Early adopter implementations of RFID.
- Los Alamos Scientific Laboratory, Northwestern University, the Microwave Institute Foundation in Sweden, Raytheon, RCA, General Electric

1980-1990

- Mainstream commercial RFID applications, especially in transportation and tolls, animal tagging, and personal access.
- 1987: Norway tests RFID toll collection.
- 1989: Dallas North Turnpike and the Lincoln Tunnel (between New York and New Jersey) test RFID toll collection.

1990-2000

- Standardization by the International Organization for Standardization (ISO) RFID widely deployed.
- 1991: first open highway electronic tolling system opens in Oklahoma.

2003-2004

- NFC became an acceptable standard for the International Organization for Standardization (ISO).
 - NFC became an accepted Information Communication Technology and Consumer Electronics (ECMA) standard.
 - The NFC Forum is created by Sony, NXP Semiconductors, and Nokia. It is a consortium which works to define standards on top of the ISO standards to ensure maximum compatibility across all implementation of NFC technology.
-

Mobile payment systems have evolved and in Kenya there are three primary mobile payment modes used to pay for a wide range of services, and digital and hard goods; the premium SMS based transactional payments, direct mobile billing, and mobile web payments. Mobile manufacturers have started building their mobile phones equipped with NFC chips embedded in the devices especially United States, Europe, Asia and the main drive of this advancement is contactless payments through NFC technology.

Problem Statement

The existing mobile payment modes in Kenya - have challenges to the customers (in terms of usage – the apps are menu based ('sub-menus' are deeply nested) and apathy in purchasing of hard goods using this mode of payment), banks and telecom companies especially in the development of the mobile payment applications and with the existing infrastructure.

Purpose of the Study

The purpose of this paper was to research on the common mobile payments modes in Kenya and the probable future opportunities of NFC technology as mobile payment solution in Kenya.

Research Questions

1. What are the common mobile payment modes?
2. What are the future opportunities of NFC technology as mobile payment system to the customers?
3. What are the future opportunities of NFC technology as mobile payment system to the banks?
4. What are future opportunities of NFC technology as mobile payment system to the telecom companies?

2. LITERATURE REVIEW

The world is headed towards a cashless society and focus is on true mobility and financial service evolution years ahead. Anciently proven business methods of lending money and gold, which investors had in excess, pioneered the profitable act to charge interest against loaning their money and gold. This system led to the birth of banking and finance system, and actual money coming to play. Then there was birth of government and institution bonds which were traded for valuable things such as gold and was referred as *Fiat Money* or *greenback*. These bonds were a necessity to uphold up something against large sum of money for trade, then later that saw the introduction of *cheques*. The time of *fiat money* and *cheques* has come and gone and now it seems that even the time of credit cards and allied business activities may just come to an end with the birth of NFCs.

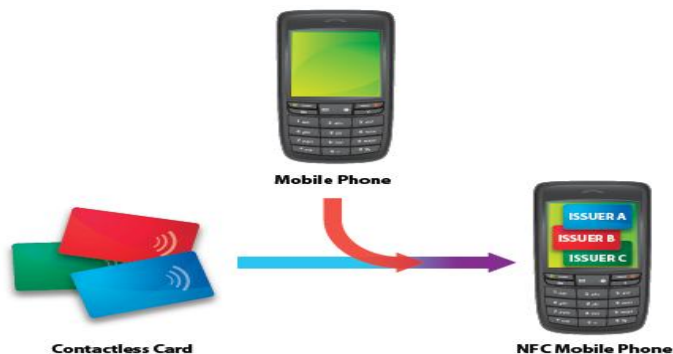


Figure 2: Concept of NFC phone. A graphic courtesy of NFC Forum

NFC, or Near Field Communication, allows consumers pay for goods and services on the go through their mobile phones simply by touching or passing them over another NFC-equipped device such as a register or terminal. The funds themselves are transferred from the user's credit card account stored through the mobile phone (see Figure 2). According to Lance Whitney of CBS's news.cnet.com, *a variety of industry players have kicked off their own efforts to tap into the potential of NFC. Google recently announced its own mobile payments service called Google Wallet that would let owners of NFC-enabled Android smartphones pay for items from participating merchants. Financial companies, such as Visa and Intuit, have also jumped onto the NFC bandwagon as have mobile carriers, such as Sprint, AT&T, Verizon Wireless, and T-Mobile in the US telecom industry; NTT DoCoMo, SoftBank Mobile, WillCom and Felica in Japan telecom industry.* The main drive of NFC is contactless payments though NFC and according to Koichi Tagawa the Chairman NFC Forum Sony it is broken down into three type of category:

(1. Card Emulator Mode



Figure 3: Illustrates how card emulator mode in NFC is used to pay for parking. A picture courtesy of NFC Forum

This mode emulates a traditional smart card (such as Mastercard or Visa) and makes this mode convenient because of the already existing setup for the contactless payments by these smartcards companies. Thus NFC enabled mobile phones becomes a credit card.

(2. Peer to Peer (P2P) Mode



Figure 4: Illustrates how NFC's P2P mode offers interaction between two phones.

P2P offers interaction between two active NFC-equipped devices such as phones. Using this mode, one could make payments to another individual or business just by tapping the two phones together, for instance,

'Sambaza' credit to a friend's phone by tapping the two NFC enabled phones. As the name implies, P2P could also go a long way in creating an enhanced multiplayer gaming experience.

(3. Reader Mode



Figure 5: Illustrates NFC's reader mode allows phone to read passive RFID tags on posters. A picture courtesy of NFC Forum

This allows the phone to read passive RFID tags on posters, stickers, and other stationary objects that contain certain types of information on them. For instance, you could tap your phone on the reader tag in a movie poster and it would begin playing the movie trailer, provide theater times, locations, and so on.

Pairing Bluetooth with NFC

NFC technology works in a similar manner to Bluetooth because the two technologies rely on close-range and secure transmission although NFC is faster to connect two active devices together but it cannot transmit as far as Bluetooth. Nokia is the only manufacturer who has taken advantage of pairing Bluetooth and NFC. Nokia's recent Bluetooth devices, like the *Luna* headset and Play 360 external speaker, can be paired with a NFC-equipped Nokia phone with just a mere tap, sidestepping the old Bluetooth pairing process that often required users to find deeply hidden settings menus, execute searches for the device, and then enter PIN codes. Pairing Bluetooth and NFC by tapping on the phone to setup a connection is known as *Wireless Nirvana*.

NFC SIM Card

NFC hardware could be embedded on SIM cards or MicroSD that could allow the same kinds of contactless pay on NFC-less phones. But the problem with this method is that these chips are laying underneath multiple layers of metal and plastic which could down grade the quality of the antenna's signal.

NFC could be developed for the following work, if already out or ready to go:

1. Monitor health, for instance, in Germany the diabetic read their blood sugar and their testing kit is NFC enabled and the data is transmitted to a NFC enabled mobile. Then the data is send to the patient's doctor and stored in a database,
2. Kenyan tourist and residents could unlock doors of their hotel rooms, pay their entry fees at various national parks gates and for their transport using their NFC enabled smart phones,
3. Initiate a video chat or multiple player games or join conference call for *Chamas* and fun loving youth
4. Share file between mobile phones such as doc, video and music.

Some key players of interest to Kenyans in the NFC technology are:

1. Google – They introduced Google wallet, added NFC hardware to its Nexus S (a venture with Samsung) and also into their *Gingerbread* version of their Android OS,
2. Nokia – They also incorporated NFCs to their phones a few years ago in US, that is, their 6,131 on T-Mobile and also in their latest C7 already in the Kenyan market,
3. Mastercard - MasterCard is one of the pioneers of mobile payments and was instrumental in setting up a thriving infrastructure with Paypass in the US market. Enough time has passed for consumers to become accustomed to the concept of contactless pay, and the costs of setting it up on NFC enabled phones are a lot lower thanks to existing infrastructure.
4. Samsung/Visa - Visa has already been hard at work rolling out its mobile payment system worldwide, but Samsung has partnered up with the company to get London hooked up for the 2012 Olympics. An Olympic and Paralympic Games mobile handset will be available complete with a Visa-enabled SIM card. The idea is so crazy it might just work -- so long as the handset is offered at an affordable price, that is. International travellers will rely mainly on prepaid SIM cards to communicate during their Olympic visit, and we think having an inexpensive phone to go along with that SIM is a no-brainer.

The Keys to Truly Interoperable Communications a publication by the NFC Forum indicates that, NFC forum was an initial gathering of three companies and has swelled to over 135 members representing manufacturers, applications developers, retailers, financial services institutions, governments, transport organizations, and non-profits. Working together, the Forum promotes the use of NFC technology in consumer electronics, mobile devices, and PCs by providing a highly stable framework for extensive application development, seamless interoperable solutions and extraordinary security. To meet that goal, the NFC Forum develops standards-based specifications that define NFC device architecture and protocols for interoperability

1. Encourages the use of NFC Forum specifications
2. Works to ensure that products claiming NFC capabilities comply with NFC Forum specifications
3. Educates consumers and enterprises globally about NFC

NFC Forum-compliant products designed to work in concert with other wireless technologies, will offer intuitive access to content and services, making it possible for nearly any consumer to pay for physical goods, enter controlled environments like stadiums or transit stations like the modern railway systems Kenya is planning to build, and access digital services anywhere, at any time, using any NFC-Forum-compliant device anywhere, at any time.

The NFC Forum mission statement is as follows:

The Near Field Communication Forum was formed to advance the use of Near Field Communication technology by developing specifications, ensuring interoperability among devices and services, and educating the market about NFC technology.

The Forum now has 140 members: manufacturers, applications developers, financial services institutions, and more all work together to promote the use of NFC technology in consumer electronics, mobile devices, and PCs. The Forum's membership spans the full ecosystem of industries from electronics to finance to security and beyond. By pooling their expertise and their understanding of individual markets, Forum members have been able to develop the best possible solutions for advancing the use of NFC. Members have worked closely to forge a comprehensive set of common protocols and specifications from which many types of interoperable products and applications can be developed. All decisions are vetted by the voting membership to bring a wide range of perspectives to bear on the development of common protocols for basic links between devices, standards for interoperability based on common data structures and formats, and specifications for device-independent service delivery.

In future many phones will have NFC support if the technology becomes the mainstream in the next two or so years. Since early 2010, there has been an outpouring of original equipment manufacturers (OEM) support for NFC tech in phones and OS. Samsung will sell a NFC-equipped version of the Galaxy S II by the end of 2011; RIM announced that their Blackberry Bold touch 9900 will be equipped too with NFC, as well as any devices using OS7 going forward; HTC is working on embedded chips into its hardware within the next 12 months and Apple is adding NFC technology in the iOS5 and future hardware built into the next iPhones. A news report from Juniper Research, forecasts that global NFC mobile contactless payment transactions will reach nearly \$50 billion worldwide by 2014. Following on from the Orange Mobile Payments service launch in the UK, 2011 and 2012 are expected to be banner years for NFC service rollouts. In researching the new report, Juniper concluded that prospects for NFC have improved markedly in the last half year 2011. This has resulted in a vibrant sector with significant potential to make peoples' lives easier by simplifying lower value payments whilst also offering a range of exciting retail possibilities including coupons and promotional offers. Together these elements form a compelling consumer proposition that will help to drive transaction frequency and value. Juniper sees 2011 and 2012 as "banner years" for NFC deployments. As more industry players start to roll out the necessary devices and technologies, the research firm believes consumers will gravitate to NFC not just to make mobile payments but also to download coupons, promotional offers, and product information. That capability will offer not just convenience to the customer but also greater sales potential to the retailers, notes Juniper.

3. METHODOLOGY

This research study reviewed relevant literature published on the common mobile payment modes in Kenya. The goal of this methodology was to give a deeper understanding or description of the transaction charges and limits to stakeholders of different mobile payment services and NFC's future opportunities as mobile payment system in Kenya.

4. FINDINGS

4.1 Premium SMS/USSD payments

This mode of mobile payment is the typical end user payment process where:

- User sends SMS with Keyword and unique number to a Premium Short Code.
- User receive a PIN (User billed via the short code on receipt of the PIN)
- Finally user enters PIN to get access to content or services.

4.1.1 Cost of Transactions

Premium SMS/USDD Baud Transaction Payments

- M-Banking using USSD as follows:

- *667# for MPESA Transactions

CO-OPERATIVE BANK OF KENYA		
*667# M-PESA Account Transactions		Customer Tariff (KShs.)
Ledger Fees		Nil
Minimum Balance		Nil
Account Opening		Nil
Requests & All Alerts	Bank Balance	5/=
	Mini Statement	5/=
	All Alert	30/=
Cash Deposit	Transfer to Bank	Nil*
Cash Withdrawals	Withdraw from Bank	30/=
Pay Bills	A/C to A/C Transfer	30/=
Orange Money Account Transactions		Customer Tariff (KShs.)
Cash Deposit	Transfer to Bank	400/= - 500/=

Table 7: Cooperative Bank's M-Banking Tariffs using USSD.

* For the cash deposit process the charges in Table 4 will still apply because the customer is withdrawing from MPESA account to deposit to the bank account.

- *522# for MPESA Transaction

KENYA COMMERCIAL BANK		
M-PESA Account Transactions		Customer Tariff (KShs.)
Ledger Fees		Nil
Minimum Balance		Nil
Account Opening		Nil
Requests & All Alerts	Bank Balance	30/=
	Mini Statement	30/=
	All Alert	30/=
Cash Deposit	Transfer to Bank	30/=
Cash	Withdraw from	30/=

Withdrawals	Bank	
Pay Bills	A/C to A/C Transfer	30/=
Orange Money Account Transactions		Customer Tariff (KShs.)
Cash Deposit	Transfer to Bank	400/= - 500/=

Table 8: KCB'S M-Banking Tariffs using USSD.

(iii) *325# Pesa PAP Transaction

FAMILY BANK		
M-PESA Account Transactions		Customer Tariff (KShs.)
Ledger Fees		Nil
Minimum Balance		Nil
Account Opening		Nil
Requests & All Alerts	Bank Balance	5/=
	Mini Statement	5/=
	Other Requests	5/=
Cash Deposit	Transfer to Bank	35/= - 140/=
Cash Withdrawals	Withdraw from Bank	35/= - 50/=
Pay Bills	A/C to A/C Transfer	30/=
Orange Money Account Transactions		Customer Tariff (KShs.)
Cash Deposit	Transfer to Bank	400/= - 500/=

Table 9: Family Bank's Pesa PAP Tariffs

- b) Ringtones are transacted at a minimum KShs5.00 above SMS premium rates and different service providers will use different USSD.
- c) Multimedia such as wallpaper, pictures, music and animation are KShs10.00 above SMS premium rates and also different service providers will use different USSD.
- d) News alerts and information requests using USSD are transacted at a minimum of KShs5.00 above the SMS premium rates.

4.2 Mobile Direct Billing

The customer uses the mobile billing menu option during a transaction and the customer's mobile account is charged for the service.

4.2.1 Cost of Mobile Payment Services

Transaction Type	Transaction Charges and Limits (Kshs)						
	Min	Max	MPESA	AIRTEL ZAP	ORANGE MONEY	YU CASH	TANGAZA
Deposit Money	50	70,000	Free	Free	Free	Free	Free
Cash Withdraw	50	100	5	15	25	N/A	N/A
	101	2500	25	25	45	20	25
	2501	5000	45	25	75	40	45
	5001	10000	75	75	75	65	75
	10001	20000	75	145	145	130	145

	20001	35000	75	170	170	15	170
	35001	50000	75	250	195	N/A	N/A
	50001	70000	75	300	225	N/A	N/A
	70001	100000	75	N/A	225	N/A	N/A
Cash Transfers	100	2500	60	5	30	25	30
	2501	35000	30	25	30	25	30
	5001	10000	60	25	30	25	30
	10001	20000	250	25	30	25	30
	20001	35000	N/A	25	30	25	30
	35001	50000	N/A	25	N/A	N/A	N/A
	50001	70000	N/A	25	N/A	N/A	N/A
	70001	100000	N/A	N/A	N/A	N/A	N/A
ATM Withdraw Charges	2001	2500	30	40	40	N/A	N/A
	2501	5000	60	55	40	N/A	N/A
	5001	10000	100	80	40	N/A	N/A
	10001	20000	175	175	40	N/A	N/A
	20001	40000	N/A	N/A	40	N/A	N/A
Information on Transactions	5	1000	0	0	0	0	5
Change PIN			20	20	0	0	20
Show Balance			1	0	5	0	5
Buy Air Time	10	20000	0	0	0	0	0
Register SIM			0	0	0	0	10
Register Phone			N/A	N/A	N/A	N/A	20

Table 10: Mobile Payment Tariffs and Limits from different Telecom Companies

4.2.2 Cost of Mobile Banking Transactions

4.2.2.1 Equity Banks' M-Kesho Service

EQUITY BANK		
M-KESHO Account Transactions		Customer Tariff (KShs.)
Ledger Fees		Nil
Minimum Balance		Nil
Account Opening		Nil
Requests & All Alerts	Bank Balance	5/=
	Mini Statement	5/=
	Insurance Request	5/=
Cash Deposit	Transfer to Bank	Nil*
Cash Withdrawals	Withdraw from Bank	30/=
Pay Bills	A/C to A/C Transfer	30/=

Orange Money Account Transactions		Customer Tariff (KShs.)
Cash Deposit	Transfer to Bank	30/= - 50/=
Cash Withdrawals	Withdraw from Bank	30/= - 50/=

Table 11: Equity Bank's M-Kesho Tariffs.

* For the cash deposit the charges in Table 4 will still apply because the customer is withdrawing from MPESA to deposit to the bank account.

4.3. Mobile Web Payments

According to CCK, the total number of Internet subscriptions was at 12.53 million by September 2011 and the number of Internet users was estimated at 14.3 million, out of those statistics ITU estimates that Kenya has 5.4 million mobile phone Internet users. Though in mobile web payments, use of Visa or MasterCard's (Credit cards) were not utilized well in Kenya and in Africa generally, and no statistics were provided.

4.4 Opportunities for NFC in Kenya

4.4.1 Customers

According to CCK's quarterly report for October 2011/January 2012, Kenya has 18.4 million Mobile Money Transfer subscriptions totaling to KES 56 billion as amount deposited and those subscribers pay for a wide range of services, and digital and hard goods. In future if NFC tech services were rolled out, in transactions that goods or services have to be paid for using NFC enabled mobile phones, the customers of these mobile payment solution using NFC in Kenya will benefit by having choices of payment either being debited directly from their bank account, that is, if banks adopt this technology or from their mobile money transfer accounts such as MPESA if the Mobile Services Providers will adopt this technology too. This will eliminate the process and cost (see Table 3 and 5) of transferring money from mobile account to bank account and vice versa.

The current mobile payment applications are 'Menu' based Apps and the process of navigating through the menu is quite a challenge to most users of these services but with NFC it is a '0-click' process that only prompts a security PIN for the transaction to be complete and secure. This will enable customers buy hard goods from supermarkets, boutiques, electronic shops and cars show rooms /car bazaars. Most merchants in Kenya have not adopted transacting at the point-of-sale using the current mobile payment modes because the process is long and tedious.

4.4.2 Banks

This will be a new business opportunities for banks because the RFID infrastructure already exist in the ICT industry USA, Asia, Europe and some African countries, and their customers with NFC enabled phones will take full advantage of the situation where they (banks) don't have to rely on the mobile service operators for the payment services – the NFC enabled mobile acts as a credit card (see Figure 3). The banks will not have to rely on the terms and conditions of any mobile service provider (telecom) in order to provide mobile payment services, thus banks will have their own independent mobile payment service.

4.4.3 Telecommunication Companies (Mobile Service Providers)

In the 1st Quarter 2011/12 of the CCK's report shows that, the Kenyan telecoms industry has grown to 26.2 million costumers and with around 18.4 million mobile payment accounts, while banks have around 7 million accounts according to Central Bank of Kenya. While with 18.4 million mobile payment accounts, NFC is good business opportunity and a strategy for telecoms to have a competitive advantage over banks because with the ease of using NFC enabled phones customers will be able to purchase hard goods such as items bought from a supermarket or rental services over-and-above purchasing digital and services.

5. CONCLUSION AND RECOMMENDATION

NFC technology has come to its maturity with big ICT and telecom industry players such as Google, Samsung and Nokia having embraced the technology. We are headed to an era of Mobile Wallet where cash value that can be stored on a card, phone or other electronic device that may be topped up. The term wallet is used because

the card or phone is considered a replacement for the cash carried in a person's wallet (Frost and Sullivan, 2009). Thus this will enable Users of Smartphone and ordinary mobile phones in Kenya to pay through a '0-click' process for a wide range of services, and digital and hard goods.

With around 26 million mobile subscribers and Kenya's population is 39 million, it shows that more than half of the population owns a mobile phone. The three human basic needs are food, water and shelter but in Kenya there is a fourth one and that is communication. Half of the Kenyan population will benefit from the NFC technology if implemented by banks and the telecom companies. It will be easy for NFC to be implemented because banks already have the VISA card and Mastercard infrastructure in place while Safaricom has already laid down a VISA infrastructure where their customers can top-up their M-PESA Prepay Safari Card. Interesting is that this is a VISA and KENSWITCH branded card that is accepted both locally and internationally on all VISA/KENSWITCH terminals. This will ease mobile payments especially for hard goods and some services such as transport, even though M-Banking, Mobile money transfer and SMS/USSD payment transactions still exist.

More research can be done in the use of NFC technology in the transport sector especially the new modern railway line for commuters that Kenya is building in the near future at Syokimau. Also Implementation of NFC in 'Smart Bus', Taxi/Cabs (especially in the Nairobi's CBD and its environment) and airport terminal for domestic or East Africa flights.

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Acknowledgement: "This paper was presented at The First nternational conference on mobile money (AMMREC2012) whose theme was 'Evidence of Financial Inclusion Through Mobile Technology', organised by the Africa Mobile Money Research (AMMREC) initiative of the School of Computing and Informatics (SCI), University of Nairobi, Nairobi, Kenya, April 2 -3, 2012".