
A Systematic Assessment of Existing Mobile Payment Technologies and Models

Adamugono Endurance, Otaren Fredrick Enoma & Oghenevbaire Efevberha-Ogodo

Department Of Computer Science

Southern Delta University, Ozoro

P.M.B. 05, Ozoro-Kwale Road, Ozoro, Delta State, Nigeria.

E-mails: ¹adamugonoe@dsust.edu.ng, ²ehevberhaogodo@dsust.edu.ng³otaren@biu.edu.ng

Phone: +2348109161345

ABSTRACT

The rapid growth of mobile technology in Nigeria has significantly transformed the financial services landscape, leading to the emergence and widespread adoption of mobile payment systems. This survey examines the existing mobile payment systems in Nigeria, focusing on their operational models and the range of services they offer. Key models identified include the bank-led model, where traditional banks such as Radio Frequency Identifications and Mobile Web Payments Banking provide mobile platforms for financial transactions; the mobile network operator (MNO)-led model, seen in services like MTN's MoMo Agent; and the collaborative model, which involves partnerships between banks and telecom operators to extend financial services to unbanked and underbanked populations. Prominent mobile money services in Nigeria, such as OPay, PalmPay, Paga, and Firstmonie, are widely used platforms that facilitate financial transactions across the country. These services offer essential features such as money transfers, bill payments, airtime recharge, and merchant payments, playing a crucial role in bridging the gap between traditional banking and financial inclusion, especially in underserved areas. Despite significant progress, several challenges persist, including infrastructural limitations, security concerns, low levels of digital literacy, and regulatory barriers. The survey also highlights proposed mobile money solutions aimed at addressing these challenges. These include enhanced interoperability, support for offline transactions via USSD, expanded agent network integration, and the use of blockchain technology to improve transparency and security. Ultimately, the study emphasizes the importance of robust policy frameworks, technological innovation, and multi-stakeholder collaboration in strengthening mobile payment systems and advancing financial inclusion throughout Nigeria

Keywords: Mobile, Technology, Blockchain, Infrastructural, Survey, Underbanked, Payment Systems

CISDI Journal Reference Format

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1. INTRODUCTION

In the digital era, mobile technology has significantly transformed the payment landscape, enabling seamless financial transactions without the need for physical cash or cards. Mobile payment systems, which allow consumers to pay for goods and services using mobile devices via wireless technologies, are fast becoming integral to modern commerce.

These systems represent an evolution from traditional payment methods by offering convenience, speed, and mobility. However, despite the growing availability of mobile payment platforms, their adoption remains inconsistent. Research indicates that security concerns and a lack of user trust continue to hinder widespread acceptance (Forrest, 2016). The emergence of electronic payment methods has addressed several limitations of conventional banking systems, fulfilling new financial demands that require more dynamic, decentralized, and accessible solutions (Sumanjeet, 2009).

Mobile payment technology has evolved from merely enabling mobile access to internet-based banking systems to fully-fledged mobile wallets that substitute traditional payment tools such as cheques, cash, or credit cards (Dennehy & Sammon, 2015). According to De Bel and Gâza (2011), mobile payments involve fund transfers initiated and confirmed through mobile phones. This dual functionality enhances usability but also raises complexities related to system security and integration. In developing economies, the mobile payment ecosystem is rapidly evolving. In Nigeria, for instance, while the payment culture has traditionally been cash-based, recent statistics show that approximately 98,000 agents and 24 million subscribers have enrolled in mobile money services, generating transaction volumes of up to ₦815 billion (Ogwu, 2016). Despite this growth, the adoption rate remains below potential, primarily due to infrastructural, regulatory, and trust-related challenges. A well-functioning mobile payment system must fulfill certain criteria including security, confidentiality, authentication, system integrity, availability, cost-effectiveness, and international accessibility (Gao, 2000).

When these factors are compromised, user confidence diminishes, threatening the long-term viability of the system. Payments made through mobile devices generally fall into two broad categories: payments for purchases (retail transactions) and payments for bills or invoices. In both cases, users must be authenticated, and transactions verified, typically through connections with payment service providers and secure servers. Given the wide variety of mobile payment platforms and the subtle technological differences among them, consumers and merchants often face difficulty selecting systems that best align with their needs. This research aims to provide clarity by reviewing and comparing existing mobile payment systems, identifying their core features, assessing their limitations and associated risks, and offering practical recommendations to stakeholders.

2. REVIEWS AND INVESTIGATION

The existing mobile payment systems have been implemented using different technologies such as IVR, SMS, WAP, phone based applications etc in order to meet the needs of data transfer from business and personal perspectives. Some of these existing modes of transactions are hereby explained accordingly below.

MMS (Multimedia Messaging Service)

A Multimedia Messaging Service can also deliver barcodes which can then be scanned for confirmation of payment by a merchant. This is used as an electronic ticket for access to cinemas and events or to collect hard goods. Since a trusted physical delivery address has typically not been given, these goods are most frequently digital with the merchant replying using a Service to deliver the purchased music, ringtones, wallpapers etc.

Limitation

The major concern about this system is security, which was why it could not succeed. (Mobey, 2011).

Mobile Web Payments (Wap)

In the Wireless Application Protocol (WAP) scheme, the user connects to the banks by using WAP gateway and can do the transaction online. WAP sites offer the familiar form based interface and can also implement security quite effectively. The actual forms are stored into a mobile application on a WAP server, and served on demand. The WAP Gateway forms an access point to the Internet from the mobile network. E.g. Payporte, Jumia

Limitation

The mobile account is directly charged through a mobile network operator, the use of a credit/debit card or pre-registration at online payment solution such as PayPal is still required just as in a desktop environment. (Mobey, 2011).

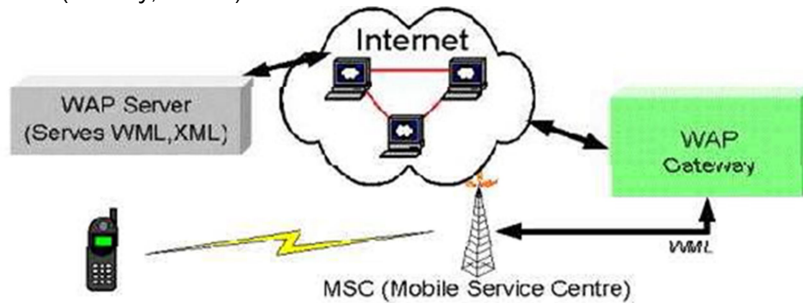


Figure 1. : WAP Architecture

Phone-Based Application

Phone-Based applications are the ones that are most suitable to implement complex banking transactions like trading in securities etc. They can be easily customized according to the user interface complexity supported by the mobile. In addition, mobile applications enable the implementation of a very secure and reliable system. The important requirement is that it should be installed on client and merchants mobile device.

Limitation

The major disadvantage of mobile application clients is that the applications needs to be customized to each mobile phone on which it might finally run. (Mobey, 2011).

Cloud-Based Mobile Payment

Cloud-based mobile payments store your payment information “in the cloud” (i. e. on a remote server), and not on your mobile device. Consumers can typically register one or more payment accounts to be used with the mobile wallet including bank accounts, credit and debit cards, pre-paid cards, store cards, gift cards, and loyalty cards. Most commonly, the consumer accesses their mobile wallet from an application on their mobile device. During registration, the consumer can typically set up a username, password, or PIN to secure access to their wallet – credentials that are stored in the cloud as well. Once the account is set up, there are several methods to employ the wallet from a mobile device to complete an in store payment. In each case, the customer’s registered account is debited at the time of transaction.

Limitation

The major concern in this type of system is Security. All the account related information of clients and merchants are stored on cloud and encryption of this information should be strict. (Pan, 2015).

Wireless Technologies Used In Mobile Payment

The different types of wireless technologies are explained below:

Bluetooth

Bluetooth wireless technology is a cable replacement technology that provides wireless communication between portable devices, desktop devices and peripherals. It is used to swap data and synchronize files between devices without having to connect each other with cable. The wireless link has a range of 10m which offers the user mobility. This technology can be used to make wireless data connection to conventional local area networks (LAN) through an access point.

Limitations

The major disadvantage of Bluetooth technology is that the connection between two medium is not constant, it means connection can be dropped by small interruption. The drawback with Bluetooth 2.1 version was authentication but in later versions of Bluetooth this encryption problem has been solved.

Radio Frequency Identifications (RFID)

RFID systems consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted. RFID systems can be used just about anywhere, from clothing tags to missiles to pet tags to food -anywhere that a unique identification system is needed. The tag can carry information as simple as a pet owners name and address or the cleaning instruction on a sweater to as complex as instructions on how to assemble a car. Tags coupled with sensors can provide important information on the state of the goods (International Journal of software Engineering, 2014).

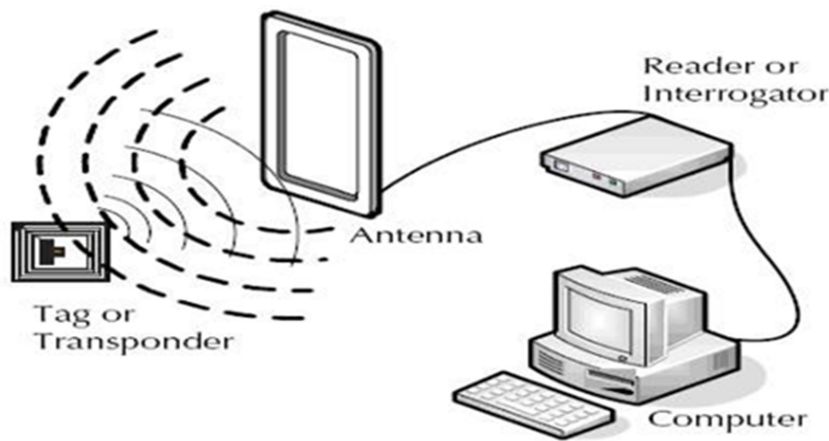


Fig 2: RFID Architecture

Limitations

RFID chips have high power consumption and therefore result in reduced battery life they also add an addition cost to the mobile phone. It’s a combination of these factors that have prevented RFID chips been included in all mobile phones.

Near Field Communication (NFC)

Near field communication (NFC) is a set of ideas and technology that enables Smartphone and other devices to establish radio communication with each other by touching them together or bringing them into proximity, typically a distance of 10 cm (3.9 in) or less. Each full NFC device can work in 3 modes: NFC target (acting like a credential), NFC initiator (as a reader) and NFC peer to peer. Most of the first business models like advertisement tags or other industrial applications have not been successful, always overtaken by another technology (3D barcodes, UHF tags) NFC is the fusion of contactless smartcard (RFID) and a mobile phone. The mobile phone can be used as a contactless card. NFC enabled phones can act as RFID tags or readers. NFC chips are embedded within mobile hand-sets enabling them to read NFC tags. Mobile phone industry has shown several NFC mobile phones manufactured in last few years.

Limitations

It only works at very short distances.

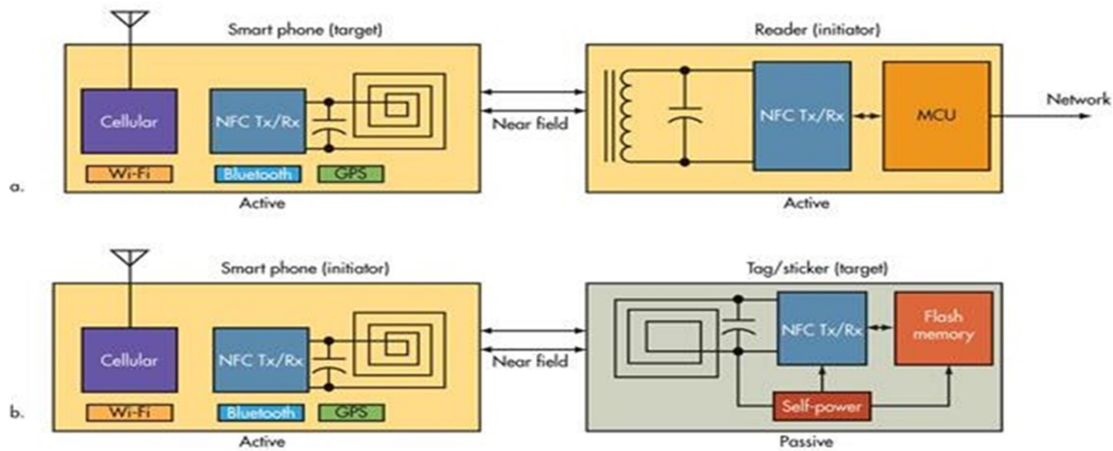


Figure 3: NFC Architecture

3. MOBILE PAYMENT SYSTEM DESIGN AND INFRASTRUCTURE SUPPORT

With the rapid adoption and growth in mobile technologies worldwide, mobile money services are being adopted all over the world, albeit in different ways in the developed and developing worlds. Mobile money will be used increasingly in the future to complement cash, cheques, credit cards and debit cards. Moreover, it can also be used for payment of bills (especially utilities and insurance premiums) with access to account-based payment instruments such as electronic funds transfer, Internet banking payments, direct debit and phone bills. The scope of m-money has also expanded beyond just goods and services. Mobile payment processing must be global (i.e. what works in United States should also work in Asia, Europe, the Middle East and Africa). The only way to ensure that processing is uniform is to develop and adopt global standards.

As has been shown, the interest in mobile money is evident, standardization efforts are ongoing, and the search for the right business models and successful approaches is ongoing. This proves that the area is active and of great interest, but also indicates that we are still at the beginning of a long road. In this project work, it is recommended that in order to achieve a comprehensive analysis regarding mobile payment environment, a multi perspective approach should be considered. In the realm of technology different requirements, which is necessary for a successful realization of mobile payment system, have been discussed. The market and stakeholders' perspective shows that in designing and developing mobile payment systems, adaptability with market segment needs is of great importance while the cross boarder operability of mobile payment system should be kept. Beside this, role and relations of many players and their respective strengths and weaknesses are very influential in this industry and requires an efficient collaboration among them.

4. CONCLUSION

Lots of challenges like security in particular, are to be overcome for a successful implementation of mobile payments to be widely accepted as a mode of payment. Business, merchants and consumers have to come forward and make value producing investments. A regulatory framework and widely accepted standards will be the pillars on which mobile payment applications will be built. The major threat to all the existing mobile payment system is security. Consequently, the following strategies are recommended to mitigate threat: **Strong Customer Authentication:** MPSPs should ensure that the initiation of mobile payments, as well as access to sensitive payment and personal data, is protected by strong customer authentication.

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