



The Power of USSD: A Solution to African Financial Transaction Problems

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ABSTRACT

Paying mobile bills has now become simple with the help of Internet banking and credit cards, Customer adapted to prepaying and get credited by buying them online or at the store nearby. Whereas the post-pay adapted customer pays his bills by end of his service session through online money transfer or paying bills at the store. These payment processes are hard to make sometimes, considering the resources available in underdeveloped countries or in a place where the Internet is difficult to find. Unstructured Supplementary Service Data payments (USSD) also come in handy when a customer runs out of Internet credits or uses a phone which does not provide him internet on the go. With limited resources, USSD payment provides clients the advantage of getting a phone card credited on tap. To make this happen, network providers and banks must work together. The network provider creates a database to save bank card details and accesses them when required with permission of the respective customer whenever a transition is made through USSD. For every payment, an authentication protocol is performed to avoid hackers and make secured money transfer. This Journal highlights the downsides of financial exclusion in modern societies and how we can leverage the technology of mobile money to drive financial inclusion in our society with a particular interest in unbanked areas in Nigeria. The financial sector is a heavily regulated sector in Nigeria, so it will be





essential to see what it takes to set up mobile money operations in Nigeria and make it accessible to people who actually need it and the availability of the technology needed to make that happen. Even though mobile money operation is not so new, adoption has been very slow and this study is going to primarily highlight how adoption can be improved and the infrastructure needed to drive that adoption. The result of this study shows that the adoption of Mobile money can increase financial inclusion in Nigeria to 95% and as well connect over 99% of the adult population to easy credit facilities and financial services.

In conclusion, the study recommends the quick adoption of mobile money wallets for personal finance considering the literacy landscape of Nigeria and the ease with which it provides credits and financial services to people in remote areas of the country, improving the ease of doing business, and bringing much-needed financial literacy to the people.

Keywords: Unstructured Supplementary Service Data payments, Mobile money, database.

INTRODUCTION

1.1 Background of Study

Mobile payment is a form of payment service operated under a defined financial regulation and performed from or through a mobile device. In several developing countries, the mobile payment solution has been a way of bringing financial services to a certain group of the adult population always referred to as “the unbanked” or “under-banked” in order to drive financial inclusion in those countries.

Financial inclusion involves the process of making available, a wide range of financial services, such as savings, credit, insurance, pensions, and payments in an accessible manner, no matter the location or the literacy level of the adult population in that area, especially those in the low-income cadre. This has been recognized as a critical tool in tackling the issues of poverty and





financial inequalities while generating wealth, creating employment, and improving the living standard of those in the rural areas that are financially excluded.

The Central bank Of Nigeria (CBN) has adopted two initiatives in order to drive financial inclusion in the country and these are the licensing of Mobile Money operators, popularly known as MoMo, and Payment Service Banks (PSB). Since the inception of the Mobile Money initiative, the telecom companies (Telcos) have been particularly interested in the initiative as it relies extensively on the infrastructure and technology that they provide. Under this Mobile Money initiative, the Telcos provide the infrastructure that powers the exchange of messages for mobile money payments and the PSB licenses are needed to leverage mobile and digital channels for the provision of their services, which ends up enhancing financial inclusion and stimulating economic activities at the grassroots. Therefore, telecommunication companies are critical stakeholders in the drive for financial inclusion.

1.2 Statement of Problem

One of the primary purposes of mobile money is to drive financial inclusion and with the recent policies from the Central Bank Of Nigeria (CBN) around cashless banking, we have seen more people embrace digital mobile wallets and new Financial Technology (FinTech) startups being set up in several cities which have made it very easy for people do a financial transaction on the go. However, the actual people who are unbanked are still left out and this can be a result of several reasons. How do we bring mobile money to those in the rural areas with little or no internet connections and how do we make financial services available to the people irrespective of their age, location, financial status, and level of literacy.





1.3 Purpose of Study

The primary purpose of this study is to critically examine how Mobile Money payment can be a driving tool for financial inclusion at the grassroots in order to bring financial services to those who wouldn't have been able to have access to such due to no banking infrastructure, remote location, financial status or level of literacy.

1.4 Aim and Objective

The specific objectives are as follows:

- i. To outline how financial services can be extended to those who cannot easily access them through Internet
- ii. To access the current level of financial exclusion.
- iii. To determine the level of infrastructure needed to make financial services available to the unbanked.
- iv. To point out the economic benefit of financial inclusion, using a readily available infrastructure like mobile telecommunication.

Review of Related Literature

2.1 Conceptual Framework

The primary aim of this chapter is to establish a framework within which we will examine the degree of financial exclusion in the country and a possible remedy using mobile money. This framework depicts the idea of mobile money, the accessibility and economic upside of adopting mobile money to society, and those who are financially excluded.



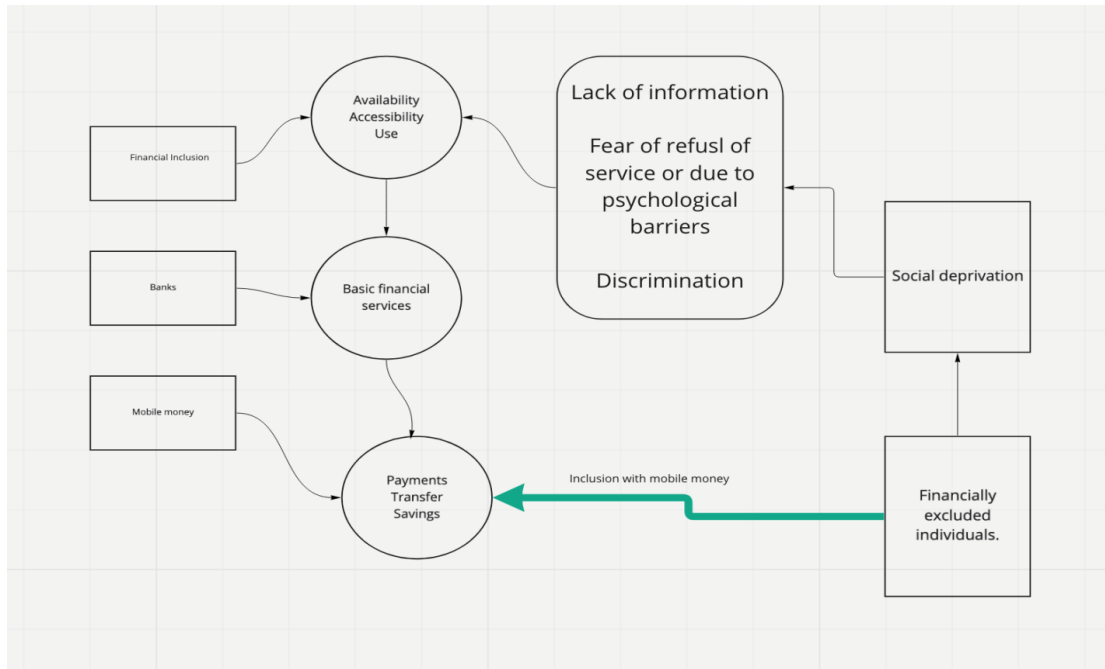


Fig 2.1 Conceptual model

From the conceptual model in the figure above, we can deduce that financial inclusion stands to give access to available financial tools and services using conventional institutions, such as Banks. However, there are social vices that are preventing a particular category of people from accessing these financial services and these can be a result of illiteracy, ignorance of what is obtainable from financial institutions, and lack of trust in the system. But mobile money can bridge that using lowered entry barriers, such that all you need to start transacting is a registered sim in a mobile phone. People who don't have access to mobile phones can access mobile money services using local mobile money agents who are already familiar faces to them and be able to access financial services without all the hassle of conventional banking systems. Being able to connect to the unbanked directly using mobile money and mobile money agents in cases where applicable removes the fear of rejection and discrimination from those in rural areas and the



availability of agents in local communities makes it easy for people to understand all the financial services that they can access in a language that they also understand. Cost of operation is also drastically reduced as mobile money's driving technology is the existing telecom connections. Using services like USSD makes it very possible to do transactions in local communities without any need for an internet connection.

2.2 Theoretical Framework

A lot of literature explained financial exclusion as a process by which financially excluded members of the society such as the poor, ethnic minority, informal entrepreneurs can have access to relevant financial services (Sarma 2008, Klapper 2012a). It is easier to understand these definitions from the context of financial exclusion to mean a situation in which a particular category of people in the society are exempted from accessing the services of a formal financial system (Sama and Pais 2011). What this means is that we have to extend the scope of the current financial sector by providing a better process that makes it possible for the excluded groups to have access to banking services (Dev 2006). Therefore, financial inclusion in this context is described within the parameters of a particular category of individuals that are directly or indirectly excluded from accessing basic financial services.

Studies have illustrated that access to deposit services has the potential of providing an enhanced mechanism for the management of daily financial transactions (Sarma 2008). Research has also shown that low-income earners and the financially excluded need for the ability to save and make payments are greater than their demand for credit provided by the banks. (Allen et al 2012).

Access to good financial services has been a major challenge for millions of people across the globe. 2.5 billion people are estimated to be unbanked, especially in developing countries (Kunt and Klapper 2012a).





2.3 Empirical Studies

In early April of 2022, the Federal government of Nigeria in a bid to drive financial inclusion around the country issues a banking license to MTN Mobile money. What this means is that your phone and sim are your passports to get all financial services on the go irrespective of location. This will also provide employment opportunities as people are already signing up to become mobile money agents. The job of the mobile money agent is to help those who neither have access nor know how to operate one to also benefit and access financial services without hassle. Since its initial launch before the license in 2019, the MTN mobile money service in Nigeria has attracted 9.4 million users and this proves the willingness of the population to switch to a new banking system as an alternative to the conventional banking system in the country. By receiving a banking license, MTN is stepping forward in driving digital and financial inclusion in Nigeria, helping millions of users to open a bank account and gain financial independence and security.

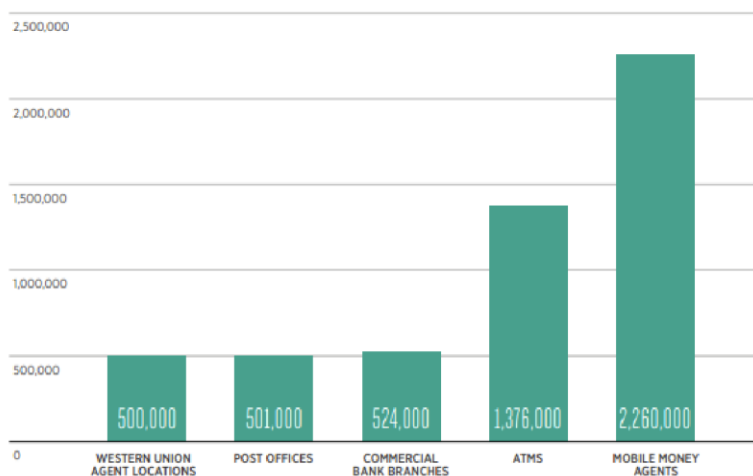


Fig 2.2: Number of financial access points across developing countries





According to a report published by GSMA, the figure above shows the number of mobile money agent operators against the conventional banking system emphasizing on mobile money services like payments, transfers, and savings. Looking at one of the objectives of this study is to examine how mobile money can be used as a means to access basic financial services by those excluded by the conventional system of banking, a report released by the Bank of Ghana (BoG) which is a country that has fully embraced mobile money shows that they have over 79,747 registered mobile money agents that are visible in different parts of the country. The agents offer an easy service of cash-in and cash-out for individuals who cannot or may not want to access a regular bank. The federal government of Nigeria was also able to disburse over 20 billion Naira in 2019 at 10,000 nairas each to those in poverty around the country and this was made possible with the help of mobile money technology integrated into Eyowo to send money directly to people's phone numbers without having them go to the banks and this was achieved in the shortest possible time.

Methodology

3.1 Building Mobile Money With USSD Technology

Unstructured Supplementary Service Data (USSD) is a protocol that is used by feature phones to exchange data with their service provider's computers. USSD can be used for WAP browsing, prepaid callback service, mobile money services, location-based content services, menu-based information services, or even as a way to control the phone over a network.



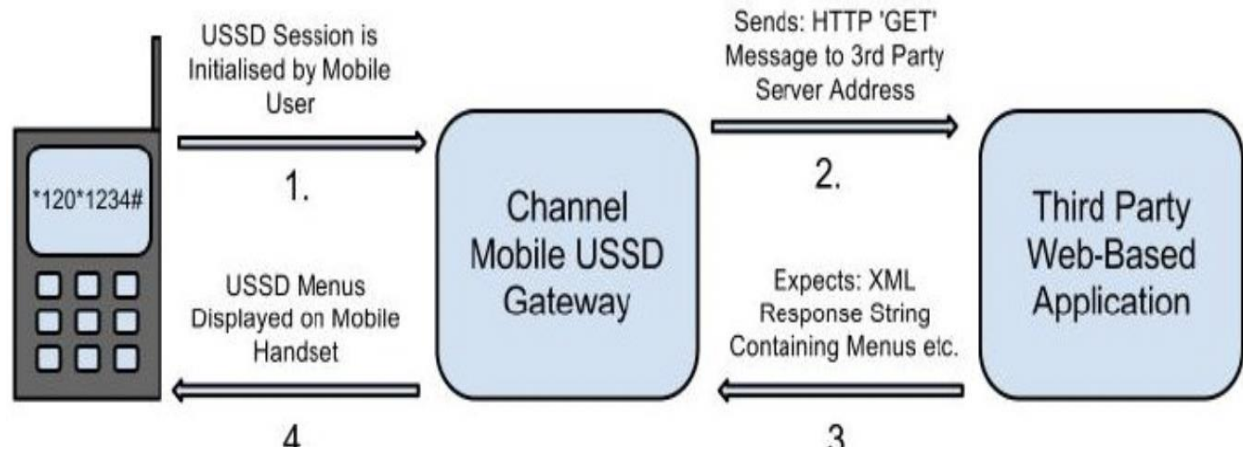


Fig 3.1 USSD Request Architecture

Based on the diagram above, a request can be sent from the phone to a telecom service provider (e.g MTN). The USSD Gateway (telecom) then sends the request to your USSD application (i.e. where we have the business logic which determines the menu to serve the users on receiving user’s request.) Your USSD application then responds to the request, and the USSD gateway goes ahead and displays the response on the user’s screen. This basic flow is exactly how users access the mobile wallet by sending requests via the telecom gateway to get account balance, transfer money and even load their wallets with money as well. Here is an outlined flow of how the cheapest feature mobile phones can interact with USSD application platforms.

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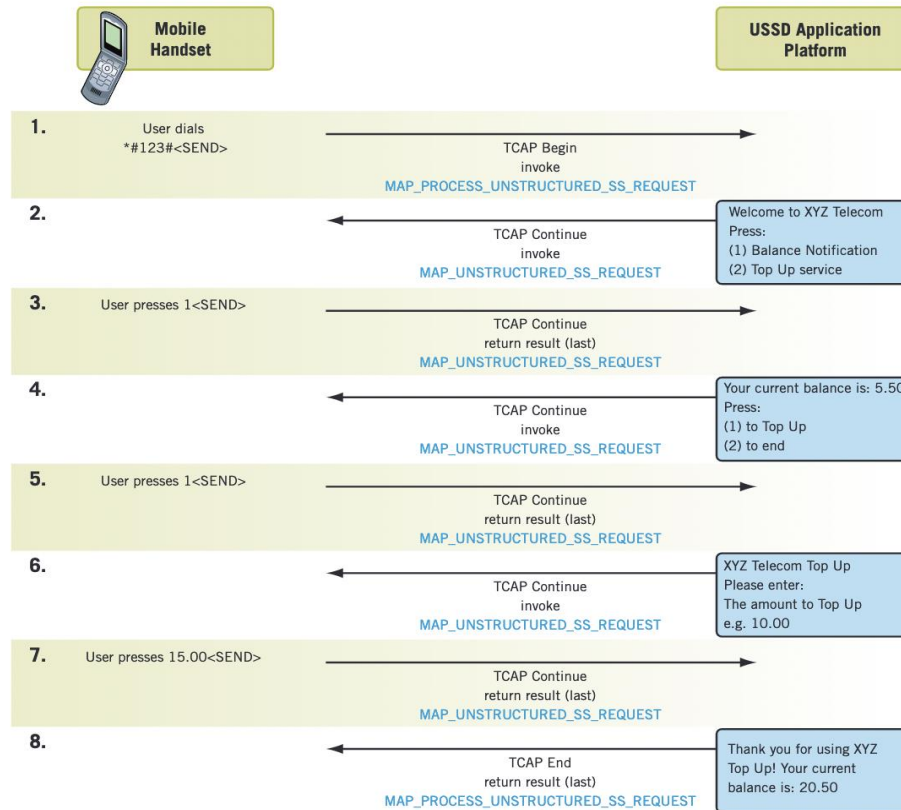


Fig 3.2 A mobile-initiated balance inquiry flow

How it works:

- i. The mobile-initiated USSD service commences with a mobile user dialing the USSD string (for example, *#123#). A TCAP dialogue is initiated following this, with the MAP_PROCESS_UNSTRUCTURED_SS_REQUEST service component sent to the USSD application platform.



- ii. The USSD application platform receives the request to initiate a USSD service from the mobile user. The platform determines the specific USSD service requested by checking the USSD string dialed. The USSD platform requests additional information from the mobile user via the MAP_UNSTRUCTURED_SS_REQUEST service.
- iii. The USSD platform receives the user's response within a MAP_UNSTRUCTURED_SS_REQUEST return result component.
- iv. The USSD application requests more information from the mobile user several times for the same TCAP dialogue, each time the MAP_UNSTRUCTURED_SS_REQUEST service would be used, as shown in step 4 above.
- v. Finally, the network USSD application platform ends the TCAP dialogue, sending the MAP_PROCESS_UNSTRUCTURED_SS_REQUEST return result (Thank you for using XYZ...).

USSD Coding Scheme:

As defined in 3GPP TS 29.002, this parameter details “the alphabet and the language used for the unstructured information in an Unstructured Supplementary Service Data operation.” Encoding is according to 3GPP TS 23.038 section “Cell Broadcast Data Coding Scheme”. The following code sample shows how the “GSM 7 bit default alphabet” USSD Data Coding scheme parameter could be encoded within a customer application:

Here are some code snippets from the Github repository for a robust smartphone mobile money wallet. This application can also be hosted on any cloud server.





```

/* USSD coding parameter */
bit _ set(req.pi, MAPPN _ USSD _ coding);
/*
 * USSD coding set to 'GSM default alphabet' @0001111
 * see 3GPP TS 23.038 'Cell Broadcast Data Coding Scheme'
 * for further detail
 */
bit _ to _ byte(req.ussd _ coding.data, 0x1, 0);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 1);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 2);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 3);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 4);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 5);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 6);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 7);
req.ussd _ coding.num _ bytes = 1;

/* USSD string parameter */
bit _ set(req.pi, MAPPN _ USSD _ string);
/*
 * USSD string
 */
mtu _ args.message=
"Welcome to XYZ Telecom\n Press:\n 1. Balance Notification\n 2. Top Up Service";
num _ da _ chars = MTU _ str _ to _ def _ alph(mtu _ args.message,
&req.ussd _ string.data[req.ussd _ string.num _ bytes],
&da _ len,
MAX _ DATA _ LEN - req.ussd _ string.num _ bytes);

```

```

static int MTU _ process _ uss _ req (dlg _ id, invoke _ id) /* USSD */
u16 dlg _ id; /* dialogue ID */
u8 invoke _ id; /* invoke ID */
{
MTU _ DLG *dlg; /* dialogue data structure */
MTU _ MSG req; /* structured form of request message */
u8 da _ len; /* length of formatted u-data */
u8 num _ da _ chars; /* number of formatted*/
dlg = &(dlg _ data[dlg _ id]);
/*
 * The following parameters are set in the
 * MAP _ PROCESS _ UNSTRUCTURED _ SS _ REQUEST:
 * ussd-DataCodingScheme
 * ussd-string - this will be entered by the user e.g. *#123#
 */
memset((void *)req.pi, 0, PI _ BYTES);
req.dlg _ id = dlg _ id;
req.type = MAPST _ PRO _ UNSTR _ SS _ REQ _ REQ;
req.invoke _ id = invoke _ id;
bit _ set(req.pi, MAPPN _ invoke _ id);
/* USSD coding parameter */
bit _ set(req.pi, MAPPN _ USSD _ coding);
/*
 * USSD coding set to 'GSM default alphabet' @0001111
 * see 3GPP TS 23.038 'Cell Broadcast Data Coding Scheme'
 * for further detail
 */
bit _ to _ byte(req.ussd _ coding.data, 0x1, 0);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 1);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 2);
bit _ to _ byte(req.ussd _ coding.data, 0x1, 3);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 4);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 5);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 6);
bit _ to _ byte(req.ussd _ coding.data, 0x0, 7);
req.ussd _ coding.num _ bytes = 1;
/* USSD string parameter */
bit _ set(req.pi, MAPPN _ USSD _ string);

```





```
/*
 * USSD string
 */
req.ussd _ string.num _ bytes = 1; /* USSD string, allow byte for data length */
num _ da _ chars = MTU _ USSD _ str _ to _ def _ alph(mtu _ args.ussd _ string,
&req.ussd _ string.data[req.ussd _ string.num _ bytes],
&da _ len,
MAX _ DATA _ LEN - req.ussd _ string.num _ bytes);
/*
 * fill in the ussd _ string, the number of formatted default alphabet
characters
 */
req.ussd _ string.data[req.ussd _ string.num _ bytes - 1] = num _ da _ chars;
req.ussd _ string.num _ bytes += da _ len;
/*
 * Operation timeout - 15 seconds
 */
bit _ set(req.pi, MAPPN _ timeout);
req.timeout = 15;
MTU _ send _ srv _ req(&req);
return(0);
} /* end of MTU _ process _ uss _ req() *
```





```
● ● ●  
  
* new application context networkUnstructuredSsContext-v2 */  
static u8 networkUnstructuredSsContextV2[AC _ LEN] =  
{  
06, /* object identifier */  
07, /* length */  
04, /* CCITT */  
00, /* ETSI */  
00, /* Mobile domain */  
01, /* GSM network */  
00, /* application contexts */  
19, /* map-ac networkUnstructuredSs */  
02 /* version 2 */  
};
```

```
● ● ●  
  
case MTU _ PROCESS _ USS _ REQ:  
/*  
* Send MAP _ PROCESS _ UNSTRUCTURED _ SS _ REQUEST  
*/  
for (i=0; i<AC _ LEN; i++)  
req.applic _ context[i] = networkUnstructuredSsContextV2[i];  
break;
```





Results

4.1 Introduction

The attempts in this chapter are to provide empirical results for the study, which seeks to find out the extent to which mobile money is being used as a tool to provide access to basic financial services and drive financial inclusion for the unbanked by looking into how mobile money can be used when powered by a USSD technology. We were also able to establish the conceptual framework that mobile money is providing access to essential financial services to the financially excluded groups. Based on that established hypothesis, these findings provided answers to the main research questions.

In the first part of our results, we discussed the financially excluded with regards to how they make payments, transfer money, and save. Then in the second part, we will focus on the accessibility and use of mobile money financial services by the excluded group. In the last part of this section, we will examine the challenges of their accessibility and the role of mobile money considering some of the derivations established in the literature.

4.2 Using and running a deployed USSD technology on a phone

The USSD code base developed for mobile money purposes will be integrated with all local mobile phone operators to provide services to all who are using the network. The mobile phone operator will issue a unique USSD code that their subscribers will use to access the service via their phones as we have in the example below:





Fig4.1: Sample of a USSD implemented on a feature phone

Description in details

Have you ever typed a code starting with an asterisk (*), number set, and hash (#) on your mobile? If yes, then, knowingly or unknowingly, you have already been using the USSD service. USSD is a communication protocol used to send text messages between a mobile phone and applications running on the network. It is a messaging service used in Global System for Mobile Communications (GSM) networks similar to SMS, where it sends data utilizing the signaling channel. However, unlike SMS which follows a store and forward-oriented message transaction; USSD provides session-based connections. Because of its real-time and instant messaging service capability, USSD service is up to seven times faster and much cheaper than SMS for two-way transactions. It is a technology unique to GSM networks and is the standard for transmitting information over GSM Signaling Channels.



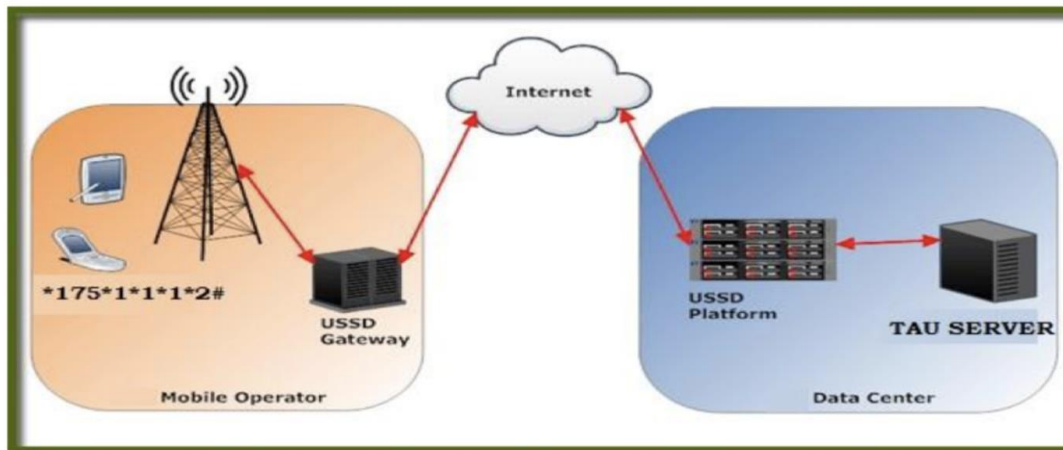


Fig4.2: Topology of a typical USSD infrastructure

4.3 What are the benefits of mobile money payment in a digital economy?

This section provides empirical evidence to answer the question of how mobile money can be beneficial to the economy. While speaking with one of the mobile money agents, he said that:

“I have been a MoMo agent for over two years now and the commission is enough to pay my bills and people use it because it is faster and cheaper” It goes without saying that mobile money is also an avenue to create jobs. Considering how less expensive it is to set up a MoMo agent outlet, it means that more people can use that to lift themselves out of poverty. Also, to the country, the Mobile money can help track financial records that wouldn't have been captured by the conventional system, reduce corruption and prevent tax evasion to a great extent. Individuals are always looking for a more convenient and secure way to accumulate, hold and transfer value. Inclusion helps families to save money for unforeseen emergencies and make plans for recurring expenses.



Banks are also looking to serve and grow future markets that are more inclusive and larger. Scale is an important thing to banks and growing the business and market means developing products and services for more segments of the economy. Petty traders and SME owners have innovative ideas and considerable energy but need services, markets, and capital to thrive. Bringing petty traders into the formal financial sector is an important first step to building a better connected financial market and ultimately, a global market.

Summary, Conclusion, and Recommendations

The federal government's cashless policy has gone a long way to encourage the use of card transactions and POS, now people can easily pay for goods and services with their ATM cards. Despite these financial activities, there is still a shortage of these provisions in rural areas. With

5.1 Summary

POS agents are now located everywhere around town, people can transfer money and withdraw from their accounts but you still need a bank account for a start. With just a basic phone, mobile money makes it possible for people to receive money without having a bank account as their mobile number is their wallet account number. This exposes the user to numerous advantages presented by mobile money and these includes:

- i. Funds can be transferred anywhere, even when there are no banks nearby, and this increases accessibility in rural areas.
- ii. It enables cashless payments which reduces dependency on cash and allows the tracking of financial records.
- iii. This solution provides services to people who are geographically inaccessible and or have a very low-income power.





- iv. Mobile money services are accessed using the most basic mobile phones with very low transaction costs.
- v. There are distributed vast network of agents that provides person-to-person contact and training to those who are unfamiliar with mobile money technology.

5.2 Conclusion

The financial sector is a heavily regulated sector in Nigeria, so it will be essential to see what it takes to set up mobile money operations in Nigeria and make it accessible to people who actually need it and the availability of the technology needed to make that happen. Even though mobile money operation is not so new, adoption has been very slow and this study is going to primarily highlight how adoption can be improved and the infrastructure needed to drive that adoption. The result of this study shows that the adoption of Mobile money can increase financial inclusion in Nigeria to 95% and as well connect over 99% of the adult population to easy credit facilities and financial services.

5.3 Recommendations

In this light mobile money, based on the evidence presented in this paper, it is suggestive of the potential for improving access and use of basic financial services among socially deprived people. Even though MMS have been identified to be heavily dependent on the network of people and interrelations. They are Unbanked despite being a marginalized group who are socially estranged from the community they live in. Still access and use the service like most other financially excluded groups. The ease of access without fear of discrimination could be attributed to the fact that the agent's commission is dependent on the number of transactions they do.





Evidence is suggestive that the Unbanked are often deprived of access to some services because of their social deprivation. Either directly, or becomes a precursor to their inability to access services that are privy to other segments of communities they live in. Still, the evidence from this finding is suggestive that mobile money financial services to a certain degree if not wholly are supplementing their provision of financial services to the socially deprived. And may lead to reduced financial vulnerability and smoothen their consumption, and risk managing ability. Even though MMS may not be a single bullet for their financial inclusion but it serves as a means for the improved day-to-day management of their finances. Subsequently, further research may be needed to determine how the application is being used for the reduction of vulnerability in other contexts. Overall this paper uses the theoretical and conceptual framework to analyze and present findings on the financial lives of those who are excluded. It highlights their challenges in access to basic financial services provided by banks. It also presents empirical data on their access and use of financial services provided by the new mobile money technologies. And discussed how they use this technology for their day-to-day management. The paper also identifies their challenges with the new technology and establishes the effect of how being socially deprived has not affected their access and use of the service. Nevertheless, it also highlights in what ways their social deprivation has restricted their full utilization of the services it offers.





References

- [1] Abrams, D., J. Christian and D. Gordon (2007) *Multidisciplinary Handbook of Social Exclusion Research*. Wiley Online Library.
- [2] Airtel (2015) Airtel Money accessed on 19th September 2016. <http://africa.airtel.com/wps/wcm/connect/africarevamp/africa/home/about-us/airtel-money/airtel-money>
- [3] Financial inclusion in Nigeria: mobile money services, payment services, bank, and telecoms operators <https://www.ibanet.org/article/0D41A6F8-2BD5-4FBC-9A0C-7F3B92319AC5>
- [4] Aker, J.C. and I.M. Mbiti (2010) 'Mobile Phones and Economic Development in Africa', *The Journal of Economic Perspectives*: 207-232.
- [5] Allen, F., A. Demirgüç-Kunt, L. Klapper and M.S.M. Pería (2016) *The Foundations of Financial Inclusion: Understanding Ownership and Use of Formal Accounts*, *Journal of Financial Intermediation*
- [6] Ayyagari, M., A. Demirgüç-Kunt and V. Maksimovic (2010) 'Formal Versus Informal Finance: Evidence from China', *Review of Financial Studies* 3048-3097.
- [7] Ardic, O.P., M. Heimann and N. Mylenko (2011) 'Access to Financial Services and the Financial Inclusion Agenda Around the World: A Cross-Country Analysis with a New Data Set', *World Bank Policy Research Working Paper Series*
- [8] Donovan, K.P. (2012b) 'Mobile Money, More Freedom? the Impact of M-PESA's Network Power on Development as Freedom', *International Journal of Communication* 6: 23.
- [9] Dreze, J. and A. Sen (1999) *India: Economic Development and Social Opportunity*, OUP Catalogue.
- [10] Dymnski, G.A. (2005) 'Financial Globalization, Social Exclusion, and Financial Crisis', *International Review of Applied Economics*(4): 439-457.
- [11] *East African Business Week* (2013) 'News; Financial Inclusion will boost EAC status' <https://www.busiweek.com>

