

Public Electronic Payments

A Case Study of the Electronic Cash System in Ecuador

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Abstract—Electronic payment methods, or ePayments, are frequently used by the private sector for eCommerce transactions for buying and selling goods or services offered through the Internet. This term describes the process needed to carry out the supply chain without changing media channels. Mobile payment systems and electronic cash have emerged as a quick and safe opportunity, which draws high penetration and use of cell phones for payments in the world. This type of payment method can also be extended and implemented by public administrations. In this paper, a case study on an electronic payment method developed by the Central Bank of Ecuador is presented as an alternative model to the electronic cash system offered with the public sector, seeking to provide the Ecuadorian population with an alternative for economic inclusion and allowing interoperability with different service providers and economic actors. In this work, the design of the system and a comparison with other electronic payment projects is presented. The findings are used to provide recommendations on how to enhance and replicate the development of this type of public projects.

Index Terms—eServices, ePayment, eGovernment, eCash.

I. INTRODUCTION

Electronic payment methods are frequently used for eCommerce to facilitate the acceptance of payment for online transactions. According to Meier [1], electronic payment systems can be classified by different criteria: A first classification could be made by the amount of money to be transferred (e.g., pico payment, micro payment, and macro payment). A second classification criterion could be the status of anonymous and non anonymous users; the latter provides payments for users that do not want to be identified. A third classification of ePayment methods is made by the time of the payment. For that purpose, three categories have been proposed by Meier [1]: prepay (e.g., www.GeldKarte.de and www.paysafecard.com), pay now (e.g., www.paypal.com and www.pago.de), and pay later (e.g., www.clickandbuy.de). Other innovative solutions that were not able to establish themselves in the market have existed. For example, there were systems proposed that were able to generate and exchange electronic coins [2] or coupons. Payments independent of time and place made with the help of a mobile device are called mPayments (mobile payments). In mobile procedures, network carriers and operators have to

collaborate with established banks and financial institutions, because, for example, macro payments are often handled over the accounts of the citizens. In the public sector, there are a number of initiatives to provide ePayments for citizens to secure electronic payments are made to government agencies to pay for public services (e.g., European Payments Council¹ (EPC), Pay.Gov², and the city of Salem³). The development of information and communication technologies is not an exception in Ecuador. Mobile telephony has achieved wide coverage and widespread use, not only gaining relevance in areas of the daily life of people but also in socio economic activities of all actors in the economy, positioning itself as an important factor for improving productivity. According to the Agency for Regulation and Control of Telecommunications of Ecuador (ARCOTEL), mobile penetration exceeds 100%, with a coverage of over 90% throughout its territory [3]. In addition, Ecuador financial inclusion indicators have estimated that by 2014 at least 40% of the population is unbanked or has no alternative means of physical money payment [4]. The foregoing conditions of access to technology and the need for financial inclusion have generated the right conditions for the implementation of an *electronic cash system*.

This paper is structured as follows: First, Section II gives a brief introduction to the case study presented in this paper. Section III presents the development of the case study in this paper. In Section IV, different types of electronic payments for both: public and private sectors are presented and compared with the case study *electronic cash system* proposed by the Central Bank of Ecuador. Then, V gives an overview of the expectations of this project. Finally, concluding remarks, recommendations and the outlook are presented in Sections VI and VII.

II. BACKGROUND

The Central Bank of Ecuador (BCE) [5] is responsible for the development of a public electronic payment method

¹www.europeanpaymentscouncil.eu

²www.pay.gov

³www.cityofsalem.net/epayments/Pages/default.aspx

called *electronic cash* [6]. The main goal of this project, according to the BCE, is to provide a public payment service to support citizens with their transactions, especially for people with no access to the private banking system, by giving them the possibility to make transactions and to pay for services electronically via time- and place-independent channels. Transactions are made via unstructured supplementary service data (USSD), which sends data through GSM and CDMA mobile technologies, encompassing the full range of phones, allowing citizens to execute transactions without the need of Internet connection or smartphones. Nevertheless, solutions for these type of devices are also provided. To be able to use these mobile services, users need to register in the system using their identification card, which has to be linked to the mobile number. After the registration process, the user can start to cash in, cash out, receive, and pay for services or to make transactions with other users. Additionally, users are able to access their transactions histories.

In Ecuador, monetary species in circulation (physical currency) as of July 2015 represent about 26% of the total liquidity in the economy [7], reflecting a high level of use of physical money compared to countries of a similar level of development or with developed countries, where the use of physical money represents less than one-digit percentages of total liquidity. There is an analogy between electronic money with physical money; for that reason, the *electronic cash system* can be a potential substitute.

III. THE ELECTRONIC CASH SYSTEM

The *electronic cash system* in Ecuador is a payment method that seeks to promote financial inclusion, strengthening networks of popular organizations and a solidarity system⁴, including the majority of people using mobile lines with full interoperability, reducing transaction-levels costs to allow universal access, delivering tools for productive sectors as well as private and public services, to generate initiatives to improve efficiency, and generating solutions that suit their own needs and the sociocultural and economic reality of the country. On this basis, the BCE issued regulation 055-2014 by which the *electronic cash system* was created, including defining the participants and their responsibilities; then, the Board of Monetary Financial Regulation issued Resolution No. 005-2014-M [7], which mainly regulates the rates and fees of the system according to the objectives of economic inclusion.

The following definitions for an electronic money system are used to better understand the use of the system. They are considered terms that combine financial and telecommunications concepts and adapt to the Ecuadorian reality.

- Electronic money system (EMS) is a set of operations, and regulatory mechanisms that facilitate flow, storage and money transfers in real time among the different economic agents affiliated with the system through the use of electronic devices, electromechanics, phones, smart

⁴Popular organizations and solidarity system (SPS): In Ecuador the SPS include credit unions, financial social networks, popular finance public entities, social organizations to promote financial inclusion, and NGO's, among others.

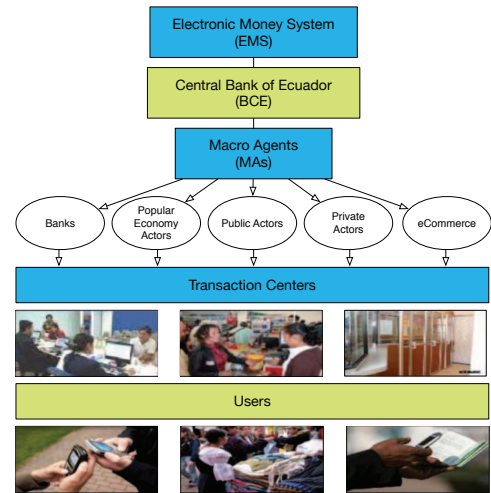


Figure 1: Participants of the Electronic Cash System, Adapted from BCE

cards and other products that incorporate technological advancement.

- Electronic money (EM) is equivalent to the monetary value expressed in the currency of the country (dollars of the United States of America), mainly through electronic exchanges, in a mobile value form. It is accepted with unlimited free movement and discharging, recognized as payment for all operators in Ecuador and for the payment of public duties, in accordance with regulations established by the Regulatory Competent Body.
- eMoney account (EMA) is a virtual record that will be created for each user of the EMS in which consists of all transactions generated by the associated electronic purses. A EMA can have one to three electronic purses partners.
- Electronic purse (EP) is the virtual register associated with an account of electronic money in the records of the transactions in the system using a mobile device or other mechanisms defined for use.

A. Participants

Participants in the *electronic cash system* are actors, individuals and corporations that have decided to voluntarily interact with the administrator to provide the technological infrastructure for monetary and non monetary transactions. All participants organize their operations according to the regulation of participants, operations manual issued by the BCE, and the agreements signed. Figure 1 shows the different participants in the *electronic cash system*.

- 1) *Manager*. The BCE manages the EMS in terms of the technological aspects, as well as the user accounts, customer service, and dissemination and generation of projects, among others, allowed by the system divers.
- 2) *Regulatory and Supervisory Authorities*. Each of these governing bodies perform control activities according to their competence.

- 3) *Technology and Telecommunications Channels*. These include mobile operators, regulated by the competent authority.
- 4) *Macro Agents*. These correspond to public and private institutions, financial institutions, and the popular and supportive financial system. They fulfill the function of managing use case, loading and unloading money, as well as other functions that are incorporated into the system.
- 5) *Transaction Centers*. These are recorded by *macro agents* who meet the conditions set by the BCE and provide services and products to users of the EMS. Each center has an EP that identifies users and allows them to make transactions, such as loading, unloading, drafting, and paying bills, among others.

B. Operability

The BCE distributes electronic money through its technology platform (electronic money platform (EMP)), which is connected to transact in real time with the national payment system. The EMP will connect with the technological channels (e.g., cellular operators) via transactional networks and qualified systems. To this end, the BCE signed a connection agreement with mobile operators where in the economic, technical, operational, financial, and legal aspects were established for the connection between the infrastructure of the *electronic cash system* by the BCE and the public telecommunications network operator, so users can access via EMS for monetary and non monetary transactions through mobile terminals.

Natural and legal persons may voluntarily open EMAs, constituting these virtual logs created by each user, where the user ID corresponds to the national identity card number or the taxpayer registration number (RUC) and where their transactions are recorded for the electronic partners. An EMA may contain one or more EPs, which are virtual records associated with an account. It consists of transactions in the system using a mobile device or a secure Web connection, which are identified by a telephone number or code from mobile service providers allowed to operate in Ecuador. There could be as many EPs as there are mobile or fixed accounts that the user would like to associate with his or her personal account. In the first stage, individuals may associate up to three EPs to an EMA. In the case of legal persons, the BCE defines the number of purses partners, depending on the needs of each organization.

The BCE will set the amounts of money, including minimum and maximum, that can be administered in an EMA and each of its associated purses so the administrator can establish the minimum and maximum number of transactions that can be performed in an account of electronic money or purse partners. The limits are important since they allow the system to adequately monitor and mitigate risks of misuse by users or illegal activities. These limits will be permanently evaluated based on the needs of the society as well as protection regulations for cases of fraud and money laundering issued by the relevant authorities.

One of the main innovations of the Ecuadorian system is its easy account-activating process in a paper less fashion, allowing citizens, regardless of the technology capabilities of their mobile device, to activate an account without the need for a data plan or Internet access. Users are only required to have an active mobile line, and they can open an account directly from their phone by dialing *153#. An example of the type of communication used to create an account is presented as follows:

- To open an electronic money account: 1-yes, 2-no.
- Operating conditions. Conditions are available at [6]: 1-yes 2-no.
- Enter the user's identification number or ID, or the system responds and asks the user to confirm the name: 1-yes, 2-no.
- Enter the user's date of birth: day-month-year.
- Place of birth, place of last suffrage, marital status; two additional 2 random questions are asked.

After completing the basic information over the mobile phone, a temporary password is sent to users. This allow users to access the transactional menu, where the first action invites them to replace it with a personal password. To activate the account, the system validates users' personal information with public databases, such as the ID registry, internal revenue system, national electoral council, and national traffic agency, and checks lists for money laundering, among others, allowing users to configure their profile, validate their identity, and ensure the correct use of accounts and purses. In the following hours, user receives a call from the contact center to welcome him/her, provide support and give complete information.

For legal persons who wish to use the system for payments and collections in the process, the registration process includes sending information digitally to the BCE. Institutions interested in becoming *macro agents* must sign an agreement with the BCE.

To efficiently manage the EMS, the BCE will have a team that provides customer service to macro and contact center agents. The system maintains three types of accounts: one for individuals who maintain a monthly transaction limit of \$9,000 USD that can manage up to 3 purses; a second for legal persons who maintain limited amounts of transactions that starts at \$20,000 USD and can maintain multiple, limited wallets; and, finally, macro agent accounts, which are special accounts that are allowed to have multiple purses with several features and do not have any limit.

The *electronic cash system* from the BCE begins with the concept that all mobile phone lines and mobile devices are technically qualified to use as electronic money, act as a purse and therefore be associated with an electronic money account. According to the Ministry of Telecommunications and Information Society (MINTEL), as of June 2015, in Ecuador, there are more than 18 million mobile lines, which represents more than one telephone line per capita [8]. The use of mobile media covering almost all the Ecuadorian population ensures that in every family there is a working phone line with high territorial coverage, constituting an effective means to

implement the *electronic money system* and expand the access and use of financial services, using the technology of advanced mobile (cellular) services, where the telephone or other mobile device can become an electronic wallet.

C. Fees and Commissions

The rates charged to users are the most competitive in the Ecuadorian banking system. The loading and unloading transactions have no cost for the first four transactions per month, and payments from person to person keeps rates ranging from 2 cents to 35 cents. The transactions in commercial establishments have no costs for people, as costs are paid by the institutions at more convenient rates than what the people would be charged. The institutions handle physical cash or the costs of alternative means of payment [6]. The commissions paid to macro agents for load management, downloads, and orders allow for a wide network of trading centers across the country. It works especially with institutions that are in the so-called *popular and solidarity economy* [9], supported by unions and credit are the institutions expected to capitalize financial inclusion arising from the development of the *electronic cash system*.

IV. COMPARISON WITH OTHER ePAYMENT PROJECTS

In this section, a non-exhaustive search of ePayment methods is presented and compared with the *electronic cash system* developed at the BCE.

a) *Electronic Cash System vs. M-Peso*: M-Peso was introduced by Safaricom⁵, a leading mobile network operator in Kenya. The principle of M-Peso is similar to that of *electronic cash* from BCE, where the client must have a phone number and to register with M-Pesa, a password is also provided by the carrier. Due to a special function of his SIM card, the user is the owner of his account. If the account has cash in it, the client can transfer money to other accounts. According to Safaricom, there exist 11,000 agents with shops to cash in or cash out money [12]. Likewise, in the *electronic cash* project from BCE, the use of smartphones or Internet access is not required to execute transactions. Both services are not free, but in comparison with traveling to town or using other providers to pay bills, M-Peso is less expensive [11].

b) *Electronic Cash System vs. Mobile Applications*: Transactions of the *electronic cash* project from BCE are made via USSD. They allow people to pay and access money without an Internet connection. The UBS-Paymit [13] or Google wallet [14] can be used only on smartphones that use these mobile applications. An Internet connection is needed in the case of UBS-Paymit to make an electronic payment. Google Wallet does not require an application to send money to anyone in the United States (U.S.), only an email address. It is free to send directly from the debit card, bank account, or Wallet balance. In turn, again, the Internet and an appropriate device is needed. Nowadays, nearly everyone has a mobile phone USSD, so with the use of *electronic cash* from BCE,

users have an additional channel through which to transfer money.

c) *Electronic Cash System vs. Internet-Based Payment*: PayPal costs could be more expensive than *electronic cash* from BCE since the cost of a transaction corresponds to a percentage of the total amount to be transferred. While *electronic cash* from BCE has some fixed costs for transactions [10], PayPal is free for some services such as: "Send money to family and friends when you use only your PayPal balance or bank account, or a combination of their PayPal balance and bank account [15]." Nevertheless, not all transactions are free of charge using PayPal. The use of PayPal implies that users must have access to bank accounts, credit cards, Internet access and/or smartphones.

d) *Electronic Cash System vs. Bitcoins*: The *electronic cash* from BCE is different from the *bitcoin* project [2]. According to the *bitcoin* project [2], "*bitcoin* is an innovative payment network and a new kind of money." While *bitcoin* is a new type of cryptographic currency, the *electronic cash* from BCE is based on existing money. The BCE has full control over the cash and over the digital money. The value of the dollar fluctuates only with real fluctuations in the money trend, while *bitcoins* are very susceptible to small or big changes. In a very short moment, the price of a bitcoin can increase or decrease rapidly. The use of *bitcoins* and their exchange rate depends on the market, while the value of *electronic cash* from BCE is attached to existing money in U.S. dollars.

Table I summarizes the different features, advantages and disadvantages of a non-exhaustive search of ePayment projects and products. Most of the projects available are private, and their main goal is either to increase their portfolios of services or to generate revenue for their companies. Contrary to most of the existing ePayment methods, *electronic cash* from BCE is a public service for citizens that does not require one to have a bank account, credit card, or Internet access on a smartphone in order to use this service. One is mainly required to have a registered mobile line with a SIM card.

V. OUTLOOK

The first years of acceptance of the payment method will be the most difficult, as the population has to understand its benefits and how it works. For this, the biggest challenge of BCE is to conduct effective communication. The system started operating in February 26th, 2015. In October 2015, the *electronic cash system* registered more than 51,000 active members, who have made transactions for more than USD \$800,000 USD. Additionally, more than 150 macro agents and about 1,000 trading centers operating throughout the country.

The expectation is to have at least 60% of the economically active people, which corresponds to about three million people registered in the EMS, having active accounts and using them at least once a month. Moreover, there will be citizens who make the *electronic cash system* a standard tool and others who use it sporadically. The success of this project will depend on the variety of services and use cases available. It is also expected to improve by at least 10% due to the financial

⁵<http://www.safaricom.co.ke>

Table I: A Non-Exhaustive Search of ePayment Projects and Services for Both, Public and Private Sectors

Payment Method	Type	Goals, Features and Properties	Advantages	Disadvantages
Electronic Cash System [6]	Public	<ul style="list-style-type: none"> - Provide an electronic payment method and saving accounts for citizens - Transactions via USSD; no Internet required - No bank account required - User account is required (registration of user) - No banking history is required - Users on blacklists cannot open an account 	<ul style="list-style-type: none"> - No bank account required - Secure transactions (password required for transactions) - High penetration (no smartphone needed) - Easy to use (transactions via USSD) 	<ul style="list-style-type: none"> - Added cost for some transaction [10] - Trust from citizens is difficult to achieve
M-Pesa [11]	Private	<ul style="list-style-type: none"> - Provide an electronic payment method and saving accounts for citizens - Produced by the mobile provider Safaricom - Transactions via USSD (over special SIM card) - No Internet or bank account is required 	<ul style="list-style-type: none"> - No bank account required - Secure transactions - More attractive costs than postal services 	<ul style="list-style-type: none"> - Added cost for every transaction - Social implications as described in [12]
UBS Paymit [13]	Private	<ul style="list-style-type: none"> - Being present in the community and to increase portfolio of services - It is an application for smartphones - Internet connection needed - Credit card or bank account needed 	<ul style="list-style-type: none"> - Free of charge - No bank account (UBS account or any) needed 	<ul style="list-style-type: none"> - Payments only via smartphone (app) and only if the recipient has the same app on his smartphone. - Credit card required (which is in general not free)
Google Wallet [14]	Private	<ul style="list-style-type: none"> - Increase portfolio of services - Application - Smartphone required - E-mail address required 	<ul style="list-style-type: none"> - Any debit or credit card required - Possibility of sending money to anyone with an e-mail address - If money is received, it can be cashed out directly by the bank account using the debit card. - No account by Google wallet is needed 	<ul style="list-style-type: none"> - Internet connection required - Smartphone is required - Available in the US only
PayPal [15]	Private	<ul style="list-style-type: none"> - Attract new customers - Electronic payment method - Internet access is required - E-mail account is required - Bank account or credit card is required 	<ul style="list-style-type: none"> - Very easy use - Free payments 	<ul style="list-style-type: none"> - Internet access, bank account or credit card necessary - To get money from PayPal you need an account from PayPal
Bitcoin [2]	Private	<ul style="list-style-type: none"> - Revenue driven - Type of currency (not official) - Money only exists digitally 	<ul style="list-style-type: none"> - Fast and easy - Secure (based on cryptographic methods) - ID address of the owner cannot be associated with the bitcoin address. 	<ul style="list-style-type: none"> - High risk of losing money - Security relies on the right use of bitcoins - Payments cannot be undone - Bitcoin transactions are public - Highly experimental - Subject to fluctuations in the currency market

inclusion of citizens and thereby decrease the use of physical money.

VI. RECOMMENDATIONS

To make the *electronic money system* a popular and trustworthy means of payment a timely adaptation and inform the society. Experiences in several countries show that an electronic cash system reaches an important use from the third year of operation and can achieve maturity after eight years. Additionally, experiences in other countries show the importance of innovation in use cases, applications, additional products and services.

The model proposed by the BCE, to become an open and accessible platform, requires the participation of innovators, entrepreneurs and businesses to develop applications and propose new types of services. To accomplish this goal, the BCE should provide appropriate ecosystems for developers to help with the integration of applications and services for mobile (e.g., cell phone, smartphones, and tablets) and Web-based platforms, such as that proposed in the work of Zygiaris [16]. An example of such an ecosystem for smart cities was implemented in the city of Barcelona and described in [17]. This scenario is an opportunity to promote the creation of startups willing to cooperate with the *electronic cash system* and provide such services as: public transport, vending machines, tickets purchasing (e.g., sports, concerts, cinema, etc.),

eBusiness and eCommerce, parking slots, fines or penalties (e.g., traffic, library, legal), restaurants, and tax payments, among others.

An important issue to take into consideration regarding the *electronic money service* developed at the BCE is related to the user's perception of privacy and security to engage citizens in using this payment method. An empirical study of customers' perceptions of security and trust in e-payment systems is presented in [18]. It provides a theoretical foundation and practical guidelines for service providers dealing with the security aspects of electronic payment systems. Without putting aside the main purpose of implementing digital money among Ecuadorians, it is recommended in further stages to expand its customers segments based on different parameters, such as age, income and education level, etc., in order to develop strategic approaches in which not only the poorest sector will be considered but also the rest of the economically active population can be encouraged to use this system.

Mobile operators around the world have reported an increase in their revenues after the implementation of mobile money [19]. In this sense, the BCE should develop cooperation alliances with mobile telephony companies by promoting all of the benefits that can be obtained through participation in the electronic money project (better profits and a reduction of its client's rotation in time [20]). Developing a well-defined interoperability plan with similar electronic money systems

from other countries can not only help to strengthen bilateral ties but also boost the local economy.

Finally, a periodic benchmark on the impact of the project should be conducted by the BCE in order to determine possible improvements and actions to be taken to enhance the technological platform, ecosystem, and citizens' satisfaction.

VII. CONCLUSIONS

Several types of mobile payment systems exist. Most are administered by private actors. The case of Ecuador is the first one involving law enforcement, is inter-operational, and is open to use by all actors of the economy. The *electronic cash system* is completely open to interoperate across the private or public sectors to improve the efficiency of the current monetary system, with positive effects on financial and economic inclusion. It contributes to the *popular and solidarity economy* [9] with reduced transaction costs (time, money and security), access to financial services, and information and market transparency. It benefits the business sector and entrepreneurs, reducing operating costs, revenue, cash management, cash flow, and inventory management, among others.

The keys to success for the *electronic money system* are a sustainable long-term incentives to all participants, interoperability, ease of use and trustworthiness in the system. The challenges and roles of central banks in the world are redesigned and go beyond efficient monetary policies. Nowadays, central banks are concerned about issues such as: economic inclusion, the protection of users and social inequality.

One of the goals that the *electronic cash system* from BCE pursues is to support people not included in the private banking system and do not have access to the Internet. According to the Ministry of Telecommunications and Information Society (MINTEL), Ecuador moved from 63.2% in 2006 to 104.98% in 2015 [8]. This means that nearly everyone is able to use the *electronic cash system* via USSD. People who are living in rural areas and/or do not have access to the Internet need to travel to the main cities to pay their bills and thus have lots of commuting costs. This costs are much higher than the costs originated by payments with the *electronic cash system*.

The *electronic cash system* proposed by the BCE can be applied to other regions and countries with similar conditions and in developed countries due to its well-defined configuration in which all of the participants have a clear idea of their roles and responsibilities. In addition, this innovative system presents the advantage of been a non-static structure thanks to its ability to adapt and incorporate new use cases and actors.

In order to prevent any illegal action, digital money provides an efficient account activation process; it executes strong information validation through interaction with several databases of regulatory entities. Additionally, based on the monthly number of customers, commercial activities, the system handles three types of accounts and establishes transactions limits.

Due to all of the facilities that the Ecuadorian electronic cash systems provides, it will be easy to implement this means of payment in other countries, as it works regardless of the

model of the mobile device or its operator and does not require users to have a data plan or Internet. Only an active cell line is required.

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