One Cash

A New Generation of E-wallet for Mobile Money

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***Abstract*— Launched in Congo in 2012 by mobile phone operators, Mobile Money is a digital financial service that offers the possibility of opening an account for free and carrying out financial transactions easily and flexibly. Subscribers can then carry out several types of operations: pay bills, transfer money, receive money, deposit money, etc. In Congo, in addition to the fact that financial transactions are still very expensive, the solutions offered by operators currently only allow transactions to be carried out between subscribers of the same mobile operator. In addition to this lack of a gateway between operators, the old Unstructured Supplementary Service Data (USSD) or Subscriber Identity Module (SIM) hierarchical menu interfaces used do not facilitate or encourage the use of the solutions offered. A single transaction can require up to seven or eight screens and the entry of two to three sequences of numbers. In this article, we propose an innovative solution, called "One Cash", which provides a concrete and practical solution to these major concerns, by integrating the Application Programming Interfaces (APIs) of mobile and/or financial operators and by exploiting the richness and flexibility of smartphone interfaces to simplify use. In particular, the content is presented in a richer and clearer way than a simple text; the number of manipulation steps has been reduced with the proposed solution, thus reducing the cognitive load of the user. We highlight the interest of a diversified offer of m-payment services including a simplified solution offered by the operator alone, and more elaborate services, in particular by associating technological and financial partners such as banks. The proposed architecture is easily adaptable to respond to future extensions and improvements of the system.**

Keywords-Ubiquitous computing support; e-payment; m-payment; mobile money; mobile telephony; User Interface/eXperience User; usage; useful; transactions; financial inclusion; Unstructured Supplementary Service Data (USSD); lower-cost and user-friendly solutions.

I. INTRODUCTION

Mobile banking [4]-[7][10][12][15][20][26] is a technological ecosystem that allows, from a mobile terminal [21], to access financial services: mobile payment, money transfer, mobile banking and mobile finance (microcredit, microinsurance or savings). Transactions can be done via the Internet, directly between two phones or between a phone and any other type of terminal [5]. The impact of mobile banking is totally different between developing and developed countries. In developing countries, while the low penetration rate of banks and the number of mobile phones sold has enabled mobile phone providers to understand the marketing and financial interest of this means of communication, in developed countries the impact remains minimal since mobile banking is considered an additive channel, not dissociable from a bank account. Offering a much narrower range of services than those available in developing countries and incorporating few or no payment solutions, these services remain incomplete and do not allow unbanked populations to access a first level of banking inclusion [23]. It is, therefore, difficult to propose mobile banking as a solution to unbanking in developed countries. It is also important to note that access to banks in developed countries is facilitated by a high penetration rate and a good network of branches. With 8% of the population unbanked in Organisation for Economic Co-operation and Development (OECD) countries [7], banks do not see the financial interest in developing platforms and managing these customers for obvious profitability reasons.

The African continent has thus become one of the main areas for the deployment of mobile money and e-payment. Under-banking partly explains the success of mobile payment services in Congo and in developing countries.

A. Local context of the banking sector, issues of bancarisation in Congo and e-payment system in Congo-Brazzaville and in Africa

(a) The banking sector and the challenges of banking in Congo

After more than three decades of crisis, the banking landscape in the Republic of Congo has been transformed from a fragile context marked by repeated crises and bankruptcies to a reassuring paradigm that is solid, integrated and increasingly systemic. With about ten active credit institutions (excluding microfinance institutions and development banks), we can distinguish: pan-African groups (UBA Bank, EcoBank, BGFI Bank), Moroccan groups (LCB Bank, CDCO Bank, BCI Bank), the French bank “Société Générale Congo”, and finally Congolese banks, notably BSCA Bank, Banque Postale, BCH Bank and BESCO Bank. The situation here is dominated by foreign banks, which control almost 90% of the market. The Republic of Congo is a Central African country with a population of 5 million (5.518 million (2020)), of which, despite this strong presence of banking players, barely 13% is banked. This percentage

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remains low. This means that 87% of this population is excluded from traditional banks, according to a paper in one of the largest Congolese newspapers, "Brazzaville Dispatches" in French "Les Dépêches de Brazzaville" (2016), on the situation of Congolese banks. When commercial banks are inaccessible to part of the population, they are not considered efficient institutions [1][2][8][11].

(b) Weaknesses in electronic communication infrastructure

In addition, Congo has major weaknesses in terms of electronic communication infrastructure. Optic fiber Internet coverage only serves three urban areas (Brazzaville, Pointe-Noire and Oyo). This is despite Congo's connection to the West Africa Cable System (WACS) submarine fibre-optic cable since 2012 and cross-border interconnections with Gabon and the Democratic Republic of the Congo (DRC).

(c) The combination of banking and technological shortcomings

The combination of banking and technological shortcomings is the breeding ground and the driving force behind mobile money in this country. The Congolese mobile phone market is made up of two mobile network operators, Mobile Telephone Networks (MTN) and Airtel [3]. The operator Azur, although still licensed, is no longer operational. Launched in 2012 by the two mobile telephone operators Mobile Telephone Networks (MTN) and Airtel, mobile money, commonly known as "MoMo", is a digital banking financial service offered by these operators through mobile phones. Congolese consumers have quickly and massively adopted this new technology based on mobile telephony, which combines the power of information technology [31] and microfinance practices. Faced with the problems of Internet coverage throughout the country, on the one hand, and the difficult conditions and administrative red tape inherent in opening an account in traditional banks in Congo, on the other, mobile telephony has revolutionised the financial ecosystem and economic habits thanks to mobile money. Mobile money allows the holder to transfer money and/or credit from their user account to another account, whether or not they are a subscriber, using mobile phone technology. For some time now, this service has also been used to pay certain bills.

(d) Local electronic payment offers

Airtel Payments Bank is a leading Indian payment bank headquartered in New Delhi. The company is a subsidiary of Bharti Airtel. In Congo, Airtel Money is a service of Airtel that allows money transactions to be made using a telephone. In May 2022, Mobile Telephone Networks (MTN) was pleased to inform all its stakeholders that the subsidiary Mobile Money Congo (MMC) had been created. As an electronic payment company in Central Africa, Mobile Money Congo (MMC) is now authorised to provide payment services. The approval marks a new milestone in the development of the Mobile Money service in Africa and establishes this service as a major driver in the acceleration of financial inclusion [8][13][17][25] for more than a decade.

B. Technological context: the strategic advantage and power of smartphone interfaces

In this context, the problem of improving the services offered to the target populations, accessibility, ease of use and interoperability of systems can, therefore, has been raised [22]- [24]. Little known and abandoned in Europe in favour of mobile web applications since the arrival of the smartphone, Unstructured Supplementary Service Data (USSD) technology continues to be massively used throughout the world and particularly in Africa. Where there is no Internet network and where certain services are difficult to access, USSD opens up the possibility of offering mass digital services. The USSD is a source of innovation. Beyond the basic functions of this protocol, entrepreneurs have quickly understood the development potential of this technology and have used it to respond to numerous concrete uses (USSD and agriculture: informing farmers, use of USSD in health, USSD and education: revising lessons, consulting results, USSD and insurance, USSD and transport, etc.) [18][19]. Its simplicity is one of its advantages. In practice, the user sends a code that connects him in real time to a telephone operator to exchange data. Unlike a Short Message Service (SMS), there is no storage in USSD, the information is only available during the opening of the session and then disappears. USSD is, therefore, a real tool for democratising digital uses. However, it is a technology that remains relatively basic. Firstly, this is the case because each session has a cost (network fees) and a limited opening time (time session). As there is no data backup, the user has to start from scratch. This is costly, but also relatively limited in terms of customer experience: it is impossible to perform long tasks. The main competitor is, therefore, the rise of the mobile Internet. However, while it is clear that its use will become increasingly limited in the future, USSD technology undoubtedly has many years ahead of it. Although Internet penetration is growing rapidly across the African continent, it is still low compared to the rest of the world. This is an obstacle to the development of more advanced technology for a significant proportion of the population. Mobile broadband is still very expensive in some African countries. The power of smartphone technologies and interfaces [31] can contribute significantly to the improvement of services. It is true that smartphones are not yet accessible to many people. But the number of people with smartphones has increased significantly. This increase concerns all strata of the population. African countries in particular are rapidly urbanising. As in Asia, more financial transactions are done via a smartphone than through traditional banking channels. This may include many low-income people who would otherwise not have access to formal financial services. However, interface design could have an even greater impact. Today, the old hierarchical USSD or SIM toolkit menu interfaces alienate many users. A simple cash transaction can require seven to eight menu screens and the entry of two-to-three-digit sequences. Errors are too easy. It is too painful to use often or for everyday purposes. Many stay away completely. Smartphone interfaces not only have the potential to simplify basic

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transactions, but they can also solve many other obstacles. The richer graphical interfaces of smartphones can present services more clearly than simple text. Information is presented in an understandable and intuitive way. Ease of use can persuade users to make transactions more frequently.

Unfortunately, early uses of smartphones did not exploit the full capabilities of smartphones. New applications often mimic the hierarchical menus of the USSD, rely too heavily on text or simply try to replicate a laptop interface on a much smaller smartphone screen. To take full advantage of the transformation potential, it is important to invest in User Interface design and User eXperience (UX). Interfaces are a strategic asset. A report on #DesignInTech [16] highlights the growing importance of design in technology. In recent years, experts have been collaborating to collectively help develop a consensus set of principles based on experience, including [9]. This is seen as an emerging area of research that can harness the power of smartphones to better serve users. The User Interface (UI), therefore, plays a key role in optimising accessibility and improving the user experience.

C. *The goal of the study*

The goal of this research is to propose some advances in the form of new architectures and new solutions. Specifically, we propose a mobile and web-based platform and client application that provides solutions to the problems described, including ease of use and access for all segments of the population. It is a technological solution designed in a particular context of use to improve financial and commercial services or uses in Congo.

II. ARCHITECTURE AND FUNCTIONALITIES

A. *Architecture*

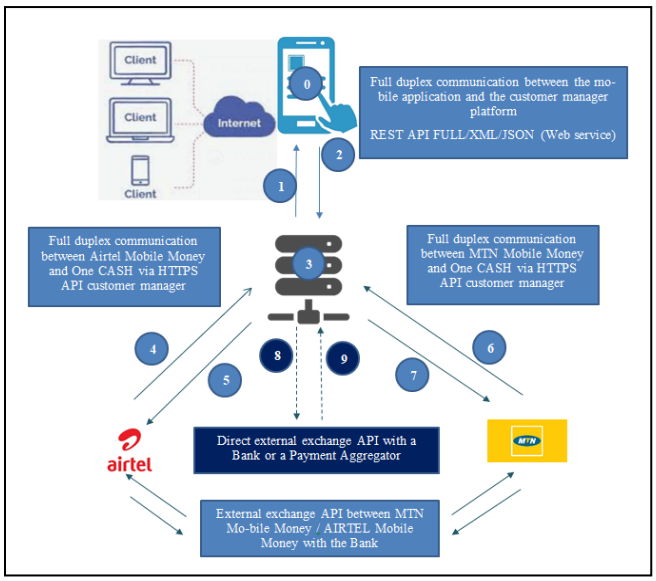

Figure 1. One Cash general architecture and functionning.

One Cash is a payment aggregator facilitating mobile and online payments, an e-payment solution via mobile or web to boost e-commerce and sales. An Application Programming Interface (API) allows the One Cash solution to be integrated into other applications, in particular e-commerce and matchmaking solutions. It includes a web-based management platform in the BackOffice and a mobile application and web interface for managing and viewing transactions in the FrontOffice. It is designed to allow easy payments on mobile and online via e-commerce platforms.

The functioning of the application (Figure 1) is described below.

(a) The 0, 1, 2, 3 scheme: For data consultation and information update type transactions, this scheme allows balance consultation, account linking, etc.

(b) The 0, 1, 2, 3, 4, 5 scheme: This scheme defines a transaction of type Money Deposit (CASH IN) or Money Withdrawal (CASH OUT) between One Cash and Airtel Money:

o CASH IN case: When a One Cash customer wants to debit his Airtel Money account to credit his One Cash account in order to make an online payment.

o CASH OUT case: When a One Cash customer wants to debit his One Cash account to credit an Airtel Money account.

(c) The 0, 1, 2, 3, 6, 7 scheme: This scheme defines a CASH IN or CASH OUT type transaction between One Cash and MTN Mobile Money:

o CASH IN case: When a One Cash customer wants to debit his MTN Mobile Money account to credit his One Cash account in order to make an online payment.

o CASH OUT case: When a One Cash customer wants to debit their One Cash account to credit an MTN Mobile Money account.

Transactions between MTN Mobile Money or Airtel Money and banking systems are handled by external APIs and are, therefore, not handled by One Cash.

(d) The 0, 1, 2, 3, 8, 9 scheme: This scheme defines a CASH IN or CASH OUT transaction between One Cash and the Bank. The solution consists of three main modules:

- Client module: One Cash Client (Mobile application: connected or disconnected mode - limited functionality). The mobile application will allow users to make payments from their mobile or via a web interface.
- Server module: One Cash Web-based administration platform (One Cash Manager).
- Dashboard & Customer Manager: The dashboard will be used to manage customer transaction accounts for One Cash.
- Server API: One Cash API interface.

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The One Cash API makes it possible to integrate the One Cash solution with the rest of the internal applications of the cluster network (management platform for a central purchasing and e-commerce unit, contact platform for the payment of services) or with other external e-commerce applications through a subscription agreement (Figure 2).

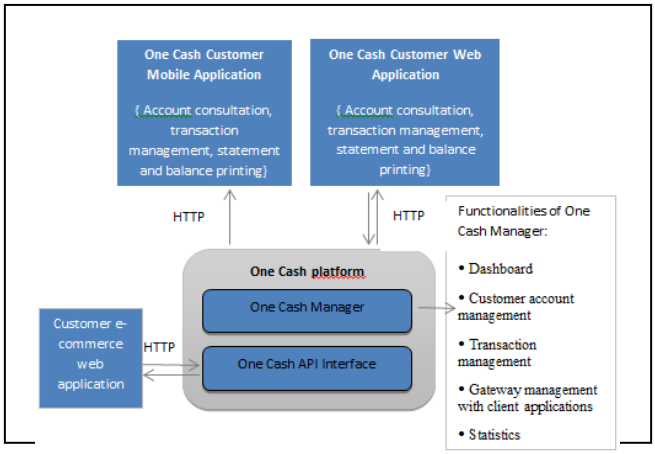

Figure 2. One Cash general architecture.

B. *Services offered (functionalities)*

1) *One Cash Customer*

Regardless of the customer application used, Mobile or Web, the One Cash Customer Mobile / One Cash Customer Web application offers the following services:

- Creation of ONE CASH accounts
- Airtel Money to One Cash Transactions (AM2OC) & One Cash to Airtel Money Transactions (OC2AM),
- Mobile Money to One Cash (MM2OC) & One Cash to Mobile Money (OC2MM) transactions,
- Pay online including via QR Code,
- View transaction history,
- Transfer money between two One Cash accounts.

2) *The Dashboard & The Customer Manager*

- Account management,
- Transaction management,
- Transaction monitoring: Dashboard, Consultation of transaction history (all types of transactions).

In the rest of this paper, we present the interface of the mobile application. The web client application offers the same functionality as the mobile client application. For security reasons, the administration module will only be briefly described in this paper.

III. SOME USE CASES OF ONE CASH INTERFACE

A. *One Cash Customer Mobile interface*

One Cash Customer Mobile is an Android mobile application that can be downloaded from the Google Play Store or App Store. Once you have downloaded the application, simply follow the installation instructions which only take two to three minutes. At the end of the installation, the application icon will appear on the smartphone screen, as shown in Figure 3 below:

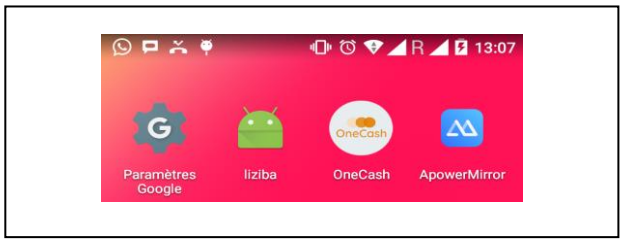

Figure 3. One Cash launch icon after installing the app.

Launching the application is simple using the One Cash icon above. The application then starts up. Once connected, the application displays the user dashboard, as shown in Figure 4.

The dashboard presents:

- The name of the user,
- The available balance,
- Transaction history.

For a debit, the colour of the amount debited and thus transferred to another account is red. For a credit, the colour of the amount received is green. To obtain the details of a transaction, simply click on the corresponding line.

The screen on the right shows the amount of the transaction, the date of the transaction, the type of transaction (sending or receiving), the cost of the transaction if applicable, the sender and the receiver, each identified by their name and One Cash ID.

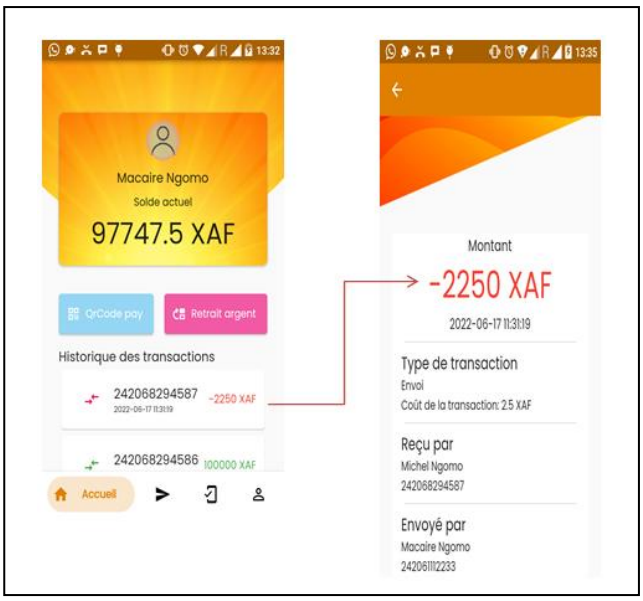

Figure 4. One Cash interface for customer (XAF = CFA franc).

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1) Funding / Reloading a One Cash account

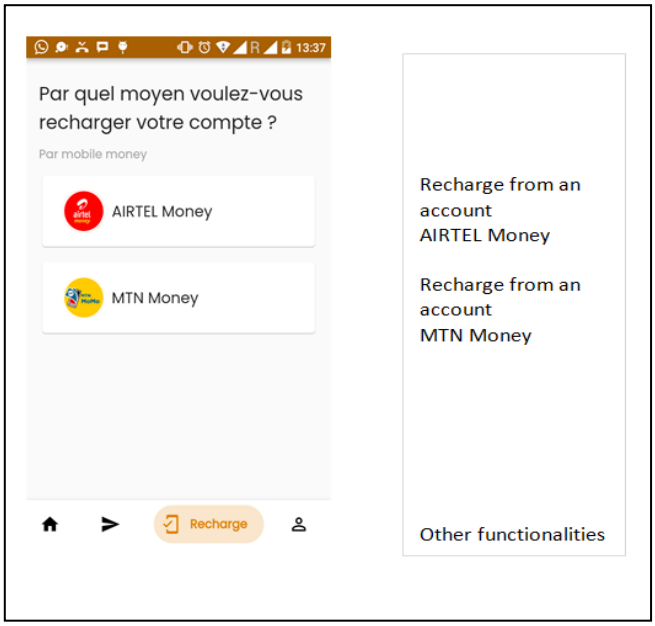

Figure 5. One Cash account funding interface.

One Cash allows the user to fund his One Cash account by debiting his MTN Mobile Money or Airtel Money account. the One Cash account funding is done by the user from his MTN Money or Airtel Money account (Figure 5). To do so, the user simply selects one of the Mobile Money accounts and enters the amount to be transferred to his One Cash account.

The Mobile Money account must have an amount greater than or equal to the amount to be transferred. The user has the same level of security as his Mobile Money account. For security reasons, the user must confirm the transaction by entering the PIN code of his Mobile Money account.

2) Withdrawal or transfer of money to an MTN MONEY or Airtel MONEY account

To withdraw money, the user must transfer from their One Cash account to a Mobile Money account and then make a withdrawal from a kiosk. To do this, the user uses the withdrawal button available on a home screen (Figure 6).

By selecting this operation, they enter the amount to be transferred. They have the same level of security as their Mobile Money account.

For security reasons, they must confirm the transaction by entering the PIN code of their Mobile Money account.

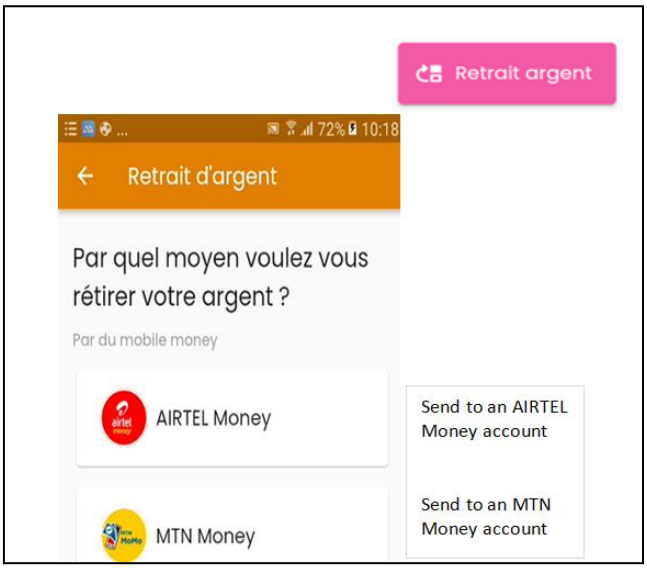

Figure 6. One Cash Transfer interface to an MTN MONEY or Airtel MONEY account.

3) Send or transfer money to another One Cash account

To transfer money from a One Cash account to another One Cash third party account, simply use the transfer button on the home screen. The user can then enter the phone number associated with a One Cash account and the amount to be transferred to the account.

4) Transfer of money by QR Code (QR CODE PAY)

Sending money to a third-party One Cash account can be done by QR Code. To do this, the user uses the QR Code Pay function in the application (Figure 7).

After scanning the QR Code, the phone number of the beneficiary is read by the sending phone. The user then enters the amount to be transferred and confirms the entry. For security reasons, he confirms the transaction by entering his One Cash secret code. If the operation is successful, the application displays the transfer confirmation message.

Figure 7. One Cash QR Code.

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B. *One Cash Manager interface*

1) *Dashboard & One Cash Manager*

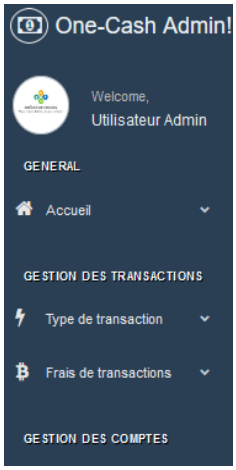

Figure 8. Diagram of master and slave.

As already mentioned, for security and confidentiality reasons, the One Cash Manager administration module will be presented only partially and briefly in this paper. One Cash Manager is a web-based platform designed according to architecture models that meet the requirements of robustness, scalability, interoperability, availability, security, reliability and resilience. It is based on a high-level technological foundation.

One Cash Manager offers a set of services for data administration, application management, transaction management, user account management, transaction cost management, platform configuration, etc. (Figure 8).

This administration module is only accessible to the solution managers.

C. *Examples of concrete experimentation*

In order to test the effectiveness of the solution, the first concrete experimental use of the One Cash was made within the framework of a program to strengthen the commercial and entrepreneurial capacities of Congolese companies in 2002. This operation was organized to allow nearly 4,500 members of the community of Congolese agribusiness clusters to carry out financial transactions between themselves, without additional costs other than Internet connection fees, only for operations carried out within the network. The second concrete experimental use is within a community of students for the payment of small student life services. Like mobile money or noCash platforms, One Cash is being tested for example in a university cafe-restaurant to allow the payment of restaurant bills or to give tips from a phone in a few clicks without any cash, or to pay for document reproduction services. Since the regulations that can govern this type of system are not yet ready in Congo, the uses of the One Cash solution remain at the experimental level with voluntary communities of farmers or students who carry out transactions between themselves or with small service providers, by first making a deposit with a trusted third party. These experiments allow us to test different aspects (ergonomics, robustness, scalability, interoperability, availability, security, reliability, resilience, etc.).

IV. CONCLUSION AND FUTURE WORK

There is no doubt that the unbanked market is a market with great potential. Mobile banking can only have a certain future, especially in developing countries. It seems to be the solution to disseminate financial services and bank a new population [17]. Numerous studies [4]-[6][14][17] have shown the strong potential of the mobile phone to provide access to financial services to the unbanked in developing countries while lowering transaction costs. As a high potential market [32], mobile banking seems to have a very favourable future in developing countries. It is, therefore, important to pursue the development of services aimed at mass access and satisfaction of target populations, in line with technological evolution [16][23][24][27]-[31]. This study is in line with the work on the use of ICTs in Africa and in particular in Congo. Its goal is to propose some advances in the form of new architectures and new solutions. Specifically, we propose a platform and a client application in mobile and web versions that exploits the strategic advantages and power of smartphone interfaces to provide solutions to the problems described above, in particular ease of use, transactions that are not limited to a single mobile telephone network, and access to all segments of the population. The number of manipulation steps has been reduced with the proposed solution, thus reducing the user's cognitive load. It is a technological solution designed in a particular context of use to improve financial and commercial services or uses in Congo.

While in this first version of the solution, funding and withdrawal operations can only be carried out between a One Cash account and a Mobile Money account, we plan to extend it by integrating banking APIs and thus allowing direct exchanges between a One Cash account and a bank account. The advantages are significant both for users and for banks, which have been excluded from the mobile banking market since its launch in Congo in 2012 and are only beginning to access it via agreements with the two mobile phone operators. Access to this service for banks will offer great flexibility. The user will be able to carry out transactions remotely, between his One Cash Account and his bank account. In Congo-Brazzaville, some financial institutions are beginning to pool services with mobile phone operators. Unfortunately, transactions are still only one-way, from the operator to the bank. It is not yet possible to fund a mobile money account from a bank account. It is important to develop not only this interoperability between operators, financial institutions and payment aggregators, but also for these institutions to facilitate financial operations thanks to the potential of the new services. So, there is an opportunity

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to be seized now. There is a real need for companies to integrate mobile money APIs and financial institutions into their applications. This trend towards digitisation of transactions through mobile money will accelerate the adoption of mobile money APIs and initiate a change in the digitisation strategy. Until now, providers' applications did not communicate with the outside world. With this interconnection of applications, new partnerships and new services will emerge. Ultimately, the end customer's experience will be greatly improved. They will benefit from a simpler, less costly service that offers new possibilities. Moreover, in this way, new uses will be established and will become the norm in terms of customer service. Mobile money will thus contribute to the acceleration of digitalisation by establishing the use of mobile money APIs as the norm. Then companies will really start to integrate these APIs into their services. Companies will then gradually evolve towards a company that assembles services in the same chain to build new services. This allows for greater agility, lower costs, and building the best possible services for the end customer. This will of course lead to new points of tension in the customer experience with new uses. New players will then emerge to solve these problems, or existing players will evolve their services to do so. In both cases, the end-customer experience will be continuously improved. The proposed system architecture is easily adaptable to meet future extensions and improvements.

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