



BANK OF GHANA

Design paper of the digital Cedi (eCedi)



Introduction



The interest in Central Bank Digital Currency (CBDC) has escalated in the past few years. According to a BIS survey in 2021 on CBDC, 86% of central banks were actively researching the potential for CBDCs, 60% were experimenting with the technology and 14% were deploying pilot projects¹.

Research and development work on CBDC has gone global and spans almost all continents including; the Americas, Europe, Australia and Africa. The Bahamas was the first country to issue a CBDC, Sand Dollar, and the DCEP project of China is probably the one most well-known worldwide. Bank of Ghana (BoG) is one of the first few African central banks to declare working on a digital currency.

Ghana's payment system has improved in recent years and continues to evolve to meet the changing needs of users. This development has been facilitated by Bank of Ghana's agenda to promote innovative and affordable digital financial services as a means of expanding financial inclusion and encouraging the use of digital payment as an alternative to cash. Importantly, mainstreaming digital payments is expected to formalise the economy thereby enhancing the efficiency of fiscal operations and monetary policy transmission mechanisms. Consequently, at its press conference that followed the 91st Monetary Policy Committee meeting² Bank of Ghana declared its intention to explore a CBDC within the framework of the financial sector digitalisation program. It is in pursuit of this goal that Bank of Ghana announced the concept of the eCedi – a digital version of the Cedi banknotes and coins.

Globally, technological developments and modernisation of payments in response to digitalisation of society have been identified as the key accelerators of CBDC. The disruption caused by Covid-19 in recent times has become an additional impetus. In Ghana the motives include a combination of factors such as; facilitation of financial inclusion, pursuit of a cash-lite economy, enhancing operational efficiency and cost-effectiveness in payments, and provision of a safe, secure and trustworthy alternative to privately issued digital currencies.

The Bank of Ghana has proceeded on the understanding that a CBDC may be designed with a variety of possible architectures and design features. In this regard, Ghana's CBDC project is tailored to needs as stated in its policy objectives. To better identify such needs, BoG conducted comprehensive research on the issue, the results of which has informed the effective design solution for the eCedi. It is envisaged that the digital currency will dovetail with the existing payment landscape of Ghana. Bank of Ghana therefore would extensively engage stakeholders to the extent possible for their active participation and successful implementation.

This paper gives an overview of the motivations of issuing the eCedi, the potential benefits for stakeholders, the design principles of the eCedi, including the governance, accessibility, interoperability, requisite infrastructure and security.

We appreciate the feedback from the individuals, banks, FinTech companies, and academics for the useful answers and comments to questionnaires, interviews and interactions. We encourage all Ghanaians to jointly support the eCedi pilot project towards a future stable, digitally advanced, and innovative financial system for Ghana.

Dr Ernest Addison
Governor of Bank of Ghana

1. Ready, steady, go? – Results of the third BIS survey on central bank digital currency. BIS Working Papers No 114.

2. Press Release of the Bank of Ghana dated November 25, 2019.

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Contents

Chapter	Introduction	2
	List of abbreviations	5
	Executive summary	6
1	KEY CONCEPTS	8
2	OVERVIEW OF THE GHANAIAN PAYMENT LANDSCAPE	10
3	KEY MOTIVATIONS FOR ISSUING THE eCEDI	13
4	POTENTIAL BENEFITS FOR STAKEHOLDERS	15
	4.1 Consumers	16
	4.2 Banks	16
	4.3 FinTech	16
	4.4 Merchants	16
	4.5 Government	17
	4.6 BoG	17
5	eCEDI VISION	18
6	PAYMENT SCENARIOS WITH THE eCEDI	20
7	DESIGN PRINCIPLES OF THE eCEDI	24
	7.1 Governance	26
	7.1.1. Two-tier architecture	26
	7.1.2. eCedi compliance with AML/CFT	26
	7.1.3. Monitoring and reporting	27
	7.2 Accessibility	27
	7.2.1. Accessible to anyone, trusted by everyone	27
	7.2.2. Offline functionality	27
	7.2.3. Fees model	28
	7.3. Interoperability	28
	7.3.1. eCedi interconnecting with existing infrastructures	28
	7.3.2. Cross border perspectives	29
	7.3.3. Programmability of payments	29
	7.4. Infrastructure	29
	7.4.1. Highest IT security standards	29
	7.4.2. Resilience, availability, and scalability	30
	Questions for the public discussion	31

Abbreviations

AML	Anti-Money Laundering
ACH	Automated Clearing House
BIS	Bank for International Settlements
BoG	Bank of Ghana
B2B	Business-to-Business
B2P	Business-to-Person
CBDC	Central Bank Digital Currency
CSD	Central Securities Depository
CFT	Combating the Financing of Terrorism
DCEP	Digital Currency Electronic Payment
ECB	European Central Bank
FIO	Fintech and Innovation Office
GhIPSS	Ghana Interbank Payment and Settlement Systems
G2P	Government-to-Person
NFC	Near Field Communication
POS	Point of Sale
P2B	Person-to-Business
P2P	Peer-to-Peer
P2G	Person-to-Government
RTGS	Real Time Gross Settlement System
SDI	Specialized Deposit-Taking Institution
SDK	Software Development Kit
USSD	Unstructured Supplementary Service Data
UX	User Experience

Executive summary

- In recent years, the idea of issuing digital currencies by central banks has been topical around the globe. BoG is one of the first few African central banks which declared its intention to pilot a CBDC within the framework of its financial sector digitization program and the overall digitization agenda of the Government of Ghana.
- From the point of the CBDC taxonomy, the digital Cedi (or the eCedi) is a retail token-based CBDC. This is a value based approach that implies an eCedi that represents a token, or a digital value note. Payment is done by transferring the value note from one person to another. The concept is similar to cash payment transactions, where payment is done by transferring banknotes and/or coins from person A to person B.
- BoG has developed a view of the eCedi to meet the following strategic goals:
 - Increase digitization of the Ghanaian economy;
 - Foster financial inclusion and consumer adoption of digital payments;
 - Anticipate the future role of BoG as an active regulator and facilitator of a digital economy;
 - Foster the possibility of a more secure, efficient, and resilient payment system;
 - Address the risk of unregulated privately issued digital “currencies” or virtual assets.
- This paper identifies the main benefits that eCedi implementation would bring to stakeholder groups such as; Consumers, Banks, FinTech, Merchants, Government and the Central Bank.
- BoG has designed two types of wallets for the eCedi namely; hosted wallets managed by financial institutions and hardware wallets, which are secure portable storage devices held by individuals. Hosted wallets require access to the internet while hardware wallets work in offline mode.
- The core principles of the eCedi’s design are built around Governance, Accessibility, Interoperability, Infrastructure and Cyber security.
- The eCedi will be under the full control of BoG, which is the only entity to create and destroy digital cash. Also, the ecosystem of the eCedi will include key players such as banks and payment service providers, to provide access to end consumers.
- The eCedi balances transparency of transactions with the privacy of consumer data while being fully compliant with the KYC and AML/CFT regulations and requirements.
- Financial institutions are responsible for the monitoring of the eCedi payment transactions and shall report to the Financial Intelligence Center (FIC) all suspicious transactions.
- The BoG shall define policies for participants in the ecosystem. These would cover wallets, transaction limits, monitoring and regulatory compliance, and sanctions for breaches.
- To ensure the success of the eCedi, its functional design should ensure appropriate user experience and inclusiveness to foster broad acceptance. A well designed eCedi may help to boost financial inclusion in an increasingly digital Ghanaian society by involving financially excluded people in financial services.
- From a consumer perspective, the eCedi usage has to be as easy and intuitive as possible. Consumers should be able to make a payment in fewer and simple steps familiar to them and with no need for sophisticated digital literacy.
- BoG is aware of the existing consumer habits. Most people in Ghana are already used to paying with cashless mediums such as mobile money, cards, QR Codes etc. It is therefore envisaged that switching to the eCedi from cash, particularly the onboarding process, would be quite facile.

- The eCedi has to be accessible to everyone and any part of the country. Absence of mobile data networks in the rural areas of Ghana should not serve as a barrier to the use of the eCedi. In other words, the eCedi should work effectively in both online and offline environments.
- Speed of payment is very important from a consumer's perspective. The transfer of funds from a payer to a payee should be near instant, easy to confirm and traceable. Both the sender and receiver should receive a confirmation of a successful transaction.
- Similar to cash, an eCedi transaction will be free of charge to consumers. By this approach, the eCedi would be a strong contender of cash, promote competition in the payment market and facilitate the provision of innovative value-added services to individuals and businesses by banks and payment service providers at affordable fees and charges.
- It is particularly important that the eCedi is implemented to forestall disruption to the existing payment space. For this reason, the eCedi will be integrated into the existing interbank payment systems and mobile money interoperability platform operated by the Ghana Interbank Payment and Settlement Systems Limited (GhIPSS).
- In the era of the globalisation, it is important that domestic CBDCs are designed with the prospects of adaptation for interoperability with CBDCs of other jurisdictions. Efforts to accelerate integration of the economies of African economies, particularly under the African Continental Free Trade Area (AfCFTA) makes this a key consideration in the eCedi design. The eCedi takes into consideration CBDC standards, making it possible for Ghana to participate in international projects on cross border CBDCs.
- The eCedi will also support programmable use cases to enable innovation and new business models while maintaining the trust of the users. Notable among the programmable use cases are "government-to-person" and "person-to-government" payments. In addition, it is capable of "machine-to-machine" automated payments in the Internet of Things.
- As a currency, trust is critical to the adoption and usage of the eCedi. The eCedi will therefore meet very high security requirements. As a result, currency issuance and distribution modules of the core eCedi infrastructure will be separated to address cyber risk. The eCedi will also be scalable to handle large volumes of transactions and provide 24/7 availability and support instant payments.
- BoG would appreciate comments from individuals, banks, FinTech companies, academics, international monetary and development organisations and central banks on the eCedi design principles. Comments, criticisms and suggestions should be sent to the eCedi team at ecedi@bog.gov.gh and submit the questions in an [Electronic Questionnaire](#).



CHAPTER 1

KEY CONCEPTS



CBDC is considered to be both an evolving new form of central bank money (alongside cash and central bank's reserves), and an innovative payment instrument with its own infrastructure.

CBDCs can be classified into retail (rCBDC) and wholesale (wCBDC). Also, it is generally accepted to categorize CBDCs into token-based (value based) and account-based depending on mode of implementation.

Retail CBDC, according to BIS, is a broadly available general-purpose digital payment instrument, denominated in the jurisdiction's unit of account that is a direct liability of the jurisdiction's monetary authority¹. The ECB defines it as a publicly accessible digital form of fiat currency issued by the state and having legal tender status².

In brief, retail CBDC is digital cash that is designed to take on most traditional attributes of physical cash (in practice, though, it may have other additional functionalities depending on its final design). Retail CBDC could be used by individuals for P2P transfers, and P2B, B2P, B2B, P2G, and G2P payments besides cash and existing payment media and instruments (e-money, payment cards, etc.).


Wholesale CBDC is restricted to wholesale, financial market payments and is only accessible to financial institutions.

Token-based CBDCs are cryptographic tokens which can be stored locally on a card, on a phone, or a smart device and can be passed on from one user to another.

Account-based CBDC envisages general purpose accounts, each of which has a corresponding balance.

1. Central bank digital currencies: foundational principles and core features. Joint report by The Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors of the Federal Reserve and Bank for International Settlements.

2. Cryptocurrencies and tokens, ECB FXCG update.



CHAPTER 2

OVERVIEW OF THE GHANAIAN PAYMENT LANDSCAPE



Ghana's payment landscape has undergone remarkable transformation following the implementation of the Ghana Interbank Settlement (GIS) system, which is one of the first few Real Time Gross Settlement (RTGS) system implemented in sub-Saharan Africa. The subsequent establishment of the Ghana Interbank Payment and Settlement Systems (GhIPSS) in 2007 further enhanced the landscape with supportive structures such as the Automated Clearing House (ACH) system and the Cheque Codeline Clearing with truncation (CCC) system.

Additional improvements aimed at expanding customer access to retail electronic payments led to the implementation of the National Biometric SmartCard Payment System (e-zwich) and the National switching and Processing System – Gh-link. These systems together provided the core infrastructure for the GhIPSS Instant Pay (GIP), a secure instant electronic interbank retail fund transfer system, and the mobile money interoperability (MMI), which allows funds transfer across mobile money platforms, e-zwich platform and bank accounts using mobile money wallets and e-zwich wallet.

At the beginning of 2021, the payment systems market in Ghana was characterized by the following statistical indicators (App. 1)¹.

Developments in Ghana's Payment System in 2020.

Ghana Interbank Settlement System

The total volume of Ghana Inter-bank Settlement (GIS) system transactions increased by 4.8 % from 1,376,094 in 2019 to 1,442,182, at end-December 2020. The corresponding total value of transactions increased by 15.6 % to GH¢2,433.54 billion during the reference period.

The average value per transaction in 2020 was GH¢ 1,687,399.70 compared with GH¢ 1,530,504.36 in 2019.

Cheque Codeline Clearing

The total volume of inter-bank cheques cleared in 2020 declined by 13.6 % to 5,903,331, from 6,831,417 in 2019, while the value of transactions increased by 2.3 % to GH¢ 177.63 billion from GH¢ 173.62 billion in 2019.

Ghana Automated Clearing House

Direct Credit

In 2020, the total volume of transactions cleared through the direct credit system increased by 9.8 % to 8,131,989 from 7,404,059 in 2019. Similarly, the total value of direct credit transfers increased from GH¢ 36.14 billion in 2019 to GH¢ 49.79 billion in 2020. Express ACH direct credit recorded growth rates of 6.6 % and 34.8 % in both volume and value of transfers over the 2019 positions of 1,153,551 and GH¢ 11.53 billion, respectively.

Direct Debit

The total volume of direct debit transactions increased from 722,337 in 2019 to 827,901 in 2020. The total value of transactions also increased by GH¢ 763 million, to GH¢ 936.10 million. The average value per transaction also increased significantly from GH¢ 239.64 in 2019, to GH¢ 1,130.69 in 2020.

E-zwich and Gh-link TM

The number of e-zwich cardholders increased by 5.8 % to 3,252,493 in 2020. Within the same period, the total volume of e-zwich transactions, however, declined by 3.0 %, to 10,477,601, while the total value of transactions increased by 43.2 %, to GH¢ 9.03 billion. The Gh-linkTM platform recorded a total of 806,486 transactions, with a value of GH¢ 329.70 million in 2020, compared with 972,746 with a value of GH¢ 329.23 million in 2019. ATM transactions continued to dominate Gh-linkTM platform transactions and constituted more than 99.0 % of the total transactions.

GhIPSS Instant Pay

In 2020, GhIPSS Instant Pay (GIP) recorded a total volume of 6,804,754 transactions, with a value of GH¢ 9.15 billion, compared with 1,905,267 and GH¢ 3.46 billion respectively in 2019.

Mobile money services

The total value of mobile money transactions grew by 82.4 % over the 2019 value to GH¢564.16 billion at end-December 2020, while the total float balance increased by 92.1 % to GH¢ 6.98 billion during the same period. Registered mobile money account holders increased by 18.5 % to 38,473,734 at end-December 2020. The number of registered agents also increased to 423,892 at end-December 2020, from 306,346 at end-December 2019.

1. Bank of Ghana. Annual Report and Financial Statements 2020.

The number of active mobile money accounts increased by 18.6 %, over the 2019 figure to 17,142,677 at end-December 2020, while the number of active mobile money agents increased to 328,329 in 2020 from 226,298 in 2019.

Strategic goals and initiatives

The key strategic objectives of the Ghanaian payment and settlement ecosystem include:

- Foster non-bank payment service providers (FinTech Companies)
- Promote financial inclusion;
- Promote adoption and use of digital payment streams as an alternative to cash; and
- Create an enabling environment for the delivery of safe, efficient and reliable digital financial products and services

The Government of Ghana in collaboration with stakeholders, launched the following policies to promote financial inclusion and digitalisation of the economy in 2020:

- National Financial Inclusion and Development Strategy for 2018-2023² to address the fundamental barriers preventing the underserved population from accessing financial products and services;
- Digital Payments Roadmap³ to provide concrete steps to build an inclusive digital payment ecosystem which will provide better access to financial services;
- Digital Financial Services Policy⁴ to serve as a blueprint on how the country can leverage digital finance to achieve its financial inclusion goals.

In furtherance of its commitment to nurturing a vibrant, inclusive, safe, and efficient digital financial services ecosystem, the Bank established a FinTech and Innovation Office (FIO) in 2020 to drive Ghana's cash-lite agenda. The FIO is responsible for the licensing and supervision of Dedicated Electronic Money Issuers, Payment Service Providers, Payment and Financial Technology Service Providers, and emerging forms of payments delivered by non-bank entities. The Office also develops policies to promote FinTech innovation and interoperability in Ghana.

2. National Financial Inclusion and Development Strategy for 2018-2023.

3. Digital Payments Roadmap. Toward a Cash-Lite Ghana. Building an Inclusive Digital Payments Ecosystem.

4. Digital Financial Services Policy in Ghana.

CHAPTER 3

KEY MOTIVATIONS FOR ISSUING THE eCEDI



The Bank of Ghana considers CBDC to be of strategic importance to a progressive and digitally inclusive society and has developed the eCedi to meet the following strategic goals:

Increase digitization of the economy in Ghana.

The eCedi is being implemented as part of the “Digital Ghana Agenda”, which involves the digitization of government services of the country of 30 million people. Digital technologies play a key role in reshaping the economic system. Innovative technologies are increasingly permeating various spheres of economic activities and creating new opportunities for socio-economic and business development to achieve economic growth.

Foster financial inclusion. Financial inclusion is one of the strategic objectives of the Ghanaian financial system in accordance with the National Financial Inclusion and Development Strategy for 2018-2023. According to the World Bank Global Findex Report (Findex 2017), financial inclusion in Ghana increased from 42% in 2014 to 58 % in 2017¹. However 54% of women had accounts with a formal financial institution compared with 62% of men. Against this backdrop, the government developed and prioritized a reform agenda aimed at increasing access to formal financial services to 85% by 2023. The design principles of the eCedi, in particular accessibility and consecutive offline payments would contribute to the government’s objectives of digitizing the Ghanaian society and promoting financial inclusion.

Enhance consumer adoption of digital payments. The eCedi is piloted as part of the broad Digital Financial Services Policy² which prioritizes the digitization of payment use cases such as; small-value informal pensions, government payments, remittances, merchant payments, and utility payments.

Anticipation of the role of BoG as a progressive regulator for facilitating the development of the digital economy. The establishment of the FinTech and Innovation Office by BoG is seen as the first step towards realization of the Bank’s goal of regulating the vast digital service terrain in Ghana’s financial sector. An inclusive and innovative project on digital currency implementation will foster BoG to adopt digitization as a key policy objective to drive growth in all aspects of the country’s economy.

Foster the possibility of a more secure, efficient, and resilient payment system. Efficient, safe, and convenient payment systems are fundamental to economic activity and wealth distribution. Ghana’s payment system development, since 2000, has been guided by strategic plans to address the dominance of the informal economy and cash payments³. International approaches to financial markets regulation⁴ prove that governments have to play a key role in mission-critical services that cannot entirely be left to the private market. The eCedi would be one of such resilient digital means of payment that would also work in a crisis, even offline, without power supply and guaranteed by the central bank. The implementation of the eCedi can reduce the share of cash payments in circulation, increase the speed and convenience of cashless payments, engender competition in payment services, and enhance settlements of digital interbank and cross-platform retail payments and improve efficient use of liquidity in the Ghanaian payment ecosystem.

Address the risk of unregulated privately issued digital “currencies” or virtual assets. The scrutiny of Big Tech companies (for instance, Apple, Facebook, or Amazon) in regard to providing payment services and issuing private digital currencies is a significant challenge for regulators nowadays. Such global private “currencies”, as well as locally issued cryptocurrencies, provoke a wide range of risks including monetary, legal, operational, consumer protection, and financial stability. Digital currency issued and guaranteed by the central bank would meet the demand for digital currencies without posing systemic risks.

1. Fourth Ghana Economic Update: Enhancing Financial Inclusion – Africa Region (English). Ghana Economic Update, #4 Washington, D.C.: World Bank Group.

2. Digital Financial Services Policy in Ghana.

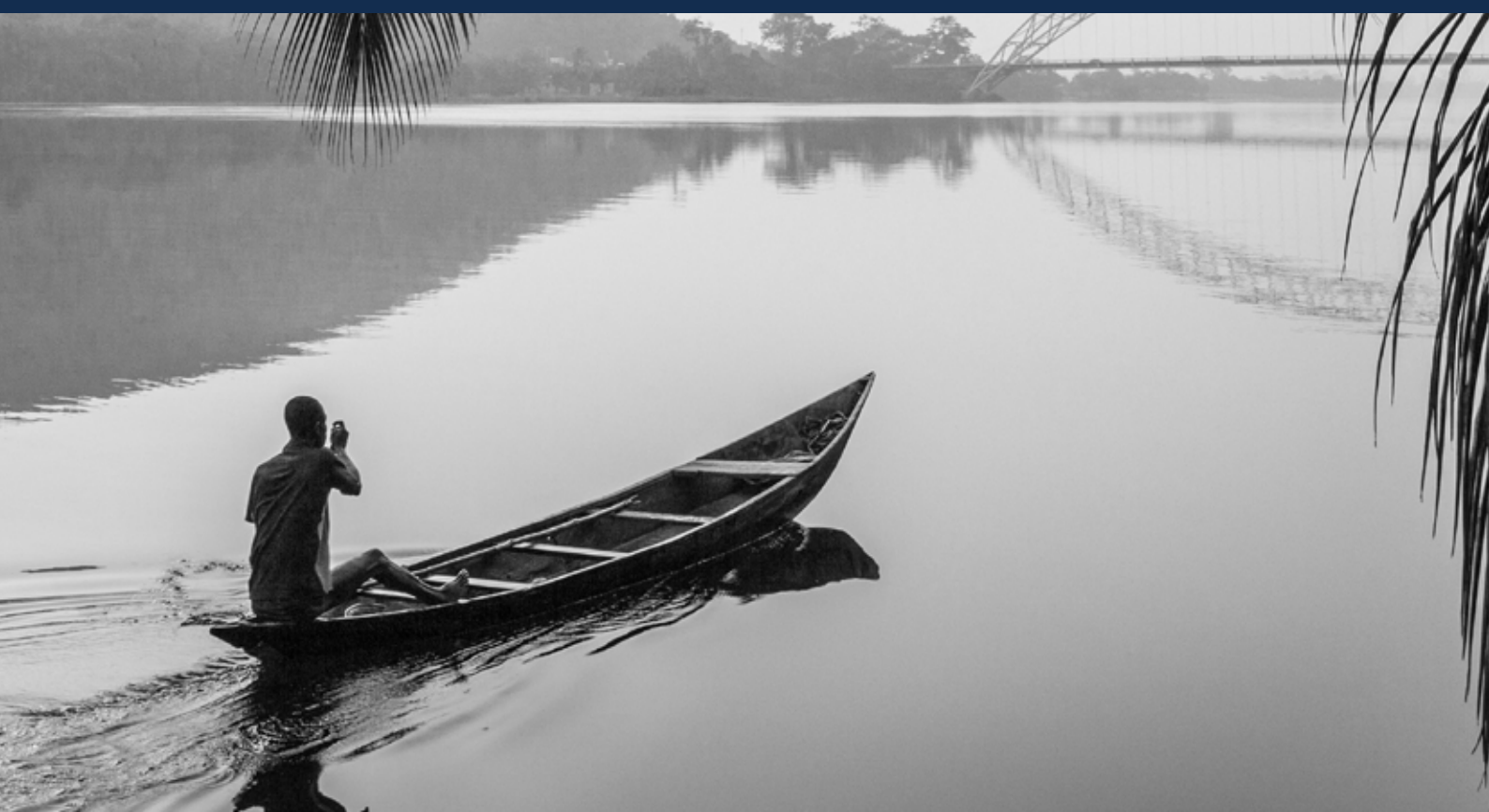
3. National Payment Systems Strategic Plan (2019-2024) in Ghana.

4. Principles for financial market infrastructures – CPSS-IOSCO – April 2012.



CHAPTER 4

POTENTIAL BENEFITS FOR STAKEHOLDERS



4.1. Consumers

A digital currency, issued by the central bank, accepted in the relevant jurisdiction as legal tender and easy to use would provide great benefits to the users. BoG believes the following aspects of the eCedi will promote its usage from a consumer perspective:

- An interoperable means of payment that can be used by everyone and anywhere in the country;
- Access to digital payment services at the last mile (inclusiveness);
- The simplification of access to and usage of a digital form of cash, will engender competition and ultimately make it easy for service providers to deliver more consumer-centric innovative products and services;
- The efficiency gains from the entire financial sector operating with a digital form of cash are expected to translate into a lower cost of service delivery.

4.2. Banks

Although CBDC carries a potential risk of shifts from deposit money to digital currency, the eCedi will be implemented to complement, preserve and strengthen the existing role of commercial banks as financial intermediaries and key service providers to consumers. Currently, commercial banks are threatened by the rise of large global payment service providers like Paypal, which might lead to a loss of direct client interaction. According to the results of the 2021 PwC Ghana Banking Survey¹ 95% of the respondents believe the eCedi will positively impact the banking sector. The architecture model for the eCedi proposed by the BoG was developed with the aim of preserving the existing financial service landscape in view of the critical role of banks. Functions banks are expected to perform in the eCedi ecosystem include:

- CBDC distribution between the central bank and consumers
- Provision of innovative technology services such as:
 - wallets, applications, and other services for consumers to use the eCedi;
 - products and services for merchants to accept and utilize the eCedi;
 - develop and brand new services e. g. programmable money and machine-to-machine based payments.

4.3. FinTech

Mobile money operators and non-bank financial institutions such as microfinance institutions, rural and community banks, savings and loan companies, finance houses, finance and leasing companies, remittance companies, and credit unions play important roles in Ghana's financial sector. The combined use of their services has been higher among the typically excluded population and have contributed the most to financial inclusion. The eCedi ecosystem can further boost financial inclusion by potentially curing existing pain points; specifically, liquidity challenges with deferred net settlement of mobile money interoperability transactions. It is also expected to open new opportunities for FinTechs as follows:

- provide wallets, applications, and other services to consumers for the eCedi;
- build upon the existing infrastructure and without having to rely on the fee-paying infrastructure of big private players;
- develop products and services for merchants to accept and utilize the eCedi;
- provide innovative services such as programmable money and machine-to-machine based payments to further the digitisation of financial services and commerce.

4.4. Merchants

Currently, intermediaries in the payment market charge merchants a percentage of the transaction value. Similarly, merchants pay for cash handling services. These two charges which have been the bane of growing merchant acceptance of digital payments can be reduced with the eCedi on the following grounds:

- eCedi as an additional instrument for retail payments brings competition to the Ghanaian payment ecosystem thus leading to lower merchant fees;
- The simplification of the payment chain has the potential of reducing the cost of payments.

1. Digital Currencies: Is the Ghanaian Banking Sector ready? 2021 PwC Ghana Banking Survey Report.

4.5. Government

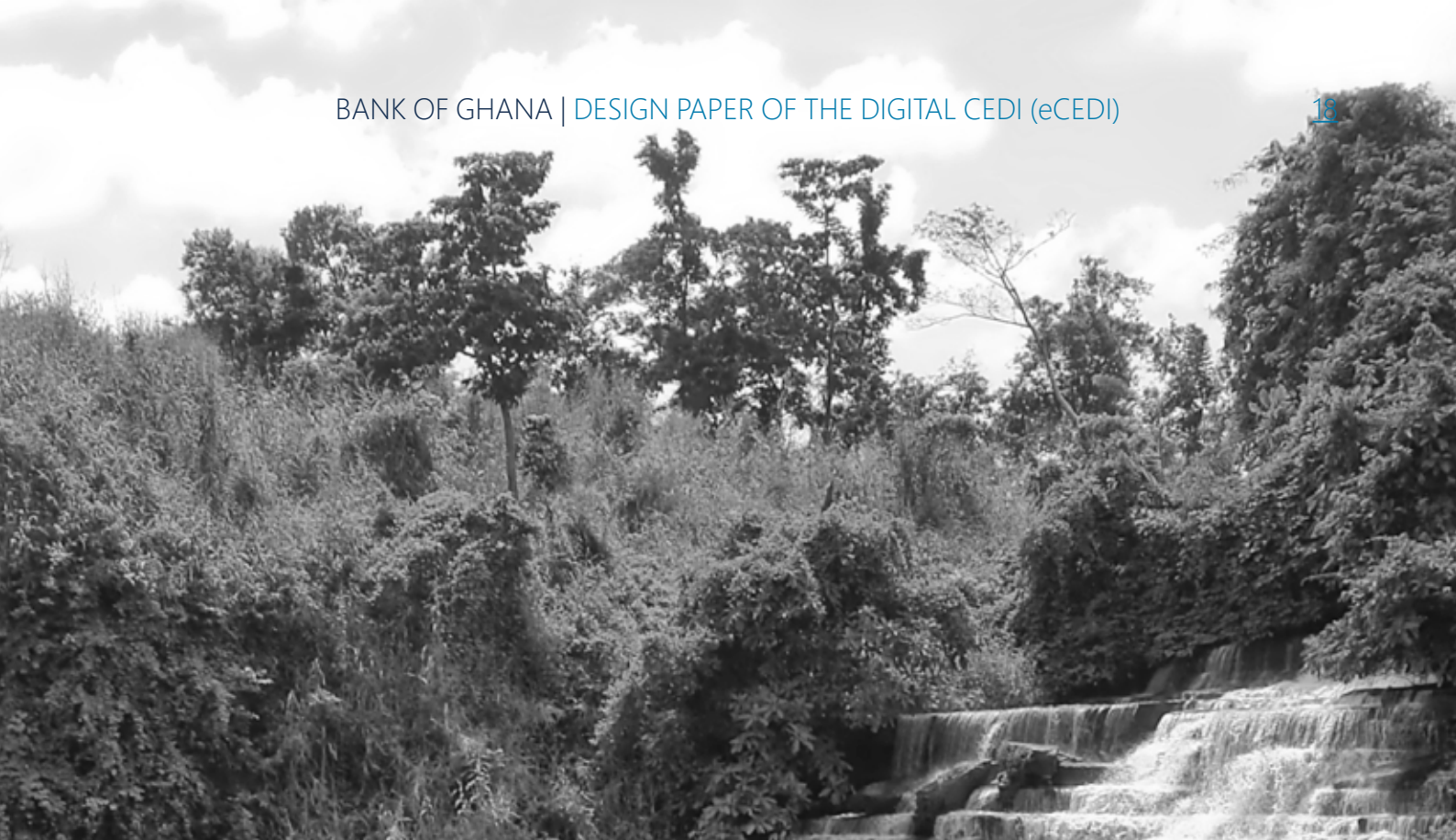
The implementation of the eCedi would benefit the “Digital Ghana Agenda” sufficiently by introducing possibilities for innovative services:

- Automated payments from customers to the Government (customs, fees, etc.);
- Programmable social welfare payments;
- Transparent taxation.

4.6. BoG

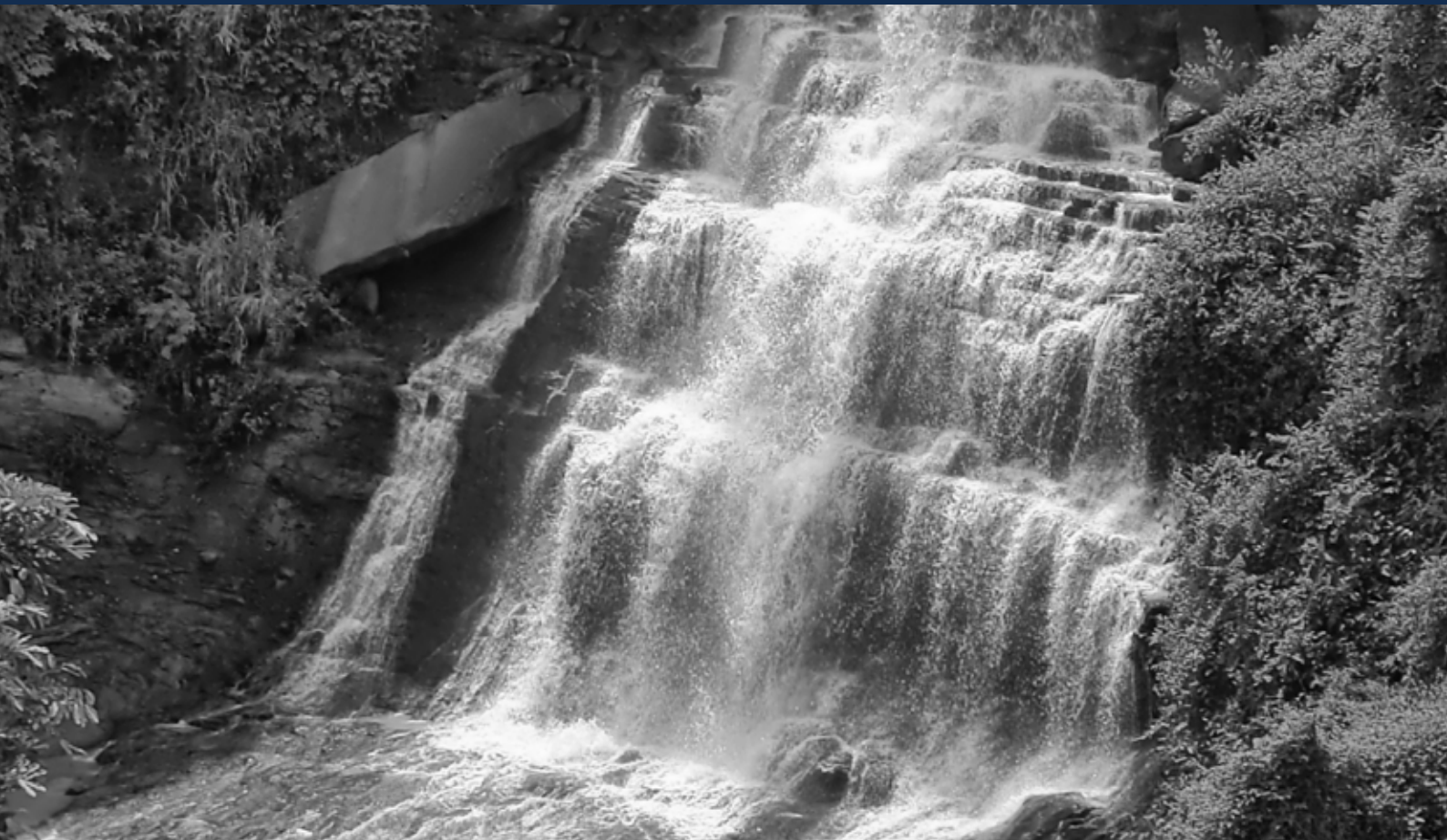
Regulators, globally, are confronted with new challenges owing to technology-driven accelerated changes in the financial service industry. Ghana is grappling with similar challenges and anticipates leveraging the eCedi to:

- Promote financial inclusion;
- Spur competition in the payment system;
- Strengthen the efficient monetary policy transmission mechanism;
- Maintain monetary sovereignty;
- Improve transparency;
- Improve financial stability;
- Bring down the cost of issuing currency.



CHAPTER 5

eCEDI VISION



In line with the strategic initiatives and key motivations of the eCedi implementation, the eCedi would be designed to have the following characteristics:

- be accessible both to the general public and businesses;
- cover low-value payments;
- utilize existing payment infrastructure;
- mitigate potential risks for the banking system disintermediation.

On the basis of these characteristics, the eCedi of choice is a retail token-based CBDC from the point of the CBDC taxonomy (see Chapter 1). In this context, the eCedi is considered a digital version of the Ghana Cedi notes and coins that are issued by BoG. Accordingly the eCedi is a legal tender and convertible to Ghana Cedi in the form of cash or deposit money in the 1:1 ratio.

Contrary to banknotes that are stored in physical wallets, eCedi is stored in a digital wallet since it is represented by a token, which is also a value note (Fig. 1). Payment is done by transferring the value note from one person to another, similar to cash, where payment is done by transferring physical banknotes and/or coins from person A to person B.

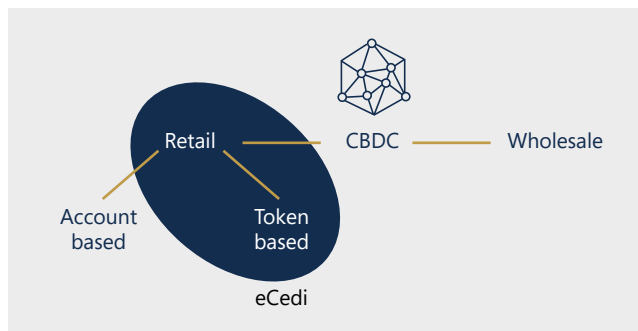


Fig. 1 eCedi as a token-based retail CBDC

User acceptance of the eCedi is contingent on it meeting consumer needs. Consequently, the eCedi design will factor in the needs and expectations of the consumers (on the client's side) and merchants (on the acceptance side).

Recent market surveys indicate that smartphone apps and smartcards are considered to be the optimal solutions from clients' perspectives¹. A smartphone is more preferable as it has functionalities that are capable of facilitating a variety of financial transactions including setting of

transaction amount and checking of wallet balance with no need for an additional device. A smartcard has comparatively less functionality, although it is more inclusive.

Nonetheless, it is crucial to provide accessibility of the eCedi for the financially excluded population.

With these considerations, BoG has designed two types of wallets for the eCedi:

- Hosted wallets i.e. server-based storage systems that are managed by financial institutions;
- Hardware wallets i.e. secure portable storage devices held by individuals.

The most optimal form factor for the eCedi wallet is the app for a smartphone developed by commercial banks, FinTech companies, and other service providers. Other devices can be utilized depending on user preferences and payment scenarios. These could be smartcards (including the biometric ones) or wearables such as smart watches that contain communication capabilities and a secure element. Similarly, debit cards and USSD devices (feature phones) which are associated with the existing payment landscape in Ghana can be adapted for eCedi. Thus users can get the type of wallet that suits their needs from a bank or other financial service provider (Fig. 2).

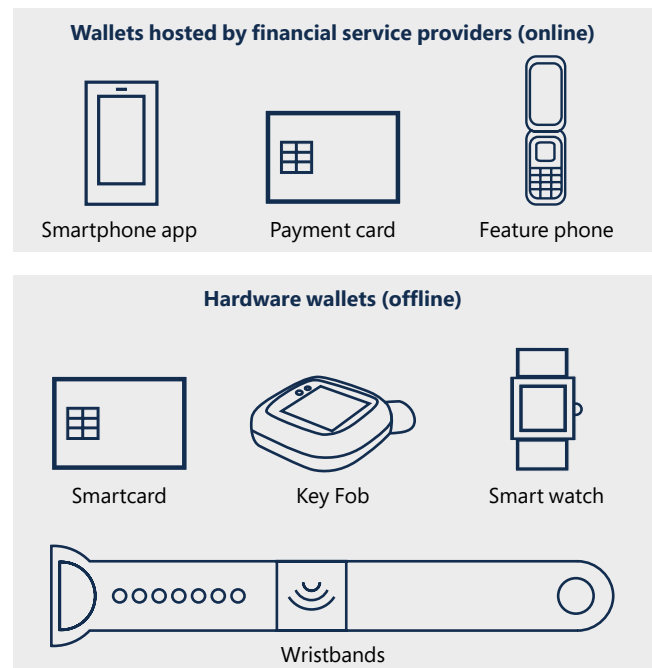


Fig. 2 Variety of user devices for the eCedi

1. Survey results on the possibility of e-hryvnia implementation / 2021. National Bank of Ukraine.



CHAPTER 6

PAYMENT SCENARIOS WITH THE eCEDI



The success of the eCedi is crucially dependent on public acceptance. This means that it must provide real benefits for the users. As a result, it has to be accessible to everybody, usable for payments in all sorts of situations and everywhere: one can pay with the eCedi in a retail shop, but also use it for online shopping or sending money to another individual.

The payment scenarios below describe the range of operations possible with the eCedi in a full cycle from the consumer's and merchant's perspectives: onboarding and receiving a wallet or the necessary software, topping up the wallet with eCedi, storing, payment, and redemption.

Figure 3 describes the journey of an unbanked person without a smartphone or a feature phone visiting a bank (or another authorized institution) and receiving a smart card with an offline eCedi wallet. Such a wallet can be utilized without access to the internet. The wallet can be topped up with the eCedi directly at the bank or by means of a P2P transfer. Thereafter, this consumer is able to purchase goods and services (in person) or instantly transfer the eCedi to other consumers (face to face). Redemption of the eCedi to Cedi is available at any time.

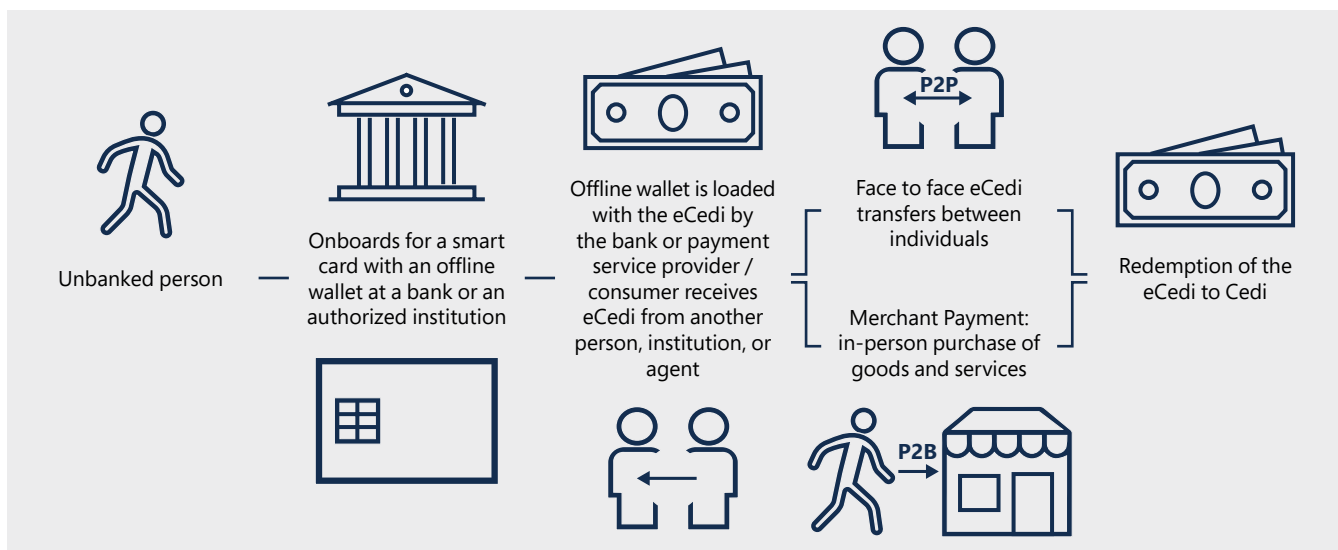


Fig. 3 Consumer journey: offline wallet on a smart card

In the next two scenarios, a consumer visits a financial institution to onboard for the online wallet (hosted eCedi wallet). Unlike the previous situation, hosted wallets require access to the internet. Alongside opening an online wallet,

the consumer receives a payment card (Fig. 4) to access his wallet online. Otherwise, the consumer is able to initiate transactions with his online wallet by USSD commands using a feature phone (Fig. 5).

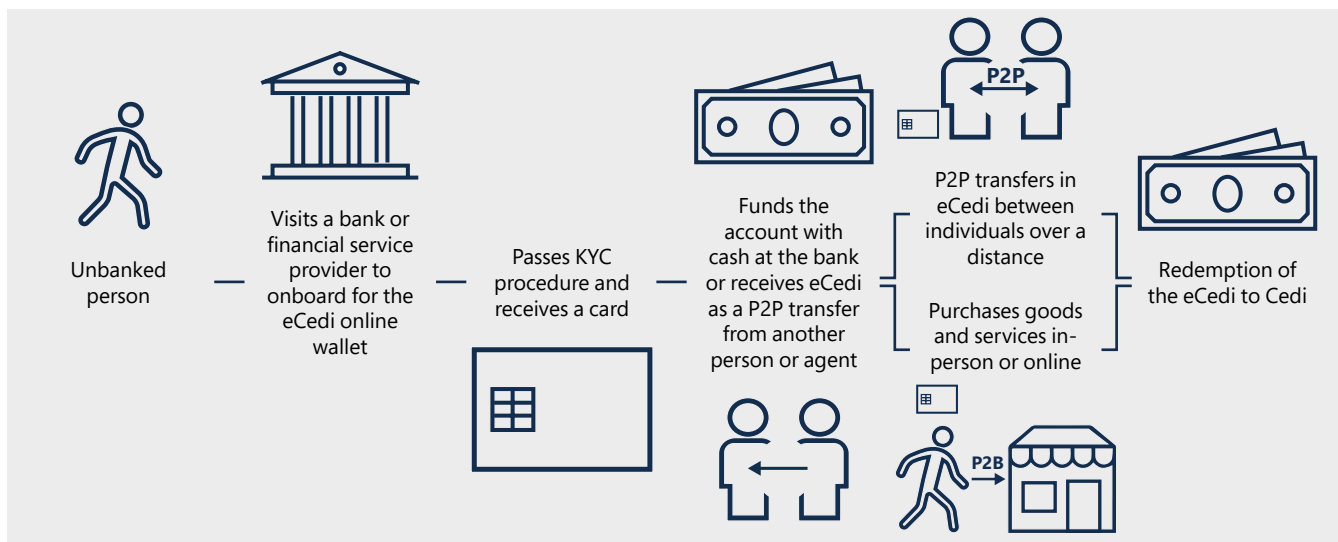


Fig. 4 Consumer journey: online wallet hosted by a financial service provider

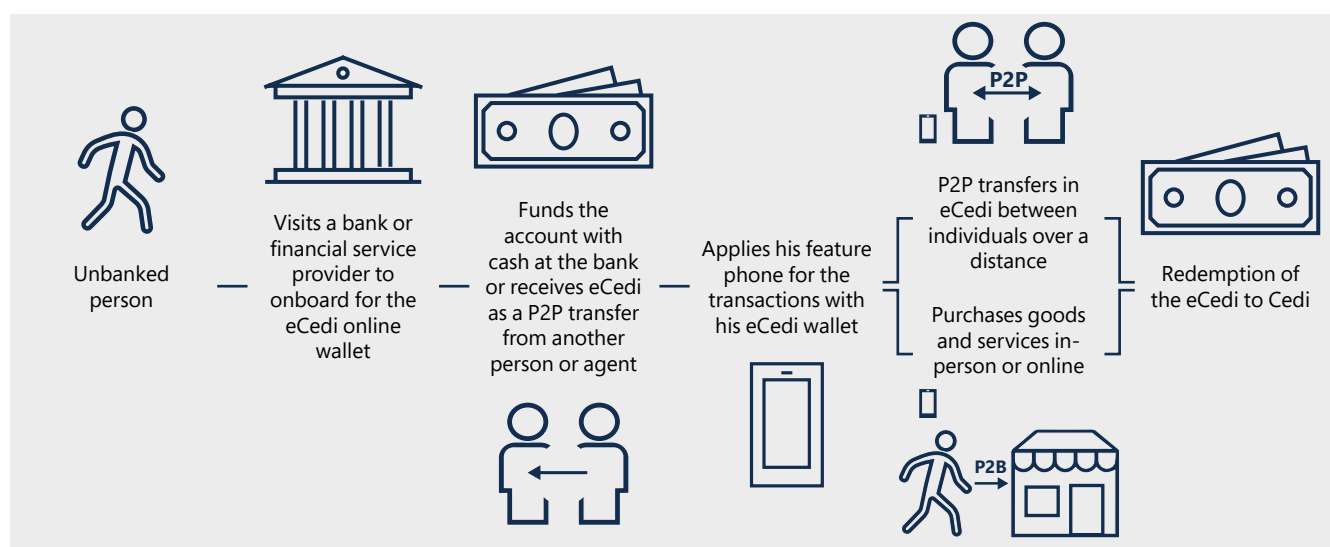


Fig. 5 Consumer journey: online wallet hosted by a financial service provider

A new or existing client of the financial institution can utilize his smartphone for online access to his eCedi wallet (Fig. 6). The procedure includes

onboarding by further downloading the eCedi app (for new clients) or updating the existing app with the eCedi functionality (for existing clients).

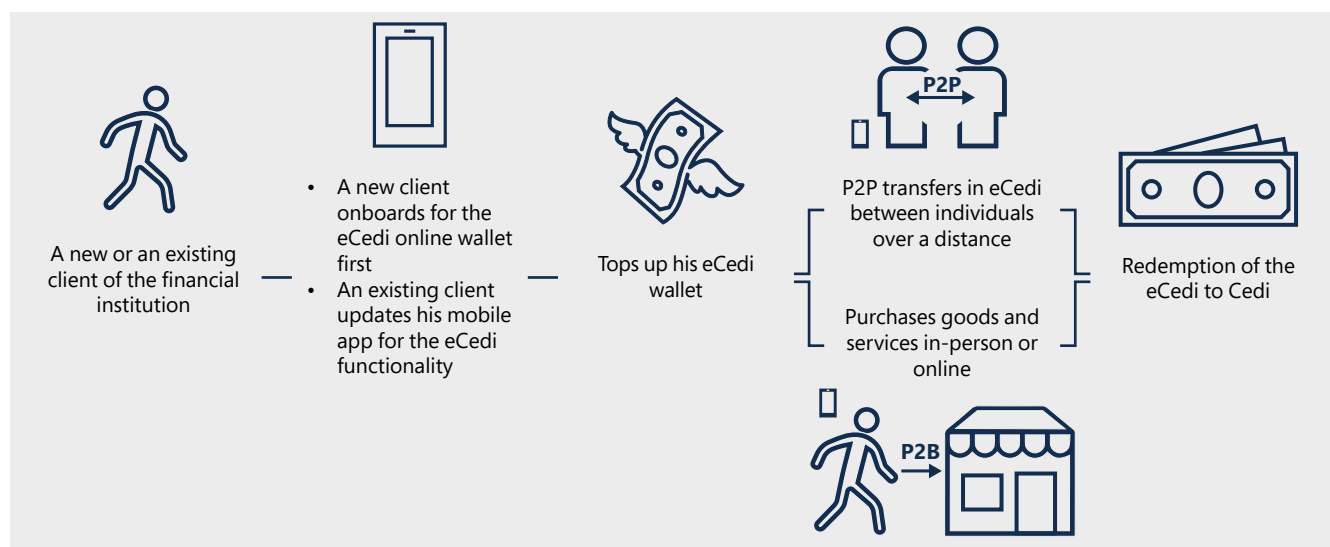


Fig. 6 Consumer journey: mobile app

Figure 7 illustrates the process of the eCedi acceptance by merchants. A merchant can initiate the onboarding procedure remotely by downloading the eCedi app and filling in the

registration form. A bank or service provider at the other end checks the registration form and opens the merchant a wallet. A customer purchases goods and services using his mobile app.

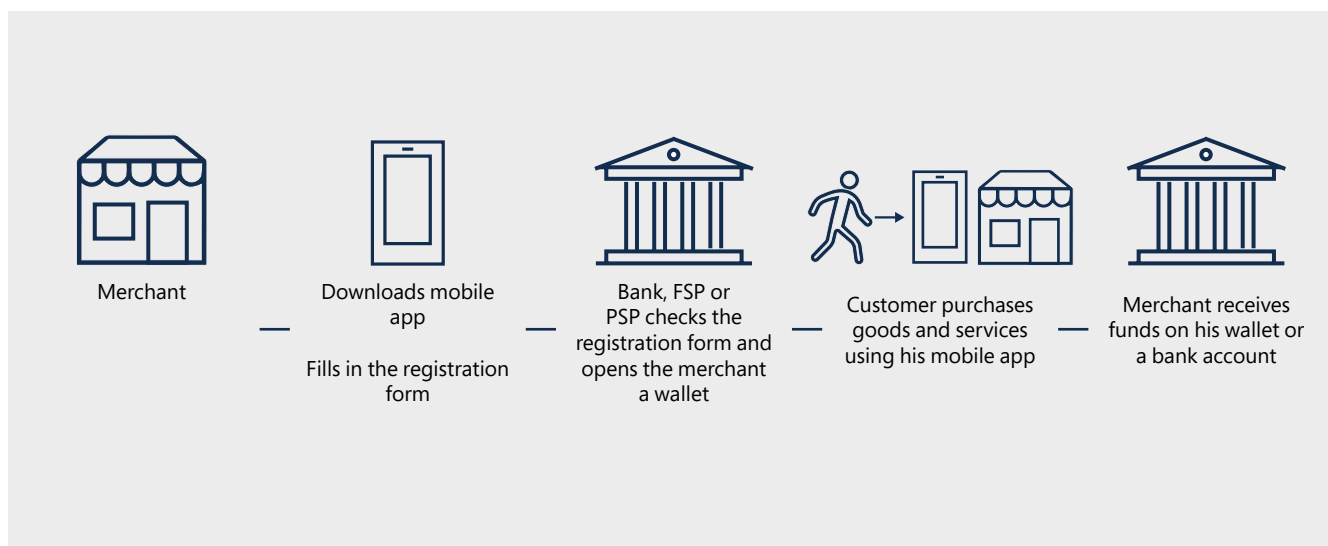


Fig. 7 Merchant journey: mobile app

An alternative scenario of the eCedi acceptance is described in Fig. 8 with a bank updating the merchant's POS terminal or providing the merchant a QR-code with the requisites of the merchant's wallet. Bank of Ghana anticipates the existing

universal QR-codes to be integrated into the eCedi ecosystem and ensures its interoperability with other digital financial systems/products within the national payment ecosystem.

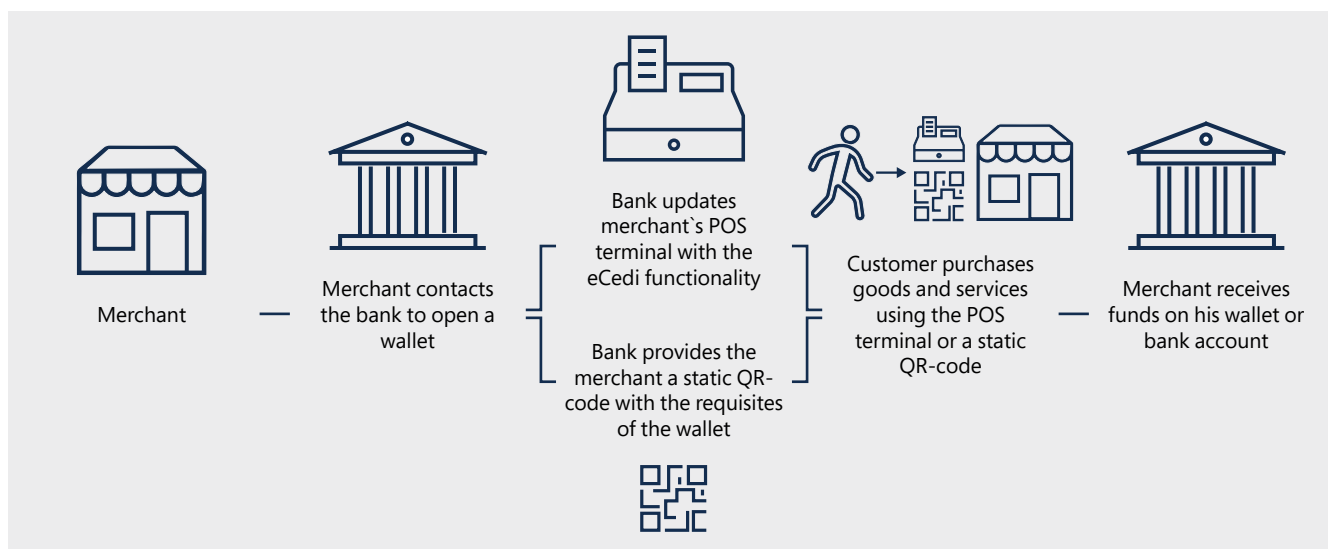
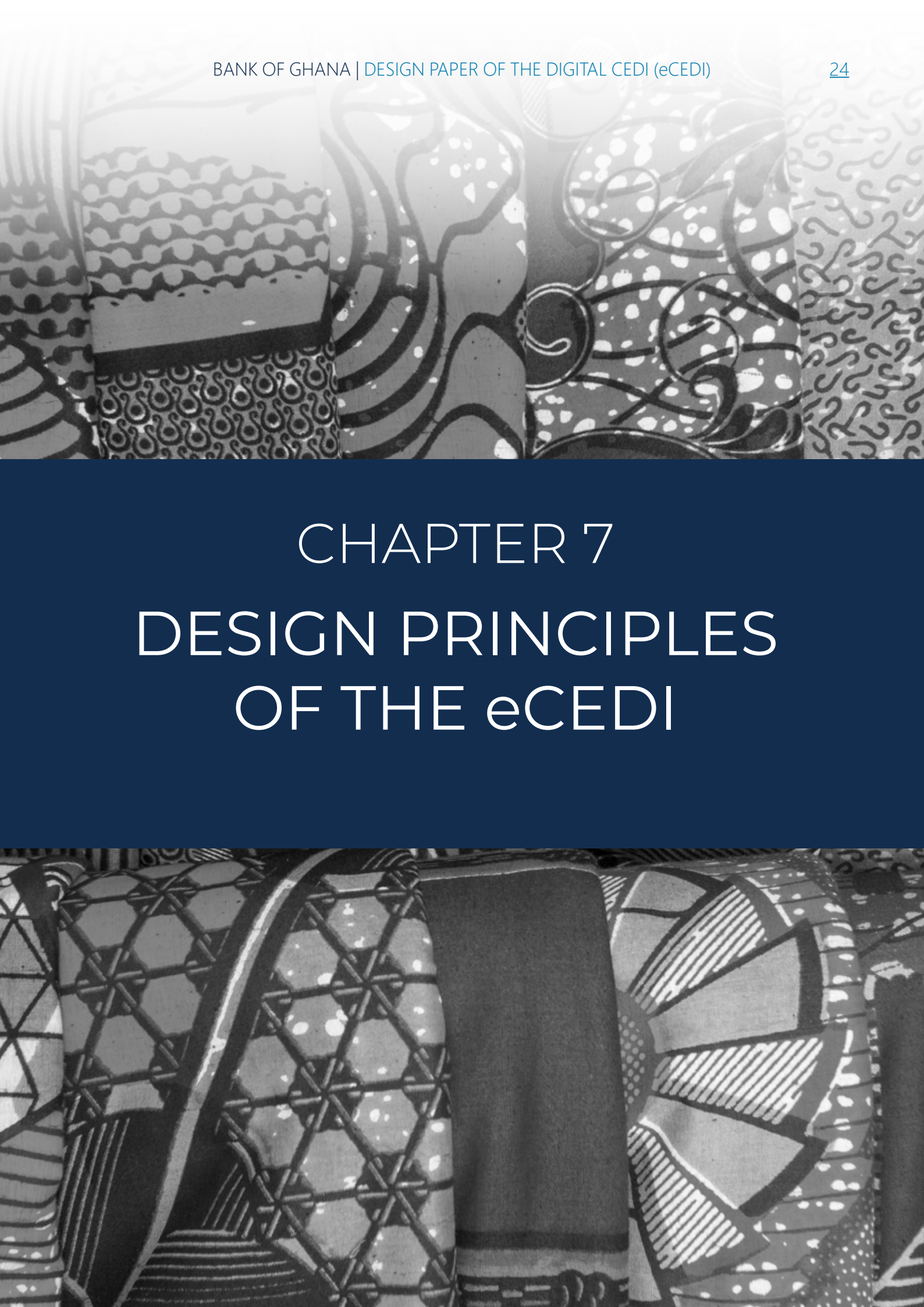


Fig. 8 Merchant journey: POS update / QR-code



CHAPTER 7

DESIGN PRINCIPLES OF THE eCEDI

The following four (4) principles underpin the design of the eCedi: Governance, Accessibility, Interoperability and Infrastructure (Fig. 9).

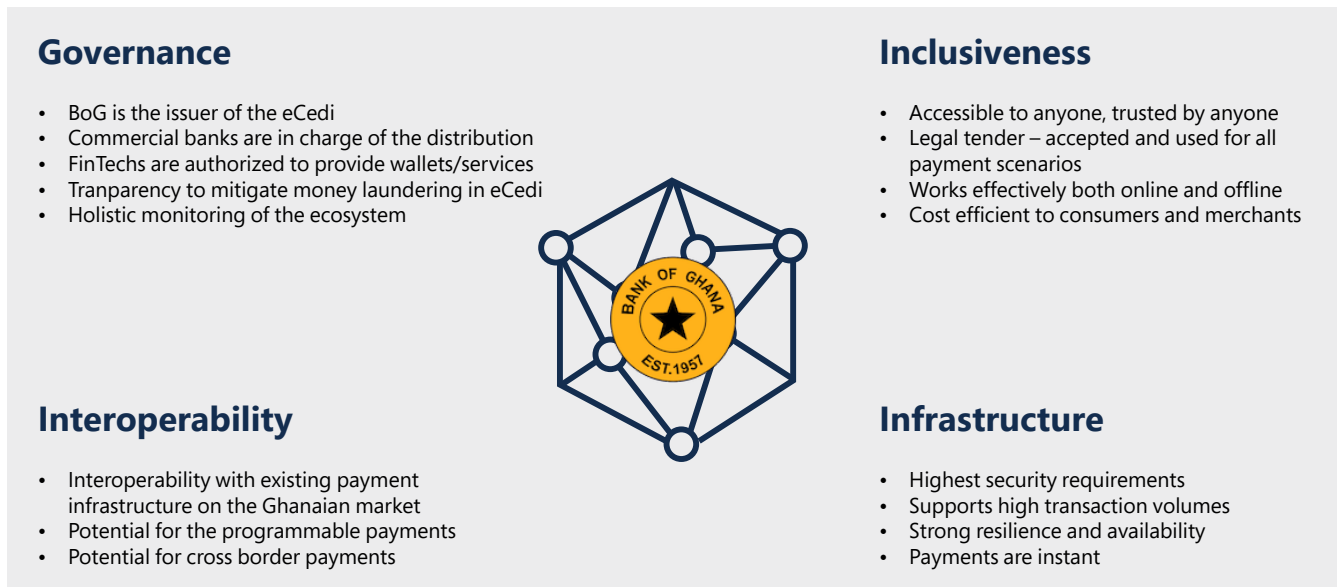


Fig. 9 Design principles of the eCedi

The core principles of the design of the eCedi are built around the discussions and the analysis of the ongoing projects as well as the existing conditions of the financial system in Ghana.

Foremost, the eCedi has to be under full control of BoG, being the only entity to create and destroy digital cash. Simultaneously, the ecosystem of eCedi should include the participation of banks, SDIs and PSPs to facilitate interaction between the central bank and end consumers. This will be an approach to encourage adoption through user-focused value-added services, accessibility and innovation on the back of the eCedi.

The eCedi has to provide transparency of consumers and transactions in order to mitigate money laundering in the eCedi ecosystem.

The eCedi might become a target for cyber-attacks of all sorts, similar to counterfeiting banknotes by criminals. It therefore, has to meet very high security standards by design. One of the eCedi's technical solutions addressing cyber-attack prevention is the separation of the issuance and distribution modules of the core infrastructure. The eCedi will also be scalable to handle large volumes of transactions and provide 24/7 availability and support instant payments. As eCedi is considered to be a legal tender it has to be accessible and trusted by everyone, hence merchants and

enterprises within a country have to accept the eCedi for payments. Thus the acceptance of the eCedi should be as easy as possible, not requiring expensive devices or network connection. For this reason, the possibility of offline transactions is a relevant requirement.

It is important that the eCedi is implemented to complement and enhance the existing payment systems. The eCedi therefore has to be integrated into existing infrastructure and payment instruments. The various existing electronic and mobile payment solutions will therefore have to be interoperable with the eCedi to enable their utilization of the eCedi. This also applies to POS terminals, which preferably should be upgraded and not replaced, to accept eCedi transactions.

Last but not least, the eCedi should support programmable use cases to enable innovation and new business models while maintaining the trust of the people.

From the foregoing, it is obvious that the eCedi must be a close resemblance of cash in addition to having the capability for online transactions among other similar features.

7.1. Governance

The fundamental design choice for a retail CBDC is its architecture and must reflect the anticipated operational roles of the central bank and those of other stakeholders such as banks, payment service providers, specialised deposit-taking institutions (SDIs), merchants and consumers. BoG has considered a number of different models of CBDC architecture based on the approach of the BIS, including one-tier direct CBDC, two-tier hybrid / intermediated CBDC, and a bit aside from them indirect CBDC¹ (latter is marked out as synthetic (sCBDC)²).

7.1.1. Two-tier architecture

The optimal choice for eCedi would be a two-tier architecture model, where a central bank is the only issuer of eCedi, owner and operator of the core eCedi infrastructure. The eCedi is a direct claim on the Bank of Ghana.

Banks are in charge of the distribution of the eCedi and will be able to offer value-added services. Banks, mobile money operators, special deposit-taking institutions, and other non-bank financial institutions provide services, such as custody, mobile applications, and user-friendly presentation of information on customer transactions, etc. They already have the experience of processing Know-Your-Customer (KYC) checks and providing customer support.

Merchants accept payments in eCedi from hardware and hosted wallets in the same way they accept card and mobile payments today. Once a payment is received, a merchant can store the eCedi in a wallet, or convert it into deposit money right away to store it in a bank account. The eCedi as legal tender should be accepted in all sorts of payment scenarios (Fig. 10).

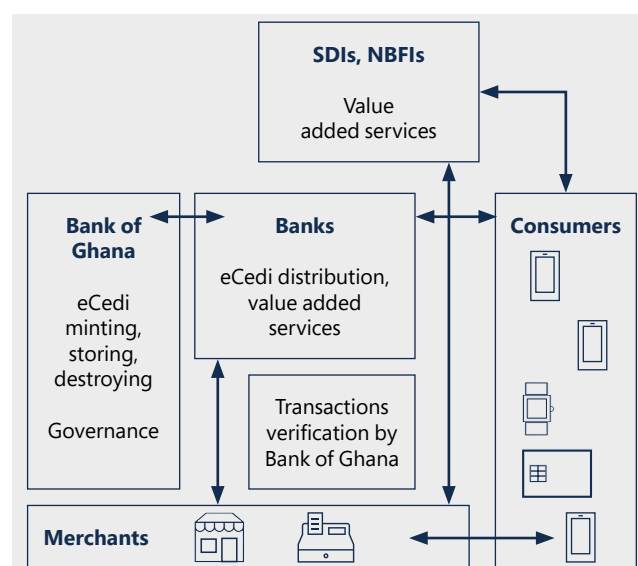


Fig. 10. The architecture of the eCedi

7.1.2. eCedi compliance with AML/CFT

As previously mentioned, a CBDC like cash, is characterized by dual nature; being both a central bank money and a payment instrument. However, as a token payment, it has to be stored in a digital wallet like other digital payment instruments and should therefore comply with the AML/CFT and PF regulations and requirements for onboarding of customers for financial transactions.

The Anti-Money Laundering Act, 2020 (Act 1044) provides a legal framework to implement an optimal level of AML/CFT and PF compliance by striking a balance between privacy and transparency requirements and define same in the eCedi design.

Banks, SDIs and payment service providers have a responsibility to make eCedi available to end-users and largely will be responsible for AML/CFT and PF compliance in the eCedi ecosystem. With nationwide high penetration of national biometric identification card, the foundation is laid for a universal access to eCedi which is likely to expand financial inclusion.

Compliance with the AML/CFT and PF norms is aimed at preventing the use of the eCedi to carry out illicit financial activities so as to maintain its integrity. Notwithstanding, the eCedi is designed with full respect for user privacy and data protection in line with the Data Protection Act, 2012 (Act 843).

1. Central bank digital currency: the quest for minimally invasive technology. BIS Working Papers N° 48.

2. The Rise of Digital Money – International Monetary Fund.

The KYC regime for eCedi will be risk-based and therefore provide for tiered KYC access criteria to meet the needs of diverse user groups. In this regard, eCedi wallets with different requirements for the identification checks depending on the thresholds and daily/aggregate transaction limits, and maximum account balances will be available.

Such an approach ensures access to the eCedi for all Ghanaian citizens regardless of social status. A specific focus on the financially excluded (low income) population with the possibility of minimum KYC is therefore essential.

7.1.3. Monitoring and reporting

In line with the two-tier architecture of the eCedi, banks, SDIs and payment service providers will be responsible for monitoring of eCedi payment transactions and reporting of activities, including fraud and suspicious transactions to the Financial Intelligence Centre and BoG. BoG, in addition to monitoring of transactions at the interbank level, will issue policies on wallets and transaction limits among other issues, for compliance by participants in the eCedi ecosystem.

The monitoring and reporting requirements will be risk-based and will seek to promote financial stability without undermining financial inclusion and consumer privacy.

7.2. Accessibility

For the eCedi to be accepted as an alternative to cash and also co-exist with other forms of digital payment instruments it should provide an appealing UX and must be inclusive. A well designed eCedi may help to boost financial inclusion in an increasingly digital world by encouraging financially excluded people to use the services of regulated financial service providers.

From the consumer's perspective, eCedi usage has to be as **easy and intuitive** as possible. Consumers should be able to make a payment in the minimum number of steps, with a minimum required level of technical literacy.

BoG is aware of the existing consumer habits. People in Ghana are used to paying with mobile money and cards; such that switching to the eCedi, and particularly its **onboarding process** will possibly be **seamless** and easy.

The eCedi has to be **accessible** to everyone and **inclusive**: with minimum barriers by technical literacy and disabilities. It must avoid reliance on access to mobile data networks in Ghanaian rural areas, which means the eCedi should work effectively both online and offline.

Speed of payments is very important from a consumer's perspective. The transfer of funds from a payer to a payee should possibly be **instant**. Both payer and payee should receive a confirmation of a successful transaction.

The **cost of payments** with the eCedi has to be **clear** to the participants and **competitive** relatively to the existing market alternatives.

7.2.1. Accessible to anyone, trusted by everyone

The eCedi must be accessible to everyone, including persons without bank accounts, persons who are less attractive to commercial payment providers, or who cannot afford the latest mobile devices. It must be easy to use different instruments to support persons that might have difficulties following complex onboarding processes or utilizing the latest technical solution.

Another essential requirement for the eCedi's wide accessibility is trust. As a form of central bank money, it should have the same level of trust like cash, if not better. In this regard, eCedi's technical instruments and solutions will be either standardized/certified by BoG or provided as SDK solutions.

7.2.2. Offline functionality

The eCedi's conceptual similarity with cash makes offline (no internet) transactions highly relevant. Another argument in favour of offline capabilities is the financial inclusion goal. For Ghana, it definitely makes much sense to provide retail CBDC capable of functioning in rural areas without internet access to ensure countrywide access and accelerate financial inclusion. From a perspective of technology, it is feasible to implement an offline eCedi with a smartcard (potentially – with a smartphone) using standard interfaces like NFC or Bluetooth. Transactions for offline payments are therefore instantly settled without accessing a backend system³.

3. Eurosystem experimentation regarding a digital euro. Research workstream on hardware bearer instrument.

7.2.3. Fees model

The eCedi is a digital equivalent of the physical Cedi by design. This follows that the eCedi is an instrument that does not bear interest (i. e. has zero interest rate), just as cash. Another cash-mimic characteristic of the eCedi is its convertibility into the deposit money in the 1:1 ratio.

Like cash today, the eCedi transactions will be free of charge to the consumers. Nevertheless, the model recognizes and takes into account the value added service provided by banks, SDIs and payment service providers to facilitate access to and use of eCedi and compensate accordingly. In accordance with the liberalization ethos of the Ghanaian financial service industry, BoG does not intend to interfere with the business models of banks, FinTech companies, and merchants regarding fees for eCedi related services. This approach is expected to promote competition in the payment market and facilitate the provision of innovative value-added services on the back of the eCedi ecosystem. However, BoG will ensure that the consumers are given fair treatment in every aspect of eCedi transactions by ensuring that banks, SDIs, payment service providers and merchants comply with relevant consumer protection regulations and norms.

7.3. Interoperability

Significant investments and time would be required to create the infrastructure from scratch to introduce a new instrument like the eCedi. This extremely important task demands careful analysis, particularly when interoperability is required with existing infrastructure. Ghana, with its already established payment infrastructure, will have to design the eCedi, with interoperability with existing infrastructures in mind while enabling innovative functionalities on the eCedi platform.

7.3.1. eCedi interconnecting with existing infrastructures

One of the pillars of the eCedi interoperability is its interconnection with the GhIPSS [Fig. 11]. GhIPSS' payment infrastructure is currently used by all banks in Ghana including the ARB Apex Bank and its affiliates, savings and loans companies, and third party payment providers.

In line with its mandate, GhIPSS has implemented and manages the following:

- National Switch & Biometric Smart Card Payment System – e-zwich
- Cheque Codeline Clearing System
- Ghana Automated Clearing House systems – Direct Credit & Direct Debit
- National Switching and Processing System – Gh-link.

Consequently, eCedi's integration with GhIPSS provides great opportunities. On the one hand, it allows the eCedi to utilize ready-to-wear infrastructure. On the other hand, it addresses the existing pain points of the Ghanaian payment market.

Mobile money infrastructure is well developed in Ghana with about 38.5 million registered mobile money accounts and approximately 424 thousand registered agents. The mobile money interoperability platform has further stimulated the ecosystem by enabling cross platform funds transfers. However, the settlement of mobile money interoperability transactions among mobile money operators in Ghana needs improvement. The deferred net settlement approach to settling transactions on the MMI platform has proven inefficient for the liquidity needs of the interoperability platform which settles on instant basis. The interoperability between the eCedi and GhIPSS would enable settlements between different mobile money solutions in digital currency, improve the speed and reduce frictions in settlements.

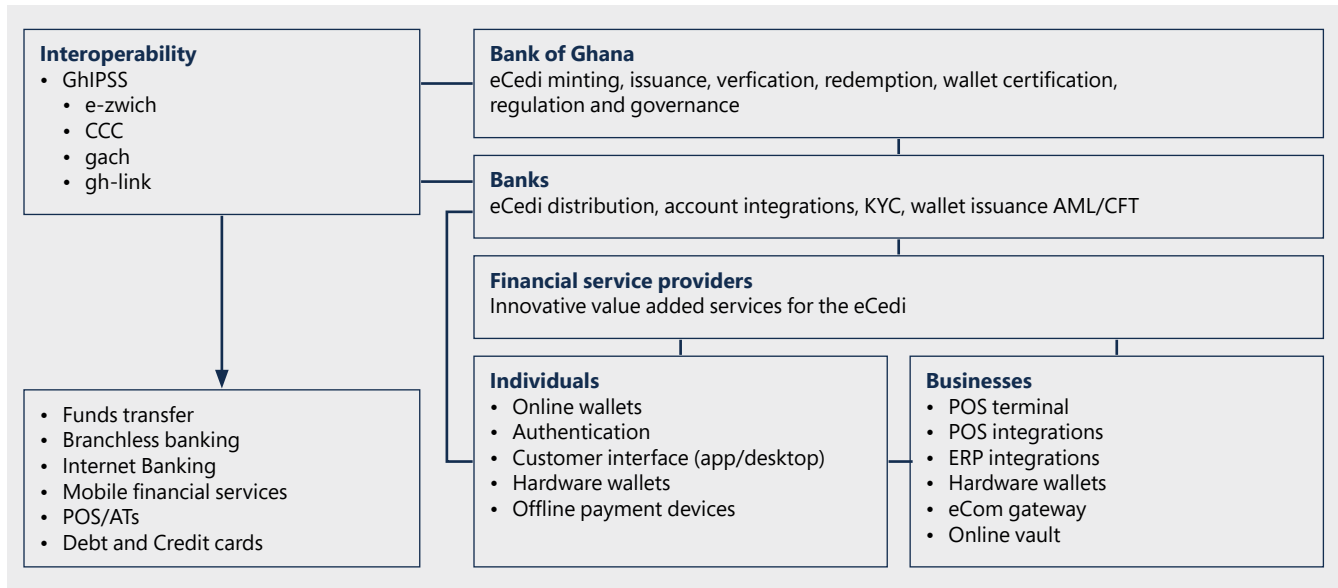


Fig. 11 Interoperability of the eCedi ecosystem with external systems

7.3.2. Cross border perspectives

In the era of the globalisation, it is important that domestic CBDCs are designed with the prospects of adaptation for interoperability with CBDCs of other jurisdictions. Efforts to accelerate integration of the economies of African economies, particularly under the African Continental Free Trade Area (AfCFTA) makes this a key consideration in the eCedi design. The eCedi takes into consideration CBDC standards making it possible for Ghana to participate in international projects on cross border CBDCs.

According to BIS, this may be achieved via [1] common technical standards, [2] linking multiple CBDCs through a common interface, [3] integrating multiple CBDCs in a single multi-CBDC system⁴. Thus, eCedi is designed with the global CBDC standard in mind (once introduced). Participation in international projects around cross border CBDCs will also be considered.

7.3.3. Programmability of payments

Digitalization of the economy triggers digitalization of entire industries; and the sphere of payments is on the frontline of this transformation. Implementation of programmability within eCedi wallets opens the door to a great variety of innovative business models and brand-new services.

One potential direction is programmable “government-to-person” and “person-to-government” payments, among them welfare payments in eCedi (including “helicopter money”). The second direction is “machine-to-machine” automated payments in the Internet of Things.

From the eCedi’s applied design perspective, programmability should be applied as programmable payments on the level of eCedi smart wallets. This approach is more beneficial in terms of policy considerations compared to the programmability of the currency itself.

7.4. Infrastructure

One of the primary BoG policy objectives requires that CBDC should be reliable and resilient⁵. This provides that eCedi infrastructure needs to be secure, resilient, available, and scalable.

7.4.1. Highest IT security standards

The eCedi fulfils the highest standards of cyber security against fraud and cyber attacks. It is designed with no single point of failure. There are clear policies developed around who is responsible for redress in the case of fraudulent payments. One of the eCedi’s technical solutions addressing cyber-attack prevention is the separation of the issuance and distribution modules of the core infrastructure.

4. Multi-CBDC arrangements and the future of crossborder payments. BIS Papers No 115.

5. Discussion Paper: Central Bank Digital Currency. Opportunities, challenges and design. Bank of England.

Figure 12 demonstrates selected security aspects which are further explained below.

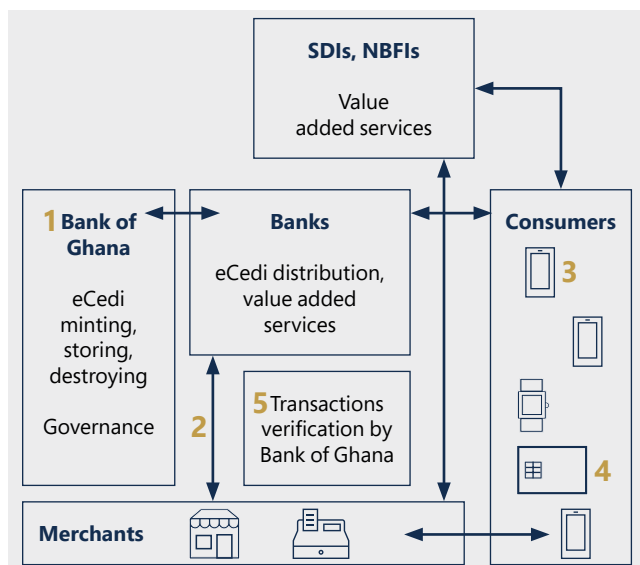


Fig. 12 Infrastructure security aspects

1. The most sensitive part of the entire system is the creation and destruction of the eCedi. This infrastructure is under full control of BoG. Separating this into a highly secure air gapped offline environment at the central bank with strong organisational controls removes a lot of potential risks from the entire eCedi ecosystem.
2. Highly secure communication channels that are utilised in the most sensitive environments with many thousands of installations.
3. Providers of the eCedi apps on smartphones like commercial banks, or financial service providers will be provided with the frameworks or software development kits (SDKs) to secure their apps against tampering and manipulation.
4. Smartcard security is based on different pillars:
 - The security of the use cases of a smartcard is due to the entanglement of software and hardware driven inside a secure environment;
 - Smartcards allow the storage and processing of data in a secure way and can be used as an end-point in an end-to-end security system;
 - Smartcards can handle proper symmetric and asymmetric cryptography;
 - Hard- and software uses a set of countermeasures to be resistant against security attacks;
 - The resistance against possible attack scenarios is investigated within security certification criteria.

This also refers to POS terminals which typically provide secure elements or other hardware security out of the box.

5. The strength of the system's core protocol relies on the use of cryptographic algorithms and well-established cryptographic components. The protocol has gone through phases of intensive investigations to demonstrate its strength.

7.4.2. Resilience, availability, and scalability

The eCedi is designed to be able to recover from operational disruption, such as failures in its hardware or software. The design also seeks to minimize any credit and liquidity risk in the wider eCedi ecosystem.

Payments with the eCedi will be provided 24/7 with no scheduled downtime.

The technology powering eCedi payments will be able to handle increased volumes if the demand for eCedi payments increases significantly. The eCedi will be functionally compatible with the existing payment instruments and will support instant payments. In effect, the process of a payer initiating a payment to a payee should be completed as quickly as possible, with certainty of completion. Transactions for offline payments are settled instantly without accessing a backend system.

Questions for the public discussion

BoG appreciates feedback from the Ghanaian citizens, banks, FinTech companies, and academics sharing opinions on the possible design principles of the eCedi. You are welcome to send your comments and ideas to the eCedi team ecedi@bog.gov.gh and submit the questions below in an [Electronic Questionnaire](#).



Comparative Payment System Statistics, 2017-2020¹

Payment system		2017	2018	2019	2020
Ghana Interbank Settlement (GIS)	Volume	934,234	1,221,650	1,376,094	1,442,182
	Value (GH¢ mln)	2,083,846.27	1,963,465.27	2,106,117.85	2,433,537.47
Cheque Code Clearing	Volume	7,334,460	7,255,220	6,831,417	5,903,331
	Value (GH¢ mln)	179,555.47	203,465.32	173,623.25	177,625
Gh-LinkTM (National Switch)	Volume	2,340,409	1,830,182	972,746	806,486
	Value (GH¢ mln)	603.43	543.74	329.23	329.7
E-Zwich	Volume	8,367,017	7,759,354	10,796,560	10,477,601
	Value (GH¢ mln)	3,431.49	5,651.14	6,308.37	9,033.25
GhIPSS Instant Pay (GIP)	Volume	41,795	143,879	1,905,267	6,804,754
	Value (GH¢ mln)	83.23	534.04	3,456.89	9,146.76
Mobile Money	Volume	981,564,563	1,454,470,801	2,009,989,300	2,859,624,191
	Value (GH¢ mln)	155,844.84	223,207.23	309,352.25	564,155.90
ATMs	Volume	57,317,491	57,763,558	55,709,252	56,603,211
	Value (GH¢ mln)	18,542.95	21,796.49	26,392.44	32,148.03

1. Bank of Ghana. Annual Report and Financial Statements 2020.

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