Potential of Blockchain for Financial Inclusion in Nigeria

2021 Report

EFInA

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Executive Summary

01

EFInA

Blockchain is a digital ledger of transactions that is replicated across the network and is securely accessible by all participants on the network

What is Blockchain

Blockchain is a type of database that stores information or data in a structured and decentralized way. It is an electronic ledger system that creates a cryptographically secure and immutable record of any transaction of value.

Key Features of Blockchain

Distributed ledger
Every participant in the network has simultaneous access to a view of the information

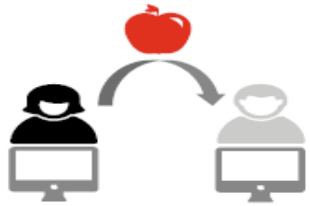
Consensus
Peer-to-peer verification replaces the need for a third party to authorise transactions

Cryptography
Cryptographic functions ensure integrity and security of the information on the blockchain

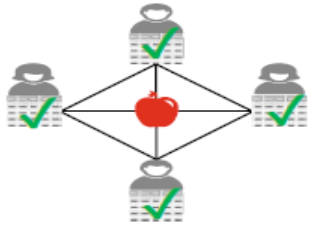
Smart contracts
Additional business logic implies that agreements on the expected behaviour of financial instruments can be embedded

How Transactions on Blockchain Occur

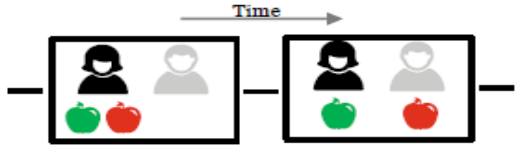
1 Transaction requested



2 All parties on network must approve of transaction



3 New block gets added to the previous chain



4 Transaction occurs

Key Benefits of Blockchain

- **Increased transparency and traceability**
- **Data is immutable and reliable, and information is transparent**
- **Enables decentralised systems for peer-to-peer activities**
- **Reduces transaction costs due to elimination of intermediaries**
- **Promotes dynamic pricing**
- **Enables effective monitoring and compliance of transactions**

Source: PwC Analysis

Blockchain has the potential to boost global GDP by $1.76 trillion by 2030

USD 1.76 trillion

Blockchain has the potential to boost global GDP by USD 1.76 trillion by 2030. This is according to a PwC research report that assessed how blockchain is currently being used across industries. This report also identified 5 areas with the most potential; these are Source Verification (USD 962bn), Payments and Financial Instruments (USD 433bn), Identity (USD 224bn), Contracts and Dispute Resolution (USD 73bn) and Customer Engagements (USD 54bn).[2]

USD 270 billion

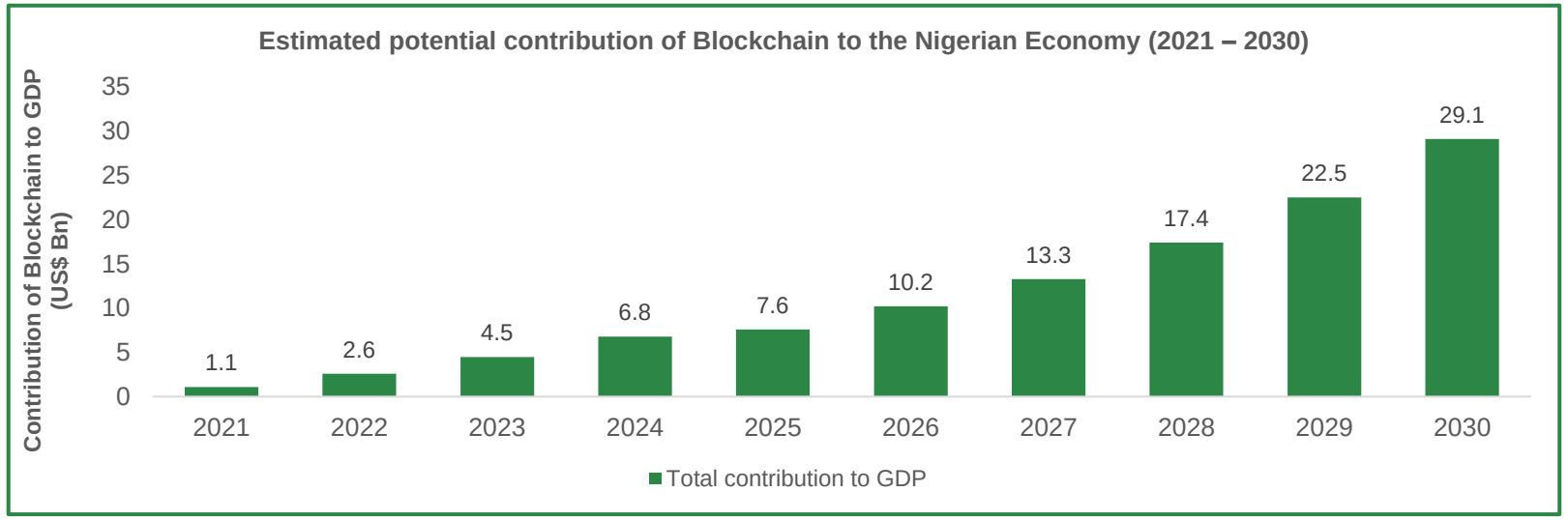
There is an opportunity for the global financial services sector to gain USD 380bn in revenue annually on the back of including the unbanked and underserved.[3] 71% (USD 270bn) of this amount is attributed to closing the MSME credit gap. Blockchain has the potential to drive access to finance for MSMEs, to achieve this target and potentially generate revenue for the financial services sector.[3]

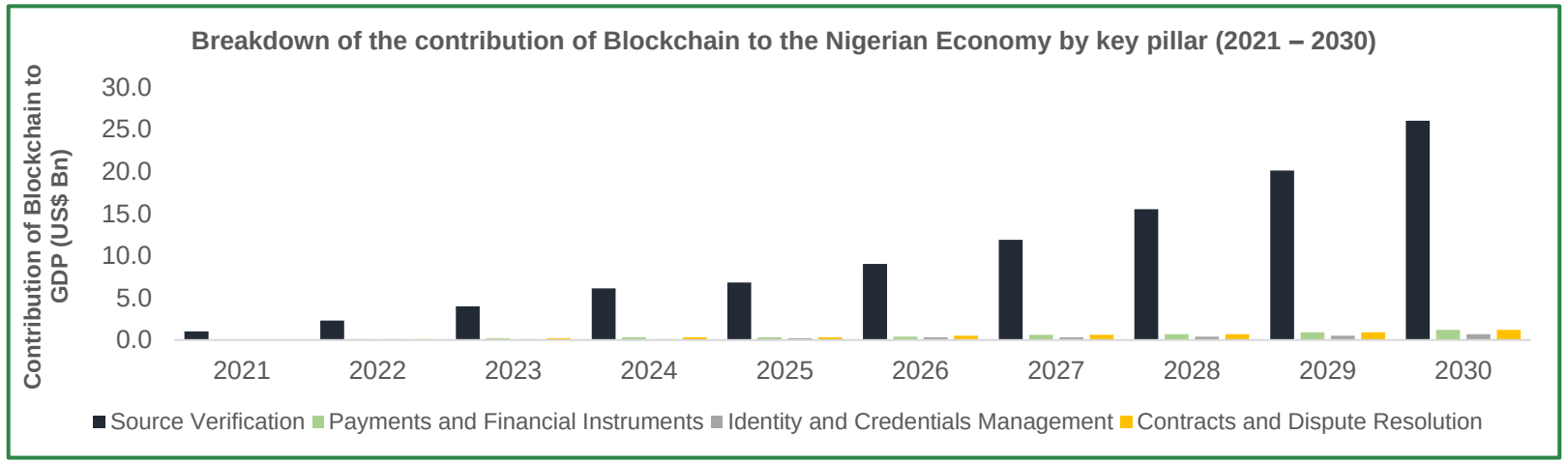
USD 110 billion

Blockchain also has the potential to generate about USD 110bn simply by including unbanked adults into the formal financial system and raising their financial services spending levels.[3]
Person-to-person payment solutions that ride on blockchain technology and augmented by an agency network can facilitate low cost and fast transaction services, especially for the bottom of the pyramid.

Nigeria can tap into this opportunity by economically empowering its people, leveraging blockchain to provide inclusive financial services

Blockchain could increase Nigeria's GDP by $29 billion by 2030, about 3% of total estimated GDP by 2030





Source: PwC Analysis

- Blockchain has the potential to contribute ~$1 billion to the Nigerian economy in 2021[1], largely by enabling efficiency and transparency in supply chain financing and facilitating payments
- This impact is expected to grow at a cumulative annual rate of 40% each year to ~$29 billion by 2030 [1]
- The impact of blockchain on the Nigerian economy would be primarily driven by enhancing trust in different aspect of business and governance
- Other impact areas include payments and securitisation and identity management.
- Nigeria's low level of enrolment for formal identification poses an opportunity for public services to utilise blockchain.

There are four key areas in which blockchain can be deployed to improve financial inclusion

1 Identity Management

- KYC mapping - identifying, verifying and evaluating customer profiles to prevent illegal transactions
- Record keeping and documentation - creating, storing and managing consistent, formal records of transaction activities

2 Payments

- P2P transfers and payments particularly with respect to trade and remittances - domestic and international remittances
- G2P transfer, particularly with respect to poverty alleviation programmes and targeted intervention schemes

3 Access to Finance

- Supply chain financing
- Input financing
- Micro and decentralised lending
- Micro savings and investments
- Real estate assets

4 Land Titling and Registration

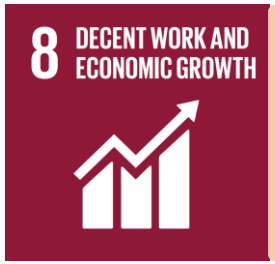
- Permanent, tamper-proof records of land ownership and associated transactions
- Comprehensive database of urban plans and foundation for technology-enabled cities

Source: PwC Analysis

Beyond financial inclusion, blockchain can help Nigeria achieve its developmental goals as enshrined in the SDGs (Sustainable Development Goals)

We have identified four developmental goals that blockchain can address to provide more inclusive economic growth for Nigeria.[4]

Blockchain could help reduce poverty through effective G2P programmes and improved access to financial products such as micro savings, lending and investments



Blockchain can power an effective identity management system which is the foundation of promoting a sustained, inclusive and sustainable economic growth

Blockchain has the potential to foster innovation and drive the provision of solutions to key problems in the country

Blockchain can power the growth of MSMEs and sustain income growth for the bottom of the pyramid thus improving income inequalities and enhancing opportunities

Source: CBN, PwC Analysis

The foregoing depends on the activities / roles of select critical stakeholders as highlighted below

Regulators

- Develop policies that would ensure compatibility of blockchain technology with existing privacy and data protection framework
- Promote intergovernmental working groups and encourage an adaptive regulatory approach to emerging technologies to better address the dynamic nature of the financial services sector
- Explore issuing a central bank digital currency (CBDC) underpinned on a permissioned blockchain
- Provide the vision and leadership for blockchain through industry-wide consultation with key stakeholders in the blockchain community
- Explore the participation of key stakeholders that can impact financial inclusion including CBN, NIBSS, NCC, SEC, CAC etc. in collaboration with technology companies to conduct testing and experimentation of appropriate blockchain applications and fast-emerging technology innovation to support the financial sector

Financial Institutions

- Explore forming a consortium with other players within the Nigerian financial services ecosystem to develop and test blockchain-based solutions that address current state challenges and improve access to finance
- Improve interoperability of systems to facilitate easier connectivity and collaboration with other players in the financial ecosystem
- Participate in industry-wide awareness, educating Nigerians on the impact of blockchain-related solutions and the importance of privacy and security of key resources

Donor Agencies and Financial Sector Deepening (FSD) organisations

- Implement policy advocacy and capacity development initiatives through conferences, hackathons, skills acquisition etc. for various stakeholder groups including financial sector regulators, blockchain experts, programmers, software designers
- Provision of reliable industry data through evidence-based research that offers insights into the state of the Nigerian financial sector and the role of emerging technologies (blockchain, IoT, AI etc.) in driving financial inclusion
- Monitor the blockchain ecosystem with a view to providing recommendations on factors that hamper its development and design strategies to ameliorate these challenges
- Set up dedicated funding desks for fintech startups working on embedding blockchain-enabled technology to drive financial inclusion and poverty reduction especially for the underserved such as the poor and MSMEs
- Implement media and enlightenment campaigns to drive and deepen awareness for blockchain adoption in the financial services sector

Developmental Institutions

- Establish a network comprising regulators and relevant stakeholders within the region for industry-wide collaboration and cooperation
- Provide technical support to regulators for the development of blockchain technology and tools within their ecosystems

Source: PwC Analysis

Learning from other Countries - Countries have implemented similar initiatives in the past with quantifiable benefits

Coins.ph partnered with banks and other financial institutions, using blockchain to improve remittance networks and increase financial inclusion in Philippines and South Asia

Results

- Significant reduction in transaction charges to 1% - 3% against 7.5% per transaction at conventional remittances transfer centers.[5]
- Users can easily withdraw cash by inputting the code generated from the app without an ATM card.[5]
- Coin.ph has established 17,000 physical locations, which was more than the number of bank branches and offices in the country.[5]
- Average cost of sending remittances to the country reduced from 7% (per US$200) in 2013 to 5.5% in 2017. [5]

Source: Chamber of Digital Commerce (2017)

The National Bank of Cambodia (NBC) leverages blockchain to improve financial inclusion and promote the use of the national currency

Results

- In July 2016, NBC successfully conducted a pilot test with a network of 16 banks supporting over 10,000 users, this translated to reduced costs for Interbank transfers.[6]
- Transaction processing time improved from twice-daily batches to 5 seconds or less with retail throughput exceeding 2,000 transactions per second.[6]
- NBC plans to expand the use across the country as well as explore other use cases for the retail payment system, including securities trading, digital identity, ATM withdrawals, term deposits and cross-border payments within Thailand and Malaysia, reducing the costs attached to cross-border remittances.[6]

Source: Hyperledger (2019)

The Tunisian post in collaboration with DigitUs and Monetas, launched a mobile money payment platform (e-Dinar) to increase financial inclusion

Results

- Operation processing reduced by 60% - 80%.[7]
- Successfully executed over 100 real business transactions on the blockchain within two months.[7]
- Enhanced trust in financial service system. [7]
- Increased efficiency and streamlined credit verification process. [7]

Source:coindesk (2015)

Learning from other Countries - Governments are also leveraging blockchain to drive government services

The use-case for DLT is not limited to the private sector alone. Indeed, the application of blockchain technology across different use cases would almost be incomplete in the absence of a critical assessment of how it will significantly disrupt the public sector service offerings.

Estonia and the United Arab Emirates (UAE) are examples of countries that have implemented blockchain technology for government services such as:

Licence renewal	Business can process and renew their licenses and exchange commerce information between government agencies using blockchain technology.
Land allocation	Using eLand register on the blockchain to store registration of ownership data and track land sale agreements.
Real estate management	To manage real estate property records from ownership verification to property sale by developers and smart leasing process.
Tax filing	Citizens can file tax returns within minutes on the government platform.
Healthcare record-keeping	Blockchain technology is used to store data for health, pharmaceutical government, private facilities, health practitioners and drug information.

The United Arab Emirate (UAE)

- Using blockchain technology, the UAE plans to digitise its over **100 million documents** from visa applications, bill payments and license renewals by 2020. This move will save the UAE government **25 million man-hours** which translates to **$1.5 billion per year.**

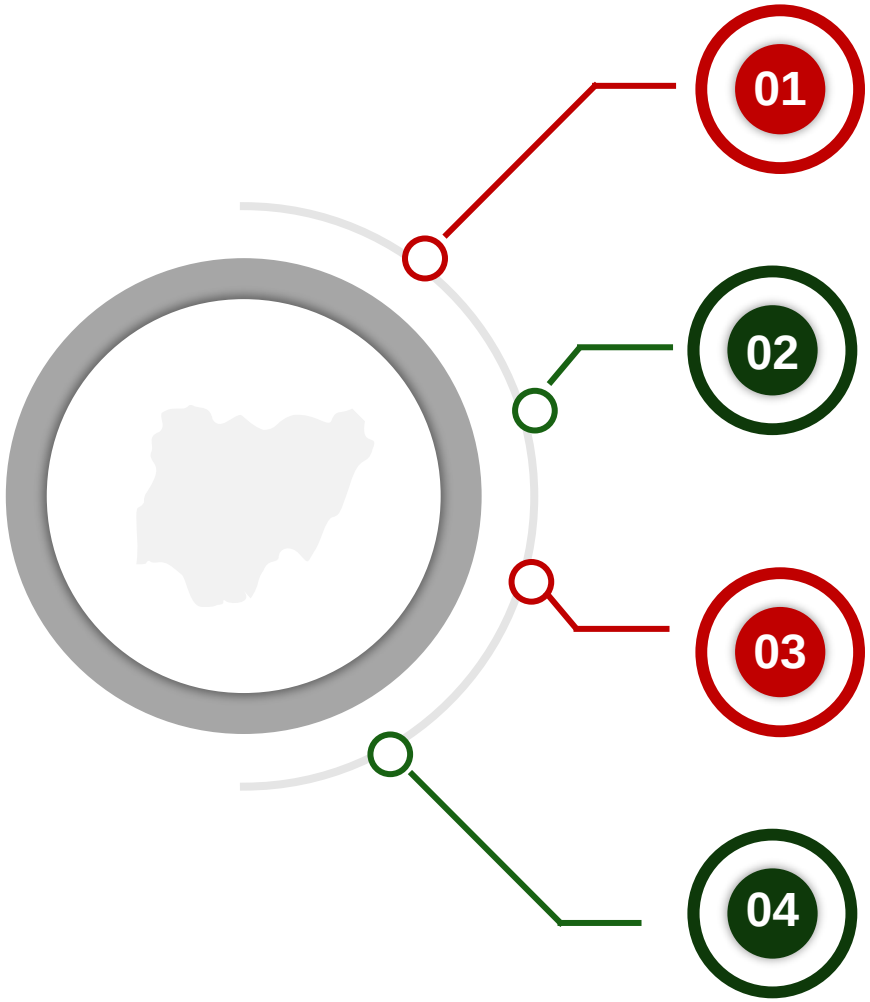
It is imperative for the government to let the existing legacy system run concurrently with the new system to be powered by blockchain technology to give enough room for adjustments and adaptation.

Lessons to improve government services in Nigeria

- The process of Government to People (G2P) disbursements including the conditional cash transfer (CCT) programme and the Government Enterprise and Empowerment Programme (GEEP) such as the tradermoni, marketmoni etc. can be simplified and streamlined leveraging blockchain technology.
- Deploying blockchain technology alongside other mobile technology capabilities can significantly improve the transparency of these disbursements and curb corrupt practices as government disbursement moves down the value chain to the final beneficiaries.
- Through monitoring and evaluation, blockchain can help the Federal and State Governments better understand what works and what does not work.

Source: Forbes

Based on the success of blockchain adoption in other countries, we identified some lessons which must be considered in Nigeria's blockchain adoption drive



01 Public sector commitment is important to improve financial inclusion by providing enabling infrastructure with proper regulation for effective supervision

02 Using blockchain technology for G2P payments can lead to significant reduction in leakages due to direct transfers to the targeted bank account holders

03 Public private partnerships are important to deepen the reach to the underserved and maximise gains from expanding the digital finance economy

04 Increased interoperability across Digital Financial Service (DFS) providers will improve P2P transfers and ease transaction settlements

Source: PwC Analysis

The Financial Inclusion Landscape in Nigeria

02

Financial inclusion comprises the access to, and affordability of a broad range of financial services that meets individual needs

Fundamentals of Financial Inclusion

Ease of access to financial products and services

Financial products and services must be within reach of all segments of the population.

Use of broad range of financial products and services

Financial inclusion implies usage of services including, but not limited to payments, savings, credit, insurance, and pension products.

Financial products designed according to need

Financial products must be designed to meet the needs of clients and should consider income levels, and access to distribution channels.

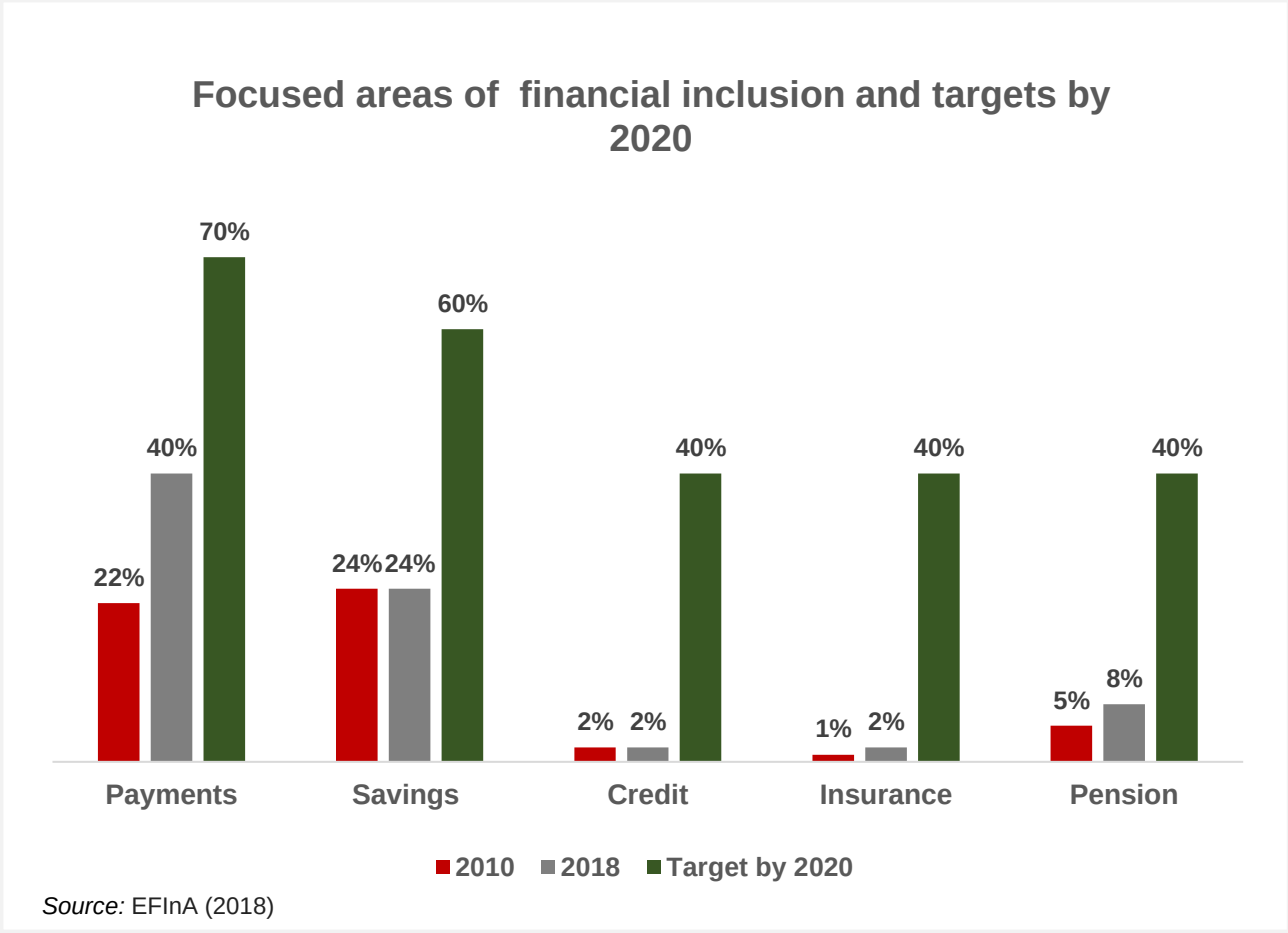
Affordability

Financial services should be affordable, especially for low-income grouped.

Importance of Financial Inclusion

- FI stimulates efficient access to financial services by facilitating savings mobilisation, enhancing payments and remittances, boosting access to credit and promoting affordable products and services.
- The United Nations' (UN) 2030 Sustainable Development Goals (SDGs) affirms that access to financial solutions are highly essential to achieving eight (8) of its seventeen (17) developmental goals.[8]
- The World Bank Group highlights financial inclusion as an enabler to reduce poverty and enhance shared prosperity.[9]

Despite gains made over the past decade, financial inclusion levels in Nigeria remain far from targets



Source: EFInA (2018)

Source: EFInA Access to Financial Services in Nigeria 2018 Survey

63.2%

Financial inclusion rate as of 2018*

80%

Target financial inclusion rate by 2020[11]

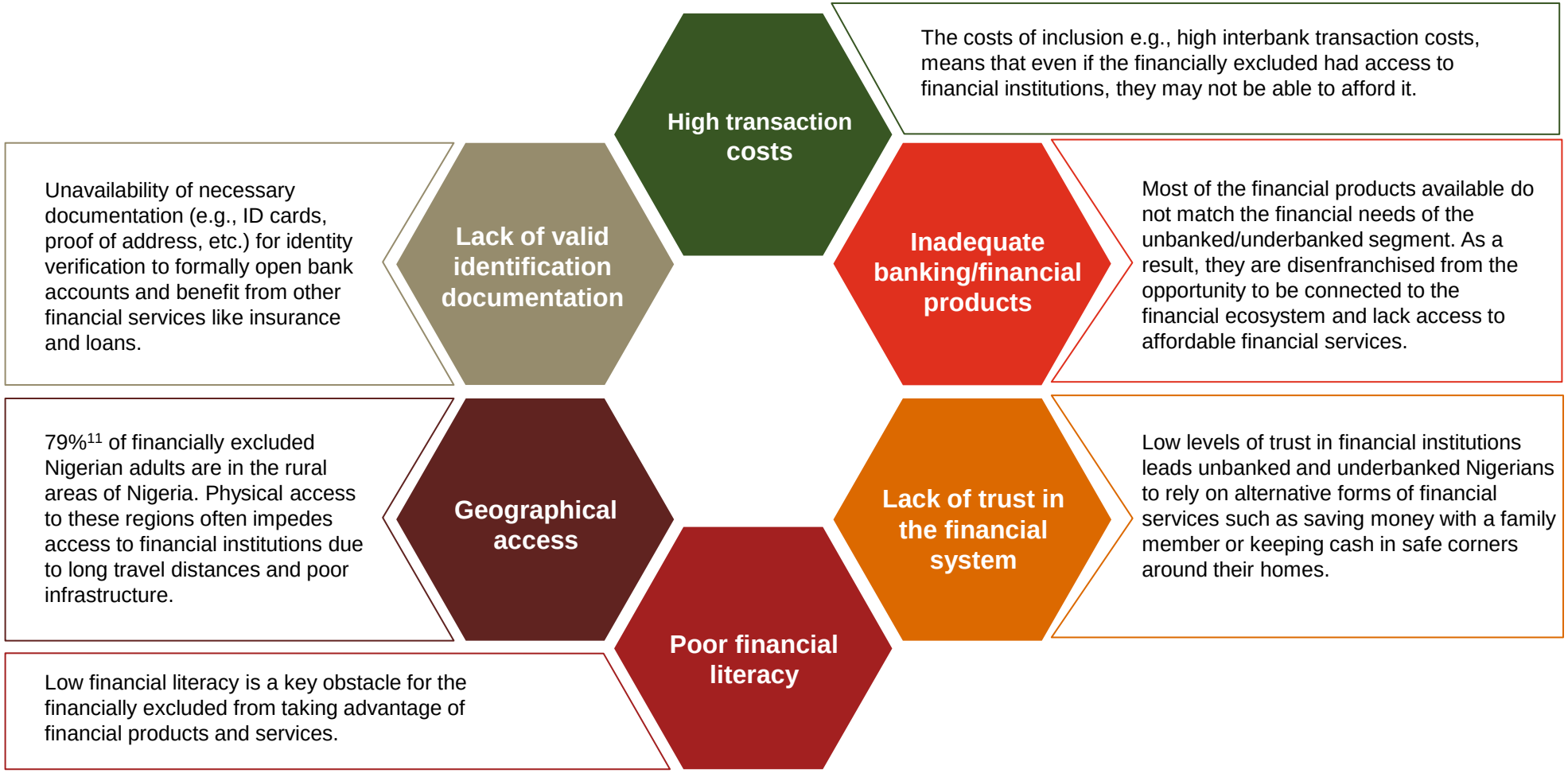
The Financial Inclusion (FI) rate of 63.2% significantly lags behind the 80% target stipulated in the National Financial Inclusion Strategy (NFIS)[10]

To achieve the 80% target stipulated in NFIS, about 21.7 million people would need to be added to the financial system[1]

While financial inclusion has grown in the past decade, change has been incremental. Meeting financial inclusion targets will require transformational solutions.

Meeting financial inclusion targets will also require improvements in access to infrastructure such as mobile network coverage.

Multiple challenges inhibit financial inclusion growth



Source: PwC Analysis

These challenges are primarily responsible for the 36.8% financially excluded adult population in Nigeria …

According to EFInA, over 60.1 million Nigerian adults do not have a bank account.[11] The goal of the 2012 National Financial Inclusion Strategy (NFIS) as revised in 2018, was to reduce the number financially excluded to 20% by 2020.[10]

36.8% (over one-third) of the adult population in Nigeria are financially excluded

79% of the financially excluded adults live in rural areas

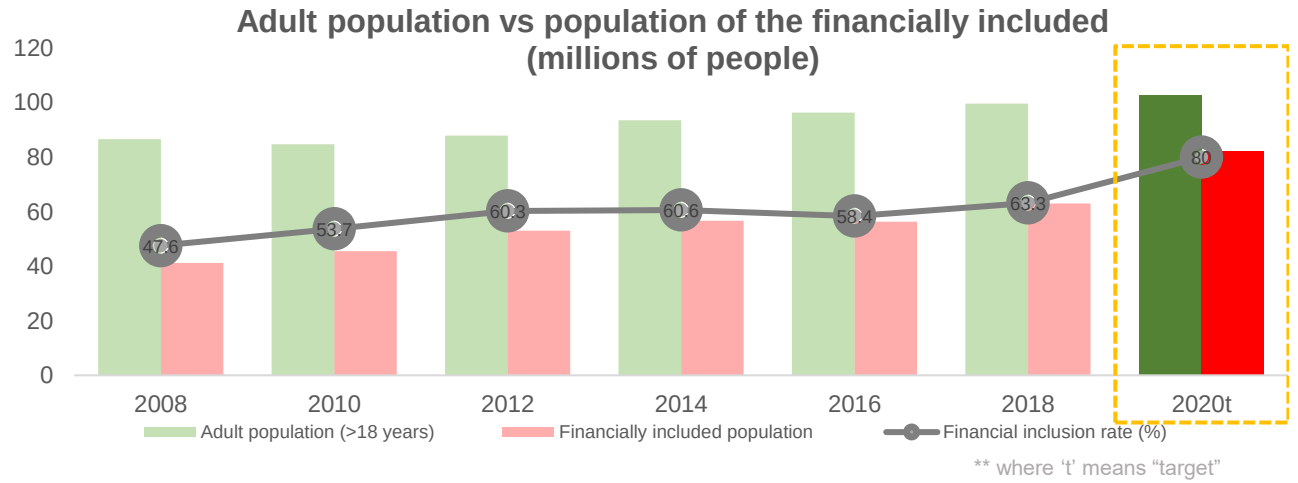
41% of Nigerian women are financially excluded, compared with 33% of Nigerian men

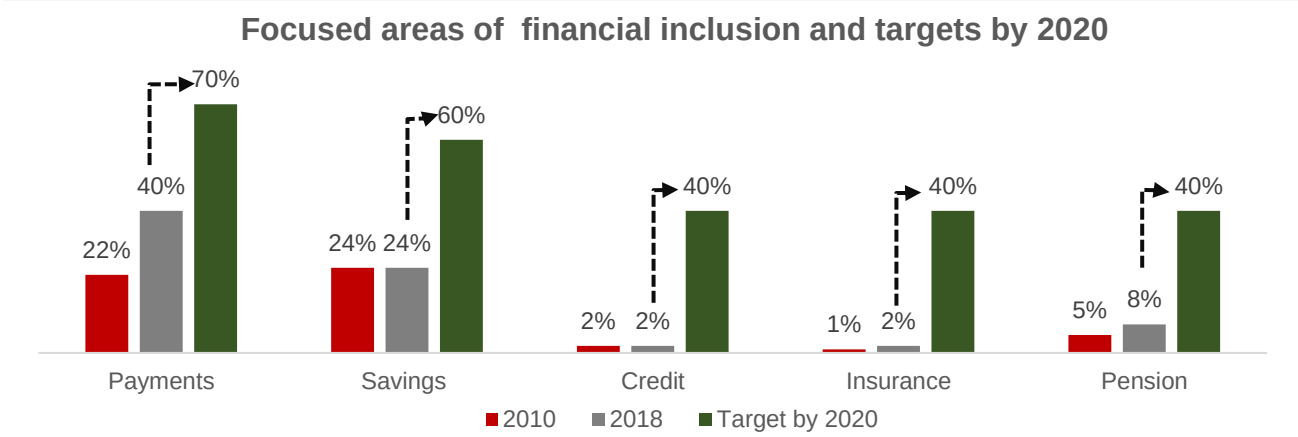
28 million adults use formal financial services from non-bank providers such as microfinance banks

71% of the financially excluded own or use a mobile phone

Source: EFInA (2018) Access to Financial Services in Nigeria 2018 Survey, Ventures Africa:(2018)[16]

Nigeria's FI has improved overtime rising from 60.3% in 2012, to 63.3% in 2018, increasing the banked population by 10.9 million.





… especially among women and rural adults, who make up 56% and 79% respectively of the total financially excluded adults in the country

A comprehensive understanding of financially excluded adults in Nigeria has motivated the introduction of new financial products and services in recent times. **Some noticeable attributes of the financially excluded population include:**

Profile of Financially Excluded Adults in Nigeria

Gender

55.9% female
44.1% are male

Area

78.5% in rural areas
21.5% in urban areas

Geopolitical zone

68.6% in the North
31.4% in the South

Mobile Money

>96%
of financially excluded adults in Nigeria are not aware of mobile money

Banking Agent

>89% of financially excluded adults are not aware of banking agents

Access to Financial Institution

76% of financially excluded adults do not have access to any financial institution

Income

>63% of financially excluded adults earn less than N35,000 per month

Education

58.1% have secondary school as their maximum qualification, 20.2% have no formal education, and 19.4% have no education at all.

Source: EFInA (2018) Access to Financial Services in Nigeria 2018 Survey

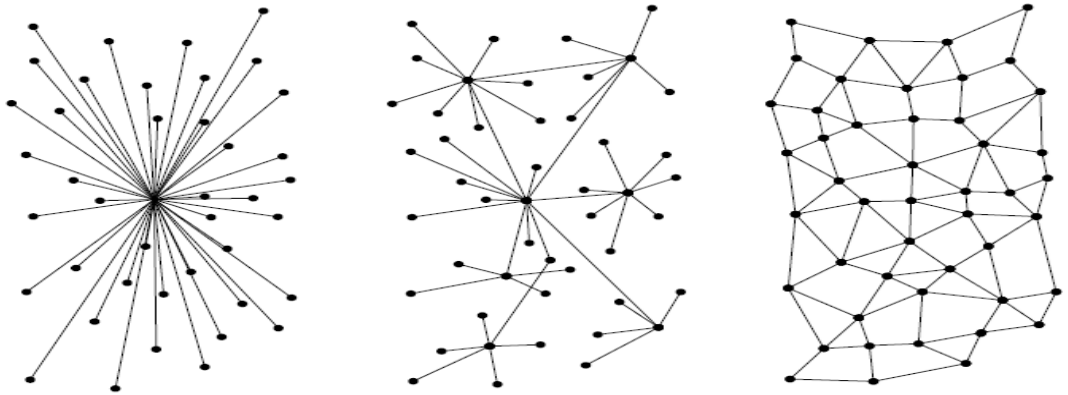
Overview of Distributed Ledger Technology (DLT) and Blockchain Technology

03

EFInA

A Distributed Ledger Technology (DLT) is a digital database which is replicated, synchronised, and managed by various ‘peer’ participants

The Distributed Ledger (DLT) is a secured network that records ownership of shared transactions, data or assets. A distributed ledger differs from a traditional, centralised ledger as it does not require a central authority or trusted intermediary to verify or validate transactions on the ledger. It is a decentralised network, that distributes data across network participants (technically known as “nodes”) in an immutable manner.[12]



Centralised [A] | Decentralised [B] | Distributed [C]

Properties or characteristics of the DLT

DLT is simply distributed databases with certain specific properties.

01 Data is replicated, synchronized and distributed across multiple nodes on a secured network

02 The append feature of the DLT provides transparent transaction history

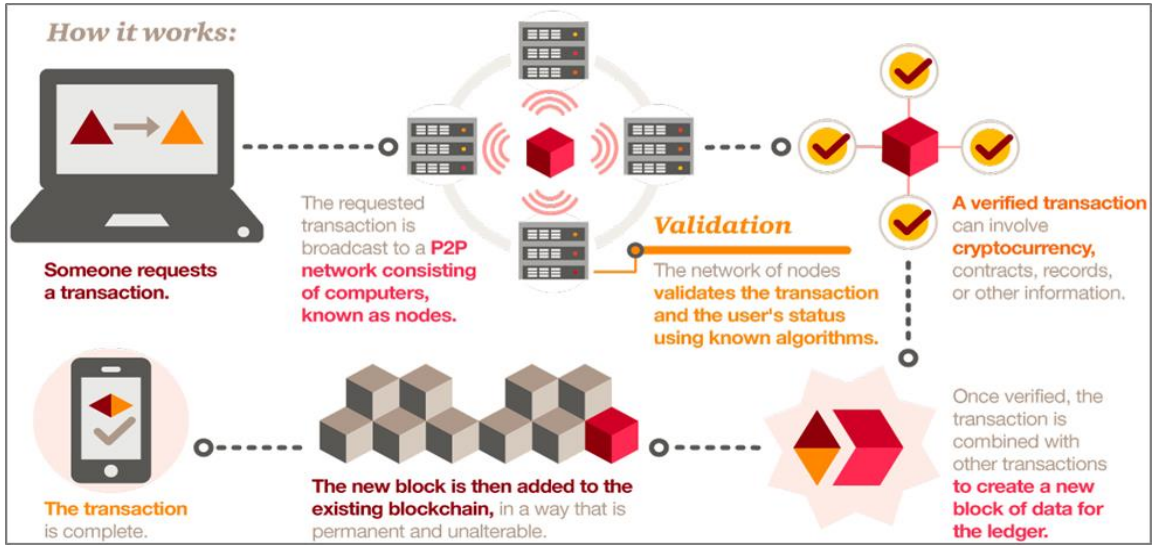
03 Immutability of data within the ledger

04 Cryptographic element of DLT ensures that data is verifiable

Blockchain is one of the best-known examples of a DLT. In many cases, blockchain is sometimes used as a synonym of DLT.

Source: GSMA (2018),, Robeco

Blockchain utilises DLT to simplify, sustain and secure a shared, decentralised peer-to-peer database



Distributed ledger
Every participant in the network has simultaneous access to a view of the information

Cryptography
Cryptographic functions ensure integrity and security of the information on the blockchain

Consensus
Peer-to-peer verification replaces the need for a third party to authorise transactions

Smart contracts
Additional business logic imply that agreements on the expected behaviour of financial instruments can be embedded

Source: PwC Analysis

Blockchains employ cryptographic and algorithmic methods to record and synchronise data across a network in an immutable manner. Data in this context means money, insurance policies, contracts, land titles, medical records, birth and marriage certificates, buying and selling goods and services, or any other type of transaction or asset that can be translated into a digital form.[1]

Blockchain technology can be deployed towards achieving:

1. Data redundancies
2. Information transparency
3. Data immutability
4. A consensus mechanism across certain use cases like financial services.

Potential Benefits of Blockchain Technology

- Lower operational cost
- Increased transaction speed and efficiency
- Reinforce the immutable trust reposed on the system

Cryptocurrency is a digital currency with an attributed value for transaction exchanges or to store value, leveraging blockchain to ensure secure transactions

What are Cryptocurrencies

Cryptocurrency is a digital currency that can serve as a means of payment for goods or services. It leverages blockchain technology and its cryptographic features to manage and record transactions on an online ledger in a secure manner.

It uses a combination of four concepts – cryptography, decentralization, immutability and proof-of-work (PoW) or proof-of-stake (PoS) consensus to verify transactions. Early blockchains such as Bitcoin use PoW verification method.

Bitcoin was the first blockchain-based application and has become the most widely known cryptocurrency. The technology enables users transfer crypto assets between them without involving a third-party intermediary.

Blockchain ≠ Cryptocurrency

Blockchain

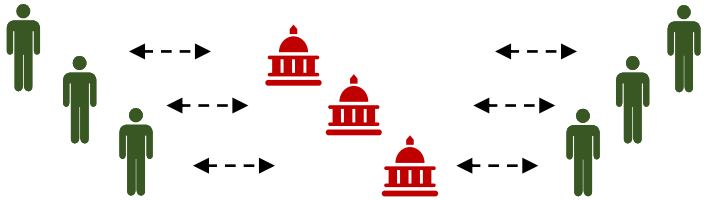
- Blockchain ***does not*** require cryptocurrency to function
- The platform can be constructed to handle a varying set of rules and configurations as desired
- Related technology, such as smart contracts, can greatly improve process efficiency, transparency, reliability and reduce risk

Cryptocurrency

- A cryptocurrency is ***one application of*** crypto-technology, that allows the transfer of value via transactions leveraging blockchain technology
- There are many existing cryptocurrencies like Litecoin, Tether, Ethereum, most notably Bitcoin
- Specifically, crypto-currencies facilitate efficient cross currency transactions as well as an efficient transaction clearing and settlement process

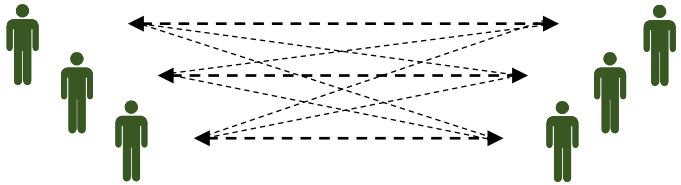
Evolution of Transaction Processing

Traditional Transaction Model



Centralised framework | **Trusted intermediary** | **Reliance on a central authority**

Cryptocurrency Transaction Model



Decentralised framework | **Immutable transactions**

Publicly accessible | **Consensus driven**

Key Benefits

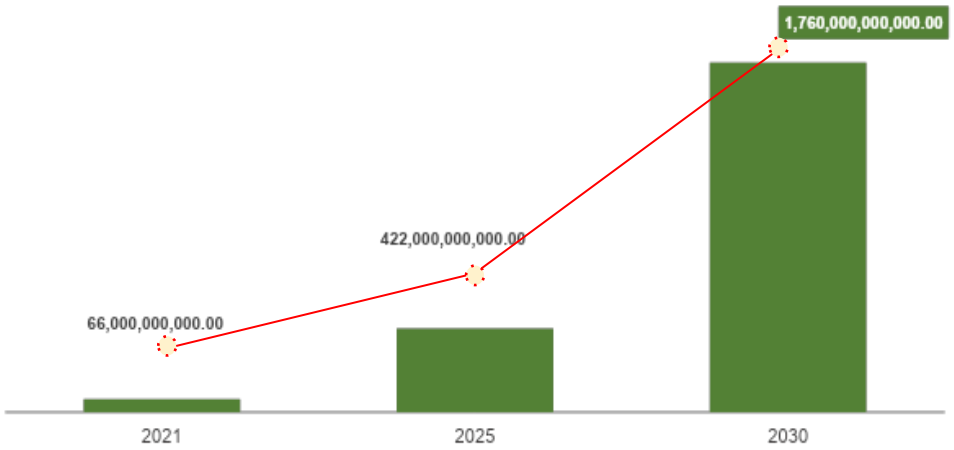
- Significant transaction cost savings particularly for cross border transactions through cryptocurrency exchanges
- Cross border payment and settlement processes can be achieved with complete validation real time
- Strong encryption techniques employed ensure that transaction processes are backed by specific agreement to be made between the buyer and seller
- Increased access to credit as currency exchanges can be made available to anyone on the network

Source: PwC Analysis

Blockchain technology has the potential to boost global GDP by 1.4% (USD$1.76 trillion) by 2030

Blockchain can create unique competitive advantage across several industries including; finance, supply chain, logistics, manufacturing, healthcare, government and retail. [2]

Key findings from PwC's research show that blockchain technology has the potential to create boost global gross GDP by USD$1.76 trillion by 2030.[2] It is expected that most businesses will use the technology in some parts of its operations by 2025, and as adoption becomes mainstream, benefits are expected to materialise increasingly.[2]

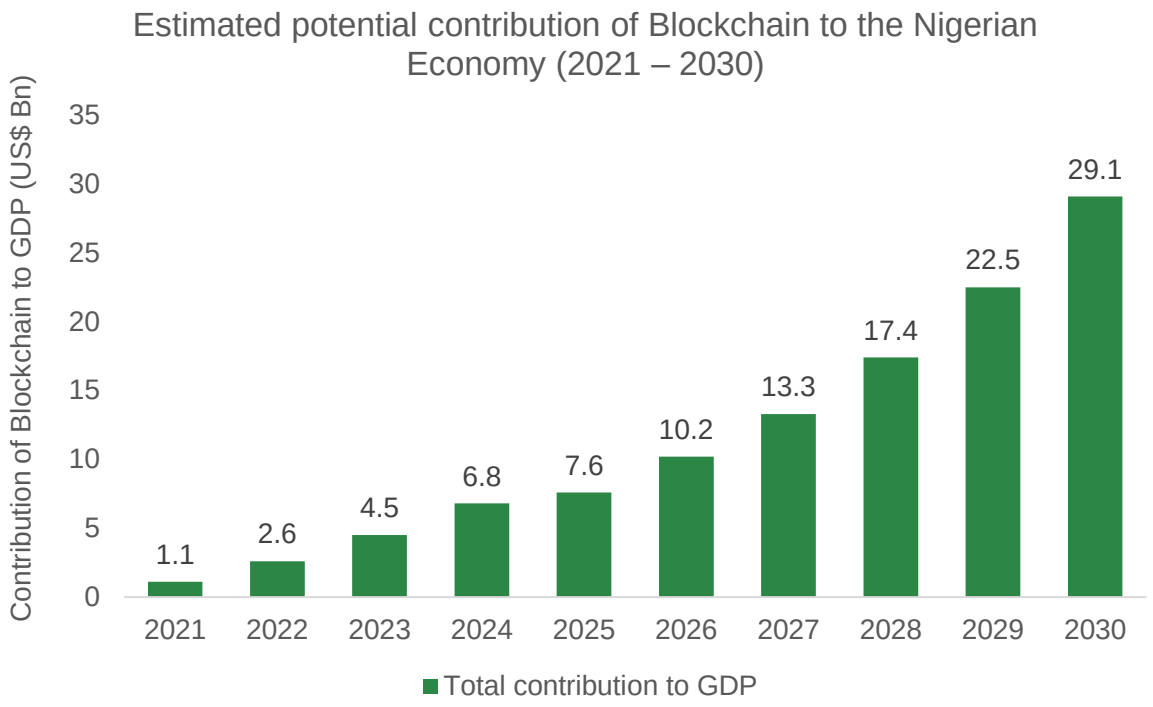


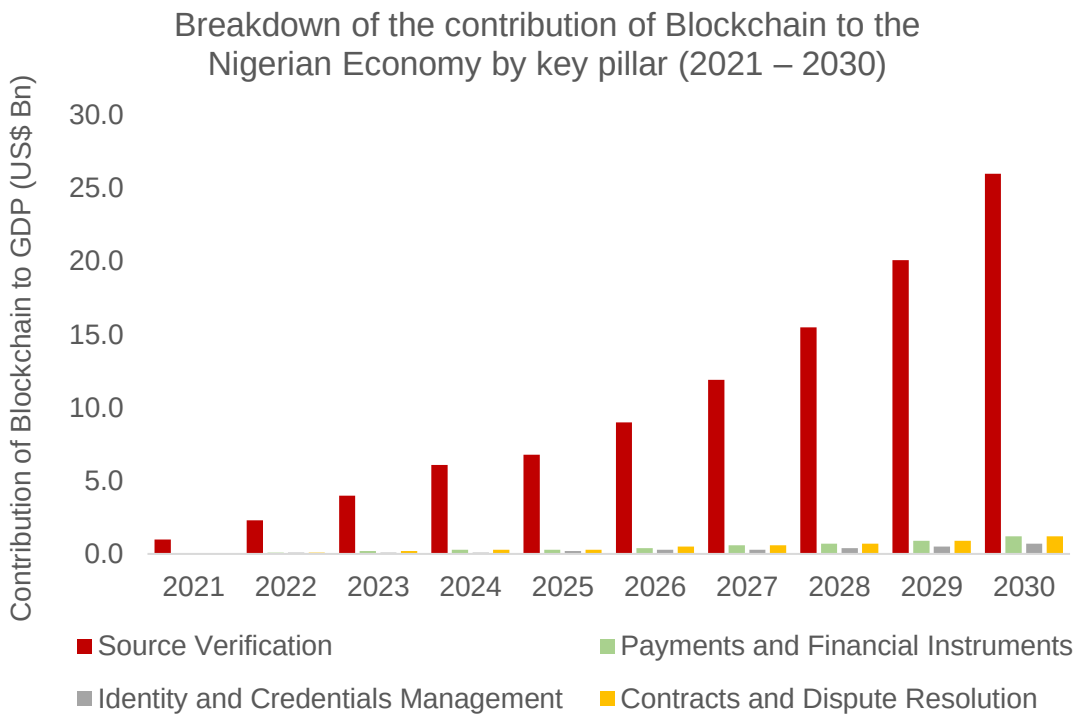
* GDP (in US$, 2019 prices) which is the net additional value created by blockchain

Source: PwC (2020) Time for trust

Contracts and Dispute Resolution (US$73bn)	Blockchain holds great promise in the realm of contracts and dispute resolution. The technology can bring together ledgers, contracts and payments, improving the flow of commercial agreements and flagging any disputes.
Payments and Financial Instruments (US$433bn)	A shared motivation for the use of blockchain is to serve as a channel for payments. Central banks across the world have been exploring the potential of blockchain technology to improve the payments infrastructure through central bank-issued digital currencies.
Identity (US$224bn)	Blockchain can safeguard valuable personal credentials online, from personal identification, such as driving licenses, to professional credentials and certificates, bringing vast cost efficiencies and helping to curb fraud and identity theft.
Source Verification (US$962bn)	Blockchain can help organisations track, verify and monitor the sources of their goods end-to-end, strengthening transparency across the supply chain.
Customer Engagement (US$54bn)	Blockchain can improve traditional, card-based loyalty and reward programmes. The technology can boost engagement through integration with customer relationship management (CRM) platforms and generate more value by making them more user-friendly for smartphone users.

Blockchain technology can potentially add USD$29 billion to the Nigerian economy within the same time period (2030), about 3% of total GDP by 2030





- Our estimates indicate that Blockchain has the potential to boost the Nigerian GDP by ~3% by 2030
- Most of these gains will likely emanate from enhancing transparency with respect to supply chain financing and identity management
- In addition, blockchain also has the potential to generate c. $5 billion by raising the transaction volumes of P-2-P payments and financial instrument transactions

Source: PwC Analysis, World Bank

Thus, in Nigeria, measures are being put in place to encourage the adoption of blockchain technology

Central Bank of Nigeria

The Central Bank of Nigeria has identified Distributed Ledger Technology (DLT) in the development of the Payment Systems Vision (PSV) 2030[13] as one of the top global trends and new practices in payments that have been deployed in other countries which must be considered in Nigeria.

The Payment Systems Vision (PSV) would define the strategic agenda for the Payments System for the next ten years.

NITDA
National Information Technology Development Agency

The National Information Technology Development Agency (NITDA) initiated the process of developing a blueprint and strategy document for the national adoption of Distributed Ledger Technology (DLT) and Blockchain in Nigeria.[14]

The agency is currently constituting a technical working group with key stakeholders to review the draft national blockchain adoption framework and develop a document that will guide the enhanced adoption of blockchain in Nigeria, leading to additional benefits.

SEC NIGERIA
SECURITIES AND EXCHANGE COMMISSION, NIGERIA

The Securities and Exchange Commission in Nigeria (SEC) in September 2020 issued regulatory guidelines for digital currencies and crypto-assets.[15] The proposed set of rules will regulate Crypto-token or Crypto-coin investments when the character of the investments qualifies as securities transactions.

According to the commission, the objective of the regulatory guidelines is not to hinder technology or stifle innovation but to create standards that encourage ethical practices.

Source: Central Bank of Nigeria, (2019), NITDA (2020),, SEC Nigeria (2020)

Some private sector players are already exploring blockchain technology across five (5) broad use cases

Payments and cryptocurrency exchanges

busha
sesacash
BuyCoins
KuBitX
LUNO
COINAPPS
quidax
Bit Pesa
PATRICIA
PAXFUL
FLASH
bitsika

Lending

AFEX COMMODITIES EXCHANGE LIMITED
OpenFactor

Land registration and Real Estate

SESO GLOBAL
houseafrica

Commodity Exchange and Trading

AFEX COMMODITIES EXCHANGE LIMITED
BINKABI

Supply Chain

Interswitch
Sterling

Source: PwC Analysis

Legal & regulatory uncertainty as well as other challenges still exist, limiting the adoption of Blockchain technology in Nigeria

Key Factors	Stakeholder Groups Affected
Poor Digital Literacy There is a lack of understanding of how blockchain works which negatively affects adoption and investment opportunities.	Customers Banks and other Financial Institutions
Talent and Expertise There is wide gap between the demand and supply of qualified technical experts to fully grasp and explore the potential of blockchain technology. Although this can be expensive, organisations may not reap the benefits blockchain provides and as a result, may be unwilling to adopt blockchain.	Banks and other Financial Institutions Blockchain Platform Providers
Regulatory Uncertainty The unclear standpoint of regulators and lack of policy or framework to guide blockchain adoption which discourages financial service providers and other organisations from exploring blockchain technology.	Banks and other Financial Institutions Blockchain Platform Providers Regulators
Inadequate Infrastructure Unsustainable energy supply, poor connectivity and technology infrastructure, makes it difficult to implement and support blockchain technology operations.	Banks and other Financial Institutions Blockchain Platform Providers

Source: PwC Analysis

The Potential and Impact of Blockchain in Nigeria

04

Blockchain has the potential to improve financial inclusion and support the achievement of some of Nigeria's developmental goals

Impact on Financial Inclusion

Blockchain could potentially impact financial inclusion through the implementation of solutions and use cases that increase access to financial products and services to the under-banked and unbanked population in Nigeria.

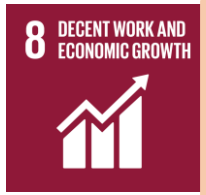
Person-to-person payment solutions that ride on blockchain technology and are augmented by an agency network can facilitate low cost and fast transaction services especially for the bottom of the pyramid. Through these P2P blockchain solutions and a robust agency network, Nigerians can have access to low-cost savings, insurance, lending and money transfer products and services.

Impact on Developmental Goals

Some of the key development goals in Nigeria include poverty reduction, enhanced innovation, improved identity management, SME empowerment and effective land title and registration management. These development goals can be mapped to some of the global Sustainable Development Goals (SDGs).

Blockchain could help reduce poverty through effective G2P programmes and improved access to financial products such as micro savings, lending and investments

Blockchain has the potential to foster innovation and drive the provision of solutions to key problems in the country



Blockchain can power an effective identity management system which is the foundation of promoting a sustained, inclusive and sustainable economic growth

Blockchain can power the growth of MSMEs and sustain income growth for the bottom of the pyramid thus improving income inequalities and enhancing opportunities

Source: PwC Analysis

Blockchain can be leveraged to address some of the leading barriers to financial inclusion in Nigeria

High transaction costs

Micro transactions usually suffer high costs due to the low value but high-volume nature, a ₦100 Naira transaction via USSD or Card could cost between 10% and 20% in fees.

Blockchain minimizes fees by using a peer-to-peer network (and eliminating intermediaries) that allows value to be exchanged between two participants just as cash would have been exchanged only digitally.

This means fees to conduct a transaction can be greatly reduced or eliminated to promote micro transactions

Lack of trust in the financial system

Levels of trust in the financial system are highly correlated with usage of formal financial services. Financially excluded groups are much more likely than banked Nigerians to say that they do not trust formal financial service providers.

Blockchain ensures that your account is secured, and transactions cannot be authorised without your cryptographic keys. This means no excess charges, no identity theft and no data breaches.

If your cryptographic keys are not stored safely, you will lose all the above benefits

Offline transaction capability

Network outages affect banking applications, wallets, POS, ATM machines and USSD services. When these happen, digital financial activity usually grinds to a halt, also because there is no visibility into the status of the transactions, customers have to resort to customer service to trace transactions.

Blockchain provides visibility and transparency to transactions in the network hence all transactions can be tracked and verified as being finalised or pending.

Also, blockchain when implemented with a combination of cryptography, near field communication and smart contracts can facilitate offline transactions during periods of downtime by storing a copy of the ledger offline in a tamper resistant device and incentivising POS Agents/Devices to synchronise their transactions for proper reconciliations and to be able to spend the value received.

Source: PwC Analysis

We have identified four (4) key use cases which blockchain can be deployed to improve financial inclusion

Payments

- P2P transfers and payments particularly with respect to trade and remittances - domestic and international remittances
- G2P transfer, particularly with respect to poverty alleviation programmes and targeted intervention schemes

Identity Management

- KYC mapping - identifying, verifying and evaluating customer profiles to prevent illegal transactions
- Record keeping and documentation - creating, storing and managing consistent, formal records of transaction activities

Access to Finance

- Supply chain financing
- Input financing
- Micro and decentralised lending
- Micro savings and investments
- Real estate assets

Land Titling and Registration

- Permanent, tamper-proof records of land ownership and associated transactions
- Comprehensive database of urban plans and foundation for technology-enabled cities

Alignment with CBN's Financial Inclusion Priorities

- Create an enabling environment for the expansion of DFS
- Enable the rapid growth of agent networks with nationwide reach
- Harmonise KYC requirements for opening and operating accounts/mobile wallets on all financial services platforms
- Create an enabling environment to serve the most excluded
- Improve the adoption of cashless payment channels, particularly in government-to-person and person-to-government payments

Source: PwC Analysis

04

Payments

4.1

Use Case 1 - Exploring the opportunities for blockchain to create an enabling digital payment infrastructure to ease flow of funds

Payments

- P2P transfers and payments, particularly with respect to trade and remittances - domestic and international remittances
- G2P transfer particularly with respect to poverty alleviation programmes and targeted intervention schemes

Background

- The payments system within Nigeria has evolved over the past few years, driven by the evolution of Fintechs and mobile payments providers
- However, payments services remain largely inaccessible for the bottom of pyramid population in Nigeria. Where available, payment/transfer services are relatively expensive and error-prone
- In addition, global (cross-border) payments, to and from Nigeria, remain slow, expensive and error-prone.
- Although remittances to Nigeria ($23.8 billion in 2019)[18] represent an essential component of the Nigerian economy and a source of foreign exchange, cost of remittances to Nigeria is prohibitively high. In 2019, the cost of remittances to Nigeria was 8.5%, significantly higher than both global averages (6.8%) and SDG 10 targets (3%)

How Blockchain can help

- Leveraging the use of encrypted, decentralised ledgers, blockchain can enhance the efficiency of financial transactions and expand the reach of payment services to increase access to the financially excluded population
- In addition, blockchain can reduce the cost of transactions across all three phases of internal and cross-border payments (first mile, transfers and last mile) by housing the digital identities of senders and recipients, simplifying the relevant KYC and AML processes

Potential Benefits

- Higher transfer speed
- Lower cost of transfers
- Enhanced security of financial transactions
- Enhanced cross-border transfers
- Enables more efficient audits for financial institutions

Source: IMF (2019), PwC Analysis

Case Study – Powering African businesses using bitcoin to enable payment flows

BitPesa is an online foreign exchange payment platform designed to bridge the gap between Africa and global businesses

Challenge

The lack of financial infrastructure available to growing businesses created friction for businesses operating in Africa. Liquidity risk exposed foreign exchange players to substantial losses from delayed settlement time and various counterparties involved in the process. BitPesa aims to simplify remittance systems for cross border B2B foreign exchange transactions for large, multinational corporates and small businesses across Africa.[5]

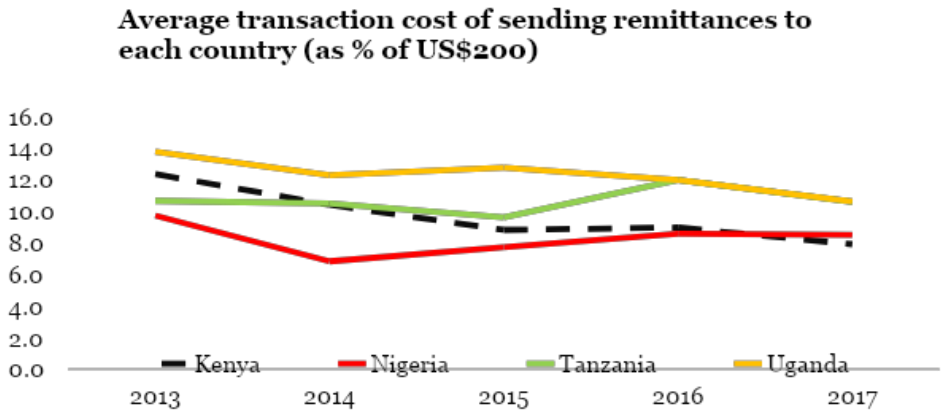
Approach

BitPesa was founded in November 2013 in Kenya and then extended its services to Nigeria, Uganda and Tanzania. The company partnered with existing mobile money operators to achieve wider coverage, penetrate local markets, with specific focus on the rural areas. BitPesa provides a real time settlement process that drastically reduces the risk of changes to pre-contractual conditions.[5]

However, most African countries did not license operation due to lack of practical knowledge on blockchain and digital currency, which impedes BitPesa's impact in most SSA countries where it has physical presence.[5]

Results

- Over 6,000 users were successfully enrolled across Kenya, Nigeria, Uganda and Tanzania.
- Cost of sending remittances reduced. but declined more significantly in Kenya compared to other African countries.[5]



Source: World Development Indicator, PwC analysis

Source: Chamber of Digital Commerce(2017), PwC Analysis

Case Study – Improving remittance services to increase access to the underserved

Coins.ph partnered with banks and other financial institutions, harnessing blockchain to improve remittance networks and increase financial inclusion in Philippines and South Asia

Challenge

Philippines is notable for the significant number of emigrants overseas. After India and Mexico, Philippines was the third largest recipient of remittances globally in 2018 at US$33.81 billion.[5]

Approach

Coin.ph was introduced in Philippines in 2014 as a blockchain-based mobile platform that allows access to financial services, particularly for the unbanked and underserved population.[5]

The platform is integrated with blockchain and bitcoin and supports about 500,000 users. With Coin.ph, remittances are converted into cryptocurrencies like bitcoin or Ethereum before being sent to individual recipients who then convert to local legal tender.[5]

Results

- Significant reduction in transaction charges to 1% -3% against 7.5% per transaction at conventional remittances transfer centers.[5]
- Users can easily withdraw cash by inputting the code generated from the app without an ATM card.
- Coin.ph has established 17,000 physical locations, which was more than the number of bank branches and offices in the country.[5]
- Average cost of sending remittances to the country reduced from 7% (per US$200) in 2013 to 5.5% in 2017.[5]

Source: Chamber of Digital Commerce(2017)

Case Study – Using DLT wholesale payment system to achieve seamless interbank payment and streamlined reporting network

South African Reserve Bank

South African Reserve Bank

Project Khokha

The South African Reserve Bank, in collaboration with the national banking community, explored the use of DLT to provide a more resilient and cost-effective wholesale payment system

Challenge

The high cost associated with providing an available, reliable and resilient banking system that is immune to attacks or operational failures. There are also additional costs from inefficiencies in reconciling interbank payments and reporting process for suspicious transactions.[20]

The South African Reserve Bank (SARB) wanted to assess the capabilities of blockchain technology to improve performance, scale, confidentiality and reduce overall costs.[20]

Approach

The South African Reserve Bank (SARB) in partnership with ConsenSys solutions and seven commercial banks built a solution utilising Quorum (an enterprise Ethereum solution) to process a daily volume of payments for the South African Reserve Bank, with full transaction confidentiality in a real-world simulation.[20]

The project aimed to evaluate the use case of DLT payments for wholesale payments for interbank settlements but not replace SAMOS, the SARB's standing interbank settlement system.[20]

This is part of South Africa's effort to contribute to the global initiatives of the application and use of DLT through collaborative efforts.[20]

Results

- Reduction in a daily transaction processing time by 75%, executing 70,000 transactions in less than two (2) hours.[20]
- Performance targets of scalability, confidentiality, resilience and settlement finality were attained.[45]
- Maintained privacy and confidentiality despite large transaction volumes.[20]
- Based on successes recorded, the Khokha project is now focusing on sharing of know your customer (KYC) and anti-money laundering (AML) payment information between banks and the Financial Intelligence Center (FIC), by enabling access to decrypt relevant transaction data.[20]

Source: ConsenSys Solutions Project(2018) Project Khoka

Case Study – Using digital currency to modernise retail payments

The National Bank of Cambodia (NBC) leverages blockchain to improve financial inclusion and promote the use of the national currency

Challenge

Despite a mobile penetration rate of >50%, over 78% of the population did not have a formal bank account. In addition, the country struggled to maintain and promote the use of its national currency – Khmer Riel as most transactions happened in US dollars.[21]

This resulted in discrepancies due to varied retail banking systems applied by different banks and third parties, poor communication between banks and wholesale settlements between banks were prone to discrepancies.[21]

Approach

The NCB wanted a blockchain platform that was secure and could protect the integrity of all accounts and transactions, continuity of the system even if one node was offline, an accounts management system to supervise transactions and a simple architecture that will be easy to maintain with little vulnerabilities.[21]

In collaboration with Tokyo-based Soramitsu, a blockchain and Fintech company, the Bakong project was created to modernise the country's legacy retail payment system to penetrate rural areas leveraging the use of Hyperledger Iroha blockchain framework. It allowed for P2P transfers at no charge using the smartphone app.[21]

Results

- In July 2016, NBC successfully conducted a pilot test with a network of 16 banks supporting over 10,000 users, this translated to reduced costs for Interbank transfers.[21]
- Transaction processing time improved from twice-daily batches to 5 seconds or less with retail throughput exceeding 2,000 transactions per second.[21]
- NBC plans to expand the use across the country as well as explore other use cases for the retail payment system including securities trading, digital identity, ATM withdrawals, term deposits and cross-border payments within Thailand and Malaysia, reducing the costs attached to cross-border remittances.[21]

Source: Hyperledger (2019)

04

Identity Management

4.2

Use Case 2 – Blockchain can be used to create formal, legal, digital identities to boost financial inclusion and digital transformation

Identity Management

- KYC mapping - identifying, verifying and evaluating customer profiles to prevent illegal transactions
- Record keeping and documentation - creating, storing and managing consistent, formal records of transaction activities

Background

- Identity management, the process of identifying, authenticating and authorising individuals for access to services, is critical to modern economic and social prosperity. A universal identification infrastructure forms the basis for providing important social and economic amenities to citizens and enabling increasingly interconnected economies.[23]
- Two broad components of identity management necessary for inclusion are:
  - KYC mapping – identifying, verifying and evaluating customer profiles over time to identify and prevent illegal transactions, and
  - Record keeping / documentation – creating, storing and managing consistent, formal records of transaction activities.
- Together, these components act to safeguard the financial system from threats such as money laundering, terrorism financing, fraud, and reputational damage.
- However, these may act to limit participation in the economic system for individuals with limited identification records, especially low-income populations.[1]

Current Situation in Nigeria

The national identity management process is tenuous, fragmented and inefficient with overlap across multiple agencies resulting in low enrolment (<20%).[22]

The absence of a uniform, overarching form of identification of citizens is a major impediment to financial inclusion.[22]

What is being done?

Tiered KYC model adopted by the CBN to enable low value account transactions.[24]

The **National Identification program** aims to provide all Nigerians with a unique National Identification Number.[22]

Digital Identity Ecosystem to centralise and harmonise existing functional identities,

Synchronisation of the NIN and BVN, a unique identifier for all Nigerians registered in the banking system.

Despite all these initiatives, a large proportion of the unbanked population still lack adequate KYC documentation (proof of identity and proof of address), and consequently are unable to access a wide range of formal financial services. In addition, they are often unable to receive benefits from the government (digitally) and to remittances from foreign countries

Source: World Bank (2018), NIMC (2017) , PwC Analysis

Use Case 2 – Blockchain can support current initiatives, increasing the speed and cost-efficiency of implementation

- Uzo is a petty trader living in Mbaise, Imo State
- Uzo has no form of identification and has been unable to open a bank account to access credit for her business
- The closest NIMC registration center is several hours away from her village
- Uzo owns a feature phone with a registered sim card

Journey through the Blockchain Identity Lifecycle

Phase 1 – Data collection

1 Pre-enrollment

Uzo pre-enrolls using a USSD code on her registered phone number. The phone number is linked to NCC database and is used as an identifier for next stage

2 Validation and Verification

Uzo visits an agent to perform biometric validation, to ensure information stored is accurate and avoid data replication..

System verifies Uzo's phone number, photo and performs a security check

Conversely, If Uzo's phone is capable of registering biometric information, Uzo may perform enrolment and validation processes herself

Phase 2 – Issuance

3 Credential Creation

A unique identity is created for Uzo on the database. Her details are stored on the blockchain and authentication keys are provided

4 Credential Issuance

Simultaneously, an official identifier is communicated to Uzo – a number, code, or card (which she can pick up later).

Access and privacy rights are determined

Phase 3 – Storage and Use

5 Authentication and Verification

- Uzo can update and validate her address and other dynamic information via USSD codes
- Access to services requires the unique identifier and authorisation (pin, biometric, or a combination)
- Access to data is limited per non-issuing user.

6 Maintenance

- Ongoing management of privacy, security and other concerns
- Blockchain is loosely coupled with other existing functional identity databases

Potential Benefits

- Access to digital identity for lower-income citizens with enhanced privacy and security – Citizens control with whom they share their data
- Reduced cost of providing digital identity for citizens for NIMC
- Elimination of current issues e.g., agency overlap, data insecurity and identity fraud
- Improved access to financial products and services
- Rapid onboarding and healthy competition between Financial service providers
- Reliable records of activity and transactions leading to improved credit ratings and compliance tracking
- Enhanced management of G2P, CCTs and foreign remittances
- Support the inclusion of internally displaced persons (IDPs) within the country
- Increased revenue to Government and enhanced citizen planning for government

Source: PwC Analysis

Case Study – Self-sovereign identities for low-income individuals and displaced persons

Gravity created self-sovereign identities for low-income Kenyans

Challenge

Many low-income Kenyan residents were unable to access a wide range of services due to a lack of verifiable identification

Consequently, service providers struggle to implement KYC requirements for these individuals. KYC processes are expensive, time-consuming and potentially troublesome.[26]

Approach

Gravity, a French startup created a secure, blockchain-based platform that allows Kenyans create self-sovereign identities easily.[25]

Access to the platform is via USSD and users are taken through a series of steps where their personal details are recorded on the public blockchain (declare attributes) and stored on another, cryptographically-secured DLT.[25]

Verification is conducted via SMS to a number of identified peers, a private authority or a government entity. Machine learning is used to filter inaccurate / malevolent information

Results

- Gravity ID in its pilot, was able to provide on-the-fly identities for 1000 people in three (3) days.[25]
- 74% of the registered users in the pilot were low-income, rural dwellers.[25]
- None of the platform's users is able to modify the information on the platform. This increases the confidence of official users in the information provided
- The platform seeks to build a risk profile for users, enabling KYC processes for financial institutions and easing credit processes
- Lower cost of onboarding new users than other extant identity management systems.

Source: ID4Africa (2018), Liquid Telecom (2018) African Blockchain Report

Case Study – Economic identities for refugees, smallholder farmers and small business owners

BanQu created economic identities for refugees and smallholder farmers

Challenge

As a result of lacking identity credentials, millions of refugees find it difficult to enter or participate fully in the economic system.

These displaced individuals are unable to open bank accounts, access loans and specialised products, and are thus driven to the outskirts of society.

NGOs, who support the displaced, are unable to facilitate this assimilation and only manage to alleviate, slightly, the suffering of refugees.

In addition to refugees, small business owners have their histories undocumented and are unable to access many formal banking products at a low price.[27]

Approach

BanQu, founded by a former Somali refugee and an Indian migrant, created a proprietary blockchain-based platform to facilitate financial inclusion through the provision of economic identity for unbanked populations.[27]

The BanQu platform enables users create a digital identity on DLT, connects the users to financial institutions onboarded on the platform and creates a history of transactions on the users' digital identity, enabling risk profiling and credit management processes.[27]

In addition, BanQu connects smallholder farmers and business owners to global supply chains, enabling transparency and higher potential profitability for them.[27]

Results

- Connected small business owners with the global economy by providing them with a secure, portable identity.
- Built trusted digital identities that are portable, persistent and private.
- Farmers can give permissions to their networks to use their personal phones or BanQu's website to record and authenticate the farmer's personal and financial transactions.[27]
- Lenders can use the data on the farmers wallet to de-risk the business owner and extend affordable working capital loans.

Source: GO Explorer (2018)

Case Study – Blockchain enabled government ID for voting processes

The Zug government collaborated with private players to pioneer blockchain-based identities

Challenge

Zug (the largest town and capital of the Swiss canton of Zug in Switzerland) operates a direct democracy where citizens are called to vote four times a year.[28]

The process, consequently, was time consuming, cumbersome, and very expensive.

The government sought to leverage extensive capabilities presented by the Crypto Valley to utilise blockchain to streamline and optimise the voting process.[28]

Approach

The government leveraged uPort, a decentralised identity platform to pioneer the creation of a self-sovereign, government-issued Digital Identity

Furthermore, city authorities partnered with the Institute for Financial Services Zug (IFZ) of the Lucerne University, along with integrator TI&M for the platform and Luxoft to implement voting.[28]

Citizens created their own identities on Ethereum and validated with relevant government authorities. Access to the city's identity database was regulated by the city clerk

Citizens were able to sign and verify data, and to vote.[28]

Results

- In the pilot, 350 citizens were able to successfully create blockchain-based digital identities, verified by uPort and the city.[28]
- 70 citizens consequently participated in the voting exercise entirely off digital identities created on the Ethereum blockchain.[28]
- The city of Zug now have their own identity on the public Ethereum network that gives them the power to sign and verify data.[28]
- Residents can gain complete control of their identity and all its associated data.
- The identity has been synchronised with other platforms enabling residents gain access to several services.[28]

Source: Consensys (2018)

Case Study – Using digital cash transfers to build pathways to financial inclusion for low-income economies

Iris recognition technology has streamlined the process of registering and delivering services to refugees in Jordan and beyond to improve access to humanitarian assistance with dignity

Challenge

The kingdom of Jordan depends heavily on external financing – remittances, foreign savings and foreign direct investments due to the influx of refugees, disruption of trade routes (notably those with Iraq), and decreased and tourism inflows.[29]

The local economies are strained by the limited infrastructure, poor service access and an increased supply of informal labor. This created an urgency in finding resilient interventions for refugees and low-income communities.[29]

Approach

Irisguard is an iris recognition solutions company that uses the image of an iris and converts to a unique code to identify an individual.

In 2018, Irisguard partnered with IFC to improve registration and delivery of cash assistance to refugees to boost financial inclusion for Syrian refugees in Jordan.

Using Eyepay and leveraging the Ethereum blockchain, the biometric iris scans are used to verify identity and access delivery channels such as ATMs, point-of-sale (POS) devices and make purchases at retail stores.[29]

The solution creates a secure financial delivery platform and eliminates the need for traditional identity. This will reduce corruption and identity theft and ensure financial inclusion of vulnerable people around the world.[29]

Results

- Lower cost for disbursing cash as it eliminates the need for physical distribution centers.[29]
- Streamlined process for registering and delivering services to refugees and low income communities
- Eliminates transaction fees associated with local bank transfers
- Recipients can use their transaction accounts to access cash transfer funds as well as make payments which allows them build a financial history required to access other financial services beyond payments.
- Reduced susceptibility to theft and corruption activities
- Facilitated the registration of more than 2.7 million refugees in Jordan and other countries in the region.[29]
- Using this technology, over 5.4million refugee records enrolled by United Nations High Commissioner for Refugees (UNHCR) to date and over 45,000 transactions processed daily.[30]

Source: IFC (2019), Irisguard (2020)

Case Study – Blockchain provides a single source of truth for customer data and effectively enforce regulatory compliance

The Dubai Economy and Emirates NBD launch UAE KYC blockchain platform to provide effective regulatory oversight

Challenge

The country wanted a platform that serves as a nationwide system for exchanging verified customer data to enforce a single version of truth.

This is in alignment with the government's vision for a sustainable digitised economy to improve the ease of doing business in the country.[31]

Approach

This project was done in partnership with Norbloc, a global leader in blockchain technology with the support of Smart Dubai and the Central Bank of UAE.

The blockchain platform is designed to facilitate the seamless registration and onboarding of customers and provide instant functionality of bank accounts and sharing of verified KYC data with appropriate authorities and financial institutions on the platform.[31]

Results

- Over 120 companies were instantly onboarded by Emirates NBD and provided with active and operational bank accounts
- Dubai has migrated all active trade licenses (40% of active trade licenses in UAE) to the blockchain platform.[31]
- Financial institutions and Regulators can effectively manage and securely share verified Know Your Customer (KYC) data.[31]

Source: International Finance (2020) PwC Analysis

04

Access to Finance

4.3

Use Case 3 - Blockchain can be leveraged to enhance access to finance for excluded groups and MSMEs

Access to Finance

- Supply chain financing
- Input financing
- Micro and decentralised lending
- Micro savings and investments
- Real estate assets

Background

- Limited access to credit and other forms of finance is a major constraint to the growth of MSMEs in Nigeria and the economy at large
- Obstacles faced by banks include limited availability of credit information, high costs of recovery of bad debts among others which contribute to high interest rates which are largely prohibitive
- In addition, the process of conducting credit risk management for customers is largely cumbersome and expensive
- On the customer end, there is a widespread lack of information about available finance options, lack of access to financial institutions amid a low-trust environment

How Blockchain can help

- Blockchain can be used to facilitate easy account opening, using decentralised identity management tools. Potential customers could access and register using their mobile phones and customer information could be stored securely on the blockchain
- Blockchain offers the capability to exchange trade-related data between participants securely and efficiently. Furthermore, due to the encrypted nature of blockchain, third-party financiers can offer suppliers advance financing with much reduced risk of default or fraud
- In addition, smart contracts can be generated, permitting the performance and enforcement of contract terms between participants without third-party intermediaries

Potential Benefits

- Increased access to diverse sources of funding
- Inclusion of the financially excluded to the formal financial sector
- Enhanced visibility of transactions and commodities throughout the supply chain
- Enhanced traceability and authenticity of financing activities
- Enables a high-trust environment for the flow of trade and project-related finance
- Access to finance for semi-formal, SME suppliers as opposed to traditional, large suppliers

Source: OECD (2020), PwC Analysis

Case Study – Using blockchain to improve payment networks to increase access to finance for the unbanked population

Project i2i

UnionBank of the Philippines partnered with ConsenSys to build an enabling and accessible payment network to integrate rural banks to the domestic financial system and drive financial inclusion in the country

Challenge

The Philippines is a rapidly developing economy with a population of over 100 million. However, 70% of Filipinos are unbanked and 56% of the unbanked reside in rural areas, having limited access to financial services.[33] The UnionBank of the Philippines aimed to tackle the financial inclusion gap.

UnionBank partnered with 476 existing rural banks that have established presence to include the unbanked Filipinos in the respective areas.[33]

Approach

UnionBank partnered with ConsenSys solutions to build a decentralised platform. Leveraging Enterprise Ethereum, the solution will ensure cost-effective real time inter-rural payments to connect rural banks to each other and to the national commercial banks. The pilot-project was done with seven (7) rural banks to include rural banks to domestic financial system and increase access in communities they operate.[33]

The aim of the project was to overcome the lack of basic technological resources across rural areas and include rural banks into the domestic financial system to increase service offerings.[33]

Results

- Streamlined banking operations – eliminating 20 intermediary steps required to complete a domestic transaction and reconciliation process.[33]
- Easy operability for local banks with low technology infrastructure
- Automated real-time reporting
- Onboarded 476 banks on the system to join the inter-bank partnership.[33]
- Increased access to financial services for Filipinos

Source: ConsenSys Solution (Project i2i [48]

Case Study – Crypto-companies are providing alternatives to traditional banking offerings to reach the unbanked and underbanked

The Ripio platform offers a single sign-on solution to access Ripio products and sensitise users on the potential of cryptocurrencies

Challenge

Strengthen Argentina's digital economy by offering alternatives to the traditional banking solutions while focusing closely on reaching the unbanked and underbanked.[34]

Approach

Ripio, a Latin America based cryptocurrency company utilises blockchain to build financial products. The platform unifies all financial products (e.g. Ripio credit, Ripio exchange, Ripio wallet, Ripio account etc.) provides a solid user experience various investment for all segments of the population and educational content for users to learn about cryptocurrencies.[34]

Ripio partnered with several banks across the Argentina, Brazil and Mexico, including Mercado Libre (LatAm's largest e-commerce) and is in the process of expanding to Colombia, Paraguay, Peru and Chile.[34]

Results

- Increased growth in the use of stable coins, with over 300,000 users across Argentina, Brazil and Mexico (aged 25 and 40) were onboarded on the platform.[34]
- Savings in cryptocurrencies are protected against the constant devaluation of local currency.
- The political uncertainty and impact of de-risking are influencing the adoption of cryptocurrency and blockchain-based financial products in the region. In addition, the lack of adequate capital funding and regulatory clarity and technological ecosystem might hinder widespread adoption.[34]

Source: BlockTelegraph (2019)

Case Study – Enhancing Financial innovation and increasing trust using blockchain-enabled technology

The Tunisian post collaborates with fintech companies to form a successful public-private partnership that leverages blockchain enabled technology to enforce trust and improve financial inclusiveness in the country.

Challenge

In 2015, over 3 million Tunisians (approximately 27% of the population) were excluded from the financial system.[7]

With the aim to reduce the financial inclusion gap, Tunisia's postal service sought a blockchain enabled solution to serve as a national payment platform.[7]

Approach

The Tunisian post, in collaboration with DigitUs and Monetas, launched a mobile money payment platform (e-Dinar) to increase financial inclusion for the citizens. This was part of the country's transformation journey to a digital economy and modernised financial service offerings.[7]

The e-Dinar digital wallet is backed by the local fiat currency, leveraging on Monetas crypto-currency infrastructure, to ensure instant and secure payments. The Tunisian post controls the issuance and circulation of the e-Dinar to avoid illegal transactions.[7]

The platform allows users pay bills, withdraw cash at ATMs, manage official governmental identification documents, send and receive money at minimal transaction costs.[7]

Results

- Users can pay bills, withdraw cash at ATMs, manage easily.[7]
- Citizens can process official government identification documents
- Reduced transaction cost to send and receive money.[7]
- A successful public-private partnership that enforces trust and improves financial inclusiveness in the country.[7]

Source: Coindesk (2015)

Case Study – Enhancing security through blockchain-based identity verification system

ShoCard and Alharmrani Universal partnered to tighten verification process of customers and improve access to financial services

Challenge

The rising cases of card related fraudulent activities and access to personal banking information posed a significant problem in Saudi Arabia. This led to the need to change the card security sector in the country and sensitise customers to prevent them from being victims of such criminal activities.[35]

Approach

ShoCard, US-based blockchain identity platform, partnered with Alhamrani Universal, the largest in automated teller machine (ATM) in Saudi Arabia, to develop the country's first biometric bank access technology.[35]

The new payment system is a 5-step approach that involves a specific ShoCard ID, a QR code issued by the mobile app, timestamp verification and photo recognition and other certification.[35]

Integrating blockchain technology into the process allows the ATM machines access the necessary information about the issuer bank and the customer, thus verifying their identity and confirming that the requested funds are available without the need to type in a PIN code.[35]

Results

- The collaboration helped Saudi Arabians to address card fraud issues, especially security challenges when using the ATM. The blockchain-based app with facial recognition, enabled withdrawals without the conventional personal information number (PIN).[35]
- Increased interoperability across banks. Banks could obtain and access customers' identity, regardless of the users' bank, through the ID authentication prototype without retrieving it from the database.[35]

Source: Business Blockchain HQ,(2019)

Case Study – Enhancing Financial innovation and increasing trust using blockchain-enabled technology

Postal Savings Bank of China teams with IBM to develop a blockchain-based asset custody system to boost innovation in the financial service industry and improve efficiency of risk management

Challenge

China hosts one of the largest banking sectors and the world's dominant bitcoin trader controlling 98% of the market value. The country is focused on developing a strong internet finance industry to address the demand for financial inclusion by leveraging on blockchain-enabled technology.[36]

Approach

In 2016, the Postal Savings bank of China, in collaboration with IBM, used Hyperledger Fabric to create China's first blockchain-based asset custody system.[36]

The PSBC system allows the multiple parties involved to share information real-time. The encryption and immutability features ensure that information shared by registered parties is secure. The smart contract and consensus mechanism integrates investment compliance verification regulations.[36]

This fosters trust among participants and eliminates the need for repeated verifications.[36]

Results

- Operation processing reduced by 60% - 80%.[36]
- Successfully executed over 100 real business transactions on the blockchain within two months.[36]
- Enhanced trust in financial service system.[36]
- Increased efficiency and streamlined credit verification process.[36]

Source: IBM (2017)

04

Land Titling and Registration

4.4

Use Case 4 - Blockchain can be leveraged to enhance the efficiency of the Land administration system and the real estate industry

Land Titling and Registration

- Permanent, tamper-proof records of land ownership and associated transactions
- Comprehensive database of urban plans and foundation for technology-enabled cities
- Tokenisation and smart contracts create the potential for fractional ownership of real estate

Background

- Land administration is a major contributor to economic development. An efficient land administration system guarantees ownership and security of tenure for title holders, facilitates land and property taxation and enhances credit access for title holders
- Nigeria's current land administration system poses several challenges which include:
  - Tenure insecurity which has led to speculative activity in the real estate industry
  - Possessory uncertainty which may develop in low levels of property development in contested and volatile areas
- In addition, the system is largely paper-based and riddled with bureaucratic inefficiencies

How Blockchain can help

- Blockchain provides a potential solution for land titling challenges in Nigeria by proffering a database for recording ownership of land and assigning to owner accounts.
- In addition to ownership information, related information such as structural changes, permits, financial transactions using the property as collateral and securitisation may be recorded on the blockchain as well
- In the event of a sale, a comprehensive set of information about the property would be transferred to new owners in a secure manner
- In addition, Blockchain can be leveraged to improve collaboration and enhance efficiency across the entire real estate value chain: from administration, through construction financing and contracting, to property management

Potential Benefits

- Increased compliance with law and building regulations
- Reduction in land-related fraud
- Traceability and authenticity of land information as all transactions are timestamped and indisputable
- Protection from risks associated with storage of paper-based data
- Enhanced privacy and security as access to relevant documents is restricted to the owners and relevant parties
- Potential for fractional ownership of real estate
- Smarts contracts can be used to facilitate the generation of revenue for government via charges and taxes

Source: OECD (2020), Center for Financial Inclusion, PwC Analysis

Case Study – Leveraging blockchain to improve the security of government land registry

The Republic of Georgia collaborated with Bitfury to build trust in government land registry management

Challenge

The land registry system was previously managed by Bureau of Technical Inventory and the State Department of Land Management. They managed separate land records systems and this led to significant overlaps in records giving room to illegal change to land records by government officials. It was difficult to trace or track when these fraudulent activities occurred.[37]

In 2004 the National Agency of Public Registry (NAPR) replaced both agencies to manage land titles and related records digitally however, this did not address the issue of land titles being altered illegally.[37]

Approach

In 2016, the Georgian government partnered with Bitfury Group, a bitcoin hardware and software company, to launch a one-year pilot project to move the country's land registry system to a blockchain platform, making land titles immutable and secure.[37]

The first phase of the project require Bitfury to create a blockchain based timestamping layer on top of National Agency of Public Registry's (NAPR) existing digital system. This adds the immutability feature to the records, allowing land owners show this as proof that assets are authorised by NAPR. This provided an efficient and transparent system for investors and Georgians.[37]

Results

- Time spent on land registration process improved from 1 day on the previous system to 10 minutes. The success of the project was largely driven by accurate data and high literacy levels of blockchain technology.[37]
- All processes can be audited on the blockchain in real time.[37]
- By 2018, over 1.5 million land titles in Republic of Georgia were published on the blockchain.[37]
- Timestamping features on the system allow owners prove legitimate ownership of the land.[37]
- The success of the first phase expanded the project further to include land sales and transfers to allow users access property information on the NAPR website for properties put up for sale.[37]

Source: Qiuyun Shang and Allison Price(2019)

Lessons learnt for Nigeria

Public sector commitment

Commitment from public sector is important to improve financial inclusion by providing an enabling infrastructure with proper regulation for effective supervision.

Consumer protection

For a regulatory approach to thrive, it must consider market operations and consumer protection among banks and non-bank players.

Public Private Partnerships (PPPs)

Partnerships across public and private sectors is important to deepen the reach to the underserved and maximise gains from expanding the digital finance economy.

Interoperability across players

Increased interoperability across Digital Financial Service (DFS) providers will improve P2P transfers and ease transaction settlements.

Access to financial services

A boost in FI translates to greater access to a wide range of financial services such as savings, insurance, pension, transfer of funds and other payments.

Reliable data source

Regulators will have access to reliable data from a single source of truth which will in turn increase efficiency across government services, organisations and customers.

Reduction in leakages

Using blockchain technology for G2P payments can lead to significant reduction in leakages due to direct transfers to the targeted bank account holders.

Source: PwC Analysis

Recommendations in Driving Financial Inclusion Using Blockchain

05

We have identified stakeholders in the financial ecosystem that are required to support the collective action for blockchain adoption in Nigeria

Regulators

- Central Bank of Nigeria
- NITDA
- SEC Nigeria (Securities and Exchange Commission Nigeria)

Financial Institutions

- Commercial Banks
- Insurance companies
- Fintechs
- Microfinance Banks

Donor Agencies and Financial Sector Deepening (FSD) organisations

- World Trade Organization
- EFInA
- UNCDF (Microfinance • Capital Development)
- UKaid (from the British people)
- Bill & Melinda Gates foundation

Developmental Institutions

- International Monetary Fund
- World Bank
- Corporate Affairs Commission (CAC)
- Bank of Industry (...transforming Nigeria's industrial sector.)
- African Development Bank / African Development Fund

Source: PwC Analysis

05

Strategic Initiatives for Regulators

5.1

We identified regulatory recommendations to balance risk management and provide an enabling environment for blockchain technology adoption

1

Be a part of the innovation from inception

More than ever, regulators need to stay ahead of trends and disruptions. To this end, regulators need to be part of the innovation early to understand the technology and implement the right policies to monitor and supervise all stakeholders.

2

Create a risk-based regulatory system

Regulators need to adopt a risk-based regulatory system as opposed to a prescriptive approach in identifying the possible risks to adopting proposed developments and technologies. This way, regulators can evaluate the risks and implement appropriate controls, policies and procedures to mitigate or reduce the risks to acceptable levels and ensure compliance across the respective stakeholder groups.

3

Apply a needs-based approach to support innovators

The effect of blockchain varies significantly from country to country, therefore, regulators need to align the unique characteristics of Nigeria's financially excluded with initiated policy guidelines. This must be dynamic to keep pace with consistently evolving technologies. It will eventually build trust in financial institutions and users of financial products and services.

4

Transparent regulatory environments

The success of increasing FI through the technology is not only premised on the activities of the banks, the non-bank financial institution and players such as Fintechs, telecom companies, big data analytics firms and crowdfunding companies are also very crucial. Hence, regulators need to constantly adopt transparent and simplistic regulatory approaches to attract new players, as well as keeping existing ones. Furthermore, they have an important role in inspiring more innovators and disruptors, and ensuring fair competition, while guaranteeing that macroprudential conditions are not compromised.

Source: PwC Analysis

Use Case Exploration 1: The CBN can issue a digital currency underpinned on a permissioned blockchain to lay a foundation for a CBDC to drive financial inclusion

Issuer

Central Bank of Nigeria

- The Central Bank of Nigeria will issue CBDC units which are backed by the fiat currency
- The CBN will also act as the AML authority and ensuring compliance with set limits
- The Bank of Thailand, the Central Bank of Brazil and the South African Reserve Bank are among some of the global central banks that are exploring CBDC as a mechanism for interbank transfers.

Intermediaries

Commercial banks and relevant financial institutions

Financial institutions will exist as nodes on the blockchain and will act as intermediaries, distributing CBDCs to users through their agent networks and digital channels

Government

Government can drive effective Conditional Cash Transfers (CCT) and other Government to People (G2P) payments through the CBDC ecosystem to reach end users with speed and ease

Payments Terminal Service Providers (PTSPs)

Agent Network

Using existing NFC enabled POS terminals provided by registered PTSPs, POS Agents can onboard users and provide services, including those financially excluded or those that lack smartphones to connect to the network directly

Users

Smartphone Users / Financially Included

Digital Wallet

Digital Wallet

Financially Excluded (Offline)

NFC device

NFC device

Customers can access services such as Payments (P2P and G2P), savings, lending and investments

Tiered KYC, Cryptography, Smart Contracts

Keywords
NFC = Near field communication enables short-range communications between compatible devices
NFT = Non-fungible tokens are used to create verifiable digital scarcity, as well as digital ownership.

Source: PwC Analysis

Using existing NFC enabled POS terminals and NFT smart contracts, transactions can be done in an offline and online capacity

How can offline transactions work?

Using a combination of NFC, NFT Smart contracts, tamper-proof POS devices and a custom blockchain implementation one is able to perform hybrid offline transactions in a secure manner using the below process:

Onboarding

1. User approaches POS Agent for an account and undergoes basic KYC.
2. POS Device validates info for tiered-KYC accounts to avoid duplicity.
3. POS Agent educates user about NFC card (wireless plastic card (like an atm))
4. POS Agent generates account for user and helps user setup pin on NFC card.
5. The NFC Card stores encrypted cryptographic keys needed to sign transactions.
6. Address of wallet can be funded easily henceforth by anyone that knows it.

Transacting

1. User approaches POS Agent to perform a transaction
2. POS Agent asks user to place NFC Card on POS device and enter pin/password
3. User enters pin/password and NFC card encrypted ledger is decrypted with pin/password.
4. POS device reads the NFC card encrypted ledger and is able to perform deposit/withdrawals.
5. POS device compares and updates the NFC Card ledger with its Device ledger.
6. User performs deposit, withdrawal or transfers using the POS device.
7. NFC Card ledger balance and transaction is updated..

If offline?

- NFT Token is generated to represent value of transaction.
- POS Agent cannot redeem/spend the value of the transaction
- POS Agent is incentivised to connect online and earn fees.

When Online?

- POS Device broadcasts and finalizes transactions authorised by the user.

Actions to be Taken

- Conduct stakeholder education around blockchain concepts, especially cryptography and smart contracts
- Delegate the user onboarding of the financially excluded or underserved to agents
- Standardise CBDC transaction guidelines towards ensuring that wallets are built and operated securely
- Integrate the CBDC network with existing stakeholders and platforms (i.e. NIBSS, BANKS, PTSP, SWITCHES, SANEF)
- Standardise POS Agent devices to ensure they are eligible to run tamper-proof blockchain applications

Source: PwC Analysis

The use of a Nigerian CBDC powered by a permissioned blockchain technology blockchain could reduce transaction and transfer fees by 99.99%

01 A Central Bank Digital Currency (CBDC) provides flexibility of paper-based currencies and yet retains the traceability of online fund transfers

02 The adoption of a CBDC will foster price stability, particularly with respect to inflation as it allows for incremental changes in price as opposed to rapid change in general price levels

03 The use of a Nigerian stablecoin will offer a safer, quicker and traceable medium for cross-border payments and remittances. This will support the government's effort to improve the country's FX reserves

04 The use of CBDC can significantly reduce interbank transaction cost and improve settlement efficiency

- Using a custom blockchain network like Litecoin or Flashcoin to run the Nigerian stablecoin could reduce transaction fees by 99.99%.
- Additionally, the decentralised feature and proof-of-authority (a delegate consensus model) ensures that only pre-authorized institutions can verify transactions on the network.

Network	Transaction Value	Transaction Cost	Transactions Costs (%)
Litecoin / Flashcoin	N50,000.00	N0.002	0.000004%
NIBSS Instant Payments (NIP)	N50,000.00	N52.50	0.105%
		Transaction Cost Difference (%)	0.104996%
		Transaction Cost Savings (%)	**99.99%**

Source: PwC Analysis

Key Considerations for the adoption of a central bank digital currency (CBDC)

1

Know-your-customer confirmation

One of the biggest hurdles to the adoption of DLT-based CBDC is how to ensure disruptors comply with the know-your-customer (KYC) before onboarding new customers. To embrace DLT for FI, the CBN will require that disruptors still adhere to the KYC approach before customers are onboarded to carry out any transaction whatsoever.[1] This is an important element of the AML process to preserve the sanctity of the financial services ecosystem.[1]

2

70% to 80% public awareness before execution

The CBN should ensure all stakeholders are empowered to educate Nigerians on how the DLT-enabled financial system works along with issuance of comprehensive guide on the benefits and inherent risks of DLT.[1]

3

Protecting customers

Safety of customers' wealth and incomes is crucial to the regulators, which has led to frequent updates to existing CBN rules to ensure customers are adequately protected in order to sustain the trust in Nigeria's financial system. Therefore, a new approach to financial services like blockchain technology must hold some commitment to consumer protection. Cybersecurity is a pressing issue in the financial sector.[1]

Source: PwC Analysis

Use Case Exploration 2: We also recommend the set up of an intergovernmental regulatory approach to provide a revised policy for emerging technologies in the financial sector

Regulators should promote intergovernmental working groups and encourage an adaptive regulatory approach to emerging technologies to better address the dynamic nature of the financial services sector. This will help reduce regulatory friction and provide a safer environments for blockchain experiments.

It is important to explore the participation of key stakeholders that can impact financial inclusion including CBN, NIBSS, NCC, SEC, CAC etc. in collaboration with technology companies to conduct testing and experimentation of appropriate blockchain applications and fast-emerging technology innovation to support the financial sector.[1]

South Africa has explored the approach of an intergovernmental fintech working group to develop a regulatory approach for fintech and cryptocurrencies as well as other emerging technology as it relates to the financial services sector.

Recently, the group conducted an experimental project named “Project Khokha” in collaboration with a DLT company to develop a proof-of-concept for the use of DLT for interbank clearing and settlements which allowed SARB and other key stakeholders in the industry assess the potential and possible risks (refer to the case study on page 44 for details).

Regulators must consider the following key factors

Regulatory Framework

Ensure flexibility in the structure of the intergovernmental group to exercise discretionary exemptions and waivers to partner technology firms

Adequate Resources and Capacity

A fintech working group requires suitable staff and funding to provide the appropriate support for blockchain technology developments.

Stakeholder Ecosystem

The borderless nature of blockchain technology introduces some complexity to regulatory oversight. It is important that regulators explore beyond local partnerships but also encourage international collaborations.

Market Conditions

It is important to understand the players in the market, the level of existing competition and the types of offerings to ascertain the quality of innovation and identify market growth opportunities

Source: PwC Analysis

Use Case Exploration 3: Increased collaborations with technical vendors to establish a multi-protocol, infrastructure agnostic Blockchain as a Service (BaaS) platform for Nigeria

Blockchain-as-a-service (BaaS) enables an open, flexible and scalable blockchain platform for organisations.

This is a cloud delivery model where the blockchain platform is provided by a vendor as an on-demand service upon which blockchain use cases and applications can be developed and deployed.

Blockchain as a Service (BaaS) provides a rapid, low-cost, low-risk platform to enable organisations to collaborate by experimenting with new business processes; backed by a cloud platform.

Regulators and/or financial services providers in Nigeria can collaborate with technical vendors to establish a cloud-based Blockchain-as-a-Service platform where Nigerian financial institutions can easily subscribe to and build blockchain-based solutions that will drive financial inclusion. With a BaaS platform, financial institutions can, at a low cost, easily create new applications without the hurdle of developing blockchain protocols or provisioning infrastructure from scratch.

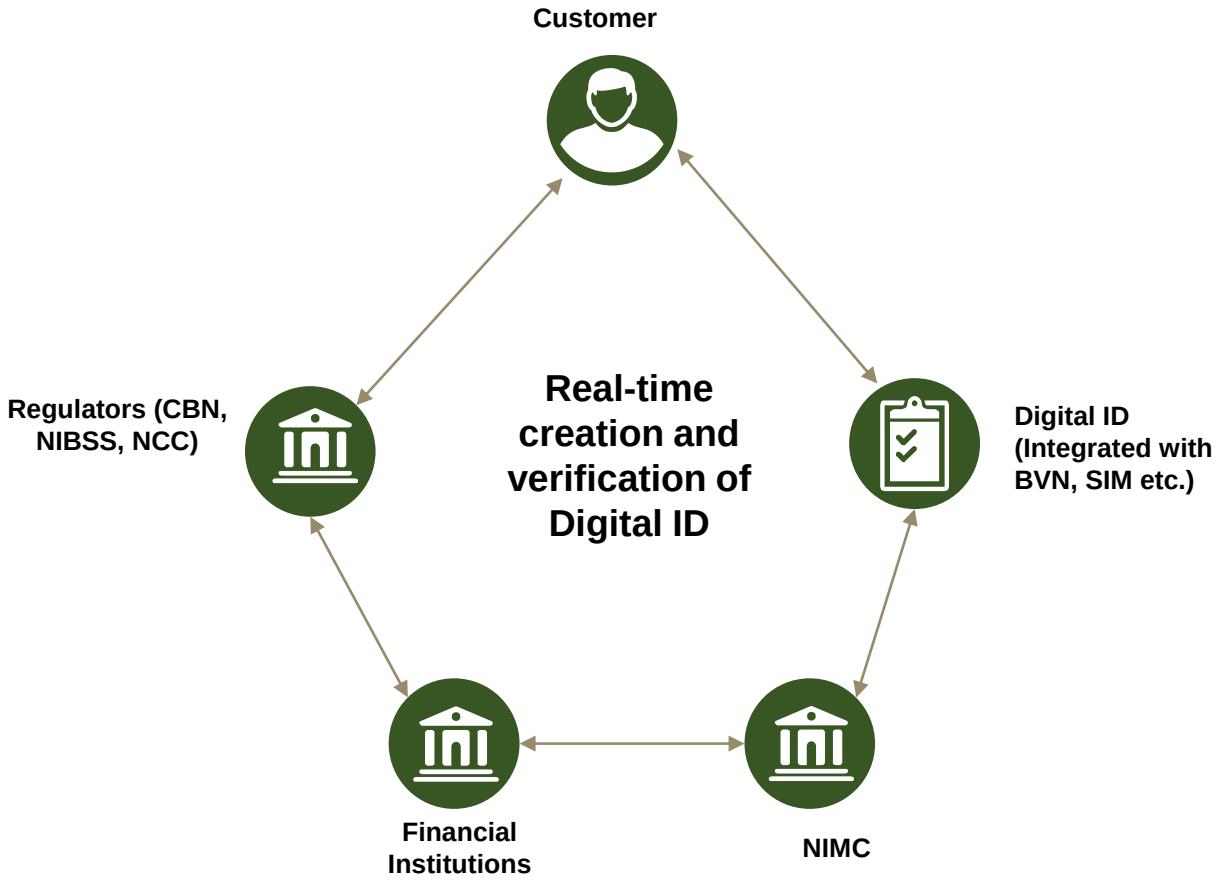
BaaS examples

Ethereum Blockchain as a Service by Microsoft Azure	Azure's blockchain platform addresses specific business and technical requirements for security, performance and operational processes. Microsoft's Azure Blockchain-as-a-service (BaaS) has attracted about 26 members and continues to gain traction in the market.[38]
IBM Bluemix Blockchain	Bluemix enables developers to create digital assets and accompanying business logic to enable secure and private transfer of assets and value among members of a permissioned blockchain network.
PwC Vulcan blockchain platform	Vulcan is a cloud-based platform that enables banks and corporate organisations to offer a suite of new digital currency related products and services to individual, retail and institutional customers within a trusted, transparent and compliant ecosystem.[1]

Source: PwC Analysis

Use Case Exploration 4: Blockchain can complement the existing NIMC Identity Management process

- We recommend the synchronisation of the national biometric identity management, BVN, SIM registration systems with the blockchain technology-driven digital identity service to create a national digital ID network that supports end-to-end self enrollment on-the-go.
- This synergy will help provide crucial privacy features like ensuring that organisations or persons who access a person's ID record can only do so for purposes of authentication & confirmation, and not for tracking them, or getting access to all their data – with the exception of security agencies accessing data for security verification and purposes.
- New data captures can be done remotely using a blockchain-enabled data entry platform. This will in turn create employment opportunities as anyone with a smartphone can become an enrolment agent.
- Since it rides on blockchain technology there is reduced risk of data breach or misuse, and only the identity owner will be able to grant access to the captured information; personally identifiable information cannot be stored or forwarded by third parties. This gives a form of integrity and confidentiality to the captured data.



Source: PwC Analysis

Additional strategic initiatives that can be implemented by regulators to maximise gains from blockchain include the following

01 

Develop policies that would ensure compatibility of blockchain technology with existing privacy and data protection framework. Regulators and policy makers have a great role to play in striking balance between promoting innovation using blockchain technology and safeguarding the interest of customers.

02 

Relevant regulators such as the CBN, SEC, NITDA and NCC should provide the vision and leadership for blockchain through industry-wide consultation with key stakeholders in the blockchain community. This is with a view to ensuring that policies are developed to globally acceptable industry standards that will enable collaborations and faster adoption of the technology within the country.

03 

Regulators should accelerate blockchain research and awareness across use cases in the financial sector.

Source: PwC Analysis

Strategic Initiatives for Financial Sector Deepening (FSD) Organisations

05

5.2

We identified initiatives that can be implemented by Financial Sector Deepening (FSD) organisations to maximise gains from blockchain

01 

Implement policy advocacy, capacity development initiatives, training and knowledge sharing through conferences, hackathons, exhibitions, symposiums, events etc. for various stakeholder groups including financial sector regulators, blockchain experts, programmers, software designers.

02 

Set up dedicated funding desks for fintech startups working on embedding blockchain-enabled technology to drive financial inclusion and poverty reduction especially for the underserved such as the poor and MSMEs.

03 

Provide reliable industry data on an ongoing basis through evidence-based research that offers insights into the state of the Nigerian financial sector and the role of emerging technologies (blockchain, IoT, AI etc.) in driving financial inclusion.

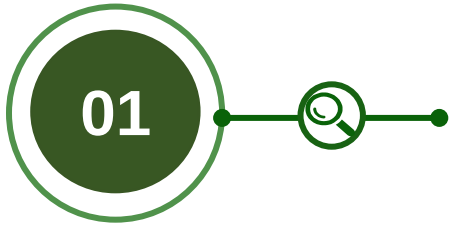
Source: PwC Analysis

05

Strategic Initiatives for Development Institutions

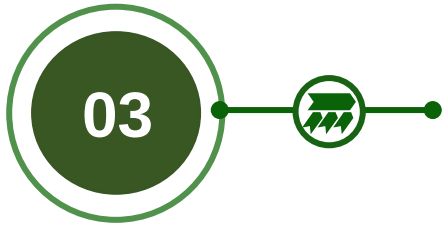
5.3

We identified strategic initiatives that can be implemented by developmental institutions to maximise gains from blockchain



Establish a network comprising regulators and relevant stakeholders within the region for industry-wide collaboration and cooperation.

Provide technical support to regulators for the development of blockchain technology and tools within their ecosystems.



Participate in dialogue, brainstorming and enlightenment sessions via conferences and seminars to identify development issues and potential technology-enabled solutions.

Source: PwC Analysis

05

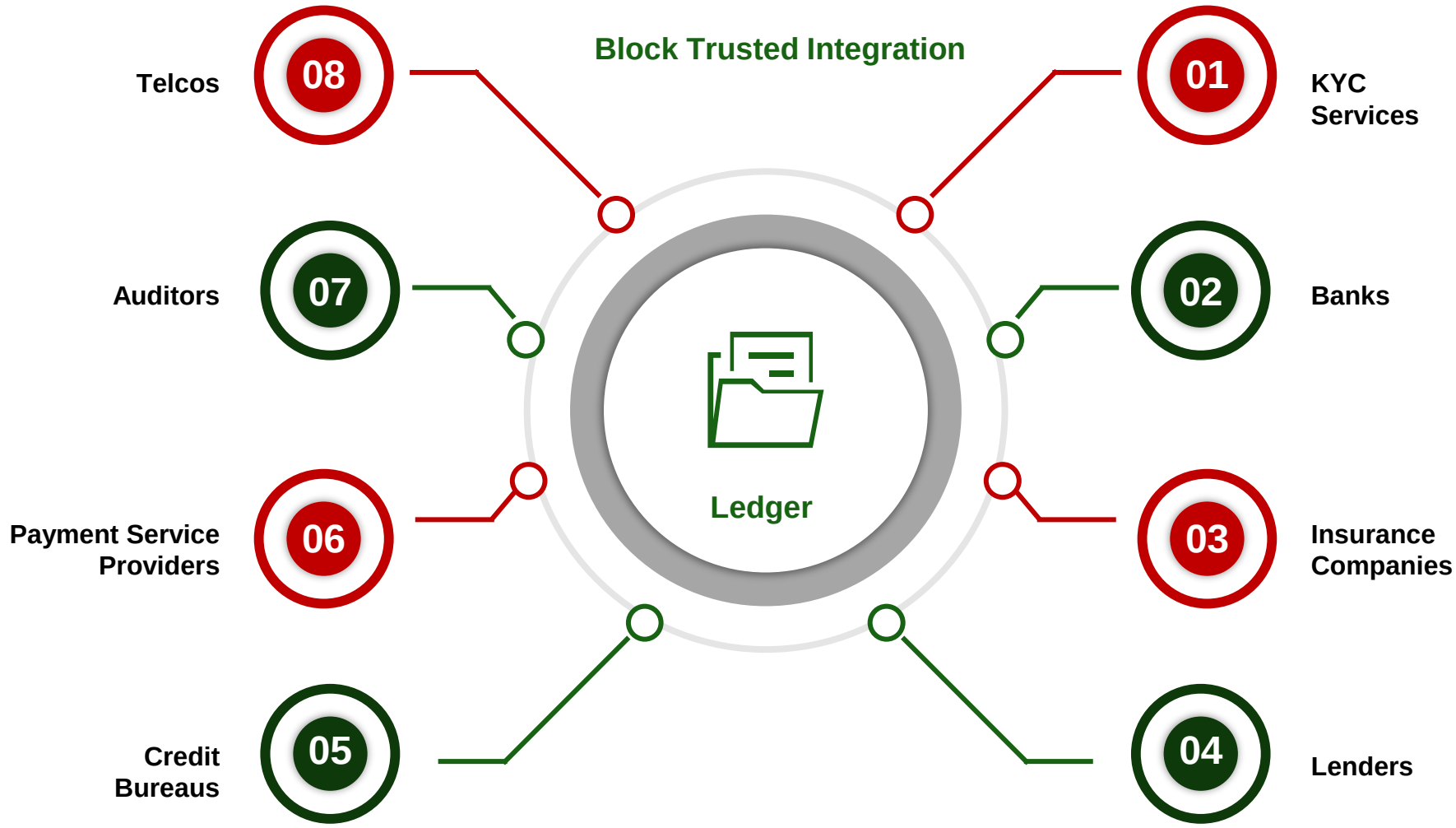
Strategic Initiatives for Financial Institutions (DMBs, MfBs, Fintechs, Insurance etc.)

5.4

Use Case Exploration 1: Set up a consortium with other players within the financial services ecosystem to provide blockchain-based solutions that address current state challenges

Explore forming a consortium with other players within the Nigerian financial services ecosystem (Banks, MFBs, Insurance companies, Telcos, Credit Bureaus etc.) to develop and test blockchain-based financial and banking solutions that address current state challenges and improve access to finance for banked and unbanked Nigerians.

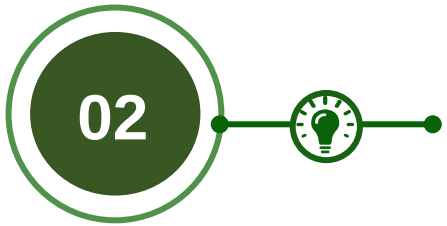
Increasing the parties involved in a blockchain increases benefits, hence the potential for different players within the financial ecosystem to experience significant value by being part of a consortium.



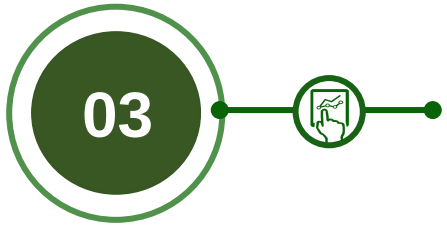
Source: PwC Analysis

Additional initiatives that can be implemented by financial institutions (DMBs, MfBs, Fintechs, Insurance etc.) to maximise gains from blockchain include

Improve interoperability of systems to facilitate easier connectivity and collaboration with other players in the financial ecosystem



Participate in industry-wide awareness, educating Nigerians on the impact of blockchain-related solutions and the importance of privacy and security of key resources



Conduct ongoing research on the use of blockchain to drive inclusive financial services and solve problems being experienced in the financial ecosystem

Source: PwC Analysis

05

Environmental Considerations

5.5

Environmental considerations for government and stakeholders in shaping the adoption of blockchain to maximise environmental benefits

Environmental impact of blockchain technology for crypto-currency

- The increased demand for servers required to power blockchain especially for mining crypto currencies like Bitcoin affects the environment, as servers occupy spaces in buildings and consume enormous amount of energy.

- Bitcoin runs on an energy intensive network due to its trust minimizing consensus powered by the proof of work algorithm. Every miner has to individually verify that the transactions are valid and abide by the predefined set of rules and this requires huge amounts of energy. It is estimated that bitcoin energy consumption from a single transaction is comparable to the energy consumed in an average U.S household in 23 days while the average annual energy used is 77.78TWh, which is equivalent to energy consumed annually in Chile. [40]

Implementing Blockchain to support environmental sustainability

Blockchain has the potential to empower stakeholders and reduce the cost associated with environmental governance by decentralizing and digitizing the evidence of trust. A key characteristic of the blockchain technology to consider in supporting environmental sustainability, is the ability to verify transactions to establish a consensus at a given time. There are two common methods used for verification of transactions: ***Proof of Work (PoW)*** and ***Proof of Stake (PoS)***.[39]

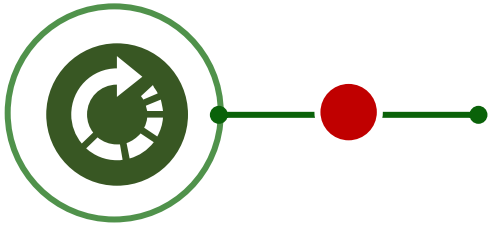
- **Proof of Work (PoW):** The PoW concept means that each block is verified through a process called “mining” before information is stored. Complex algorithms are computed that attach a unique hash to each block to verify the information stored in it. This is a continuous process to verify the hashes of each transaction in order to update the current status of the blockchain assets. It is costly, energy intensive and faces speed constraints as the network grows as it requires multiple computers to undertake complex cryptographic calculations. Early blockchains such as Bitcoin use PoW verification.[39]

- **Proof of Stake (PoS)** – With the PoS approach, users can validate and make changes to the blockchain on the basis of their existing share (“stake”) in the currency. This approach simplifies the mining process and reduces the complexity of decentralised verification to deliver large savings on energy and operating costs. Gradually more, emerging blockchains such as Ethereum, NEO and WAVES use PoS verification.[39]

Although the PoW concept is the most widely used verification method when using blockchain technology, the concerns of cost, high energy consumption and scalability has given rise to emerging blockchain applications using PoS and other less cost and energy-intensive verification methods like “proof of Authority” (PoA), “proof of importance” (PoI) and “proof of history” (PoH).[39]

Source: PwC (2018), Digiconomist (2020)

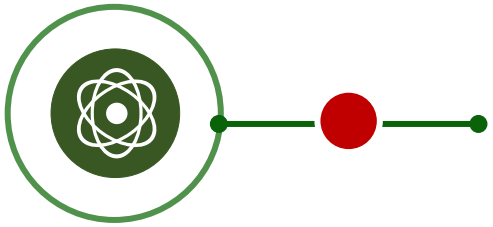
Nigeria can benefit from the following recommendations to strengthen the success of blockchain adoption for environmental sustainability



Promote the use of energy saving verification methods

Encourage the use of Proof-of-Stake (PoS) consensus algorithm and other low cost, energy saving verification methods like Proof-of-History (PoH), Proof-of-authority (PoA) etc. over Proof-of-Work (PoW) by providing incentives to blockchain innovators to reduce environmental footprint.

Government can use fiscal controls, like introducing levies on transaction that rely on blockchain technologies that pollute the environment to encourage a shift to less energy-intensive consensus protocols.



Establish a responsible blockchain ecosystem

Create measures and policies for the design, deployment and governance for blockchain solutions to ensure responsible use for society and the environment. These measures include: compliance with privacy rights, accountability for actors participating in the ecosystem, and a harmonised set of standards to guide engagements with regulators and organisations in order to minimise energy consumption.

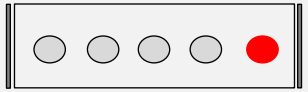
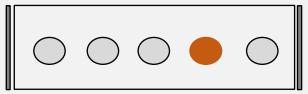
Additionally, organisations that have to use the PoW consensus algorithm to support their functions should be required to publish their ESG or sustainability report, and provide evidence of offsetting the environmental footprint of their operations.

Source: PwC Analysis

Possible Risks of Blockchain Technology and Cryptocurrency Adoption

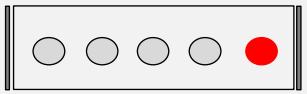
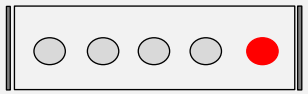
04

The potential risks that must be considered and addressed in the adoption and implementation of blockchain-enabled solutions (1/3)

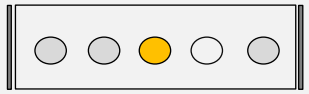
Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
1 Cyber Security With the rising adoption of digital currencies, there is an increased exposure to cyber crime. The nature of the digital currencies allows record of transactions and wallet information to be stored and publicly accessible to all participants on the network. This poses issues of cyber security and data ransoms to new forms of social engineering and data discrimination.			• Collaborative efforts led by the government with leading technology companies and engineering experts to drive a coordinated and effective cyber security architecture and framework that will shield systems set-up for digital currencies.
2 Illicit activities (e.g. money laundering and terrorism financing) Like other technology driven solutions, the increase in usage of digital currencies heightens the risk of illegal financial activities occurring. This threat is not unique to DLT as other technology-driven solutions have always been vulnerable to cyberattacks and intrusions. However, there is opportunity for DLT to help regulators properly monitor financial services activities.			• Create a strong data governance framework to help regulate, track and trace useful insights to protect against corrupt or illicit data sources and transactions. This will enable regulators have visibility on activities to properly monitor exchanges and transactions real-time based on the transparent feature of the blockchain technology. • Support efforts in data governance technologies and provide a platform to engage private sector and government agencies to improve data governance. • Institute a robust KYC procedure for onboarding all participants within the digital currency ecosystem

Source: PwC Analysis

The potential risks that must be considered and addressed in the adoption and implementation of blockchain-enabled solutions (2/3)

Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
3 Interoperability The features of blockchain technology permits individuals and organisations across territories or countries to exchange data and transact easily without restrictions. Increasingly, organisations are creating their own blockchain technology resulting in a highly fragmented network, thus, reducing the ease of data exchange with other ledgers and/or with legacy system.			• Build a shared architecture leveraging open APIs that is interoperable across solutions deployed across government services sectors. This will lead to more integrated data to better measure performance and improve service delivery. • Ensure transparency of data such that it is easily accessible by the public. • Create a strong data governance framework
4 Privacy risks Although DLT is perceived to be more secure than a centralised ledger, it does not guarantee equivalent safety for every unit of account. Therefore, appropriate measures need to be put in place to maintain the integrity and security of data on the ledger.			• Design and implement a robust policy framework to protect the privacy and security of digital identities and data to create a more balanced model for data security and ownership.

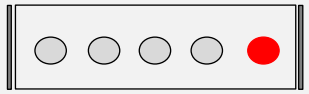
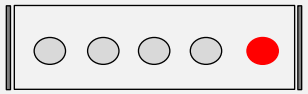
The potential risks that must be considered and addressed in the adoption and implementation of blockchain-enabled solutions (3/3)

Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
5 Threats to existing jobs The adoption of DLT to automate processes and reconciliation of transactions reducing operational cost significantly. Although job opportunities created by this technology will be significant - security fields like encryption and identity protection, existing jobs in the fields of audit, transaction processing and validation will become irrelevant with the wider adoption of blockchain technology.			• Closing the digital innovation gap by creating and investing in a more innovative technology inclined work environment across public and private sectors. This will attract business investments and further create jobs and economic prosperity. • Government and regulators can create a high-level executive mandate for public service modernisation and upskilling initiatives to align all digital transformation efforts across public service sectors to ensure a sustainable and integrated approach.

Probability Legend
Rare Unlikely Possible Likely Almost certain

Impact Legend
Insignificant Minor Moderate Major Severe

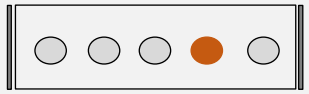
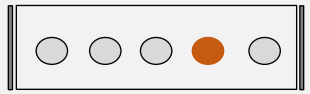
Cryptocurrencies present the future of financial transaction and settlement processing, but there are inherent risks that must be considered (1/3)

Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
1 Price Volatility Cryptocurrencies are traceable and tradeable but have no central authority, making the ultimate source and currency's path forward somewhat unknown and prone to speculation. The nature of the currencies presents a high degree of uncertainty as it is not backed by a fiat currency and value is strictly determined by the market participants which means loss of confidence impacts on trading activities and decline in currency value.			• Provide a comprehensive definition of the treatment and the criteria for cryptocurrency exchanges • Regulators can design Custody Rules to provide greater assurance that investors' accounts contain the funds that their account statements say they contain • A reserve audits should be conducted regularly to provide assurance to the public that their funds are available to the system which eliminates the risks of fund loss.
2 Cyber Security Payments using cryptocurrencies can be clearly and unambiguously verified making accounting errors on the system impossible. However, it operates in a highly unregulated environment and may lack the appropriate internal controls required making transaction activities and exchanges susceptible to theft and fraudulent activities.			• The government and regulators should Implement a risk-based approach to ensure that measures to prevent or mitigate money laundering/terrorist financing (ML/TF) risks • Develop a robust cyber security plans covering wallets integration, accounts, user access levels, APIs, and other critical exchange elements that all service providers must adhere to • All service providers must implement up to date security compliant policies to curb malicious attacks • All cryptocurrency service providers should be required to implement internal programs to mitigate user risk, and have policies to limit 'wash trading'

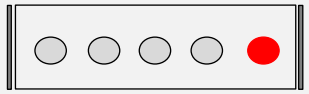
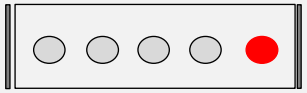
Probability Legend
● Rare ● Unlikely ● Possible ● Likely ● Almost certain

Impact Legend
▲ Insignificant ▲ Minor ▲ Moderate ▲ Major ▲ Severe

Cryptocurrencies present the future of financial transaction and settlement processing, but there are inherent risks that must be considered (2/3)

Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
3 Operational Risk A centralized authority secures the validity of a transactions and has the ability to reverse a transactions in a matched way. However, this is not achievable with a cryptocurrency. Although the cryptocurrency accounts are cryptographically secured, access to the funds in an account cannot be restored if the keys to an account are lost or stolen, and then deleted from the owner.			• Design and implement a robust regulatory framework • All cryptocurrency service providers must be licensed and regulated by the set regulatory bodies to ensure the highest standards of professionalism, skill and experience.
4 Market Risk Cryptocurrency trades only on demand and the limited amount of the currency means that liquidity shortages and limited ownership can make it susceptible to market manipulations. This can make the currency seem more volatile than other physical currencies, as it is driven by speculative demand and intensified by users hoarding the currency.			• The service providers are to maintain audit logs and provide regulators with visibility on the transactions and exchanges on the networks

Cryptocurrencies present the future of financial transaction and settlement processing, but there are inherent risks that must be considered (3/3)

Risk Identified	Probability of Risk Occurring	Impact Assessment	Mitigating Factors
5 Compliance and Regulatory Risk Some countries may not permit the use of the cryptocurrency due to the complexity and decentralized nature of transaction model. A single acceptable AML approach does not exist to govern transaction activities and exchanges of cryptocurrencies.			• Government and regulators can prescribe industry-wide KYC/AML requirements which will serve as the minimum standards for all Exchanges • All cryptocurrency service providers must be licensed and regulated
6 Unclear treatment and taxation methods of Virtual assets and Cryptocurrencies As awareness of crypto currency increases, The usage of cryptocurrency gradually increases to serve as a payment instrument, to carry out transactions and store as a form of capital asset. However, there is no clear policy to guide how gains or losses of cryptocurrency asset activities should be recognized and what regulatory compliance standards to be adhered to. It may be difficult to ascertain how to tax crypto assets or determine what currency the tax should be received in.			• Clearly define how digital assets including crypto currency assets should be classified and treated. • Establish clear regulations and rules on trading and exchange activities of digital and cryptocurrency assets. • Introduce a licensing regime for exchanges by setting entry requirements for listing entities dealing in cryptocurrencies or providing crypto-based services and setting other rules for trading/other exchange activities

Appendix

07

Project Methodology (1/3)

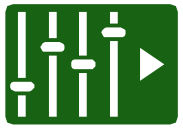
Our Approach

This research was conducted to identify the implications and potential of blockchain to boost financial inclusion – increase access to finance and provide financial products and services to the underserved and unbanked Nigerians.

To achieve these objectives, we conducted both primary and secondary research which involved desk research, one-on-one interview sessions as well as attending related seminars. This findings from this research generated a mix of qualitative and quantitative information which were analysed and highlighted in this report.

We interviewed stakeholders across the financial ecosystem including regulators, banks, fintech companies and Subject Matter Experts in blockchain technology. The responses obtained from the different engagements and interviews complemented our research analysis in evaluating the opportunities that exist for the adoption of blockchain technology.

Research Question



This research aimed to address the following;

a) The impact of blockchain technology for the financial services industry for more inclusiveness for the unbanked and underbanked population

b) The potential for blockchain to improve financial inclusion in Nigeria

Project Methodology (2/3)

Data Collection

Primary data used in this research was largely through semi-structured interviews and attending group discussions on the impact of blockchain technology. Using this form of assessment provided us with high-quality explanatory data. We also sent out questionnaires to 25 stakeholders from the stakeholder groups identified but received only seven (7) responses from the fintech companies.

In total, we conducted 14 one-on-one interview sessions with the following stakeholder groups;

1. Experts in emerging technology (blockchain) and financial services sector
2. Deposit Money Banks (DMBs)
3. Fintech companies (Remittance and cryptocurrency companies)
4. Government and regulatory agencies

As part of the research, we also attended the Central Bank Digital Currency Africa Conference (virtual) which was hosted by the Global Policy House and CoinNewsExtra. The discussions focused on the opportunities for blockchain technology and cryptocurrencies to improve economic growth and inclusion across Africa. It explored the use of blockchain and cryptocurrencies in increasing access to finance through remittances, agriculture, payments, identity management as well as the distribution of financial support.

Project Methodology (3/3)

Research and Data Limitations

Although Nigeria is a diverse country, culturally, socially, politically and economically, the results are largely generalised. This research focuses on the common qualities and challenges across the different regions.

A key drawback in this research was the limited responses from sampled stakeholders to engage in one-on-one interview sessions or respond to the questionnaires.

The quantitative data to assess the impact of blockchain for financial inclusion in Nigeria were limited and, in some cases, unavailable which consequently meant limited use of quantitative analysis in this study.

Research Ethics

Exploring the impact and potential of blockchain technology to boost financial inclusion is a relatively new field that is constantly evolving. As such, it is important to consider ethical aspects to find a reasonable balance between the interests of the different stakeholder groups. We considered the following in developing this study;

1. The data collected through interviews and questionnaires during this research is confidential and will not be shared with any 3rd party
2. For secondary data/information used in this research, proper accreditation and referencing were provided in the report

Types of blockchain system

Industry experts categorise blockchain systems along two core dimensions: access to the network (public/private) vs. roles within the network (permissioned/permissionless). Typically, the design of blockchain technology can either be public or private depending on whether the shared database can be assessed by anyone or by participants (or nodes) in the blockchain system

Private/Closed blockchain

A private/closed blockchain cedes power on who can join the blockchain to a single node or group of nodes. The validation overlay on a private blockchain is entrusted to an authorised node or group of nodes. These node(s) control and set rules for the system.

01

Public blockchain

A public blockchain grants access to anyone to take part in the network and maintain the shared ledger. Anyone can see all the transactions added to the blockchain. A good example of a public blockchain is bitcoin. It is therefore unsurprising that public blockchain is sometimes known as bitcoin blockchain.

02

Permissioned blockchain

In a permissioned blockchain, participants must be granted access by an entity to alter transactions in the system. Examples are Ripple, R3's Corda, Diem and Hyperledger Fabric.

03

Permissionless blockchain

This allows participants to join or leave the network at will, without being pre-approved or vetted by any entity. All that is needed to join the network and add transactions to the ledger is a computer with the relevant software. There is no central owner and identical copies of the ledger are distributed to all network participants. Bitcoin and Ethereum are common examples of permissionless blockchain.

04

A public blockchain network can either be permissioned or permissionless/open.

Source: PwC Analysis

Types of blockchain system (cont'd)

It is believed that the private, permissioned blockchain is the most suitable for the financial services sector as it cedes a degree of control and validation of transactions to an entity or group of entities which could either be the bank or a consortium of banks. Essentially, deciding on the amenability of the use-case to a DLT-based solution must precede the decision on whether to adopt a public, permissionless ledger or a private, permissioned ledger to solve the problem

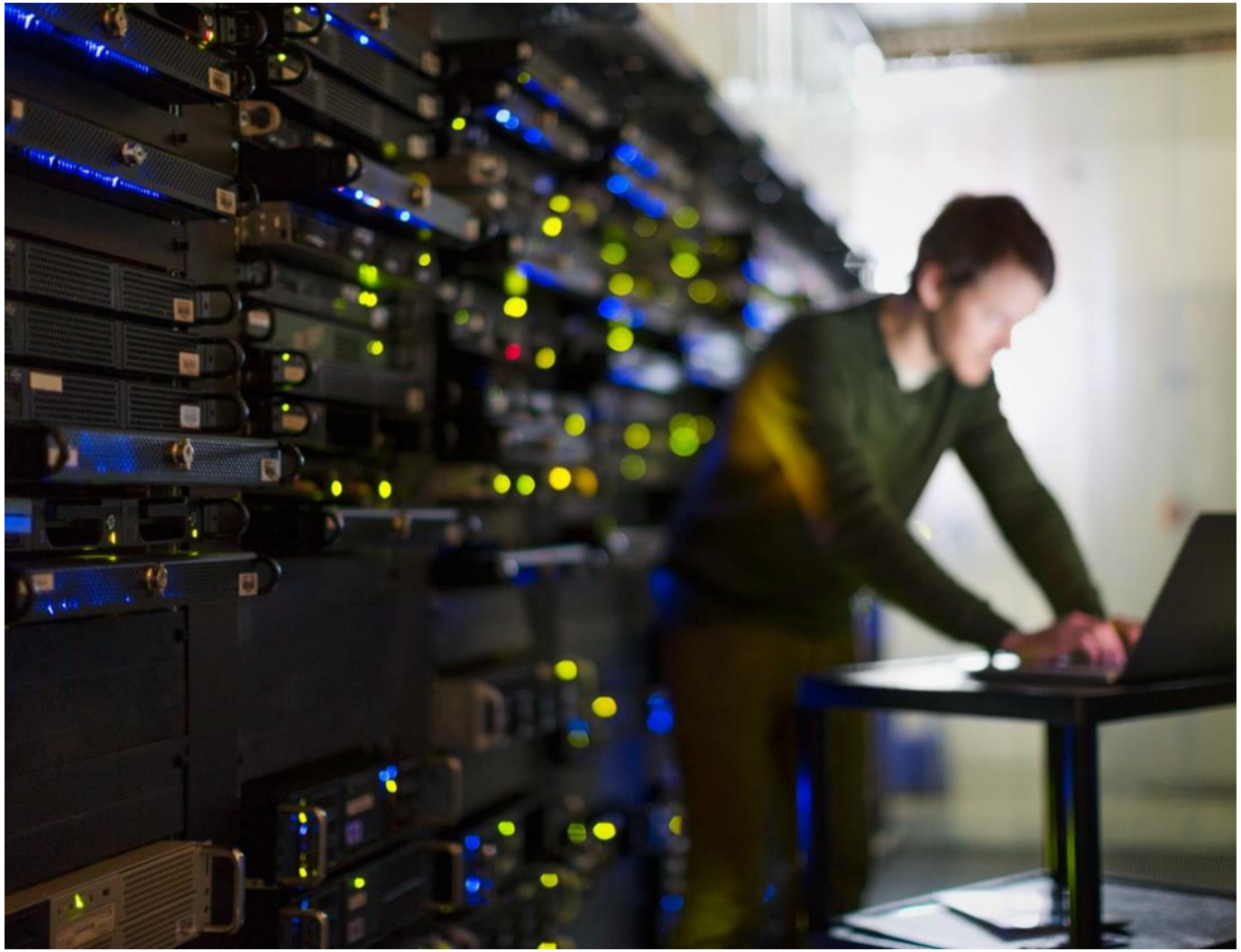
			Read	Write	Comment	Example
Blockchain types	Open	Public permissionless	Open to anyone	Anyone	Anyone*	Bitcoin, Ethereum
		Public permissioned	Open to anyone	Authorised participants	All or a subset of authorised participants	Sovrin
	Closed	Consortium	Restricted to authorised sets of participants	Authorised participants	All or a subset of authorised participants	Multiple bank operating a shared ledger
		Private permissioned	Fully private or restricted to authorised sets of limited nodes	Network operator only	Network operator only	Internal bank ledger shared between parent company and subsidiaries

Source: IFC

** requires significant investment either in mining hardware (proof-of-work model) or cryptocurrency itself (proof-of-stake)

Blockchain has the potential to drive Conditional Cash Transfers (CCT) in Nigeria

- The Nigerian government has consistently deployed conditional fund transfers to address several gaps in the society through the National Cash Transfer Office. The most central focus of the programme are increasing household consumption and improving school enrolments.
- Reaching the most vulnerable and accessing the impact of CCTs have been so challenging due to the difficulties in establishing a unique identity for the targeted population. This system may have not noticeably enhanced employment generation, but it has certainly led to an increase in overall consumption as most households that receive CCTs usually spend it on foods, hence, improve level of household nutrition.
- To drive poverty reduction in Nigeria, the transfer must be well-targeted, sufficient and structured to reach the most vulnerable of the society. Therefore, to achieve an effective, well-targeted and least costly transfer to the vulnerable population, which are mostly unbanked and underserved by financial institutions, open-source blockchain-based identity is an appropriate enabler given its ability to reduce linkages.
- Instructively, government-to-people payments are becoming increasingly digitalised, particularly using blockchain technology, but the challenge is still users literacy.



Source: PwC Analysis

Potential impact on regulators and the government

1

Impact on regulators

- Blockchain promotes regulatory compliance of corporate entities, particularly financial services firms, that deploy DLT in their operational processes. This is made possible because the underlying blockchain technology can save historical records of transactions that are unalterable.
- Ease the process of auditing of players in the financial sector given that blockchain can keep records of transactions that are distributed, verifiable and immutable.

Impact on government

- Blockchain can facilitate government social welfare programmes such as the conditional cash transfer. Using smart contracts on the blockchain, payment for such routine tasks can be done without recourse to third parties. With this in place, the government can enhance efficiency in public service delivery.
- The current land system in Nigeria is largely paper-based. This impacts the ability of households and SMEs to submit documents to access loans from financial institutions. Government can deploy blockchain technology to ease the process of land registration systems in the country which ease verification and validation of titleship to land assets.

2

Blockchain is still at its infancy in Nigeria. Our assessment will be based on what the potential impact will be when blockchain technology is deployed. We will examine potential impact across three key stakeholders in the financial services sector: regulators, financial service providers, and government

Source: PwC Analysis

Potential impact on financial institutions

Reduction in transaction costs

- One major impact of blockchain on financial institutions is the technology's ability to drastically reduce transaction costs. For instance, the use of smart contracts, a self-executing contract when requirements are met, would help banks to cut off unnecessary third parties, thus reducing associated costs.
- Adoption of blockchain in financial transaction processes is projected to reduce the infrastructure cost of global financial institutions by about $15 to 20 billion by 2022. [41]
- It is estimated that retail banks could save about US$4 billion per annum through the implementation of a blockchain-driven cross border payment system.

Better regulatory compliance

- The deployment of blockchain in financial services can result in enhanced regulatory compliance especially in the area of Know-Your-Customer (KYC) and Customer Due Diligence (CDD) necessary in adhering to the anti-money laundering (AML), counter financing of terrorism (CFT) regulations and preventing financial fraud. It is on record that more than 89% of all financial services' fraud in Nigeria occur electronically. [42] In 2018, over 38,800 cases of attempted fraud (the highest ever recorded) valued at N9 billion were reported. Of this, the financial services industry lost about N2.1 billion compared to N1.6 billion in 2017.[42]
- Efforts by financial institutions to combat financial fraud and identity theft, prevent money laundering and protect customers data, have often been at the expense of increased costs and slower processes. KYC requirements can extend over long periods of time, while AML compliance can weigh on a company's bottom-line. According to the IFC, the cost burden on financial institutions for complying with AML regulations have risen 53% since 2011. [43]
- Blockchain-based automated financial systems can simplify the process of regulatory compliance by acting as a decentralised public key infrastructure to establish and secure digital identity. DLT enables customers to use a digital fingerprint, which is uniquely traceable to the individual only. This verified identity can be used for all subsequent transactions between banks in the network, thereby eliminating overlapping KYCs and AML authentication.

Source: PwC Analysis, IFC (2017) EFInA (2019)

Potential impact on customers

1

Blockchain-enabled financial systems will help to accelerate the speed of financial service delivery, while delivering seamless experience to customers. For instance, deploying blockchain for international payment systems can hasten the process of transaction for customers who send and receive money across national borders.

2

Customers will enjoy diversified financial service offerings thereby providing avenues to hedge against risks and protect their wealth.

Source: PwC Analysis

To benefit from these technology developments, we recommend that regulators focus on the following priorities

1. **Provide clear regulatory guidelines to help traditional banks and financial institutions explore and adopt blockchain technology and digital assets**
2. **Support blockchain research and development projects**
3. **Decide on the type of blockchain design type that will be fit-for-purpose**
4. **Use regulatory targets to incentivise companies to adhere to guidelines to ensure customer protection**
5. **Support the adoption and deployment of blockchain in the public sector**
6. **Invest in adequate infrastructure to provide an enabling environment for proof of concepts and exploratory blockchain projects**
7. **Collaborate with blockchain regulators across sectors and jurisdictions to establish international harmonisation of blockchain**

Source: PwC Analysis

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06

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EFInA