Central Bank Digital Currency (CBDC): identifying appropriate policy goals and design for Nepal

A Concept Report

(Released for Public Consultation)

NEPAL RASTRA BANK

CURRENCY MANAGEMENT DEPARTMENT

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NRB intends to seek valuable input on the information and thoughts covered in this report. Stakeholders could provide their inputs and suggestions by sending their emails at *cmd@nrb.org.np* by Mid-January, 2023.

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Foreword

Central bank digital currency (CBDC) which is so much of a buzzed word in the financial world today, is a digital currency issued by central banks as legal tender money, and a likely substitute for physical cash. By July 2022, eleven countries have already launched it, and most other countries are exploring it. Plenty of literature has been published for a better understanding of the key motivators, design, and management of CBDC. Nepal Rastra Bank (NRB), in its monetary policy for the fiscal year 2021/22, announced to carry out a study about CBDC. Accordingly, a study plan was included in the annual plan of the Currency Management Department for that year. A high-level CBDC steering committee headed by Deputy Governor Mr. Bam Bahadur Mishra was formed to provide necessary direction. A task force formed by this committee has prepared this report on CBDC.

This report presents the key motivators that have encouraged most of the central banks today for adopting the CBDC project, key issues that need to be resolved, challenges that are likely to emerge from CBDC, and different design choices of CBDC available for adoption. Further, this report explores the key policy goals that could motivate NRB for adopting CBDC and recommends appropriate design choices for Nepal. Finally, this report recommends important ways forward for the development and management of the CBDC ecosystem in Nepal in a successful way. I hope this report will be useful for all the stakeholders.

I would like to thank the study task force led by Director Mr. Anuj Dahal comprising Director Krishna Ram Dhuju and Deputy Directors, Mr. Tirtha Raj Ojha, Mr. Madan Pandit, Mr. Siddha Raj Bhatta, and Mr. Bipin Kumar Mahato, for their contribution in preparing this report. I am grateful to the members of the high-level steering committee on CBDC for their valuable suggestions to the study task force, and to the Economic Research Department and Payment Systems Department for their important inputs on this report.

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Acronyms

4G	Fourth Generation
ACH	Automated Clearing House
ADB	Asian Development Bank
AED	United Arab Emirates Dirham
AML/CFT	Anti-Money Laundering/Combating Financing of Terrorism
ATM	Automated Teller Machine
BAFIA	Bank and Financial Institution Act
BFI	Banks and Financial Institution
BIS	Bank for International Settlement
BoJ	Bank of Jamaica
BOPA	Banking Offense and Punishment Act
BSP	Bankko Sentral Ng Pilipinas
BVN	Bank Verification Number
CARES	Coronavirus Aid, Relief, and Economic Security Act of U.S.A.
CBDC	Central Bank Digital Currency
CBPS	Cross-Border Payment System
CBS	Central Bureau of Statistics
CEMLA	Center for Latin American Monetary Studies
CMC	Currency Management Cost
COVID-19	Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)
CPMI-MC	Committee on Payments and Market Infrastructures and Market Committee
DDoS	Distributed Denial-of-Service
DLT	Distributed Ledger Technology
DMLI	Department of Money Laundering Investigation
DNFBP	Designated Non-Financial Business and Profession
ECB	European Central Bank
ECC	Electronic Cheque Clearing
ECCB	Eastern Caribbean Central Banks

ECCU	Eastern Caribbean Currency Union
E-CNY	Digital Chinese Yuan or Digital Renminbi
EU	European Union
FINGO	Financial Intermediary Non-Governmental Organization
FIU	Financial Intelligence Unit
FY	Fiscal Year
GBP	Great Britain Pound
GDP	Gross Domestic Product
GoN	Government of Nepal
ID4D	Identification for Development
IMF	International Monetary Fund
INR	Indian Rupee
IPP	Independent Power Producer
IPS	Interbank Payment System
JAM-DEX	Jamaican Digital Exchange or Jamaican Central Bank Digital Currency
KYC	Know Your Customer
LTE	Long-Term Evolution
MFI	Microcredit Financial Institutions
ML	Money Laundering
MLPA	Money Laundering Prevention Act
MLTF	Money Laundering and Terrorism Financing
Mn	Million
MP	Monetary Policy
MPTM	Monetary Policy Transmission Mechanism
MW	Megawatt
MYR	Malaysian Ringgit
NCHL	Nepal Clearing House Limited
NDCL	Nepal Doorsanchar Company Limited
NEA	Nepal Electricity Authority
NIN	National Identity Number
NPC	National Payments Council of Bahamas

NRAR	National Risk Assessment Report of Nepal
NRB	Nepal Rastra Bank
NTA	Nepal Telecommunication Authority
OMR	Oman Rial
P2P	Peer to Peer
PEPs	Politically Exposed Persons
PoA	Proof of Authority
PoS	Proof of Stake
PoW	Proof of Work
PPA	Power Purchase Agreement
PSMI	Payment System Modernization Initiatives (Bahamas)
PSP	Payment Service Provider
QAR	Qatari Riyal
RTGS	Real-Time Gross Settlement
SAARC	South Asian Association for Regional Cooperation
SAR	Saudi Riyal
SCT	Smart Choice Technology
SLF	Standing Liquidity Facility
TIN	Taxpayer Identity Number
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
US	United States
USA	United States of America
USD	United States Dollar
VISA	Visa Inc.
WBG	World Bank Group
WEF	World Economic Forum
ZLB	Zero Lower Bound

Executive Summary

1. Today, most central banks around the world are involved in the exploration of central bank digital currency (CBDC). Initially, central banks were motivated to explore CBDC to find a better way to perform their key policy goals. However, in the later days, the Covid-19 outbreak requiring checking human-to-human transmission of the coronavirus, and the rise of cryptocurrencies threatening currency substitution have sped up their explorations. Nepal Rastra Bank (NRB) has also formed a high-level committee to conduct a preliminary study on CBDC. A study task force formed by this committee has prepared this report.

2. While looking at the history, we find that David Chaum first floored the concept of anonymous electronic money in 1983. Later in 1993, the Bank of Finland made an unsuccessful attempt to issue prepaid money through an Avant card. In 2009, Santoshi Nakamoto proposed Bitcoin, a pseudonymous electronic cash system based on Chaum's concept. The momentum to explore CBDC sped up after the announcement of the CBDC pilot project by the Bank of Uruguay in 2014. Later in 2020, the central bank of Bahamas issued the "sand dollar", the first CBDC in the world. Till July 2022, another 10 nations (i.e., 8 Eastern Caribbean countries, Nigeria and Jamaica) have also joined the CBDC club. Many other CBDC projects are reported to be underway in different countries. The Atlantic Council states that 14 countries are in the pilot stage, 26 countries are in the development stage, and 47 countries are in the research stage by July 2022.

3. This study intends to review, from the available literature, the key motivations driving most central banks today to the exploration of CBDC, the key foundational issues to be resolved initially, some challenges that are likely to emerge from the adoption of CBDC, and the available design choice for consideration. This study also intends to identify policy goals that are currently underserved in the context of Nepal that could motivate NRB for an alternative solution, and finds an appropriate CBDC design choice for Nepal, providing a few forward guidance.

4. It seems that the central banks have been motivated to explore CBDC to find a better way to meet their key policy goals such as improving access to payments, promoting financial inclusion, enhancing the resilience of the payment system, safeguarding the central bank's monetary sovereignty, reducing currency management costs, enhancing the efficiency of the cross-border payment system, promoting financial transparency, improving monetary policy transmission mechanism, promoting financial stability and supporting the government for welfare distribution.

5. For a successful CBDC project, the literature recommends creating favorable circumstances on the key foundational issues, which are: the legal and regulatory framework (Bossu et al., 2020; MoF-J, 2021), capacity development, and restructuring at central banks (RUB, 2021; Soderberg et al., 2022), infrastructure development (CEMLA, 2019; BIS, 2020), and convenience for broader public adoption (CEMLA, 2019; BIS, 2021). Moreover, CBDC can bring some challenges such as financial disintermediation (BoE, 2020), financial exclusion, data exposure and breach (Leucci et al., 2021), operational failure of the system (Minwalla, 2020; Hall, 2022), inappropriate technology adoption (Adrian and Mancini-Griffoli, 2019; Soderberg et al., 2022), seigniorage loss to the central banks (Engert and Fung, 2017), and reduction in numismatic activities.

6. BIS has recommended 3 key foundational principles that all central banks exploring CBDC should follow: not harming other policy mandates of the central banks, not replacing other forms of monies, and promoting broader innovation and efficiency in the overall payment system. To apply these principles, BIS has further suggested 14 core features of the CBDC instrument, underlying system, and institutional framework.

7. Technically, CBDC could be developed with 2 possible use cases (i.e., retail and wholesale), 4 different types of architecture (i.e., direct, hybrid, intermediated, and indirect), 3 different types of infrastructure (i.e., centralized, semi-centralized, and decentralized), and 2 types of access (i.e., account, and token). The CBDC instruments could be remunerative or non-remunerative, 24/7 available for transactions, quantity-

restrictive, multi-system interoperable, and programmable. Among the countries that have launched CBDC by July 2022, most of them have developed CBDC for retail purposes, using intermediated architecture, and distributed ledger allowing both account-based, and token-based access. Rest countries are exploring CBDC mainly for the retail use cases in intermediated architecture with DLT infrastructure.

8. CBDC must support public policy objectives without impeding central banks' ability to fulfill their objectives. In the case of Nepal, the NRB Act 2002 has given a mandate for the bank to maintain the stability of price, external sector, and financial system, promote financial access, and develop a robust payment system in Nepal. Hence, any policy goal selected for CBDC first needs to be related to the policy mandates of NRB. Second, NRB should assess the current outcome gap to these goals, select only a few of them for CBDC where such a gap is high, and select such a design of CBDC which gives a positive contribution to achieving its policy goals.

9. Based on the secondary data and information, this study analyzes the current performance level on 10 key policy goals, identifies the policy goals which are currently underserved, and measures the likelihood of a positive contribution from CBDC to those policy goals using a 5-point Likert-type rating scale (such as very low *(VL)*, low *(L)*, moderate *(M)*, high *(H)*, and very high *(VH)*). Based on the subjective ratings, the policy goals have been plotted in a two-dimensional heat map matrix.

10. The heat map shows that improving access to payment, enhancing the resilience of the payment system, and reducing currency management costs could be the first three highly desirable policy goals for CBDC as they lie in the warmer zone of the map. Similarly, the other policy goals such as enhancing the efficiency of the cross-border payment systems, safeguarding the central bank's monetary sovereignty, and improving the monetary policy transmission mechanism seem to be less desirable policy goals for CBDC in Nepal as they lie in the greener zone of the map. Other policy goals such as promoting financial inclusion, supporting the government for welfare distribution, promoting financial transparency, and promoting financial

stability have been identified as moderately desirable policy goals for CBDC as these lie between the two zones on the map.

11. This study suggests that NRB should take all of the highly desirable policy goals, and a few moderately desirable policy goals, and focus on these goals while considering CBDC design to minimize the risk of goal setting failure. Considering the three highly desirable policy goals and a moderately desirable policy goal (i.e., promoting financial inclusion), this study suggests that a retail, intermediated, and semi-centralized infrastructure-based CBDC with both account-based and token-based access is suitable for Nepal. It also recommends making the CBDC interoperable with other domestic payment systems, non-remunerative, 24/7 hours available for use, quantity-restrictive, and programmable for broader usage options.

12. This study recommends to empower NRB to issue digital legal tender, and operate accounts for individuals and others with a targeted reform of NRB Act 2002, promulgate a new unified act to govern digital currency-related data protection issues, develop a robust framework to regulate and supervise the parties involved in the implementation of CBDC system. Interaction with the related government bodies, other regulatory authorities, technical specialists, financial institutions, and the end-users is required for developing a robust regulatory and supervisory framework.

13. Finally, this report recommends that NRB should form a dedicated team or unit for studying and managing the CBDC, formulate the strategic plans, conduct a detailed feasibility study of CBDC, ensure an adequate legal framework, select appropriate policy goals for CBDC, adopt a robust CBDC system, develop the capacity of NRB, and restructure where necessary, coordinate with other authorities and agencies for necessary support, increase public awareness, and regularly promote digital banking within Nepal to make public adoption of digital currency convenient in the future. Moreover, this study recommends developing a prototype CBDC in the beginning with the help of domestic developers, consultants, and system experts, and simulating such a CBDC in a closely controlled environment before developing and launching a real one which helps rightly design, develop and implement the final CBDC.

1. Introduction

Background

1.1 Today, most central banks around the world are exploring the possibility of issuing central bank digital currencies (CBDC). A few countries have already launched CBDC after successful pilot tests, and many others are engaged in different stages of its exploration.

1.2 It seems that the initial driver for the exploration of CBDC was to find a better way to meet a wide variety of policy goals taken by central banks such as financial inclusion, optimal payment system, and cost-efficient currency management, among others. Many other reasons, in the later days, have caused to speed up the exploration. First, the Covid-19 crisis induced a shift in payment habits towards contactless payments and e-commerce due to fear of banknotes as a way of transmitting infection, accelerating the decline of cash use. Second, cryptocurrencies developed by private companies (e.g. Novi by Facebook) or informal communities (e.g. Bitcoin) have seen significant developments and value gain (Leucci et al., 2021) creating the risk of currency substitution. Third, many other central banks are looking for alternative international payment systems the trend of which is likely to accelerate following the financial sanctions on Russia (Atlantic Council).

1.3 Considering the global context of study regarding the usage and feasibility of digital currency, Nepal Rastra Bank (NRB), in its Monetary Policy 2021/22, also announced to conduct a study on CBDC in Nepal. A high-level CBDC steering committee headed by Deputy Governor was formed to steer preliminary studies, plans, and activities relating to CBDC. The committee created a study task force of officials from different related departments to prepare a concept report on CBDC. Accordingly, the study task force has prepared this report.

Definition of CBDC

1.4 CBDC is a digital payment instrument in a national unit of account that is a direct liability of the central bank (BIS, 2020). It is a digital form of central bank money that

is different from balances in traditional reserve or settlement accounts (CPMI-MC, 2018).

1.5 Kumhof and Noone (2018) describe CBDC as electronic central bank money that: "(i) can be accessed more broadly than reserves, (ii) potentially has much greater functionality for retail transactions than cash, (iii) has a separate operational structure to other forms of Central Bank money, allowing it to potentially serve a different core purpose, and (iv) can be interest bearing, under realistic assumptions paying a rate that would be different to the rate on reserves." CBDC is stored by each person or institution in their e-wallet accounts from where they pay or transfer money to anyone's e-wallet or bank account.

1.6 Differentiating CBDC with crypto-assets, Panetta (2018) states that the former would be a liability of the central bank backed by its assets and supported by its credibility and the rule of law, while the latter is not backed by any assets and operates without clear governance, mandate, laws, or other assets. Hence, in his view, CBDC does not suffer from the excessive volatility that has been seen in the case of other crypto-assets.

Evolution of CBDC

1.7 Money is difficult to define, partly because it fulfills not one but three functions, each of them providing a criterion of moneyness, and partly because these criteria are fulfilled to different degrees by different assets. The three functions that money fulfills are a medium of exchange, a unit of account, and a store of value (Scitovsky, 1969).

1.8 New forms of money have been evolving as people constantly looked for the best item that performs the three functions of money most efficiently. The ***barter system*** had the problem of finding double coincidences of wants for people to trade with each other, and common measure of value among the items bartered. ***Commodity monies*** too failed as commodities used as monies varied across places and time, and they were impractical to use for being bulky, indivisible, and quality deteriorating. ***Metallic monies*** also became impractical to facilitate high-value trade as the coins required

could be large, and hence bulky to carry and count. ***Representative monies*** also depended largely on the credibility of the merchants who issued claim checks. The ***Paper currencies*** which we use today also run with many problems. They are inconvertible money issued as unlimited legal tender and hence have no intrinsic worth. They are simply called fiat currencies. Besides, banks and financial institutions (BFIs) also create ***deposit monies*** within the fractional reserve system.

1.9 All of the above monies required the transacting parties to meet each other to verify instructions and authorize the payments which would take time and cost. Banking services are still unavailable 24/7/365 in some places. ***Digital monies***, thus, evolved to fulfill the people's growing need for more resilient payments. However, the safety of digital money and low transaction cost had still not been ensured.

1.10 Recent development of ***virtual currencies***, which is gaining popularity in the market, has generated the risk of substituting paper currencies. However, virtual currencies too carried several risks such as facilitating non-transparent transactions leading to illicit use of money, failing to redeem public money, and weakening the central bank's monetary control by displacing official legal tender. Therefore, central banks are now proposing to offer their currencies in the digital form, i.e., ***CBDC***.

1.11 The history of digital currency is not long. Koning (2018) states that the concept of digital currency could be traced back to David Chaum's explorations into anonymous electronic money in 1983. Koning further states that Chaum wanted to develop eCash to be issued by private banks enabling everyone to withdraw their funds in the form of such eCash and anonymously spend them at retailers who have installed the requisite hardware.

1.12 Further, Grym (2020) claims that the Avant card issued by the Bank of Finland in 1993 is the first-ever Central Bank Digital Currency (CBDC) in the world. He further states that the Avant card was like a digital version of a prepaid top-up card with a chip that effectively stored digital money. The card was issued by Toimiraha Ltd., a subsidiary company of the Bank of Finland set up in 1992. Initially, it was a loss business for the Bank of Finland as the card was non-reloadable making it user-

unfriendly. So, the Bank of Finland made it reloadable through retail shops or ATM points, initially free of charge. Later a small fee was charged for operational sustainability which made it infamous. Eventually, the Bank of Finland sold the company to private banks. Therefore, the Avant card is no longer a CBDC now as it is not issued by the Bank of Finland (Grym, 2020).

1.13 Koning (2018) states that Satoshi Nakamoto, inspired by Chaum's electronic money, proposed Bitcoin in 2009 as a pseudonymous electronic cash system. But unlike eCash which is issued by commercial banks, he proposed a distributed population of competing miners be responsible for verifying Bitcoin transactions.

1.14 The Central Bank of Uruguay announced a pilot project for token-based retail e-peso in January 2014. The central bank of Bahamas released the **sand dollar,** the first CBDC in the world, to all Bahamian citizens in October 2020. It has a plan for gradual integration of the CBDC system with the commercial banking systems (McCartney, 2022).

1.15 For a cost-efficient multilateral settlement and capital flows among the member countries, eight months after the sand dollar, the Eastern Caribbean Central Bank launched **DCash** in four of its member nations, Antigua and Barbuda, Grenada, Saint Christopher (St. Kitts) and Navis, and Saint Lucia in March 2021 becoming a first currency union of the world to issue a cross-border CBDC. In August, it was extended to Saint Vincent and The Grenadines, again in December 2021, to the Commonwealth of Dominica, and Montserrat, and to the remaining nation of the union, Anguilla in April 2022. People can download DCash App or simply get the service through participating financial institutions.

1.16 In October 2021, the central bank of Nigeria also issued "eNaira" and became the first African nation to issue CBDC. Initially, eNaira was made accessible only to bank account holders by signing up with Nigeria's Bank Verification Number (BVN) with a

plan to roll out a new mobile application that allows unbanked citizens[1] to access eNaira.

1.17 The Bank of Jamaica (BoJ) has recently launched CBDC for its people. Earlier it worked with an Ireland-based technology firm 'eCurrency Mint' on the sandbox project between May 2021 to December 2021. On 31st December 2021, the bank announced the successful completion of the trial of its retail CBDC named 'JAM-DEX'. In May 2022, the BoJ announced the phased launch of JAM-DEX. The amendment to the Bank of Jamaica Act, 2020 on 14 June 2022 has designated the Bank as the sole authority to issue CBDC and has further progressed the phased rollout of JAM-DEX. Hence, the JAM-DEX is now a legal tender in the country.

1.18 As per the information updated by the Atlantic Council[2], 105 countries representing 95 percent of the global GDP are exploring CBDC by July 2022. Out of these, 51 countries are in an advanced phase of exploration (development, pilot, or launch) including 11 countries that have fully launched CBDC. 14 countries as Lithuania, Sweden, Ukraine, Saudi Arabia, United Arab Emirates, Kazakhstan, Russia, South Africa, South Korea, China, Hong Kong, Thailand, Singapore, and Malaysia are in the ***pilot*** phase and preparing for a possible final launch. Besides, 26 other countries are in the ***development*** phase. 47 countries are in the ***research*** phase. Besides, 10 countries such as Denmark, Finland, Bermuda, Egypt, Azerbaijan, North Korea, Sint Marteen, Curacao, Uruguay, and Argentina have been inactive after the initial steps whereas 2 countries namely Ecuador and Senegal have canceled their CBDC projects.

1.19 Similarly, according to the Atlantic Council's information, out of the G20 countries, 19 countries are exploring a CBDC by July 2022. Among them, 16 countries are in the development or pilot stage. The US and UK from the G7 economies are the furthest behind on CBDC development. The European Central Bank has targeted to issue digital euro by the middle of the decade. Many other countries are exploring alternative international payment systems and this trend is likely to accelerate

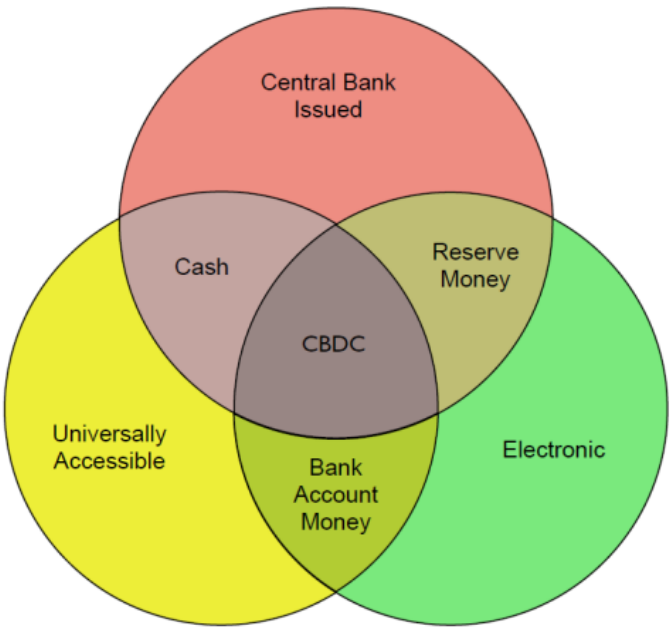
[1] Some 55% of the adult Nigerians were unbanked around 2020 which is around 58 million people. Of these, 35 million own mobile phones and could be reached with mobile money (Kedem, 2021).
[2] https://www.atlanticcouncil.org/cbdctracker/

following financial sanctions on Russia. There are 9 wholesale and 3 retail cross-border CBDC projects (Atlantic Council).

Comparison of Different Forms of Money

1.20 There are different types of currencies viz. cash, reserve money, bank account money, and CBDC. Cash is central bank-issued (risk-free) money universally but not digitally accessible. Bank account money is universally and electronically accessible for use but not central bank-issued and hence risky money. The reserve money maintained at the central bank is central bank-guaranteed money electronically but is not universally accessible. CBDC, on the other hand, is being developed as a new form of central-bank-issued money that will be both digitally and universally accessible. The difference between cash, reserve money, bank account money, and CBDC could be better explained in Figure 1.1 below:

Figure 1. 1 Different forms of money



Source: Bjerg (2017)

1.21 As cryptocurrencies are universally and electronically accessible but not central bank-issued, it creates a direct threat to the bank account money. Therefore, strong

regulation and legal enforcement is required to avoid the risk of displacement of the bank deposit money.

1.22 Table 1.1 shows the key differences between cash, regulated money, unregulated money, and CBDC in 10 different attributes where the CBDC seems to beat other forms of money like cash, regulated money, and unregulated money. However, the issuance cost of CBDC could be as high as issuing physical currency.

Table 1. 1 Difference between various forms of money

Basis of Difference	Cash	Regulated Money	Unregulated Money	CBDC
Medium of Exchange	Yes	Yes	Limited	Yes
Unit of Account	Yes	No	Rare	Yes
Store of Value	Short-run	Short-run	Unsure; volatile	Short-run
Denomination Currency	National	National or Foreign	Own	National
Underlying Collateral	None or fully or partially	Good Assets	None or some assets	Country specific
Safety	Legal tender	Sound financials; good governance	Cryptography or other technology	Legal tender
Redemption	Cash or CBDC	Cash or CBDC	None	Cash
Issuer	Central Bank	Licensed Intermediaries	Private Party	Central Bank
Issuance Cost	High	Low	Unknown	High
Maintenance Cost	High	Moderate	Unknown	Moderate

Source: Task force's elaborations

Central Banks' Key Policy Mandates

1.23 Issuing legal tender is a major responsibility of most central banks today. Issuing CBDC as a legal tender also requires to be within the mandate of a central bank stated either in its functions or objectives or powers (Bossu et al., 2020). For example, Section 4 of the Reserve Bank of Malawi Act 1989 has stated "to issue legal currency in Malawi" as an objective, whereas Section 5 of Nepal Rastra Bank Act 2002 has stated "to issue banknotes and coins" as a function, duty or power of the bank. In this

regard, Bossu et al. (2020) state that actions of a central bank beyond its mandate are vulnerable to political and legal challenges. Hence, along with research on digital legal tender, most central banks seem to be working on amending their acts to get legal power to issue digital currency.

1.24 Historically, the role of central banks has evolved considerably, and changes have often occurred in response to crises or perpetual policy problems (Dikau and Volz, 2021). The mandates of central banks have evolved in response to three factors: the existence of alternative sources of funds for the sovereign, the prevailing economic theory or broader set of philosophical beliefs, and the technology of money and financial instruments more broadly. All three factors remain in play, and central banks will likely continue to change their colors as their environments change (Redish (2012).

1.25 Monetary stability and financial stability have been two key mandates for most of the central banks around the world. Other mandates, specific to the respective central bank, include economic development (Brazil), a competitive market-based financial system (Iraq), an efficient payment system (Kosovo), issuing legal tender (Malawi), financial system stability (Malaysia), exchange rate stability (Qatar), interests of the country (Switzerland), and regulating the monetary system (Zimbabwe) among others (Dikou & Volz, 2021). Some central banks often take multiple policy goals and require to maintain trade-offs among them.

1.26 Hence, exploration of the likely positive contribution from CBDC to the policy mandate of the central bank is undergoing today. As just a few central banks have launched CBDC so far, and they are yet to garner sufficient experience, assessing the effectiveness of this digital legal tender on the mandated functions of the central banks would be an early attempt for now.

Objectives

1.27 The objective of this study is to prepare a concept report on CBDC. More specifically, this study intends:

- To review the key policy goals motivating central banks today for exploring CBDC, the key foundational issues, some challenges that could likely emerge from CBDC, and the available design choices for CBDC.
- To identify policy goals currently underserved in Nepal that motivate NRB for an alternative solution, find an appropriate design choice of CBDC for Nepal, and look into required reforms in existing laws and regulatory framework.
- To provide ways forward for implementing CBDC in Nepal.

Methodology

1.28 This report is broadly based on the review of literature related to CBDC such as working papers, discussion papers, discussion notes, scholarly articles, analytical reports, books, periodic reviews, expert views, keynote addresses, regulatory briefs, advisory publications, and other statistical reports and analyses published by International Monetary Fund, World Bank, Bank for International Settlement, Asian Development Bank, various other central banks, leading international economic journals, domestic and international organizations, universities and schools, and many other researchers. All of the above sources of literature have been accessed online.

1.29 This study uses secondary data and information to analyze the current performance level of key policy goals, and identify the underserved policy goals. The current performance or outcome gap related to the key policy goals mentioned in this study has been rated using a 5-point Likert-type rating scale such as very low *(VL)*, low *(L)*, moderate *(M)*, high *(H)*, and very high *(VH)*. A higher rating of a policy goal would mean a higher performance or outcome gap related to that goal giving NRB the same level of motivation to find an alternative solution (such as CBDC) that mitigates such

a gap. The likelihood of a positive contribution from CBDC to each policy goal (i.e., likely ability to mitigate the outcome gap to each policy goal) has been rated using the same 5-point Likert-type rating scale. Both the ratings of the current outcome gap and the likelihood of positive contribution from CBDC to the policy goals have been done subjectively through discussions in the steering committee. After this, both the rating scores have been used to plot the policy goals in a two-dimensional heat map matrix, showing the current performance or outcome gap along the X-axis and the likelihood of a positive contribution from CBDC to the policy goals along the Y-axis. The more a policy goal lies in the warmer zone of the heat map, the more it fits as a desirable policy goal for CBDC. Finally, considering all three highly desirable goals, including one moderately desirable goal, an appropriate CBDC design has been proposed.

Box 1. 1 CBDC projects in other nations of the South Asian Association for Regional Cooperation (SAARC)

- ***India*** *has been doing research on CBDC. It has recently announced in the Union Budget for fiscal year 2022-23 to introduce CBDC within the fiscal year. An appropriate amendment to the RBI Act, 1934 has been included in the Financial Bill, 2022, and the Bill has been enacted providing legal framework for launch of CBDC. With CBDC, the country aims for a more efficient and cheaper currency management system, and boosting digital economy of the country. RBI has informed that it will take gradual approach in introducing CBDC.*
- ***Bhutan*** *has announced digital Ngultrum in 2021 with a motivation to accelerate its mission to increase financial inclusion in the country to 85% by 2023. It has collaborated with Ripple to test the potential of CBDC.*
- ***Pakistan*** *has declared in 2019 that it has been working on concept to issue a digital currency by 2025 aiming to promote financial inclusion, and reduce inefficiency and corruption, for which research is ongoing.*

Source: cbdctracker.org

Limitation

1.30 This study does not use primary information sources such as interviews, surveys, etc. Public inputs on this report have been invited. The findings of this report could be reassessed based on new information and public inputs received. Hence, this report presents only a preliminary assessment and does not represent the final standing of NRB or its intention to issue CBDC.

Organization of the Report

1.31 After this first chapter, chapter 2 briefly explains the key motivations for central banks around the world today to explore CBDC, foundational issues that need to be addressed, and some challenges that could likely ensue from the issuance of CBDC, beginning with a short look at the key policy mandates of central banks. Chapter 3 presents the foundational principles and core features of CBDC, the available design choices discussed in various literature, and the design chosen by the central banks that have already launched CBDC or are being considered by central banks which are exploring CBDC. Chapter 4 identifies policy goals motivating NRB for CBDC, and recommends an appropriate design choice that fits best the CBDC for Nepal. It also recommends enriching existing laws and regulatory framework for empowering NRB, and also better managing CBDC system and digital currency-related data protection issues that could arise once CBDC is launched. Chapter 5 concludes the report providing some ways forward to be implemented for CBDC in the future.

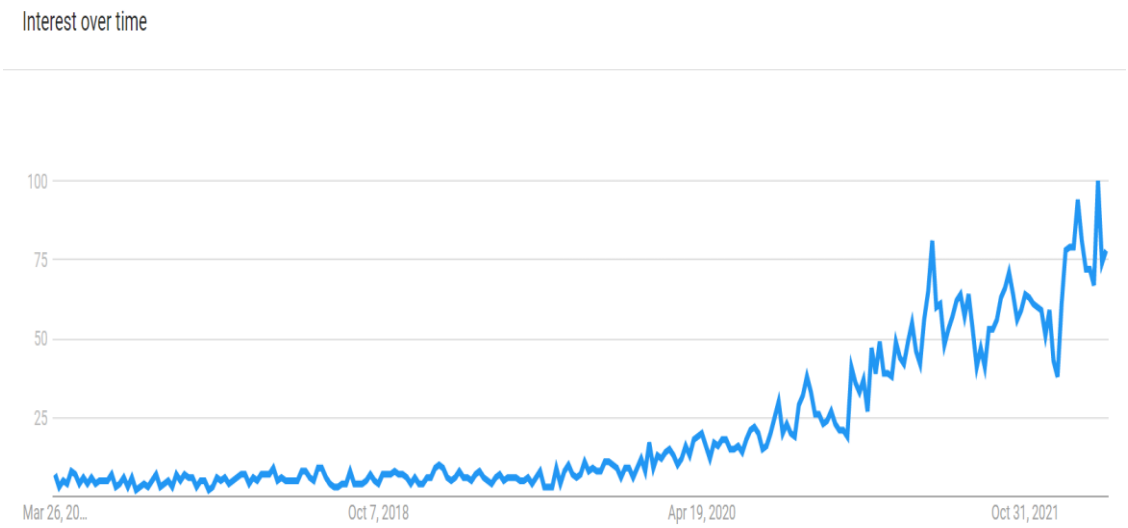
2. Motivations and Issues

2.1 This chapter discusses the factors which are motivating central banks to the exploration of CBDC today, the key issues related to CBDC that need to be resolved by them, and some challenges that could likely emerge from CBDC.

Key Motivations for Exploration

2.2 CBDC has also been a highly buzzed and searched word over the internet, particularly after March 2020. Figure 2.1 shows that the interest in CBDC (web search) has gradually risen in recent years. The number represents search interest relative to the highest point on the chart.

Figure 2. 1 Global interest in CBDC



Source: https://trends.google.com

2.3 Plenty of literature on CBDC have been available today focusing on its concepts, implication, technical considerations, and guidance for implementation. Literature has highlighted the following key policy goals motivating the central bank to the exploration of CBDC:

(a) Improving access to payments

2.4 Improving access to payments has been an important driver for CBDC exploration today. Many central banks see CBDC as a means of enhancing access to payment services for the unbanked, i.e., those without access to a transaction account (Auer et al., 2021). Some countries are worrying about the declining use of cash and increasing dependence of people on private monies as this could lead to difficulty in accessing payments when sudden disruptions occur in the payment and settlement systems. Therefore, these countries are exploring if a CBDC could help achieve or safeguard universal access to payments (Soderberg et al., 2022).

2.5 Riksbank (2017) states that a very drastic decline in currency used in some European countries has been one of the reasons to motivate the bank to conduct research on e-Krona in Sweden. The bank observed the percentage of people paying in cash for their last purchase declining from 39 percent in 2010 to 9 percent in 2020 in Sweden and found cash mostly used for small payments and primarily by older people (Riksbank, 2020). Best (2021) found the share of cash in total payment transactions constantly reduced from 19.8 percent in 2016 to 13.5 percent in 2019. The use of cash is steadily declining, also additionally contributed by the COVID-19 pandemic (Roosebeke and Defina, 2021). BIS (2020) warns that in jurisdictions where access to cash is in decline, there is a danger that households and businesses will no longer have access to risk-free central bank money. The Bank of England is exploring whether CBDCs could improve the availability of central bank money and address the consequences of declining cash use (Economic Affairs Committee, 2022).

(b) Promoting financial inclusion

2.6 There are currently 6.4 billion smartphone users worldwide (Best, 2021). Considering the global population of 7.9 billion, smartphone penetration is over 80 percent (Lin, 2021). As CBDC uses a digital platform, central banks are also exploring designing CBDC to facilitate the delivery of financial inclusion products in a targeted and quicker way. Auer et al. (2021) state that financial inclusion is an important motivation for the exploration of CBDC, especially in emerging market economies. A

BIS survey on CBDC has also shown that financial inclusion has emerged as the main factor across emerging markets and developing economies remaining a top priority for CBDC development (Boar and Wehrli, 2021).

2.7 WB (2022) considers access to transaction accounts as the first step toward broader financial inclusion as it allows people to store money, send and receive payments, and provides a gateway to other financial services. So, the Universal Financial Access 2020 initiative of the World Bank Group primarily focuses on ensuring access to a transaction account for all people through targeted interventions (WB, 2022). Demirgüç-Kunt et al. (2022) state that, globally, 76 percent of adults had an account at a bank or regulated institution such as a credit union, microfinance institution, or a mobile money service provider in 2021. They state that account ownership around the world increased from 51 percent of adults to 76 percent of adults between 2011 to 2021, i.e., an increase of 50 percent in the 10 years. Similarly, the average rate of account ownership increased from 63 percent of adults to 71 percent of adults in developing countries, i.e., by 8 percent between 2017 to 2021, the expansion largely stemming from mobile money in Sub-Saharan Africa (Demirgüç-Kunt et al., 2022).

2.8 Where a mere bank account could also facilitate the delivery of financial services, in critical periods such as natural disasters, the digital platform acts faster and more resiliently than cash as illustrious in the case of the Bahamas. The Sand Dollar was introduced to facilitate financial inclusion in this nation of about three hundred ninety thousand people spread across thirty inhabited islands, many of which are remote (Boar and Wehrli, 2021). After suffering from a monstrous Hurricane Dorian in 2019 that damaged properties worth $3 billion claiming many lives in the northern Bahamas, the country realized that restoring mobile phone coverage is much faster than resuming banks (Rolle, 2021). Subsequently, the central bank of Bahamas headed towards CBDC research and development and finally launched it.

(c) Enhancing resilience of the payment system

2.9 Central banks manage physical currencies by setting up various currency chests in different parts of the country and conducting frequent currency transfers to these

chests. However, during critical situations such as natural disasters, currency transfers might be impeded. Though private e-monies (regulated) might help people get access to payments, these are always not resilient means. The Board of Governors of the Federal Reserve System of the United States (2022) also views that many digital payments today cannot be executed during natural disasters or other large disruptions, and affected areas must rely on in-person cash transactions. So, the Board states that a CBDC could enhance the operational resilience of the payment system if it has an offline capability, i.e., some payments could be processed without using internet access, and for this reason, some central banks are currently researching the feasibility of offline payment options of CBDC. Hence. World Economic Forum (2021) states that continued access to central bank money is one of the most popular policy goals for potential CBDC in developed economies.

2.10 BIS (2020) views that cash serves as a backup payment method to electronic systems if those networks cease to function, but if access to cash is marginalized, it will be a less useful backup at the time of need. So, central banks are taking up CBDC as a better means to distribute and use funds in geographically remote locations and at the time of natural disasters as compared to cash (BIS, 2020).

Box 2. 1 Poor access to payments vs poor payment system resilience vs financial exclusion

- ***Poor Access to Payments:*** A bank is near to me but it does not serve me after office hours. I have an ATM card but cannot find ATM booth nearby.
- ***Poor payment system resilience:*** I found an ATM booth nearby, but it did not work.
- ***Financial exclusion:*** I neither have a bank account nor ATM card due to lack of identity document.

Source: Task force's own elaborations

(d) Safeguarding the central bank's monetary sovereignty

2.11 Retaining the monetary sovereignty of central banks challenged by private e-monies and declining the use of cash has also been another key motivation for the exploration of CBDC. Roosebeke and Defina (2021) have stated that excessive use of private monies, which also include cryptocurrencies, replaces cash, making cash infrastructure costly to manage, and this leads to less availability of cash in due course. As a result, conversion of deposit money into cash is sometimes not possible in times of stress. Thus, digitalization and declining use of cash will cause the central bank to fail to

steer price stability and financial stability as currencies not issued by the central bank could take a decisive role in the economy (Roosebeke and Defina, 2021).

2.12 World Economic Forum (2021) states that CBDC could support monetary sovereignty and continued use of the domestic currency when currency substitution risks arise from high adoption of foreign CBDC or stable coins or other digital currencies denominated in or backed by foreign currency. Lagarde (2020) sees the prospect of most people using payment products not denominated in or weakly linked to the sovereign currency as the most convincing reason for the development of a CBDC.

(e) Reducing currency management costs

2.13 Lowering the cash management has also been a key motivation for exploring CBDC for many central banks. Reserve Bank of India hopes CBDC can reduce the cost of printing, transporting, storing, and distributing the currency to the extent of replacing large cash usage (Sankar, 2021). The central bank of Madagascar is also exploring CBDC to find a better way to manage cash with lower costs (Atlantic Council).

2.14 The management of fiat currency is expensive, particularly in developing countries, due to the costs of distribution, security, safety, and reliance on bank branches (Raghuveera, 2020). CBDC can lower the cost of maintaining the supply of physical currency and protect it from counterfeiting risks (Didenko and Buckley, 2021). In EU nations, it will save the high costs associated with physical cash handling which is at least ½ percent of GDP, and the cost of storage of CBDC will also be quite negligible compared to the cost in the case of physical cash which is around 0.5-1 percent of the value stored in those countries (Gnan and Masciandaro, 2018).

2.15 Mancini-Griffoli et al. (2018) state that introducing and maintaining CBDC might entail substantial fixed costs, but the marginal operational costs would likely be lower, and the larger jurisdictions would be better able to absorb the fixed costs than the smaller jurisdictions. World Economic Forum (2020) has listed reducing costs and frictions associated with cash management as a potential benefit of retail CBDC.

(f) Enhancing the efficiency of the cross-border payment system

2.16 A survey conducted among central banks in late 2020, especially with regards to wholesale CBDC, has revealed that central banks are motivated to the issuance and usage of CBDC expecting that it could bring cross-border payments efficiency by simplifying intermediation chains, increasing speed, and lowering costs (BIS, 2021a).

2.17 CPMI-WB (2022) shows four key challenges to cross-border payments, viz., high cost, low speed, limited access, and insufficient transparency, arising from a series of frictions, including fragmented and truncated data formats, complex processing of compliance checks, limited operating hours, legacy technology platforms, long transaction chains, high funding costs, and weak competition. Some central banks are, therefore, exploring CBDC for use in cross-border payments with an expectation to resolve such cross-border payment issues. For example, the South African Reserve Bank is participating in a cross-border pilot with the central banks of Australia, Malaysia, and Singapore (Fuje et al., 2022).

2.18 According to WBG (2021a), CBDC is likely to reduce the cost of sending remittances and save billions of dollars each year. The average cost of sending remittances remained 6.30 percent in the third quarter of 2021 while such a cost was 4.49 percent for South Asia, as high as 8.27 percent for Sub-Saharan Africa, and remained as expensive as 10.40 percent through banks (WBG, 2021a). The price of sending remittances is particularly high in some parts of Asia and the Pacific due to which informal remittances that flow through *Hawala* or *Hundi* schemes are still high (ADB, 2021). According to BIS Innovation Hub, the central banks of Thailand, China, the UAE, and Hong Kong have established a mBridge project, a multi-CBDC initiative, to speed up cross-border payments.

(g) Promoting financial transparency

2.19 CBDC is also being explored to help better promote financial transparency. In this regard, Baqar (2021) informs that Pakistan is exploring CBDC to progress on their anti-money laundering or countering terrorism financing efforts along with promoting

financial inclusion. PwC (2021) states that the transaction history for CBDCs is fully traceable, which could aid in AML compliance procedures and investigations. BIS (2022) also states that as all CBDC payments are traceable, it may also offer new approaches to ensure that needed prudential standards are met, including the prevention of money laundering and the financing of terrorism (BIS, 2022).

2.20 The widespread use of CBDC, and the obsolescence of paper currency, would discourage tax evasion, money laundering, and other illegal activities that are made easier by paper currency, especially, large-denomination bills (Rogoff, 2016). Although anti-money laundering and combating terrorism financing (AML/CFT) requirements are not a core central bank objective and will not be the primary motivation to issue a CBDC, central banks are expected to design CBDCs that conform to these requirements (BIS, 2020).

(h) Improving monetary policy transmission mechanism

2.21 Every central bank takes some benchmark policy rates to show its monetary policy stance. The choice of policy rates varies across countries. For example, it is the repo rate for India, the rediscount rate for China, the effective Fed Funds rate for the USA, the base rate for the UK, the complementary deposit facility rate for Japan, the cash target rate for Australia, overnight target rate for Canada, and bank rate for Nepal[3]. Rather than using only one policy rate, the central banks might use more than one policy rate to show their monetary policy stance and influence market interest rates. The policy interest rate influences other interest rates in the economy such as interest rates for housing loans or business loans, and interest rates on saving accounts[4]. Changes in these rates affect the cost of borrowing or the reward for saving, the exchange rate, and the prices of some assets. During deflationary situations, the central banks reduce their benchmark policy rates to make money cheaper to spend or costlier to hold.

[3] Visit https://www.ceicdata.com/datapage/en/search?search_query=policy%20rate

[4] Visit https://www.rba.gov.au/education/resources/explainers/unconventional-monetary-policy.html

2.22 Altavilla et al. (2020) state that the modern macroeconomic principle believes that the monetary policy is ineffective once interest rates reach their zero lower bound because central banks cannot stimulate demand by further lowering the short-term interest rates since the market participants would then just love to hoard cash. From 2012 to 2016, the central banks in Switzerland, Sweden, Denmark, Japan, and the euro area reduced their key policy rates below zero for the first time in economic history (Altavilla et al., 2020).

2.23 Keister (2011) mentions that financial markets are generally designed to operate under positive interest rates and might experience significant disruptions if rates become negative. Monetary policy can be ineffective through the interest rate channel if the interest rate falls below zero. In such a situation, central banks will have to take unconventional measures like quantitative easing. Hence, Keister (2011) states that policymakers tend to keep short-term interest rates above zero even while taking liberal monetary policy in other dimensions. In his view, these policy choices are the source of the zero lower bounds.

2.24 Hence, the exploration of CBDC has also focused on overcoming the zero-lower bound constraint of the interest rates to make monetary policy effective. Mancini-Griffoli et al. (2018) find CBDC capable to strengthen monetary policy transmission mechanisms through increasing financial inclusion, and interest-bearing CBDC that eliminates the effective lower bound on the interest rate. Davoodalhoseeini et al. (2020) also see CBDC allowing monetary policy to break below the effective lower bound which requires removing cash or restricting cash holdings. especially large-denomination banknotes. Nelson (2021) explains that a CBDC removes the ZLB constraint of interest rate enabling the Fed to reduce interest rates during a deflationary spiral, and a remunerative CBDC also increases Fed's control on the interest rate.

(i) Promoting financial stability

2.25 Financial stability is the key policy mandate for many central banks. Financial stability refers to a situation in which the principal components of the financial system viz. financial institutions, markets, and infrastructure are performing their functions

smoothly and are capable of withstanding various shocks without any disruption in the operation of the financial system (NRB, 2012). In another word, it refers to having a financial system that inspires confidence through its resilience to systemic risks and its ability to efficiently intermediate funds[5].

2.26 Financial stability has also been a key matter of concern for some central banks to explore CBDC. The third BIS survey on CBDC has shown financial stability and monetary policy, over time, become the more important motivations for CBDC work in emerging markets and developing economies in contrast to advanced economies (Boar and Wehrli, 2021).

2.27 Mnohoghitnei et al. (2021) state that CBDC could support financial stability by accelerating the adoption of digital payments, improving anti-money laundering, and supporting banks' ability to finance the economy. A study conducted by Keister and Monnet (2022) shows that a cautiously designed CBDC might decrease rather than increase financial fragility. Kim and Kwon (2019) have stated that a switch over to CBDC from deposits initially makes banks short of cash reserves to pay out to depositors and might create panic or a bank run. However, once a central bank lends equal to all the deposits in CBDC account to banks, the quantity of CBDC will increase which does not require reserve holdings, and this eventually enhances financial stability by increasing the supply of private credit and lowering nominal interest rate (Kim and Kwon, 2019)

(j) Supporting government for welfare distribution

2.28 CBDC is also being explored to find a better way to quickly deliver the government's stimulus payment to the public during crises in a targeted manner. Assessed over the 181 countries covering 99 percent population of the world, the World Risk Report 2021 has revealed that among the 15 countries with the highest disaster risk, 10 are the island states. The report mentions the rise in sea level as an increasing cause of such disasters (RUB, 2021). The two independent Eastern Caribbean states Dominica, and Antigua and Barbuda ranked fourth and fifth highest disaster risk-rated countries

[5] See https://www.resbank.co.za/en/home/what-we-do/financial-stability

respectively in the World Risk Report 2021. Thus, the ECCB adopted digital currency for increasing opportunities for financial inclusion, growth, competitiveness, and resilience for citizens of the ECCU (ECCB, 2020). It extended the CBDC pilot to areas struck by a volcanic eruption in 2021 (Georgieva, 2022).

2.29 World Economic Forum (2021) states that CBDC could be employed for fiscal transfers to households or firms, such as relief or stimulus payments. Such helicopter drops or subsidies would potentially become easier when there is widespread adoption of CBDC accounts. The transfer payments could also be "programmable", with conditions such as expiration upon a certain date or a requirement to spend the funds at certain vendors (World Economic Forum, 2021).

Key Foundational Issues

2.30 There are some foundational issues that every central bank needs to consider and sort out first to create favorable circumstances for the development and adoption of CBDC. Some issues outside the central bank's purview might require high-level coordination of central banks' authorities with the concerned outside agencies. Some of the key foundational issues related to CBDC that have been discussed in different reports, papers, and articles have been found as follows:

(a) Adequate legal and regulatory framework

2.31 Appropriate national legal, regulatory, supervisory, and oversight frameworks are essential to ensure trust, resilience, security, and confidence in any CBDC (MoF-J, 2021). In this regard, Bossu et al. (2020) state that the introduction of CBDC would raise important legal questions as often highlighted by central banks and other policymakers. Such questions are: Do central banks have the authority to issue digital "currency"? Can CBDC be real "currency"? Should digital currency be legal tender? In the absence of a clear response to these questions, the monetary system will struggle to adopt CBDC widely and the digital space might become 'populated' by private alternatives.

2.32 Bossu et al. (2020) further state that many central banks' laws support issuing account-based CBDC to financial institutions but often lack a sufficient legal basis for issuing to the general public. They have noted that 85 percent of central bank laws among the IMF member countries limit the power to open cash current accounts to a limited category of institutions, while a minority of central bank laws allow for the opening of current accounts to a broader public. They argue that central banks having explicit power to open cash current accounts for the State and financial institutions can offer account-based CBDC to them within the same laws and vice versa in the case of physical persons. If the central bank law is silent on opening current accounts, it will get implied powers once a critical mass of central banks issue account-based CBDC to the general public (Bossu et al., 2020).

(b) Capacity development and restructuring at central banks

2.33 Central banks need to develop their capacity before taking up any CBDC project. RUB (2021) states that regulatory expertise will be crucial to take the benefits and curb the risks of CBDC. Even central banks in major economies may struggle with the technological implications of CBDCs (RUB, 2021).

2.34 As few countries (eleven) have launched CBDC, their experience sharing shall be too early. Central banks need time to learn more before launching CBDC. Experiences have shown that some central banks have initiated the pilot project not to be able to issue CBDC thereafter but to understand the technology, learn policy implications and build capacity (BSP, 2020).

2.35 For launching CBDC, Soderberg et al. (2022) suggest central banks decide whether to make formal organizational changes or work with existing structures. They have noted some central banks creating new committees, divisions, or research centers, and others having reprioritized the work of staff in the existing divisions. Where People's Bank of China has created a separate Digital Currency Institute with its subsidiaries across geographical areas to organize the e-CNY pilots, and the central bank of Bahamas has created a new unit for Sand Dollar that works under a policy steering committee

comprising representatives from different departments of the bank (Soderberg et al., 2022).

(c) Developing required infrastructure

2.36 CBDC should be supported by a robust infrastructure. BIS (2020) states that a CBDC system could be a better way to distribute and use funds in geographically remote locations or during natural disasters than cash. It suggests developing significant offline capabilities, both for the CBDC system and any dependencies (e.g., availability of electricity for mobile devices).

2.37 CEMLA (2019) categorically mentions that a CBDC system highly demands telecommunications, software, authentication, cybersecurity, operational risk mitigation, and other technical capacities which require huge costs to be borne by the central bank. A CBDC system might be vulnerable to outages in electricity and internet connections, to weaknesses in the geographical coverage of these critical infrastructures as well as to risks of failures of their services or to anti-competitive strategies by these commercial firms (even more so if they are monopolies or oligopolies), making it necessary for central banks to master the technical and technological know-how to deal with day-to-day and contingency situations.

2.38 Similarly, Kiff et al. (2020) have also mentioned that CBDC requires an adequately developed technological infrastructure such as electricity grids, mobile networks, and internet coverage. Depending on their circumstances, countries may opt for a combination of submarine fiber optic cables, landlines, and satellite connections (Kiff et al., 2020)

(d) Enhancing public adoption

2.39 CBDC should be widely adopted by the public. BIS (2021) suggests that the adoption of CBDC will be successful if it fulfills unmet user needs, achieve network effects, and uses the existing, accessible technology and infrastructure. It views that consumers will use CBDC if merchants are willing to accept it, and merchants will also accept it when consumers are willing to use it. So, it implies that central banks

should design CBDC with P2P functionality to facilitate adoption which gives merchants greater incentives to accept CBDC. Further, there should be little or no cost to the CBDC end user though the overall cost of a CBDC system could increase with the complexity of its design (BIS, 2021).

2.40 Further, CEMLA (2019) has rightly stated that certain groups in society with a lower level of financial education and others from the shadow economy might find digital solutions challenging to use as they have low purchasing capacity for buying smartphones or are technically less literate to adopt them. Hence, central banks should promote adoption and training campaigns developing easy-to-use technical interphases and involving relevant stakeholders to foster outreach and scalability in terms of nationwide identification mechanisms or IT infrastructure (CEMLA, 2019). For easy public adoption, BIS (2021) further suggests that public authorities disburse social benefits and transfers to consumers or pay employee salaries or allow consumers to pay their taxes in CBDC.

Some Challenges

2.41 In addition to the key foundational issues discussed above, some challenges need to be overcome to successfully implement CBDC. Balz (2021) advises central banks to be diligent and take their time as CBDC also brings several challenges besides opportunities. Before taking any decision to introduce a retail CBDC, the Bank would need to be clear that the net benefit for payments users, the financial system, and society as a whole would outweigh any risks (BoE, 2020). Some of the likely challenges discussed in literature are as follows:

(a) Financial disintermediation

2.42 CBDC is likely to substitute cash and bank deposits. BoE (2020) defines the shrinking of the banking sector's balance sheet as 'disintermediation'. It views that when households and businesses hold CBDC, they must switch some of their funds out of banknotes and commercial bank deposits into central bank money which does nothing to the households' and central bank's balance sheet but shrinks commercial banks'

overall balance sheet. BoE (2020) further states that commercial banks lose both their liabilities (deposits) and assets (reserves) to meet public demand for CBDC, and such a situation induces banks to hike deposit interest rates as well as take the long-term deposit or wholesale funding. This will increase their cost of funds prompting them to increase the cost of credit too. The rise in credit costs will lower bank banking. If the disintermediation is severe, banks then seek to borrow from central banks expanding the central bank's balance sheet.

(b) Financial exclusion

2.43 CBDC could be convenient only for tech-savvy citizens if not designed around the poor and technically lagged people. The rise in the mobile phone penetration rate in developing countries does not ensure that people get access to financial inclusion products as the majority of them carry normal cell phones that are cheaper but not smarter. So, CBDC should also be designed to promote people's access to financial inclusion products through feature phones.

(c) Data exposure and breach

2.44 Leucci et al. (2021) mention that direct access to central bank accounts of a CBDC could lead to the increasing amount of personal data in the hands of the intermediaries. Hence, they warn that wrong design choices might worsen privacy and data protection issues. For example, transactional data could be unlawfully used for credit evaluation and cross-selling initiatives (Leucci et al., 2021).

2.45 Further, central banks and financial intermediaries get enormous access to the personal financial data of the people in case of the use of CBDC. At times, they might face pressure from agencies investing in cases of corruption and money laundering, and terrorism financing to share that information with them. This could discourage people, in general, to switch to CBDC from physical cash.

(d) Operational failure of the system

2.46 Minwalla (2020) warns that an operational CBDC will draw the attention of organized crime syndicates and nation states capable to host large-scale attacks on the CBDC system of their rival states. Primary threats include sustained network attacks (DDoS, botnet), supply-side attacks, and side-channel attacks. In a DDoS attack, multiple clients bombard a server with connection requests which overwhelm the server's capability to respond to legitimate requests, and this cause legitimate clients to experience connection failures. A botnet is a large network of ordinary computers infected by malware. Supply-side attack introduces malware on the hardware level during the chip manufacturing process. In a side-channel attack, information from a running CBDC application is stolen through malicious software, or secretes from running hardware are stolen based on timing information, power consumption, and electromagnetic leaks. The central bank would have to put suitable controls and processes in place to mitigate the risk of large-scale attacks from these advanced persistent threats (Minwalla, 2020).

2.47 Managing security against all those threats is essential to avoid the likely operational failure of CBDC. Proper safeguards are therefore required to minimize risks, and threats must be continuously monitored. Operational failure can also come from technical issues. For example, the digital currency of ECCB, i.e., DCash, went offline on 14 January 2022 due to the expiry of the identity certificate on each of the nodes in the Hyper-ledger Fabric network, and it was restored after two months only in March 2022 (Hall, 2022).

(e) Adoption of inappropriate technology

2.48 Finding an appropriate technology for CBDC will not be an easy task for any central bank. One of the great difficulties in making decisions while much of the technology is still developing and remains relatively untested (Soderberg et al., 2022). CBDC research remains a young field, with limited pilot examples or testing at scale. As a result, an examination of how a system could work, including the respective roles of both the private and public sectors, is necessarily preliminary (BIS, 2020).

2.49 The choice of technology employed for CBDC should be scalable, with almost zero latency, secure, and, privacy-preserving (Biswas, 2022). Central banks must decide where to acquire technology, if they do not build it in-house, and which technology best suits their purposes (Soderberg et al., 2022).

2.50 In this case, Adrian and Mancini-Griffoli (2019) state that offering a full-fledged CBDC requires central banks to be active along several steps of the payments value chain, potentially including interfacing with customers, building front-end wallets, picking and maintaining technology, monitoring transactions, and being responsible for anti-money laundering and countering the financing of terrorism. Failure to satisfy any of these functions, due to technical glitches, cyber-attacks, or simply human error, could undermine the central bank's reputation (Adrian and Mancini-Griffoli, 2019).

(f) Impact on central bank's seigniorage

2.51 Value of outstanding banknotes multiplied by the prevailing interest rate which is less than costs of note production and distribution is a central bank seigniorage (Engert and Fung, 2017). In other words, the interest earned on money that central banks lend, or return received on the assets central banks acquire is a seigniorage income (ECB, 2017). Such income is sourced from issuance of the banknotes, foreign exchange reserves, investments, and bonds purchased as part of the asset purchase programs (ECB, 2017).

2.52 Macfarlane et al. (2017) clarify that the seigniorage income does not accrue today as described in books and academic papers, i.e., the nominal difference between the cost of producing money and its purchasing power. It is because money today is not new money directly spent into the economy, but is lent into the economy through commercial banks in the form of cash and reserves. While lending such money, central banks receive equivalent assets in exchange, which they further invest or earn interest. In their view, the need to hold the central bank's money creates a basis for generating seigniorage income for central banks (Macfarlane et al., 2017).

2.53 A remunerative CBDC thus reduces the seigniorage income of the central banks. Seigniorage would also decline if banknotes, especially higher-denomination, declined in use. If the decline is significant, the central bank might need to rely on government funding, which would undermine its autonomy (Engert and Fung, 2017).

(g) Impact on numismatic activities

2.54 Today central banks, besides circulation coins, also issue commemorative coins. Collecting old and rare currencies (i.e., numismatics) is a hobby for many people. Physical currencies help numismatic researchers to study the monetary and political history of a country as these commemorate historic times, events, figureheads, memorials, etc. of a country. Issuance of CBDC might impact numismatic studies as the physical currencies might be less available in the future. Taking into account the numismatics and the need to issue pure digital collector coins in the future, Paleckis and Pilkis (2020) suggest European Union to review their legal acts in the future to regulate the issuance of Euro collector coins so that opportunities that are opening up with the use of new technologies are met.

Box 2.2 The Bahamian Payment System Modernization Initiative (PSMI)

- *During late 1990s, the central bank of Bahamas commissioned a special study to identify the available options to modernize the country's payments systems as per the international standards. In 2003, NPC was established to direct the Bahamian PSMI.*
- *In 2004, the central bank invested in the Bahamas Interbank Settlement System – the RTGS for large-value payments between clearing banks. Later the commercial bank-owned ACH was established in 2010 for electronic settlement of small-value retail payments. Both ACH and RTGS improved the speed and efficiency of domestic payments.*
- *Later, the central bank asked for expression of interest to select its technology partner for digital currency. 30 local and international firms showed their interests. 6 of them were invited to submit formal proposal. In March 2019, NZIA Ltd. was selected as the preferred solutions provider. In November 2019, a special session of the NPC was convened with key stakeholders to reaffirm the approach to the project.*
- *Exuma, a district consisting more than 365 islands (cays), was selected as an optimal site for pilot testing. In 2019, the central bank conducted a targeted baseline survey on financial inclusion and access. The results suggested to address costs, ease of use and cybersecurity concerns to increase use of digital currency. In December 2019 the Exuma pilot was launched and expanded to Abaco in February 2020. On 20th October 2020, the central bank of Bahamas released Sand Dollar to the general public throughout the country.*

Source: sanddollar.bs

3. Models of CBDC

3.1 This chapter presents the foundational principles and core features of CBDC, and its design choices. This also presents the design choices that have been adopted or being explored by other central banks.

Foundational Principles and Core Features

3.2 BIS (2020) has outlined three key foundational principles to be considered by central banks while issuing CBDC: "Do no harm", "Coexistence" and "Innovation and efficiency". The **"Do no harm"** principle suggests that CBDC should not impede the central bank's ability to carry out its key monetary and financial stability mandates. The **"Coexistence"** principle suggests that CBDC should not be forwarded to phase out physical currencies and private monies unless people shift to CBDC themselves. And the **"Innovation and efficiency"** principle suggests that CBDC should promote broader innovation and efficiency in the overall payment system of a country (BIS, 2020).

3.3 To comply with the foundational principles, BIS (2020) has identified 14 core features, 4 related to the CBDC instrument, 8 related to the underlying system, and the rest 2 related to the broader institutional framework. The instrument features suggest making CBDC ***convertible*** to cash and private money at par, ***convenient*** to use as cash, ***accepted*** for P2P payments ***and available*** for use in offline transactions, and ***accessible*** for use in payments at no or very low cost to the end users. The system features suggest adopting a ***secure***, ***instant***, ***resilient***, high ***throughput, scalable,*** and cross-system ***interoperable*** system that is flexible and adaptable to changing conditions and policy instructions. And the institutional features suggest putting in place a ***clear and robust legal framework*** for central banks, and appropriate regulatory ***standards*** for infrastructure and participating entities (BIS, 2020).

Design Choices

3.4 Auer and Bohme (2020) suggest developing a suitable design for a CBDC and its system to realize the core features. Different technical designs meet the attributes to

varying degrees, depending on if they take intermediaries, maintain the ledger, provide access and facilitate retail interlinkages across borders (Auer and Bohme, 2020).

3.5 Literature on CBDC has focused on the following aspects of CBDC to navigate central banks' choices of CBDC design attributes:

(a) Purposes or use cases

3.6 Regarding the use case or purpose, two types of CBDC have been identified: retail or general purpose, and wholesale purpose. PwC (2021a) states that a ***retail CBDC*** can be directly held by citizens and corporates as a digital form of cash, offering a new platform for holding and exchanging money. On the other hand, an ***interbank or wholesale CBDC*** is restricted to use by financial institutions alone for interbank payments and financial settlement processes (PwC, 2021a).

(b) Architecture

3.7 Consumers primarily need a CBDC that is a cash-like claim on the central bank, transferable in peer-to-peer settings, and convenient to use. This requires central banks to choose appropriate architecture to decide the legal structure of the claims and the respective operational roles of the central bank and private institutions in payments (Auer et al., 2020).

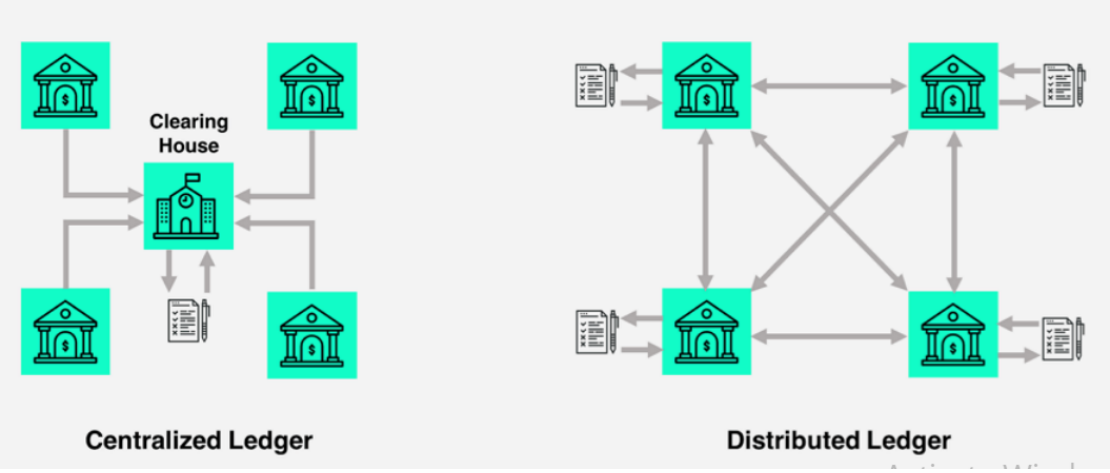
3.8 Regarding architecture, Auer and Bohme (2020) have presented three key designs of CBDC: ***direct, hybrid,*** and ***indirect***. In its direct architecture, CBDC is a direct claim on the central bank which keeps a record of all transactions and updates it with every transaction. In a hybrid architecture, intermediaries handle real-time payments while records are maintained by the central bank which it uses to transfer holdings between PSPs in the event of a technical failure. Again, Auer and Bohme (2021) present an alternative ***intermediated*** architecture where a central bank records wholesale balances of its intermediaries only, thereby, less exposing it to malicious attacks, and reducing the risk of data breaches at the central bank. But in this architecture, the central bank needs to honor claims of which it has no record (Auer and Bohme, 2021).

3.9 Finally, in an indirect (also called 'synthetic') architecture, CBDC holdings are a claim on intermediaries, with the central bank keeping a record of wholesale accounts only (Auer and Bohme, 2020). Didenko and Buckley (2021) define an indirect CBDC as a digital currency issued by a commercial bank matched by deposits held at a central bank. (See Appendix-1)

(c) Ledger infrastructure

3.10 The goal of a digital currency system is to track the balance of its users, allowing each to transact only their coins (Allen et al., 2020). This requires maintaining a ledger to record transactions and balances of end users. The ledger could be a conventional ***centrally controlled*** database, or a novel ***distributed ledger*** (Auer and Bohme, 2020). A blockchain is a type of distributed ledger technology (see Box 3.1 and Box 3.2).

Figure 3. 1 Centralized vs decentralized ledger



Source: Ward and Rochemont (2019)

3.11 Allen et al. (2020) state that in a fully-centralized design, the choice of nodes and their operation are all under the direct control of the central bank, and thus the central bank itself or a malicious insider at their will, can potentially change, roll back, rewrite or delay transactions. But in a semi-centralized design, the central bank chooses entities to run the nodes instead of having sole control over all the nodes and their operations. Hence, no single party or group of parties below a certain size can tamper with the

transactions. However, the central bank can facilitate an agreement of all parties to perform arbitrary changes (Allen et al., 2020).

3.12 On the other hand, Bech et al. (2020) define a distributed ledger as a record of transactions held across a network of computers where each computer (node) keeps a synchronized copy. A distributed ledger could be permissionless and permissioned. Allen et al., (2020) mention that in a permissionless ledger, anyone can join and operate the system without permission from the central bank, but in a permissioned or semi-centralized option, a group of entities collectively run the system, allowing centrally coordinated changes. Although every node on a permissioned or permissionless distributed ledger maintains and updates its copy of the ledger, they must have identical ledgers (Allen et al., 2020). A consensus mechanism is used to ensure that each update of the ledger is harmonized between all nodes (Auer and Bohme, 2020).

Box 3. 1 Blockchain

- *Blockchain is a type of distributed ledger technology (DLT) which is a rapidly evolving approach to recording and storing data across multiple participants in multiple locations. Unlike traditional databases, transactions and data are replicated, stored, and synchronized over a distributed network consisting of several nodes. In a blockchain, each transaction (block) is linked together in a list (chain) with a cryptographic hash.*
- *DLTs have some key characteristics: they can be public or private, permissioned or permissionless. A public DLT can be accessed by anyone, whereas a private DLT is access restricted. In a permissionless DLT, any participant can make changes to the ledger provided they are able to achieve consensus, while in a permissioned DLT, only specific entities can authorize or commit updates to the ledger.*
- *Due to the absence of a central authority to ascertain the veracity of data and to commit new transactions, DLTs rely on consensus algorithms that ensure the validity of such data. Once a consensus is reached among the participating nodes, a new transaction is added to the ledger. Reaching a consensus is appropriately difficult, and this establishes overall reliability of the system.*

Source: Bansal and Singh (2021)

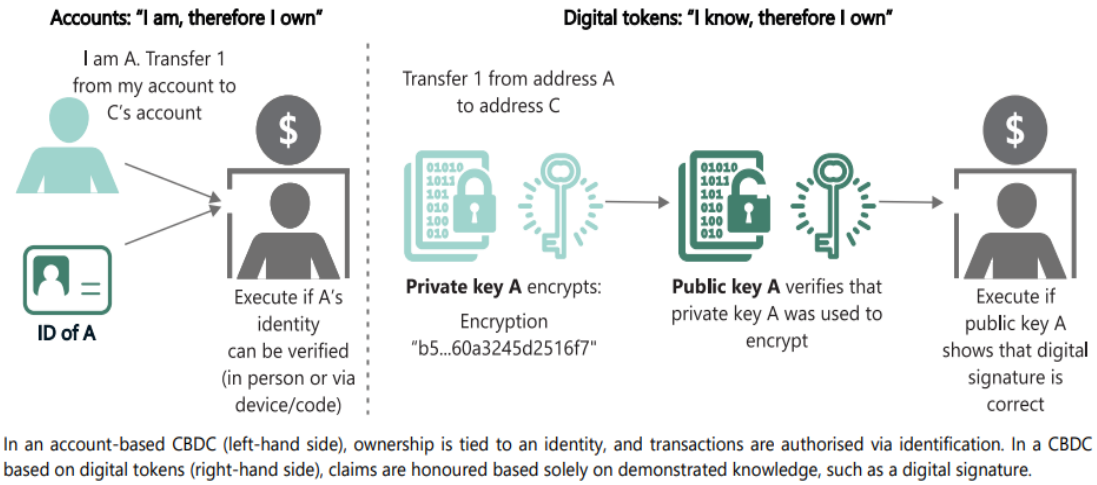
(d) Access design

3.13 Auer and Bohme (2020) state that once the architecture and infrastructure for CBDC have been chosen, the question arises of how and to whom one should give access. This design choice is concerned with either tying access to the CBDC to an identity system adopting an ***account-based*** technology, or securing via cryptographic schemes

that do not require identification by adopting a ***token-based*** technology (Auer and Bohme, 2020).

3.14 According to CPMI-MC (2018), account-based money requires the account holder to verify his or her identity whereas token-based money requires the payee to verify the validity of the payment object. So, in their view, the key concern in account-based technology is identity theft whereas the worry in the case of token-based technology is electronic counterfeiting or double-spending (CPMI-MC, 2018). Kahn et al. (2018) state that account-based systems rely on a central party to manage the accounts to record credits and debits between them, whereas token-based systems rely on decentralized transactions to operate the transfer of the tokens.

Figure 3. 2 Account-based vs token-based CBDC



Source: Auer and Bohme (2020)

3.15 According to BoE (2020), the core difference between a token and account-based system relates to the underlying data structure and the related process for moving funds BIS (2020) finds a token-based system to likely create obstacles for tracing money flows and enforcement of anti-money laundering laws.

(e) Instrument design

3.16 Literature has also highlighted CBDC design around instrument attributes. CPMI-MC (2018) states various basis for design features of a CBDC such as ***availability; anonymity; transfer mechanism***, ***interest-bearing, accessibility***, and also ***quantitative limits or caps*** on holding. The committee mentions that CBDC could be designed to make available 24/7 for use, provide different degrees of anonymity similar to private digital tokens, support payment on a P2P basis or through intermediaries, and be remunerative or non-remunerative on both token- and account-based as well as retail and wholesale CBDC, and be accessible widely primarily targeting retail transactions and much broader use or restricted for wholesale payments only. Further, limits or caps on holding can be imposed to control undesirable implications or steer usage in a certain direction (CPMI-MC, 2018).

Box 3. 2 PoW vs PoA vs PoS

- *In decentralized blockchains, three methods, viz. proof of work (PoW), proof of stake (PoS) and proof of authority (PoA) could be used for validating transactions.*
- *In PoW, transactions are verified through by the competing miners. Miners compete with each other to solve the cryptographic algorithms or equations and validate the transactions to earn blockchain rewards.*
- *In PoS, an individual who wishes to validate transaction on the blockchain can do so depending on the blocks they already hold. Greater the number of blocks or 'stake' that the miner has in the blockchain, the larger the validating power they are given. So, computational power depends on currency power, i.e., the number of token in the node's wallet. Validators are selected randomly based on stake.*
- *In PoA, a number of blockchain actors within the system are given power to validate transactions and they decide if new block is to added to the blockchain or not. Validators do not stake coins but their reputation. So, the validators are pre-approved moderators.*
- *PoW consumes a lot of energy, whereas PoS and PoA consume low to moderate amount of energy. PoA is more efficient than the other two but requires strong regulation and supervision on the validators.*

(Nahar, 2022; Learn with Whiteboard, 2021)

3.17 Literature has also discussed a programmable CBDC that is designed to work with anti-money laundering logic to reduce and mitigate fraud (Galer, 2021), use for a specific purpose only (Lovells, 2022), enable automatic transfers, or block CBDC on pre-determined conditions and carry out recurring payments (Seidemann, 2021), or ***interoperate*** with other types of payment instruments (Demidova and Turner, 2022).

Design Choices Adopted by Countries

3.18 The purpose (use case of transactions), the architecture (legal structure of claims), infrastructure (transactions verification and security arrangement) and access designs (ways to access and execute payments) of the CBDC launched in eleven countries are given in Table 3.1 below. Other key features related to instrument designs of their CBDCs have been presented in Appendix-2.

Table 3. 1 Design choices adopted by countries that have issued CBDC

Countries	Purpose	Architecture	Infrastructure	Access
The Bahamas	Retail	Intermediated	Both	Account, Token
Eastern Caribbean Countries: 1) Grenada 2) Saint Lucia 3) Saint Kitts and Nevis, 4) Antigua and Barbuda, 5) Saint Vincent and the Grenadines 6) Anguilla	Retail	Intermediated	Distributed	Account, Token
7) Dominica 8) Montserrat	Retail, Wholesale	Intermediated	Distributed	Account, Token
Nigeria	Retail	Intermediated	Distributed	Account
Jamaica	Retail	Intermediated	Conventional	Account

Source: atlanticcouncil.org/cbdctracker/

3.19 Besides the above 11 countries that have already issued CBDC, many other countries are in a different stage of exploration. The design choices adopted by these countries are shown in Table 3.2 below.

Table 3. 2 Design choices being considered by countries exploring CBDC

Purpose	Architecture	Infrastructure
Retail-48	Direct-3	Conventional-5
Wholesale-8	Intermediated-37	DLT-18
Both-20	Undecided-69	Both-16
Undecided-33		Undecided-70

Source: atlanticcouncil.org/cbdctracker/

4. Policy Goals and Design of CBDC for Nepal

4.1 After reviewing the global development, this chapter attempts to explore the necessity of CBDC and its design choice suitable for Nepal

Key Policy Mandates for NRB

4.2 CBDC must support public policy objectives and should not impede the central bank's ability to fulfill its policy mandates[6]. NRB, as a central bank of Nepal, gets its policy mandates from NRB Act, 2002. The Act states three key mandates for NRB, (i) to maintain the stability of price, the balance of payment, and the entire financial sector (ii) to increase financial access, and (iii) to develop a secure, healthy and efficient system of payment. The Bank is required to cooperate in the implementation of economic policies of the Government of Nepal without any prejudice to its policy objectives. Key functions that help NRB achieve its policy mandates include issuing banknotes and coins, formulating necessary monetary policies, and establishing and promoting the payment, clearing, and settlement system, among others.

4.3 The policy goals that NRB selects for CBDC should first relate to the policy mandates of NRB. Further, rather than taking miscellaneous policy goals for CBDC, the bank should select only a few policy goals in which there is a high outcome gap (i.e., the outcome is quite less than the desired level), and the intended CBDC could positively contribute to bridging the gap. CBDC design consideration should broadly focus on those selected few policy goals, but should also not challenge other goals.

Analyzing Policy Goals for CBDC in Nepal

4.4 This section analyzes the current situation of the different policy goals in the context of Nepal. The policy goals discussed in Chapter 2 of this report have been taken as a reference for the analysis. Then this section measures the current performance or outcome gap to these goals, which are considered a source of motivation for NRB to explore CBDC. Methodology stated Chapter 1 has been followed for assessment. This

[6] See G7 United Kingdom 2021 report on "Public Policy Principles for Retail Central Bank Digital Currencies (CBDCs)" visit https://www.mof.go.jp/english/policy/international_policy/convention/g7/g7_20211013_2.pdf

section then ranks the policy goals as highly desirable, moderately desirable, and least desirable based on their position in the heat map matrix. The more a policy goal moves right along the X-axis and upward along the Y-axis, the more it tends to lie in the warmer zone of the heat map matrix making it a highly desirable policy goal for CBDC.

(a) Improving access to payments

4.5 In Nepal, NRB has established note chests in different places of the country to supply adequate banknotes to the BFIs, and bank branches. BFIs have also been operating ATMs at different locations to ensure convenient access to payment for the people. As of mid-July 2022, there were 79 different note chests operating throughout Nepal. These note chests support BFIs in managing their physical currency.

Table 4. 1 Banking presence in Nepal

Indicators	2018 Mid-Jul	2019 Mid-Jul	2020 Mid-Jul	2021 Mid-Jul	2022 Mid-July
No. of BFIs (A, B, C, E)[7]	86	81	70	63	60
No. of MFIs (D)[8]	65	90	85	70	65
No. of Branches of BFIs (A, B, C)	4202	5057	5708	5998	6394
No. of Branches of MFIs (D)	2448	3629	4057	4685	5134
No. of Branchless Banking Centers	1285	1530	1574	1706	1548
No. of ATMs	2791	3316	4106	4325	4602

Source: Monthly Statistics of NRB

4.6 Table 4.1 presents the state of BFI's presence in recent years It shows that the presence of banks through their branches, branchless banking centers, and ATMs has been gradually improving in recent years, thereby, supporting access to payments in the country. However, until mid-July 2022, there was no banking presence in the Saipal rural municipality of Bajhang district. ATMs were present only at 332 local levels

[7] A, B, C and E refer to 'A' class licensed commercial banks, 'B' class licensed development banks, 'C' class licensed finance companies and 'E' class licensed infrastructure development bank of Nepal respectively.
[8] D refers to 'D' class licensed microfinance financial institutions of Nepal.

until that period. The cash withdrawal from these ATMs charges a transaction fee[9]. Such charges vary according to the type of the card (e.g., SCT card, VISA card, etc.). Some ATMs run down frequently barring people from access to payments. These situations show that access to payments for some people or in some locations is still not sufficient. Hence, the current outcome gap to this policy goal could be considered ***very high***.

4.7 Kemp (2022) has stated that there were 11.51 million internet users in Nepal as of January 2022 showing an internet penetration rate[10] of 38.4 percent. Hence, 61.6 percent of the population was still offline as of that period. However, the number of internet users seems to have increased by 7.7% between 2021 and 2022. The median mobile connection speed via cellular network is 18.42 Mbps. At the start of January 2022, the number of cellular mobile connections was 40.58 million (Kemp, 2022). Mobile connections and internet penetration are expected to improve further in the coming days.

4.8 Nepal Telecom, the government-owned telecommunication service provider, reports that its 4G/LTE service has reached 720 local levels from the 77 districts till mid-July 2021 (NDCL, 2022). Similarly, Ncell, the private mobile service provider, claims that its rural connectivity ratio is 58.92 percent, subscribers base is 15.76 million, the number of data subscribers is 6.71 million, 4G population coverage ratio is 58 percent, 3G population coverage ratio is 59.46 percent, and smartphone penetration among its users is 64 percent till mid-July 2020 (Ncell, 2020). CBDC uses digital platforms for payment transactions and the outlook of digital progress in the domestic market is improving. In this context, the likelihood of CBDC contributing to promoting access to payments could be taken as ***very high***.

(b) Enhancing resilience of the payment system

4.9 Ensuring seamless transfer of funds between transacting parties needs a resilient payment system. NRB presently ensures the resilience of the payment system through

[9] Some banks now-a-days charge none to its clients for a specified number of transactions per month or period.
[10] Ratio of number of people using internet service to total number of population.

several ways viz. managing note chests at different locations, facilitating electronic interbank clearing and payment systems, using liquidity injecting tools, providing lender of last resort facility during the time of liquidity stress, and regulating and supervising private payment systems for their safety and soundness. The NCHL, promoted by NRB and other BFIs, is providing clearing and settlement services through NCHL-ECC, NCHL-IPS, *Connect*IPS e-payment, and CorporatePay services. Its *Connect*RTGS is capable to process high-value and urgent payments between the participating BFIs. It also settles systemically important payment systems on a net settlement basis to reduce settlement risk.

4.10 The uninterrupted supply of power in recent years has been quite supportive to maintain the resilience of the payment systems in Nepal. A report of NEA (2021) states that Nepal's total installed capacity of all electricity projects in operation has reached 1441.35 MW by FY 2020/21. As per the report, a total of 138 IPPs-owned projects with a total capacity of 3506.8 MW are under construction after financial closure. Another 99 IPPs-owned projects with a combined installed capacity of 1851.3 MW are at various development stages. A power purchase agreement (PPA) for additional 345 IPPs-owned projects with a combined installed capacity of 6172.75 MW has been signed (NEA, 2021).

4.11 Though the presence of an electronic settlement system, infrastructural progress in the power sector, an increase in the number of bank branches and ATMs, and the presence of private digital payment services are supportive of maintaining the resilience of the overall payment systems, such resilience is largely dependent on the quality and functioning of private sector infrastructure. Experiences are that some of these infrastructures have run down frequently. NRB's note chests are also not accessible round the clock; they are accessible during office hours only. Therefore, the current outcome gap to this policy goal could be considered ***high***. As CBDC would be an alternative backup system for digital payment adding to the resilience of the overall payment systems, the likelihood of a CBDC contributing to further enhancing the resilience of the payment systems could be considered ***very high***.

(c) Promoting financial inclusion

4.12 In Nepal, several financial inclusion models have been practiced at different times as Grameen banking, wholesale microfinance, directed lending, FINGO model, project-based microcredit, cooperative banking, priority and deprived sector lending, liberal licensing of microfinance institutions, productive sector lending, refinance, consumer protection, branchless banking, mobile banking, liberalized branch opening policy, and interest subsidy, etc. These have contributed positively to the progress of financial access indicators (Pant, 2016).

Table 4. 2 Financial access indicators of Nepal

Indicators (related to A, B, and C)	2018 Mid-Jul	2019 Mid-Jul	2020 Mid-Jul	2021 Mid-Jul	2022 Mid-July
No. of Deposit Account	23544859	27866505	32454204	37770985	44971969
No. of Loan Account	1301010	1439648	1544059	1702195	1829044
No. of Branchless Banking Customers	130660	168307	193607	230154	283480
No. of Mobile Banking Customers	5086069	8347187	11306797	14194839	18307255
No. of Internet Banking Customers	834302	917344	1031227	1160321	1684310
Population Per Branch of BFIs	6859	5776	5255	5065	4566

Source: Monthly Statistics, NRB

4.13 Table 4.2 shows that financial access indicators have gradually progressed during the last 5 years. It has been estimated that 67.3 percent population has at least one bank account (NRB, 2021). The number of deposit accounts has increased partly due to the government's bank account opening campaign, the requirement of a bank account to receive social security allowance, and the expansion of bank branches to the local levels, and also partly due to the requirement of bank account for trading stocks in the secondary stock market.

4.14 Though there seems to be gradual progress in promoting financial inclusion in Nepal, a large number of people are, however, still outside the banking system. A study[11]

[11] A brief study conducted by NRB titled 'State of Financial Inclusion in Nepal' published on September 2019.

conducted by NRB in 2019 found that 39.1 percent of the population was unbanked during that period. So, the current outcome gap to this policy goal could be considered ***moderate***.

4.15 NRB's strategic plan for 2022-2026 takes a resilient and inclusive financial system as a strategic direction of the bank. Following the strategic plan, the bank is going to conduct several financial inclusion initiatives within the next five years. NRB will utilize the existing banking infrastructure and regulatory framework to deliver progress in financial inclusion. The number of mobile banking customers and internet banking customers has also increased considerably in recent years as observed in Table 5 above.

4.16 If CBDC is issued, BFIs will utilize the CBDC platform to efficiently deliver low-cost financial inclusion products to the target people. A token-based CBDC can be designed to skip the need for an identity document for operating a CBDC e-wallet up to a certain holding limit. An account-based CBDC will also help BFIs to identify the target group of people whom they would offer their financial inclusion products. Hence, the likelihood of a CBDC to contribute in promoting financial inclusion can be taken as ***moderate*** as of now.

(d) Supporting government for welfare distribution

4.17 Nepal faced a devastating earthquake in 2015 causing an unimaginable loss of human lives and properties. The government agencies used local volunteers and private agencies to deliver funds to support the victims. At the same time, NRB made policy facilitation for opening bank accounts for people against the certificate that prove that they are affected by the earthquake. The requirement of prior permission to open a bank branch was lifted for earthquake-hit districts. Policies such as one bank at one local level and one bank account for each family were taken which helped promptly later in delivering welfare funds during Covid lockdowns.

4.18 While CBDC could be tailored to fit all policy options of the governments, the current banking network with an expanded customer base in terms of the number of deposit

accounts and the post-Covid progress in digital banking seems capable to support the government efficiently channelizing welfare funds under its ongoing and future programs to the target groups. So, the current outcome gap to this policy goal has been considered ***low*** showing a low need for an alternative solution right now. However, CBDC could speed up direct transfers of funds from government accounts to the accounts of the target groups. An account-based CBDC, linked with a national digital identity scheme, could further help to identify the real victims of any crisis. The government can tailor CBDC in a way allowing the target group to spend on their needs only. A token-based CBDC can also serve the unbanked people having no identity documents by offering pseudonymous e-wallets. It is yet to see how CBDC performs for the public welfare programs, but the likelihood of its contribution to this policy goal has been considered ***moderate***.

(e) Reducing currency management costs

4.19 The currency demand in Nepal is growing every year due to an increase in economic activities. Sometimes, festive seasons and some events like elections also increase currency demand. Table 4.3 shows the Nepalese banknote in circulation in the last 10 years.

Table 4. 3 Banknotes in circulation

Period	Banknote Circulation		
	Total (Rs. Mn)	Growth (Rs. Mn)	Growth (in %)
2013 Jul	229,021.7	29,851.4	14.99
2014 Jul	266,890.0	37,868.3	16.53
2015 Jul	315,542.5	48,652.5	18.23
2016 Jul	381,512.0	65,969.5	20.91
2017 Jul	422,903.4	41,391.4	10.85
2018 Jul	486,214.1	63,310.8	14.97
2019 Jul	503,250.2	17,036.0	3.50
2020 Jul	579,708.8	76,458.6	15.19
2021 Jul	669,513.8	89,805.0	15.49
2022 Jul	632,470.0	(37,043.8)	(5.53)
Average growth of the last 10 years			**12.51**

Source: Periodic Quarterly Economic Bulletins, NRB, Economic Research Department

4.20 As shown in Table 4.3 above, banknote circulation has increased by an average annual growth rate of 12.51 percent during the last 10 years. The volume of banknotes to be printed needs to meet both the demand for additional circulation and the demand for replacing unfit banknotes with clean banknotes. It is NRB's legal obligation to supply adequate banknotes throughout Nepal ensuring a safe and sound payment system. NRB does not have a banknote printing facility. Banknotes and coins for Nepal are supplied by international security printers under the contracts signed with NRB. The bank bears millions of rupees every year on banknote printing. Besides printing costs, the bank also bears huge amounts every year as insurance costs, transportation costs, staff costs, and the cost of security arrangements, for managing currency transfers to note chests operated in different parts of the country.

Table 4. 4 Note printing and distribution expenses of NRB

Fiscal Year	Note Printing Cost (Rs. in Mn)	Fund Transfer Cost (Rs. in Mn)	Total Cost (Rs. in Mn)	Growth Rate of Total Cost (%)
2017/18	947.4	47.3	994.8	1.03
2018/19	853.8	46.3	900.1	-9.52
2019/20	837.7	36.4	874.1	-2.89
2020/21	1639.4	30.6	1669.9	91.06
2021/22	2403.7	32.8	2436.6	45.90
Total	**6682.0**	**193.4**	**6875.5**	**25.12**
Annual Average	**1336.4**	**38.7**	**1375.1**	

Source: Currency Management Department, NRB

4.21 Table 4.4 above shows that between 2017/18 and 2021/22, NRB spent an average of Rs. 1336.4 million per year on banknote printing. There are other costs related to fund transfer, insurance, security, and staff which could also reduce for NRB. The bank has its minting facility, but most of the machinery and parts at the facility are outdated and non-automatic, difficult to maintain and operate the machinery. The machinery items are quite unsupportive of large-scale coin production. The division also lacks high-skilled technical manpower to run the facility. As the cost of coins became cheaper to import than mint, NRB has taken the policy to import the coins in recent years.

4.22 So, considering the gradual increase in the demand for the banknotes in Nepal, NRB not having its banknote printing facilities and enough capacity to mint its circulation coins from its current minting facility, and growing costs of managing the currencies, the current outcome gap to this policy goal could be considered ***high*** that can motivate NRB for an alternative solution through the introduction of CBDC.

4.23 A simple data analysis shows that if CBDC issued in Nepal contributes by replacing banknote printing needs gradually to 50 percent of the current trend within the next 5 years, this could save an estimated Rs. 4.73 billion of future currency printing costs. Besides, the BFIs also benefit from CBDC since they can withdraw a significant number of their staff from the cash processing task and place them in other units. BFIs had a total of 59792 staff (excluding MFIs) as of mid-January 2022, and around 20 percent of these staff were engaged in cash processing tasks. So, it seems that CBDC has the potential to benefit not only NRB but also other BFIs in lowering their cash management costs.

4.24 However, most people in Nepal still carry cash for their daily needs despite e-monies being available. This is mainly because e-monies are still not widely accepted in the market, particularly in retail shops, medical stores, public vehicles, and remote locations. Therefore, a complete withdrawal of physical currencies from the system seems unfeasible shortly given the current practice of its usage. Further, if people convert their physical cash into CBDC more rapidly than expected, NRB might face the challenge to store cash as a massive volume of cash would return to the central bank's vaults. CBDC also requires a huge initial investment for regular operation, maintenance, and system update. Hence, the likelihood of a positive contribution from CBDC to this policy goal could be considered ***moderate***.

(f) Safeguarding the central bank's monetary sovereignty

4.25 There are some rumors that Nepalese people working abroad have put their money in cryptocurrency and non-fungible tokens causing remittance growth to decline in Nepal in recent times. Using cryptocurrencies and non-fungible tokens inside Nepal and by Nepalese citizens is illegal. Further, using cryptocurrencies for peer-to-peer payments

inside Nepal has not been noticed till now, thereby, showing no serious threat of currency substitution. The currency substitution might be triggered if Nepal could not withstand the current peg with the Indian currency. The persistent trade deficit with India has also increased this risk to some extent. However, NRB's firm commitment to peg and holding sufficient foreign exchange reserve balance has minimized this risk. Hence, given the very low threat of currency substitution, the current outcome gap to this policy goal has been considered ***low***.

4.26 India has announced to launch CBDC in 2022/23. Its design would answer how a foreigner (e.g. Nepalese) will use Indian CBDC. The threat of losing convenient access to digital Indian rupees might induce some people to hold Indian CBDC. Hence, the potential demand for similar digital currency in Nepal cannot be undermined. Further, the interoperability of CBDC between Nepal and India needs to be arranged to ensure easy access to the Indian rupees. This benefits remitters by reducing their fund transfer cost and settlement time too, and the country by reducing the risk of currency substitution. Managing the interoperability of CBDC between Nepal and India, however, requires the joint effort of the two nations. In absence of such progress, the likelihood of a positive contribution from CBDC for this policy goal could be considered ***very low***.

(g) Promoting financial transparency

4.27 The National Risk Assessment Report on Money Laundering and Terrorist Financing 2020 issued by GoN for the assessment period from 2015 to 2018, has found several threats that Nepal is exposed to, such as corruption, tax evasion, financial crimes, hundi, drug trafficking, organized crime, and extortion, among others. The report assesses the ML vulnerability of Nepal as medium-high. Due diligence of the financial transactions and the transacting parties have been recommended for better transparency. Sectorial regulators have the responsibility to implement the recommendations of the report. Independent institutions like FIU-Nepal and DMLI have contributed to promoting financial transparency and discouraging illicit payment.

4.28 NRB has started conducting AML/CFT-focused inspections of BFIs. It has also issued a separate directive on AML/CFT for BFIs requiring them to have a stringent procedure for customer due diligence. Deposit made in cash above rupee hundred thousand in others' account by a person has to go through proper due diligence together with the declaration of the purpose of such deposit. This restricts NRB to allow pseudonymous transactions in CBDC for a value exceeding such an amount in token-based CBDC. The directive allows establishing business relationships with the clients through digital platforms only when customer due diligence is properly ensured. Transactions made in the account by politically exposed persons (PEPs) and their relatives or associates are subjects to enhanced due diligence. The directive requires enhanced due diligence for persons involved in cash-based businesses as well as persons living in countries listed as 'high-risk jurisdictions subject to call for action, 'jurisdictions under increased monitoring', and countries on UN Sanction List. There are miscellaneous other provisions in the directive that would ensure proper due diligence of the banking clients. Since, all of the existing laws, directives, and practices are sufficient to promote transparency of financial transactions and leave a very limited scope of exemptions for due diligence requirements, the current outcome gap to this policy goal could be considered ***very low***.

4.29 Countries fighting against illicit use of monies have taken financial transparency as the key motivation for CBDC[12]. An account-based CBDC seems to facilitate better transparency of financial transactions. If NRB decides to launch CBDC, it could be an additional tool to further strengthen financial transparency in Nepal. Therefore, the likelihood of a positive contribution from CBDC to this policy goal could be considered ***high***.

(h) Enhancing the efficiency of the cross-border payment system

4.30 According to World Development Indicators 2022, Nepal is among the top 10 remittance recipient countries registering remittance inflows as high as 24.09 percent of GDP in 2020. CPMI-WB (2022) has mentioned the high cost, low speed, limited

[12] See point 2.19 and Box 1.1

access, and insufficient transparency as the four key challenges of global cross-border payment systems, and Nepal is not an exception. Table 4.5 shows the cost of remitting money to Nepal from 8 major remittance sending countries as recorded for the first quarter of 2022.

Table 4. 5 Cost of sending remittances

Particulars	Remittance sending Country (Currency)							
	Malaysia (MYR)	UAE (AED)	Qatar (QAR)	Saudi Arabia (SAR)	Oman (OMR)	India (INR)	UK (GBP)	USA (USD)
Money Sent	610	735	730	750	75	13300	120	200
Min. Charges	10.55	12.13	13.07	18.75	1.90	23.94	0.71	3.82
Max. Charges	23.30	46.82	42.49	47.10	2.75	1758.26	19.54	15.52
Average Charges	17.51	24.99	23.43	29.73	2.33	612.65	4.76	8.72
Average Charges to Money Sent	2.87%	3.40%	3.21%	3.96%	3.11%	4.61%	3.97%	4.36%

Note: Charges include remittance fees and exchange rate margin

Source: remittanceprices.worldbank.org

4.31 It is generally taking up to 5 days to receive remittance in Nepal from different countries. As most Nepalese workers sending money to their families in Nepal are in unskilled jobs, their remittance ticket size is mostly small making their remittance cost high. The high cost of remittance and delayed settlement is also due to the presence of multiple layers of intermediaries. The presence of multiple layers of intermediaries also increases settlement risk. Given these challenges, the current outcome gap to this policy goal could be considered ***moderate***.

4.32 Elimination of multiple layers of intermediaries could reduce the cost of remitting money. A cross-border CBDC would address this issue to a larger extent. However, as Nepal receives remittances from many countries, a multi-country interoperable CBDC is not possible from Nepal's sole effort since it requires equal efforts from all remittance-sending countries. Hence, in the lack of cross-country CBDC, the likelihood of a positive contribution from CBDC to this policy goal is almost ***nil*** for the time being.

(i) Improving monetary policy transmission mechanism

4.33 NRB has taken bank rate as well as repo rate under its interest corridor rates as the key policy rates to conduct monetary policy in Nepal. The bank rate has remained as lowest as 5 percent to as highest as 8.5 percent between 2003 to 2022[13]. In FY 2021/22, the standing liquidity facility (SLF) rate (upper bound), the target policy rate, and deposit collection rate (lower bound) of the interest rate corridor were 7 percent, 5.5 percent, and 4 percent respectively. NRB hiked these rates by 1.5 percentage points for FY 2022/23, i.e., the bank rate has been increased to 8.5 percent, the policy rate to 7.0 percent, and the deposit collection rate to 5.5 percent considering the pressure on prices and foreign exchange reserves, and for ensuring macroeconomic stability[14].

4.34 Till now, NRB has been able to conduct its monetary policy by keeping its policy rates higher and positive. Since the policy rates are well above zero for a long time, the interest rate channel of monetary policy has been capable to transmit the monetary policy impulses. Hence, the current outcome gap to this policy goal in Nepal could be considered ***very low***, showing no need for an alternative solution until the interest rates remain positive.

4.35 Literature has claimed that a negative interest rate on CBDC will be effective in abolishing the zero lower bound constraint of the interest rate. However, it will work only if cash circulation is completely contracted or the cash use limit is legally reduced to zero which seems not feasible until the near future. As per the notice published by GoN in Nepal Gazette in 2017, people in Nepal can do purchase or sale transactions in the cash for only up to one million rupees, and beyond this threshold, they must do the payment transactions through banking channels[15]. Since people's daily lives in Nepal are still largely cash-based, further reducing the cash transaction

[13] Visit https://tradingeconomics.com/nepal/interest-rate

[14] See NRB's Monetary Policy for FY 2022-23 at https://www.nrb.org.np/contents/uploads/2022/08/Monetary-policy-in-English-2022_23-Full-text.pdf

[15] Visit http://rajpatra.dop.gov.np/welcome/book/?ref=22747) to see notice published in Nepal Gazette on 23 May 2017; also see https://myrepublica.nagariknetwork.com/news/rs-1-million-cash-transaction-limit-to-come-into-effect-from-mid-july/

limit might bring difficulties in their lives, and therefore, they may resist. Hence, a completely cashless Nepal is not feasible for now, and without a cashless economy, the likelihood of a positive contribution from CBDC to this policy goal is ***very low***.

(j) Promoting financial stability

4.36 Until a few years back, financial instability was the burning issue in Nepal. Some BFIs were staggering to survive due to weak corporate governance and mounting losses. With several corrective policies such as capital increase, merger, acquisitions, upgraded capital adequacy framework, adoption of a risk-based supervisory approach, crisis management, and resolution, and continual oversight of the overall financial system, NRB has been able to minimize the financial instability risk. Over time, NRB has also developed its regulatory frameworks and supervisory approaches as per international standards. These all efforts have delivered the desired level of outcome in terms of financial stability in Nepal. Since financial instability is currently not a prominent issue for NRB to be addressed by an alternative solution, the current outcome gap to this policy goal could be considered ***low***. Nevertheless, it remains at the core of all of its macro-prudential policy decisions now and even in the future.

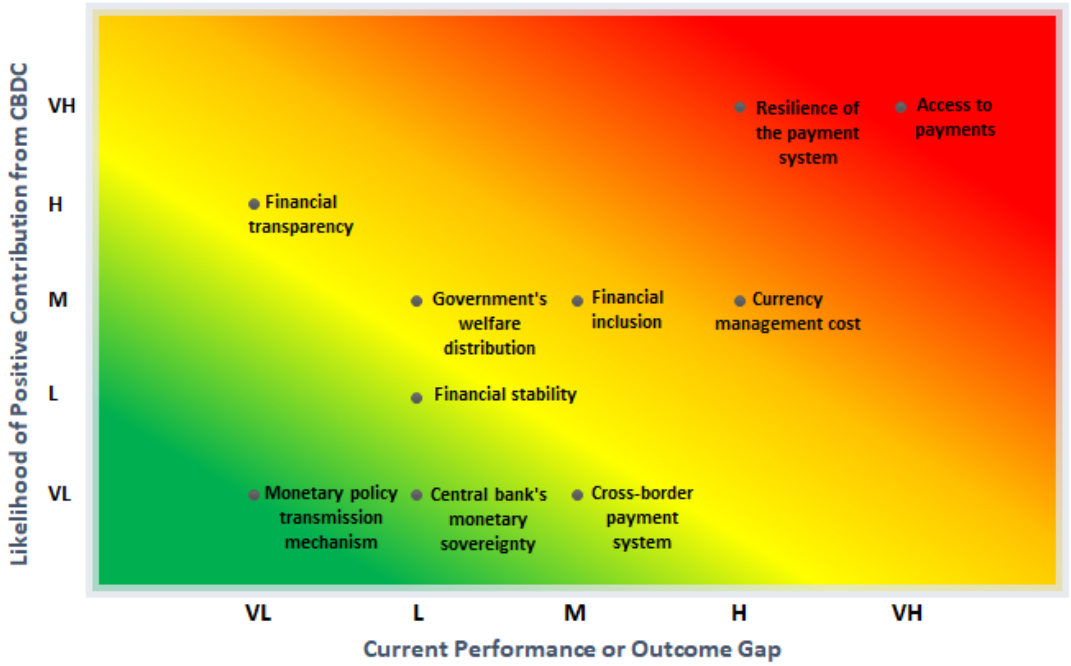
4.37 Deposits have been the main funding source for BFIs in Nepal. Heavy shifts to CBDC could lay a negative impact on overall financial stability as deposits of BFIs may dry up for CBDC. A remunerated CBDC can further attract a larger fraction of the saving deposit towards CBDC. The inability to withstand liquidity pressure could trigger the failure of BFIs leading to financial instability. So, CBDC seems a less appropriate tool for promoting financial stability as this could hike financial disintermediation risk. Hence, the likelihood of a positive contribution from CBDC to this policy goal could be considered ***low***.

Heat Map

4.38 Based on the scores on a Likert scale assigned for the current outcome gap of CBDC to the 10 different policy goals, and the likely outcome from CBDC to each of those

policy goals as discussed above, a heat map matrix has been prepared as shown in Figure 4.1 below.

Figure 4. 1 Heat map of the policy goals for CBDC



(Note: VL=Very Low, L=Low, M=Moderate, H=High, VH=Very High)

4.39 In the above two-dimensional heat map matrix, the 10 different policy goals have been plotted based on their scores (i.e., in terms of *VL*, *L*, *M*, *H*, and *VH* for very low, low, moderate, high, and very high) for their current outcome gap along X-axis, and the likelihood of the positive contribution from CBDC to them along Y-axis. The more a policy goal moves right along the X-axis and up along the Y-axis, the more it lies in the warmer zone of the heat map qualifying as a desirable policy goal for CBDC.

4.3.1 The policy goals of CBDC could be country-specific. In countries, where corruption, money-laundering, and illegal activities are high, promoting financial transparency might be an appropriate policy choice, and for countries that comprise distantly located islands, access to payments might fit as the best goal. For countries that are often hit by natural disasters, enhancing the resilience of the payment system matters most. Therefore, designing CBDC first requires selecting appropriate policy goals

rather than targeting all as CBDC could not be a "one size fits all" solution for all. This also minimizes the goal-setting risk.

4.40 For Nepal's case, we classify policy goals in the warmer zone, cooler zone, and between the two zones of the heat map as highly desirable, less desirable, and moderately desirable policy goals for CBDC. Hence, the results obtained from the heat map matrix have been shown in Table 4.6 below.

Table 4. 6 Desirable policy goals for CBDC in Nepal

Classification of Policy Goals	Policy Goals
Highly desirable	Improving access to payments Enhancing the resilience of the payment systems Reducing currency management costs
Moderately desirable	Promoting financial inclusion Supporting the government for welfare distribution Promoting financial transparency Promoting financial stability
Less desirable	Enhancing the efficiency of cross-border payment systems Safeguarding the central bank's monetary sovereignty Improving the monetary policy transmission mechanism

4.41 To minimize the risk of goal-setting failure, NRB should select all policy goals identified as highly desirable while it might still consider a few more policy goals identified as moderately desirable (see Table 4.6 above). The design of CBDC should focus more on these goals without challenging policy goals that it does not consider.

Appropriate CBDC Design for Nepal

4.42 A single design choice of CBDC might not best fit all the policy goals of central banks. Table 4.7 below presents the use case, architecture, ledger, access, and instrument characteristics of CBDC that seem best fit for each of the ten key motivating policy goals of the central banks that we discussed in chapter 2 of this report.

Table 4. 7 Appropriate design choice for different policy goals

Prioritized CBDC Policy Goals	Purpose or Use Case	Architecture	Infrastructure	Access Design	Instrument Characteristics
Improving Access to Payments	Retail				24/7 use; Interoperable
Enhancing the Resilience of the Payment System		Direct	Semi-centralized		
Reducing Currency Management Cost	Wholesale	Intermediated	Centralized	Account	Non-Remunerative
Promoting Financial Inclusion	Retail	Hybrid Intermediated		Token	24/7 use; Remunerative; Interoperable
Supporting the government in their wider economic policy	Retail			Account	
Promoting Financial Stability	Wholesale	Intermediated			Non-Remunerative; Quantity limits; Interoperable
Promoting Financial Transparency	Retail			Account	Remunerative
Enhancing the Efficiency of Cross Border Payment Systems	Retail	Intermediated		Account	Cross-border interoperable
Safeguarding Monetary Sovereignty	Retail				Remunerative
Improving MP Transmission Mechanism	Wholesale	Intermediated			Remunerative

Source: Task force's elaborations

4.43 Considering all three policy goals identified as highly desirable viz. improving access to payments, enhancing the resilience of the payment systems, and reducing currency management costs, and one moderately desirable policy goal (i.e., financial inclusion), the design choice of CBDC that looks best in terms of use case, architecture, ledger, access and instrument that looks appropriate for Nepal has been presented in Table 4.8 below:

Table 4. 8 CBDC design choice recommended for Nepal

Key Design Parameters	Choices	Remarks
Purpose or Use Case	Retail	Supports better access and inclusion
Architecture	Intermediated	Supports easy customer onboarding
Infrastructure or Ledger	Semi-centralized	Supports better resilience and control
Access Design	Account-based	Supports wholesale allocation to BFIs
	Token-based	Supports better financial inclusion
Instrument Characteristics	Interoperable	Supports better access, resilience, and inclusion
	Non-remunerative	Reduces currency management costs
	24/7 available	Supports better access and resilience
	Quantity-capped	Avoid disintermediation risk
	Programmable	Provides broader usage options

4.44 This study recommends that a CBDC design facilitating a retail use case with the use of intermediated architecture and a semi-centralized ledger providing both account-based and token-based access as the most appropriate design choice in the context of Nepal. Further, for better access, sound resilience, and wider inclusion of the payments, and for cost-efficient currency management, such a CBDC system should seamlessly interoperate with other regulated private payment systems, pay no remuneration on CBDC holding, should be available round the clock for use, have a holding limit, and be programmable for broader usage options.

Enriching Laws and Regulatory Framework

4.45 Clause 5 Sub-clause (1)(a) of NRB Act 2002 (Second Amendment, 2016) specifies issuing banknotes and coins as the functions and duties of NRB. Clause 51 Sub-clause (1) of the same Act further also NRB the monopoly power to issue such banknotes and coins as legal tenders in Nepal, and Sub-clause (2) requires that such banknotes and coins should be fully secured by gold, silver, foreign currency, foreign securities, foreign bills of exchange, coins, government bonds, promissory notes, or bills payables in Nepal within a maximum of 18 months from the date of repayment by the bank. The NRB Act 2002 does not authorize NRB to issue digital legal tender.

4.46 Clause 13 of NRB Act 2002 authorizes NRB to open and operate accounts for the Government of Nepal and other governmental bodies, commercial banks and financial institutions, public corporations, foreign diplomatic missions, foreign central banks, foreign banks, international organizations, and associations. It mentions that the bank should not operate accounts for any individual, industry, or political organization.

4.47 Data protection and privacy matters are governed by several laws in Nepal. The Individual Privacy Act 2018 and The Individual Privacy Regulation 2020 have been issued to regulate data protection issues. Further, the provisions related to privacy and data protection have been incorporated in the National Penal (Code) Act 2017. Hence, Nepal doesn't have unified data protection legislation yet.

4.48 Given the above situations, successful implementation of CBDC in Nepal asks for:

- A targeted reform of NRB Act 2002 that empowers NRB to issue CBDC, and open and operate bank accounts for the general public including industries or political parties, as well as addressing this issue in other laws as well.
- An entirely new Act to govern digital currency-related data protection issues.
- A robust framework for the regulation and supervision of the parties involved in the implementation of CBDC that addresses the regulatory concerns such as the risk of loss, counterfeiting, a threat to privacy, and customer data protection need, and also specifies the responsible body for accessing, implementing and regulating CBDC.
- An interaction with the related government bodies, other regulatory authorities, technical specialists, financial institutions, and the end-users for developing a robust regulatory framework

5. Conclusion and The Ways Forward

Conclusion

5.1 The exploration of CBDC has globally sped up today driven by its likely outcome on the various policy goals undertaken by the central banks. These policy goals are improving access to payments, promoting financial inclusion, enhancing the resilience of the payment system, safeguarding the central bank's monetary sovereignty, reducing currency management costs, enhancing the efficiency of the cross-border payment systems, promoting financial transparency, improving monetary policy transmission mechanism, promoting financial stability, and supporting the government for welfare distribution.

5.2 A successful CBDC project requires favorable changes in the legal and regulatory framework, capacity development and restructuring at central banks, infrastructure development, and convenience for broader public adoption. It seems that converting cash into digital currencies might bring some challenges such as financial disintermediation, further financial exclusion, data exposure, and breach, operational failure of the system, inappropriate technology adoption, seigniorage loss to the central banks, and reduced numismatic activities. Therefore, it is better to follow the recommendation made by BIS. In this regard, BIS has recommended 3 foundational principles to be considered by central banks while designing CBDC: not harming other policy mandates of the central banks, not replacing other existing forms of monies, and promoting broader innovation and efficiency in the overall payment system. To comply with the foundational principles, BIS has also identified 14 core features related to the CBDC instrument, the underlying system, and the broader institutional framework.

5.3 A CBDC could be developed to facilitate two possible use cases (i.e., retail, and wholesale), in four types of architecture design (i.e., direct, hybrid, intermediated, and indirect), and three types of ledger design (i.e., centralized, semi-centralized, and decentralized), and provide access in two forms (i.e., account, and token). Further, the CBDC instrument could be remunerative or non-remunerative, 24/7 available for use,

quantity-capped for holding beyond a quantity limit quantitative restriction, interoperable with other payment systems, and programmable.

5.4 According to the information updated by the Atlantic Council, out of the 11 countries that have issued CBDC until July 2022, most of them have developed CBDC for retail use cases, while two Eastern Caribbean countries Dominica and Montserrat have also developed wholesale CBDC. Similarly, all of the 11 countries have used intermediated architecture design, 10 countries have used distributed ledger technology while 1 country has used conventional ledger, and most have provided account-based access while few have also provided token-based access. Besides these 11 countries that have already issued CBDC, most other countries are exploring mainly retail use cases, intermediated architecture, and DLT infrastructure.

5.5 A CBDC must support public policy objectives without impeding the central bank's ability to fulfill its mandates. The NRB Act 2002 has mandated NRB for maintaining price stability, external sector stability, stability of the financial system, promotion of financial access, and development of a robust system of payment. Any policy goal that NRB takes for CBDC should match its policy mandates. This study identifies improving access to payment, enhancing the resilience of the payment system, and reducing currency management costs as the highly desirable policy goals for CBDC in Nepal. Similarly, policy goals such as promoting financial inclusion, supporting the government for welfare distribution, promoting financial transparency, and promoting financial stability have been identified as moderately desirable policy goals for CBDC. The other policy goals such as enhancing the efficiency of the cross-border payment systems, safeguarding the central bank's monetary sovereignty, and improving the monetary policy transmission mechanism seem less desirable policy goals for the time being.

5.6 To minimize the risk of goal-setting failure, it will be better for NRB to take all highly desirable policy goals while still considering a few, but not all, moderately desirable goals. The design of CBDC should particularly focus more on these selected goals, however, without challenging other policy goals of NRB. Hence, considering all three

policy goals identified as highly desirable, and one moderately desirable policy goal (i.e., financial inclusion), it seems that retail, intermediated, and semi-centralized ledger-based CBDC allowing both account-based and token-based access is the most appropriate design choice for Nepal. Moreover, such a CBDC instrument should be interoperable with other domestic payment systems, non-remunerative, available for use round-the-clock, quantity-capped, and programmable for broader usage options.

5.7 A targeted reform of NRB Act 2002 is required to empower NRB to issue digital legal tender as well as operate accounts for individuals and others. An entirely new unified act is required to govern digital currency-related data protection issues. A robust framework for the regulation and supervision of the parties involved in the implementation of CBDC is required. Finally, interaction with the related government bodies, other regulatory authorities, technical specialists, financial institutions, and the end-users is a must for developing a robust regulatory and supervisory framework.

The Ways Forward

5.8 CBDC is not an easy project for central banks as it requires a visionary approach to gradually shift the cash-based economy to a digital economy that demands wider political support and public acceptance. A lot of changes in the areas such as legal framework, capacity development, public awareness, and system infrastructure, among others, have to be undertaken. This study recommends that NRB should move forward in the ways for developing the CBDC project:

(i) Form a dedicated team or unit

5.9 First of all, NRB needs to create a dedicated team to look after the entire CBDC-related matters. Such a team should be composed of members from all of the concerned departments that need to involve during regular CBDC operations once it is launched. Initially, a separate department might not be required. A small unit within the payment system department or information technology department could be sufficient, to begin with. This team or unit should be fully authorized to take decisions

on all small to moderate-level matters while seeking high-level engagement on policy-related decisions and oversight functions.

(ii) Set the strategic plans for CBDC

5.10 NRB should take a strategic approach and engage itself in different stages of the CBDC lifecycle. Such a strategic plan should identify actions to be completed with a clear timeline for their completion and departments that should involve. In the beginning years, it should conduct a feasibility study and engage thereafter in developing and piloting CBDC in different locations. A full-fledged launch of CBDC could be scheduled thereafter.

(iii) Conduct a detailed feasibility study

5.11 A further in-depth study might be required to assess the economic, technical, legal, operational, and schedule feasibility of CBDC in Nepal. Such an in-depth study helps NRB identify its internal and external constraints. The economic feasibility assesses the costs and benefits of the project and determines its economic viability. The technical feasibility sets out the technical requirements of the CBDC system, assesses the adequacy of existing technical resources (manpower, skills, budget allocation, etc.) available to NRB, and assesses the gaps between the required and the available resources. The legal feasibility finds out the gaps in the existing legal and regulatory framework to support CBDC. Operational feasibility assesses how well the CBDC system delivers on the policy goals as targeted and is accepted by the end-users. Finally, the schedule feasibility assesses the project time length and measures the probability of the project being completed within the specified timeline.

(iv) Ensure an adequate legal framework

5.12 The present NRB Act 2002 authorizes NRB only for issuing banknotes and coins as the legal tender money within Nepal. The same Act also restricts NRB to operate the accounts for any individual, industry, or political organization. Hence issuing CBDC with account-based design requires such a right to NRB through amendment in the said Act. Also, the legal definition of the term 'currency' should accommodate CBDC.

The amendments are also needed in numerous other laws such as BAFIA 2073, BOPA 2064, MLPA 2063, Company Act 2063, and Tax laws, among others. An entirely new law needs to be issued for digital data protection. A separate operational and regulatory framework is required to manage, monitor, and control the entire CBDC system.

(v) Select appropriate policy goals for CBDC

5.13 The first thing NRB needs to do is to select the appropriate policy goals for CBDC. This report has made a preliminary attempt to select the policy goals for CBDC based on subjective judgment. A further in-depth study, as well as discussion, could be taken, if required, to re-measure the benefits of CBDC to each of the policy goals. Such assessments would help NRB take the right motivations for the CBDC project, thereby, minimizing the risk of goal-setting failure. CBDC should be correctly designed only around the policy goals that motivate NRB.

(vi) Adopt a robust CBDC system

5.14 The CBDC system adopted by NRB should be highly secured, and support high throughput of transaction data, maintaining full privacy of data. To protect against possible threats, a robust cyber-security system should be adopted. Strong regulatory frameworks should be set up for the security and resilience of the whole system.

5.15 ***Build capacity of NRB***

5.16 Adequate financial resources need to be allocated to support a CBDC capacity-building program in NRB. Extensive domestic and international training, knowledge sharing, and exposure visits are required for the CBDC management team and other staff. This helps in developing a sound CBDC system as well as facilitates its successful launch, operation, regulation, supervision, and maintenance.

(vii) Coordinate with other support agencies

5.17 For a resilient CBDC system, NRB needs to ensure that the power supply, a cellular connection, and a Wi-Fi network never fail. For this, NRB needs to coordinate with all

public and private companies that provide such services, line ministries, the concerned authorities such as NEA and NTA that regulate and supervise those companies, and other external agencies. Besides, the smartphone penetration rate should be increased to facilitate the onboarding of more and more people on the system for wider use of CBDC. A separate agency is required to manage the digital identities of the citizens.

(viii) Increase public awareness

5.18 To make public adoption of CBDC easier, public awareness programs should be continuously conducted through print, digital and virtual mediums. Some central banks have created a separate website to continuously update the general people with information about the plans and progress of the CBDC research, development, pilot test, and final launch. A similar practice can be adopted in Nepal.

(ix) Continue promoting digital banking

5.19 Financial institutions have always been at the forefront to make people literate about the digital ways of doing their monetary transactions. Continuous promotion of such digital banking would facilitate convenient public adoption of a digital currency issued by NRB later. Hence, NRB should not design CBDC to challenge digital banking. It should rather take a policy to widely promote digital banking.

(x) Simulate a prototype before the final launch

5.20 It is recommended that a prototype of CBDC should be developed and simulated in a closely controlled environment before developing and launching any real CBDC. Such a prototype could be developed with the help of domestic developers, consultants, and system experts. The experience gained from this could be very much helpful to rightly design and develop a final CBDC for Nepal.

-------End of the Report------

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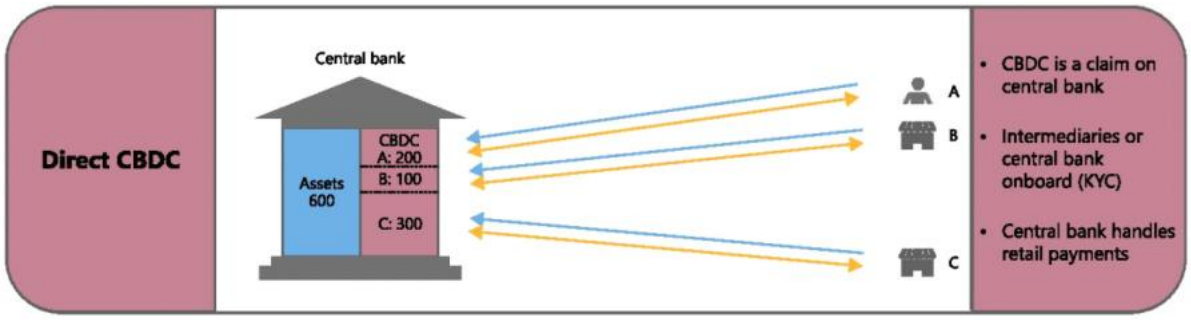
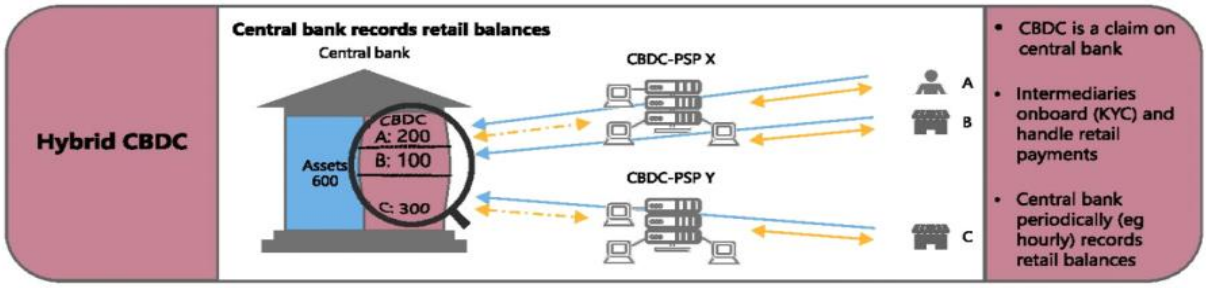
Appendix

Appendix 1: CBDC Architecture

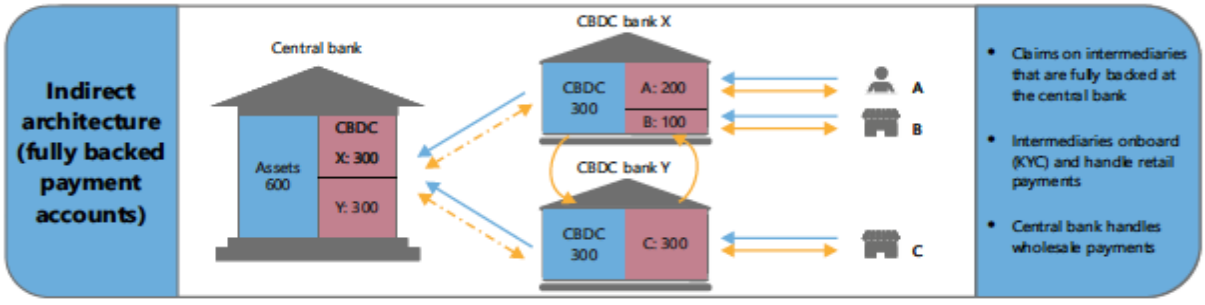
Direct Architecture:



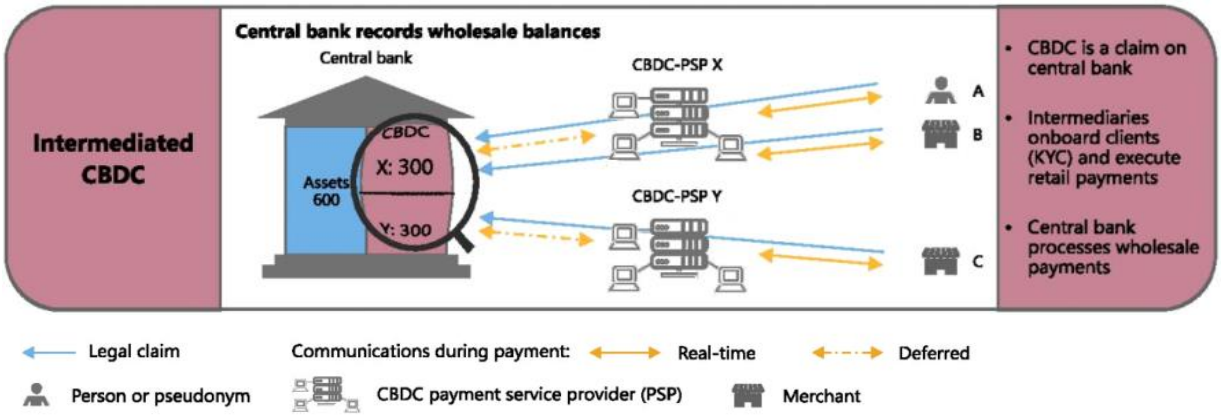
Hybrid Architecture:



Indirect Architecture:



Intermediated Architecture:



(Source: Auer and Bohme, 2020; Auer & Bohme, 2020a)

Appendix 2: Features of the CBDCs launched till July 2022

Features	Sand dollar	DCash	eNaira	JAM-DEX
Domestic interoperability	Yes	Yes	Yes	Yes (Integrated with RTGS system)
Cross-border interoperability	PSP can facilitate the purchase of foreign currency using sand dollar	Overseas payments are possible if both parties have a DCash e-wallet	Not now. However, this has been factored into the design.	Not initially. But, the bank will work on facilitating cross-border payment later on.
Remuneration	None	None	None	Unknown
Holding and transaction limit	**Tier I:** The e-wallet holding limit is $0.5K. The monthly transaction limit is $1.5K. Government-issued identification is not an enrolment requirement. The sand dollar cannot link to a bank account. **Tier II:** E-wallet holding limit- $8K. The monthly transaction limit is $10K. Government-issued identification is required for enrolment. This can be linked to a bank account. **Merchant:** The e-wallet holding limit is $8K to $1 million. The e-wallet must be tied to a bank account.	Holding limits are linked to the KYC profile as well as AML/CFT regulation. E-wallets have tiers with different transaction limits. The application and blockchain code will enforce these.	**Tier 0:** This is for the non-bank account holder. It requires a telephone number without a verified National Identity Number (NIN). This holding limit is N 120,000 whereas the daily transaction limit is N 20,000. **Tier 1:** This is for the non-bank account holder. It requires a telephone number with a verified NIN. The holding limit is N 300,000 whereas the daily transaction limit is N 50,000. **Tier 2:** This is for the bank account holder. It requires Bank Verification Number (BVN). The holding limit is N 500,000 whereas the daily transaction limit is N 200,000. **Tier 3:** This is for the bank account holder. It requires BVN. The holding limit is N 5,000,000 whereas the daily limit for transactions is N 1,000,000.	The limit is determined by the wallet provider. Based on the information provided by the clients, the wallet provider will conduct a risk-based assessment of the clients, and determine the limit for each client.

			Merchant: This is for the bank account holder. It requires BVN, Taxpayer Identity Number (TIN), or NIN. There is no limit to hold and for daily transactions.	
Transaction fees	**For individuals:** No **For merchants:** Minimum	No	Transaction fees are free for the first 90 days commencing from October 25, 2021. For electronic fund transfers, the charges are N 10 for fund transfers below N 5000, N 25 for fund transfers from N 5000 to 50,000, and N 50 for transfers of value above N 50,000.	No cost at the moment. But, it might depend on wallet providers. BoJ is licensing more wallet providers for competition. BoJ has no regulation for the cost of service but it hopes that the wallet providers get rich information about their clients and look for other value-added services where they can find a niche.
Offline functionality	Yes but within a preset limit only	The sender has to be online. Even if the receiver is offline, the payment is still processed.	Not now, but working on it	Not initially, but working on it
Source:	***(Central Bank of Bahamas, 2019)***	***(Antoine, 2021)***	***(Financial Policy and Regulation Department, Central Bank of Nigeria 2019 & 2021)***	***(Griffiths, 2022, 09:56)***