

Arab Regional Fintech Working Group

Central Bank Digital Currencies:
An Analytical Framework for Arab Central Banks

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Central Bank Digital Currencies:
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Arab Monetary Fund
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The opinions expressed in this policy paper are solely those of the writers and do not necessarily reflect those of the central banks and entities they represent.

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LIST OF ABBREVIATIONS

AML / CFT	Anti-Money Laundering / Combating the Financing of Terrorism
BIS	Bank for international Settlements
CBDC	Central Bank Digital Currency
DvP	Delivery versus payment
GDPR	General Data Protection Regulation
KYC	Know your Customer
PoC	Proof of Concept
PvP	Payment vs. Payment
R-CBDC	Retail Central Bank Digital Currency
RTGS	Real Time Gross Settlement System
sCBDC	Synthetic Central Bank Digital Currency
SSS	Security Settlement System
W-CBDC	Wholesale Central Bank Digital Currency

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EXECUTIVE SUMMARY

Digitalization is shaking both economic and societal activities across the world. In the advanced economies, digitalization will eventually reduce the role of cash and will promote new digital forms of money. Further, digitalization may provide developing countries with new financial inclusion options, and reduce operational costs and risks associated with the management of physical currency. This will also have a significant effect on the private sector's prominence in digital payment systems.

Motivations to issue digital currency differ from one country to another. Many countries have their own legacy payment systems; nevertheless, a survey conducted by the BIS indicated that 80% of 66 central banks surveyed expressed their current engagement in CBDC work or at least have near future intentions to do so. The motivations to issue CBDCs may be related to having more efficient payment systems, or to other benefits (including exploring technological innovations, responding to digital currency and cryptocurrency initiatives implemented by other central banks and/ or by private players). The drivers to issue CBDCs discussed in this paper provide a checklist for central banks to follow while deciding whether to invest or not in CBDC. Central banks are encouraged to compare those motivations with their own objectives and visions.

Although the design will be specific to each CBDC type, there are several key design principles that are applicable to all types. First, the rationale for CBDC issuance should drive the choice of the operating model, architecture, and technology choice. The CBDC architecture should be robust, secure, and mitigate cyber-security risks. Any specific design choice should consider the existing IT infrastructure capacity, the legal and regulatory framework, the central bank mandate and the market environment with a specific focus on the end-users and key private sector actors such as digital financial service providers. Finally, the design of the CBDC should be technology neutral and the choice of technology should be made in the last stages of the design process. It is vital as well to consider all design features holistically to consider possible trade-offs within the architecture.

A CBDC issuance involves several key players including central banks, governments, commercial banks, financial institutions, telecom companies, merchants, fintechs as well as IT vendors and suppliers. Each of these constituents is driven by its own interests that could eventually compete with the other players' interests. Each entity operating in a CBDC ecosystem will play a role in achieving a successful running and operation of the CBDC issuance.

Wholesale CBDC in countries with less developed financial markets can bring great efficiency improvements, such as streamlining securities trading and significantly reducing costs and settlement risks in cross-border payments. Retail CBDC may enhance financial inclusion, improve the domestic payment systems, and streamline retail remittances.



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A single system that addresses both wholesale and retail CBDC is achievable and could most likely be less costly and more efficient to operate. This additional factor should be considered by central banks if and when selecting a CBDC design platform.

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INTRODUCTION

Recently, many central banks, both in advanced or developing economies, have explored the opportunities to and benefits of issuing digital currencies. Some of these have included cross border applications. These include central banks in Canada, China, France, Sweden, and Uruguay.

In 2018, the Bank of England described a central bank digital currency (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.”

Thinking about the future of money is timely in view of new technologies and increasing use of digital payments among rising debt levels. Still, it is not yet clear whether CBDCs for consumers and businesses are necessary or desirable, the answer will differ country by country. Accordingly, each jurisdiction considering the launch of a CBDC should carefully consider the implications before making any decision.

The interest in digital currencies by central banks has been increasing, and the motivations for introducing a CBDC as well as the benefits of greatest interest for central banks and governments differ from country to country. So should central banks allocate time, efforts and budget aiming at exploring the opportunities of issuing digital currency? And for what purpose? would it be for domestic payments on a wholesale or retail level? Or maybe both. Do central banks need it for cross-border payments and settlements?

This policy paper aims at exploring the opportunities and challenges related to the issuance of digital currencies by central banks in the Arab Region and tries to address the question whether central banks should invest in it. The paper illustrates the value of issuing CBDCs to both sides, the central bank and the government on the one hand and the end user on the other hand. The paper attempts to represent a contribution to the CBDCs discussion, providing an analytical framework for a comprehensive set of perspectives to look at when a central bank explores the opportunity to initiate its digital currency project.

The following chapters outline the following pillars, drivers and motivations for issuing, the various designs, the potential implications, as well as steps to design CBDCs, and the required ecosystem to initiate it. We examine various payments’ aspects, whether on the national or cross-border levels. We then surveyed global CBDCs initiatives, with special emphasis on developments in the Arab region. Finally, the paper provides recommendations to central bankers coupled with a list of proposed actions when exploring the opportunities of issuing CBDCs.

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MOTIVATION FOR ISSUING CBDCS

Summary

Countries in the Arab region are different in their needs, priorities, resources, economics and demographics. This means they will have different monetary and payment needs.

There are a number of different monetary and payment motivations which might motivate a country to adopt CBDC. Some countries in the region might be motivated primarily by financial inclusion, while other countries might be more concerned with international remittances or international trade.

Since motivations differ between countries, the optimal CBDC for each country will also differ. Understanding the needs and priorities for a given country is the first step in designing the correct CBDC for that country.

Motivations for issuing CBDCs differ by country based on the policy objectives and strategic priorities of each country. The decision to issue CBDC and exploring its technical feasibility will come in response to challenges and problems that regulators are facing and trying to resolve, such as financial inclusion, promotion of competition, cost reduction, better conduct of monetary policy, and so on.

Some commentators have opined that national payment systems achieves the same objective of enabling electronic payments and money transfer. Also, in some regions, arrangements for cross border payments and money transfers are getting more efficient, which allows for fast money transfer with reduced transaction costs. Hence, there is no need for CBDC. On the other hand, in a 2019 survey by BIS, they reported that 80% of 66 central banks surveyed expressed their current engagement in CBDC work or near future intentions to do so.¹

So, what motivates central banks to study CBDCs?

Collective motivations

While the motivations for each country to issue CBDC vary, they might include:

Promote Financial Inclusion: 1.7 billion people globally do not have a bank account, including tens of millions of people in developed economies, according to the World Bank. Lack of bank accounts, appropriate access to payment infrastructures and inappropriate

¹ Boar, C., Holden, H. and Wadsworth, A., (2020). *Impending Arrival – A Sequel To The Survey On Central Bank Digital Currency*. [online] Bis.org. <https://www.bis.org/publ/bppdf/bispap107.pdf>

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mainstream products force people into the high-cost cash economy and exclude them from loans, insurance and other benefits of the financial system. A digital currency may encourage participation by new financial institutions, increase competition, and drive innovations in serving underbanked and unbanked populations.

In emerging markets where commercial banks are lacking or are not willing to provide low/now cost accounts at low/no fees, CBDC can help because the central bank can serve the role of the missing commercial banks and enable affordable accounts for citizens provided that access to the currency is sufficiently simple and affordable.

People without access to a commercial bank account will be able to make digital payments. CBDC would meet the general public's need for digital forms of payment that are inexpensive, efficient and stable.

CBDC may also provide open APIs and interoperability to alternate payment services from commercial banks, e-wallet companies, and payment service providers (PSPs). These new services, such as P2P money transfer, mobile cross-border remittances and bill payment, may be particularly useful to currently unbanked citizens, thereby motivating them to get an account.

Access to central bank currency: Providing universal access for citizens to central bank currency in its digital form. Skingsley² considers that “there is currently a need among the general public and companies to have access to central bank money and this need will still be there in the future.”

Issuing a retail CBDC will provide a public and risk-free alternative to private digital solutions, especially in a post Covid-19 world. It is a real momentum to move forward in this area since there has been a significant change in customer behavior, so it's crucial to look at the opportunity to go digital faster

In case of declining cash use (as is the case in Sweden), central banks will be asked, according to their statutory prerogatives to provide households with legal tender.

Reduce cost of using cash: The total cost of handling cash is high due to time and labor costs, fees, and security risks. Countries also want to formalize the cash economy and increase the tax base, including dealing with fraud and preventing money laundering.

Compliment the move to electronic money: While cash continues to be universally acceptable currently, yet the popularity of cash is declining. Consumers are shifting towards digital payment methods, most prominently card payments, as cash is considered less convenient and safe than its digital counterparts. Additionally, governments' seigniorage has experienced a secular decline attributed to a fall in global real interest rates. Many governments are likely to reach a point at which the issuance, distribution and acceptance of cash becomes uneconomical, for monetary authorities and retailers respectively.

² Skingsley, C (2016): “Should the Riksbank issue e-krona?”, speech at FinTech Stockholm, 16 November

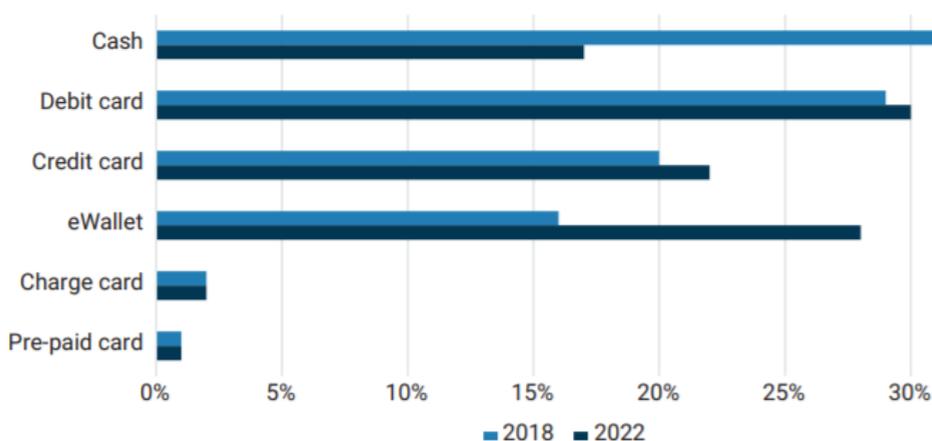
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According to a study by OMIF and IBM³, “People and businesses continue to trust commercial bank money for their regular economic activity. Partnering with regulated payments service providers and technology companies, such as Visa and Mastercard, facilitates easier electronic payments and settlement of commercial bank money given the ubiquity of their point-of-sale systems among merchants and small retail businesses. Card transactions will continue to dominate point-of-sale transactions.”

Figure (4): Cash vs other electronic payments

Cash use expected to decline as eWallets preferred

Share of global point-of-sale payment methods, %, 2018 v. 2022 forecasted



Source: Worldpay, OMFIF analysis

Source: IBM - OMFIF, 2019

Responding to issuance of a CBDC by other central banks: The issuance of CBDC may occur as a proactive approach to allow regulators to be in line with other central banks who have made progress in this area to ensure the smoothness of cross border transactions and compatibility of payments instruments. Central banks may also issue CBDC to preserve monetary sovereignty, as other nations deploy digital currencies. The best example of this are the re-invigorated CBDC efforts of a number of Asian central banks following announcement by China that it is launching the Digital yuan.

The Central Bank of Canada has stated that after the CBDC experiment, that they have no plans to issue CBDCs, but they are being ready in case the requirement for issuing a CBDC arises⁴.

³ Sinha, Saket, Bhavin Patel et al, *Retail CBDC's - The Next Payments Frontier*, IBM, OMFIF , <https://www.omfif.org/wp-content/uploads/2019/11/Retail-CBDCs-The-next-payments-frontier.pdf>

⁴ Bankofcanada.ca. (2020). Contingency Planning For A Central Bank Digital Currency. [online] Available at: <https://www.bankofcanada.ca/2020/02/contingency-planning-central-bank-digital-currency/>

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Similarly, other central banks may be motivated to build the required capacity should the need arise in future; since acquiring the capacity in future may take time.

Challenge private monopolies: The largest commercial banks and payment processors control the movement of money, and they levy significant fees on every transaction. For example, credit card companies often charge 3% of the transaction value, while banks often charge 4% for foreign exchange. In addition, many of these transactions are subject to latency and liquidity issues. Digital currencies and blockchain systems could perform transactions for a small fraction of these costs and improve market openness, thus reducing friction in the economy.

For example, Sweden's Riksbank is creating plans for an e-krona to complement (not replace) cash. The e-krona would help to ensure that the central bank's influence is not undermined by the dematerialization of payment instruments since Sweden is close to becoming a cashless society (thanks to card usage and P2P solutions like Swish). The Riksbank wants to use this digital currency to build more direct and efficient monetary relationships with Swedish citizens.

Responding to issuance of cryptocurrencies and stablecoins by non-banks: Cryptocurrencies are not issued by central banks. Stable coins are a form of cryptocurrencies with additional characteristics of being backed by reserves assets, which provides more price stability compared to other types of cryptocurrencies. For example, in Dec 2018 reports were published on Facebook's willingness to issue a stablecoin, now known as "Libra"⁵. It is intended that Libra, which will be issued by Facebook, gets backed up with reserve assets (i.e. Dollar or basket of currencies).

The introduction of Libra and other stablecoins poses a risk to the financial industry, as liquidity is removed from the monetary system and converted to stable coin. Deposits at banks may be reduced and banks may lose revenue that is usually obtained out of money transfer transactions and payments.

In this case, issuing a CBDC may represent a solution to circumvent the initiatives of big tech companies who can disrupt the global financial system. Big tech companies will be constrained to act as e-wallet providers to allow consumers access to CBDC issued by regulators.

Support micropayments: Digital currencies and blockchain could make it viable to exchange granular sums of money and even micro-assets (for example, individual parts). This capability will open new avenues for economic activity — particularly for people with low incomes and few assets who could run very small businesses with little capital — and will enable machine-to-machine transactions.

A better conduct of Monetary Policy/ Support unconventional monetary policy: "helicopter money": The effects of CBDC on monetary policy, the financial system and the

⁵ CoinDesk. (2020). From Facebook Lab To Global Stage: Libra's Timeline - Coindesk. [online] <https://www.coindesk.com/libras-long-road-from-a-facebook-lab-to-the-global-stage-a-timeline>.

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wider economy could be significant; as argued by Barrdear and Kumhof⁶, Mersch⁷, Sams⁸ and Koning⁹. However, and as considered by Fung and Halaburda¹⁰, the impact probably depends on the specific design features of the CBDC.

In terms of monetary control, by issuing their digital currency, central banks will be running their own currency which will make monetary policy more effective. Issuing a CBDC would have an impact on the whole objective, implementation and transmission tools of the monetary policy as argued by Pfister¹¹.

A retail CBDC could also benefit quantitative easing by allowing a direct transfer of central bank currency to households and firms in the form of “helicopter money”. This will encourage aggregate demand (Dyson and Hodgson 2016)¹².

Contestability and efficiency in retail payments: In their research, Fung and Halaburda¹³ argue that CBDC would enhance retail payment efficiency in two ways:

1. CBDC would allow lower user costs compared to cash, which lead to prompt substitution from cash to CBDC for retail and P2P payments.
2. CBDC would facilitate transactions since it eliminates some friction that inhibits some types of online transactions.

It could actually address security and privacy concerns and allow anonymity which will encourage consumers to opt more for online purchases. Also, even potential losses from fraud would be limited to the amount of the single, specific transaction.

A retail CBDC would also benefit small-value online transactions and allow smaller merchants to opt for selling online since costs will be lower than card fees.

Pursuing Innovations & Developments in the financial industry: Disruptive technologies have provided opportunities for innovations in the financial industry, and hence CBDCs may be explored by central banks for this purpose. In a presentation delivered by Mr. Harish from the World Bank, some innovative ideas has been suggested, like: a) Payment for IoT: payment for services like reserving parking slot, operating laundry machines, etc can be done automatically and instantly using CBDCs and the associated technology; b) Programmability

⁶ Barrdear, J. and M. Kumhof. 2016. “The Macroeconomics of Central Bank Issued Digital Currencies.” Bank of England Staff Working Paper No. 605.

⁷ Mersch, Y. 2017a. “Digital Base Money: An Assessment from the ECB’s Perspective.” Speech at the Farewell Ceremony for Pentti Hakkarainen, Deputy Governor of Suomen Pankki - Finlands Bank, Helsinki, 16 January.

⁸ Sams, R. 2015. “Which Fedcoin?” <https://cryptonomics.org/2015/02/05/which-fedcoin/>

⁹ Koning, J.P., 2014. “Fedcoin.” <http://jpkoning.blogspot.ca/2014/10/fedcoin.html>.

¹⁰ Fung, B. and H. Halaburda. 2016. “Central Bank Digital Currencies: A Framework for Assessing Why and How.” Bank of Canada Staff Discussion Paper No. 2016-22.

¹¹ Pfister C. (2020), Central bank digital currency, Banque de France, <https://publications.banque-france.fr/en/central-bank-digital-currency>.

¹² Dyson, B and G Hodgson (2016): “Digital cash: why central banks should start issuing electronic money”, Positive Money.

¹³ Fung, B. and H. Halaburda (2016): “Central Bank Digital Currencies: A Framework for Assessing Why and How.” Bank of Canada Staff Discussion Paper No. 2016-22.

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of money: unlike cash, digital money can be programmed in a way that serves our objectives. For example, instantaneous transfer of money to settle purchase of a real estate (DvP type of transaction)¹⁴. Also, introducing open APIs through CBDCs may spur banks to innovate to keep up with competitors or risk losing customer deposits.

Enhancing Cross Border Transactions Efficiency: Cross-border transactions between the Arab Region and the rest of the world have been growing.¹⁵¹⁶ This is due to a) remittance transactions by non-national labour force, b) commercial transactions related to purchase of cross-border products and services, c) investments in the international markets.

The arrangement of cross border transactions has improved, and is better in developed countries than in developing countries. However, there are some associated inefficiencies due to the current arrangements, like high transactions cost, delay in processing transactions due to the involvement of several entities in the chain in which each has its procedures with AML/CFT requirements and technical and operational requirements, and the resulting difficulty to automate the process due to different cross-border arrangements¹⁷.

CBDC systems can facilitate cross-border payments by eliminating intermediaries and enabling better interoperability.

Stopping payments for illegal activities: CBDCs can provide transaction traceable and transparency starting from the point of issuance and through the movement of CBDC over the network (Bindseil, 2020)¹⁸.

¹⁴ Natarjan, Harish (2020). 'CBDC in the rapidly evolving payment system landscape' [PowerPoint presentation].

¹⁵ "ACI Worldwide: The payments landscape in the Middle East" Fintech Magazine (July 2019)
<https://www.fintechmagazine.com/fintech/aci-worldwide-payments-landscape-middle-east>.

¹⁶ But note that the World Bank is forecasting a 19.6% decline in remittances in 2020 compared to 2019 due to the global slowdown brought about by coronavirus. "World Bank Predicts Sharpest Decline of Remittances in Recent History". Press Release. (April 22, 2020).
<https://www.worldbank.org/en/news/press-release/2020/04/22/world-bank-predicts-sharpest-decline-of-remittances-in-recent-history#:~:text=Remittances%20to%20the%20Middle%20East,percent%20growth%20seen%20in%202019.&text=Sending%20money%20from%20GCC%20countries,5%20percent%20in%20some%20corridors>.

¹⁷ Bank of Canada, Bank of England, Monetary Authority of Singapore (2018). Cross-Border Interbank Payments and Settlements: Emerging opportunities for digital transformation : MAS. <https://www.mas.gov.sg/-/media/MAS/ProjectUbin/Cross-Border-Interbank-Payments-and-Settlements.pdf?la=en&hash=5472F1876CFA9439591F06CE3C7E522F01F47EB6>

¹⁸ Bindseil, Ulrich, 2020. "Tiered CBDC and the financial system," Working Paper

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Gartner's motivations

According to Gartner¹⁹, “Financial services and economic activity have progressively become more digital. But traditional currencies (fiat and complementary currencies such as reward points) suffer from:

- Centralized issuance that limits flexibility for new digital environments such as machine-to-machine transactions
- Coarse-grained units of value — not conducive to digital environments that enable fractional ownership of a physical asset
- Limited scope for asset representation, usability and inclusion, such as through blockchain tokens
- Rent-seeking third parties (often “too big to fail” banks) that reduce the efficiency of economic exchanges
- Misaligned incentives for economic growth that fail to benefit a large swath of society
- Rigid legal, technological and financial structures that inhibit innovation such as new consumption and decentralized financing models
- An inability to deconstruct and tokenize illiquid assets to liberate sources of capital, facilitate secondary markets, and improve cash flow management and tax structures “

According to Gartner¹, “executive leaders should understand central banks’ thinking around digital currencies in three domains:

- Financial supervision — Improve the effectiveness of monetary policy, reduce systemic risks and improve compliance, including anti-money-laundering (AML) and know-your-customer (KYC) requirements.
- Economic development — Improve the velocity of money, enable new economic models, increase access to finance and innovations.
- Geopolitical and political alignment — Support a government’s geo-political stance or avoid another government’s influence on the domestic economy or monetary flows.

¹⁹ Gartner “Shape Your Digital Strategy With Central Banks’ Intentions Toward Digital Currencies,”Christophe Uzureau, David Furlonger, Mar 13, 2020

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Figure (1): Central Banks Intentions Toward Digital Currencies

Central Banks' Intentions Toward Digital Currencies



Source: Gartner "Shape Your Digital Strategy With Central Banks' Intentions Toward Digital Currencies,"Christophe Uzureau, David Furlonger, Mar 13, 2020

According to Gartner²⁰, "Central banks will resist a digital currency that disrupts their monetary policies without providing sufficient benefits to economic development. Central banks want to ensure that digital currencies don't:

- Grow dark money — Potentially, digital currencies and decentralized exchange could support a large share of the economy and wealth that central banks would have little visibility into or control over. This would disrupt the banking systems, and central banks would lose the ability to manage economic policy, regulate growth and soften the extremes of the business cycle.
- Facilitate illegal transactions — Digital currencies and decentralized exchange could enable people to move money and goods anonymously. Money laundering, tax evasion and the financing of terrorism would become much easier. Such risks are increasing as most cryptocurrency exchanges have weak AML, counter terrorist funding (CTF) and KYC processes.

²⁰ Gartner "Shape Your Digital Strategy With Central Banks' Intentions Toward Digital Currencies,"Christophe Uzureau, David Furlonger, Mar 13, 2020

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- Create alternate volatile wealth pools — Unregulated digital currencies and assets may allow for asset pools to develop that destabilize the larger system and potentially create new types of economic disenfranchisement.

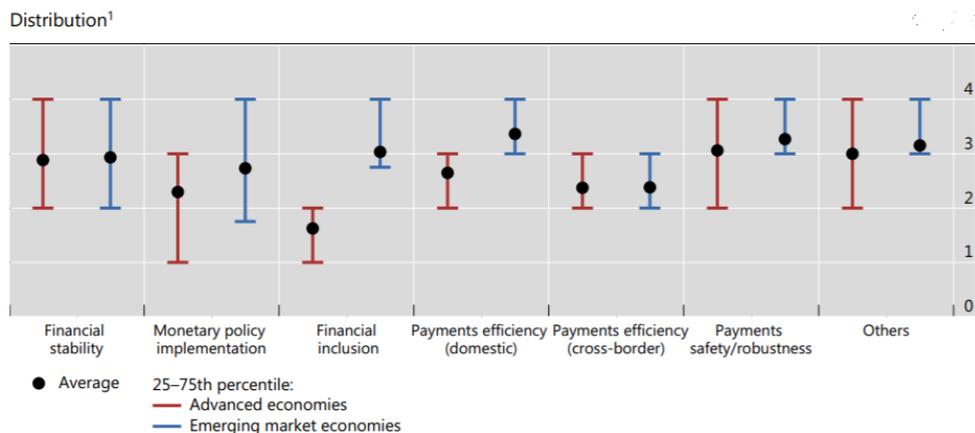
BIS study

A study by the BIS²¹ shows that the motives differ between industrialized countries on the one hand and emerging and developing countries on the other.

Developed countries with existing electronic payment infrastructure hope to increase the efficiency of payments, by reducing transaction time and costs, and increase the security of digital transactions. Monetary policy and financial inclusion considerations only play a minor role for central banks in these developed countries.

Developing countries, on the other hand, aim to improve financial stability, the efficiency, and security of transactions, but above all, to reach a higher degree of financial inclusion.

Figure (2): Motivations for issuing a general purpose CBDC²² - BIS Survey on CBDCs



¹ Not so important" (1); "Somewhat important" (2); "Important" (3); and "Very important" (4).

Source: Central bank survey on CBDCs.

²¹ Boar, C., Holden, H. and Wadsworth, A., (2020). Impending Arrival - A Sequel To The Survey On Central Bank Digital Currency. [online] Bis.org. <https://www.bis.org/publ/bppdf/bispap107.pdf>.

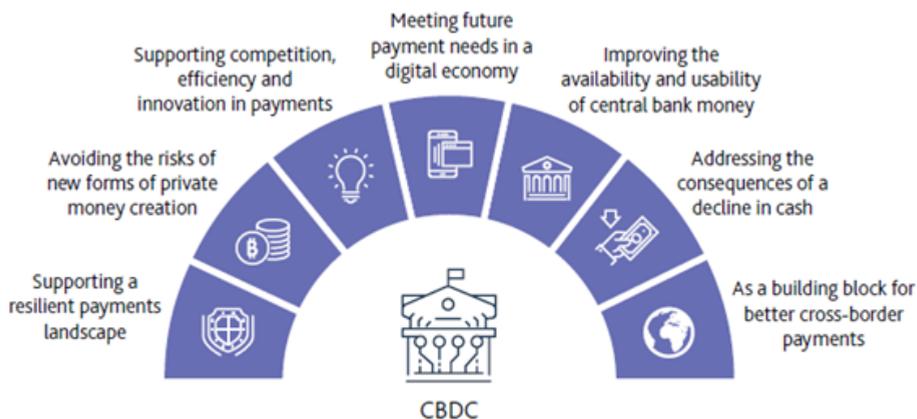
²² Boar, C., Holden, H. and Wadsworth, A., (2020). Impending Arrival - A Sequel To The Survey On Central Bank Digital Currency. [online] Bis.org. <https://www.bis.org/publ/bppdf/bispap107.pdf>.

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Bank of England's Motivations

The Bank of England in its discussion paper²³ on CBDC outlined the number of ways in which CBDC could support the Bank's objectives to maintain monetary and financial stability, through the provision of a new form of money and a new payments infrastructure (illustrated in the figure below).

Figure (3): How CBDCs can support BoE's Objectives



Source: BoE, March 2020.

CHALLENGES TO BUILDING CBDC

International cooperation and legal concerns

According to Gartner²⁴, “Central banks face several challenges to achieving their CBDC objectives:

- Variations in demand between countries such as in cash usage. For example, cash in circulation as a percentage of GDP has declined in Sweden in the last ten years but increased in Japan, the U.S. and the eurozone. Their respective central banks will, therefore, have different objectives for issuing a new digital currency.
- Differences in monetary policies (CBDCs may affect monetary flows and currency valuations).
- Lack of coordination across central banks' jurisdictions, which could lead to trade and other tensions.

²³ Digital currencies team, Bank of England, *Central Bank Digital Currency – Opportunities, challenges and Design. Discussion paper*, March 2020

²⁴ Gartner “Shape Your Digital Strategy With Central Banks’ Intentions Toward Digital Currencies,” Christophe Uzureau, David Furlonger, Mar 13, 2020

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- The technological immaturity of CBDCs, including poor integration to legacy software and hardware, and a lack of technical talent, which could result in counterfeiting and network failure, and undermine trust in financial and payment systems.
- Legal uncertainties over whether a central bank has the mandate to issue a new digital currency as discussed further below in CBDC Legal Requirements. According to the BIS, in 2019, “a third do not have authority and about 40% remain unsure.”

Financial stability concerns

Central bankers and economists are currently debating how such a retail CBDC system should be designed to preserve the stability of the existing monetary system. Many economists, such as the president of the German Bundesbank Jens Weidmann, see the main threat of a retail CBDC introduction in the facilitation of "digital bank runs" — numerous customers could exchange their bank deposits for the new digital central bank money easily. In the case of such a digital bank run, banks' liquidity holdings could be put under immense pressure and, in the worst case, lead to bank illiquidity. In addition, the direct exchange of bank money into CBDC could limit the ability of banks to create money by lending activities, as banks would have to reckon with an outflow of funds into the riskless CBDC at any time and thus would have to back the customers' deposits with a higher percentage of reserves.

Banks engage in maturity transformation and finance long-term loans through short-term deposits. The introduction of a digital form of central bank money for the non-banking sector could thus trigger risks for maturity transformation through potential and sudden withdrawal of liquidity. An extreme scenario of this disintermediation would be that banks could become pure intermediaries and could no longer create money by granting loans. In order to provide the economy with sufficient liquidity, the central bank itself might have to generate CBDC units actively. A 2019 published study by the International Monetary Fund (IMF) discusses money creation in a retail CBDC system and sheds light on the active creation of CBDC units through lending. Lending could still be carried out by banks, but no additional bank deposits would be created in the lending process, as the loan would have to be refinanced 100% in CBDC. In fact, CBDCs can enable central banks to regain control over money creation and to be the sole issuer of money.

Anonymity concerns

In addition to threats for financial stability, the introduction of a CBDC could also affect the privacy of sensitive transaction data. Today, payment methods such as Apple Pay, bank transfers, or cash transactions differ in their level of data privacy and anonymity. For example, if a transaction is made via Apple's payment service Apple Pay, the transaction data can be seen and monitored by Apple. If a bank transfer is used, payment details are available to the bank. This does not hold for cash: cash is completely anonymous. With cash, transactions are carried out on a peer-to-peer basis without any intermediary that could potentially access transaction

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data. Thus, transaction details are only available to the participating transaction partners. Such data privacy and a certain degree of anonymity are also crucial for payments via CBDC. See [“Privacy.”](#)

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DIFFERENT APPROACHES AND DESIGNS FOR ISSUING CBDCs

Summary

Different countries have different motivations and goals with respect to the payment and monetary systems.

A country's motivations will determine the design of their CBDC.

In addition to motivations, there are other key CBDC design decisions which a central bank must make: availability, anonymity, interest payment and limits or caps. These design decisions may be impacted by the country's motivations for adopting CBDC.

There are various design choices to model the CBDCs depending on a country's motivations for adopting CBDC²⁵.

Availability: Access to conventional central bank money is limited to working hours and usually only five days a week. CBDCs could be available 24*7*365 or for a limited duration (e.g. it could be created, issued and redeemed on an intraday basis).

Anonymity: CBDC can, in principle, be designed to provide different degrees of anonymity in a way that is similar to cash. A key decision for a central bank is the degree of anonymity, balancing, among other things, concerns relating to money laundering, financing of terrorism and privacy.

Different from cash and deposits, however, CBDC can be designed to blend intermediate amounts of anonymity and security. For example, anonymity may be preserved vis-à-vis third parties only, and transactions can be recorded but not accessed by the central bank unless a transaction size limit is breached and/or there is suspicion of wrongdoing.

Transfer mechanism: CBDC may be transferred either on a peer-to-peer basis or through an intermediary, which could be the central bank, a commercial bank or a third-party agent

Interest-bearing: As with other forms of digital central bank liabilities, it is technically feasible to pay interest (positive or negative) on both token- and account-based CBDCs. The interest rate on CBDC can be set equal to an existing policy rate or be set at a different level to either encourage or discourage demand for CBDC. Or interest can be set dynamically based on other program parameters and objectives. The payment of (positive) interest would likely enhance the attractiveness of an instrument that also serves as a store of value. Meanwhile, paying interest may generate operational challenges to interest calculation and have an unfavorable impact on the anonymity due to tax reporting requirements. The International Telecommunication Union reported in 2019 that none of the central banks exploring CBDC

²⁵ CPMI (2018). Central bank digital currencies, March 2018. Committee on Payments and Market Infrastructures, Markets Committee, Bank of International Settlements. <https://www.bis.org/cpmi/publ/d174.pdf>.

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issuance are considering making them interest-bearing. However, Sweden's e-Krona will have the built-in ability to pay interest if the central bank ever opted to introduce this feature.²⁶

Limits or caps: Different forms of quantitative limits or caps on the use or holdings of CBDCs are often mentioned as a way of directing potential usage. For instance, limits or caps could make a CBDC less useful for wholesale rather than retail payments. Such limits or caps on holdings or use are most easily envisioned in non-anonymous account-based systems.

²⁶ International Telecommunication Union (2019). "Reference Architecture and Use Cases Report", July 2019, ITU-T Focus Group Digital Currency including Digital Fiat Currency. https://www.itu.int/en/ITU-T/focusgroups/dfc/Documents/DFC-O-014_RA%20Deliverable_Reference%20Architecture%20and%20Use%20Cases%20Report.pdf

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CBDC MODELS: WHOLESALE, RETAIL (DIRECT, INDIRECT/SYNTHETIC, HYBRID)

Summary

Wholesale CBDC – is digital currency issued by central banks for use by commercial banks and other regulated financial institutions.

Retail CBDC is digital currency issued by central banks for use by the general public, households and businesses. Depending on the central bank's desired level of involvement, there are three architectures: direct, synthetic and hybrid.

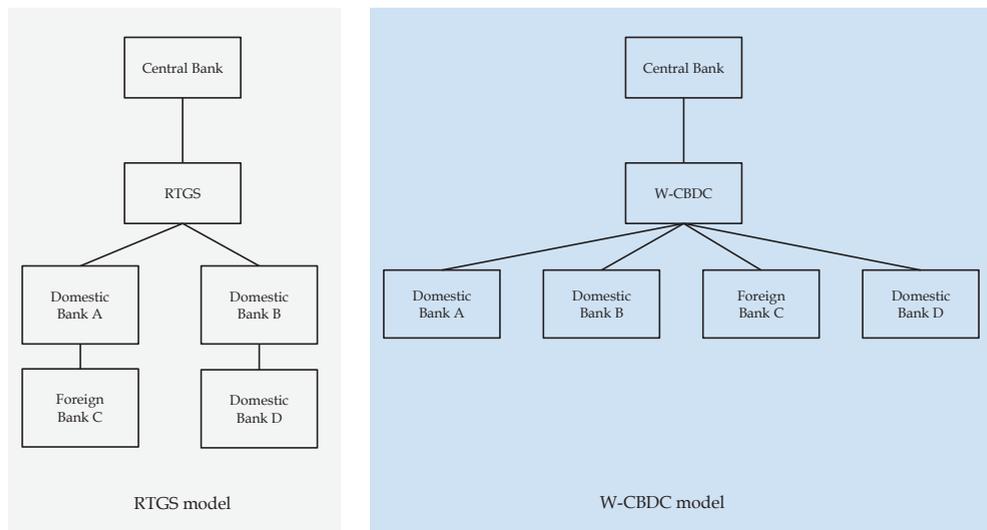
There are two general categories of CBDCs: wholesale and retail. The wholesale CBDC (W-CBDC) is for use in financial markets such as settlement of delivery-vs-payment (DvP) and payment-vs-payment (PvP) between financial institutions. A retail CBDC (R-CBDC) is aimed at households, or individuals and small businesses for various use cases including P2P payments, bill payment, e-commerce, in-store payments, etc. Common for both wholesale and retail CBDC is that they would serve as legal tender.

Wholesale CBDC

W-CBDC functions similarly to a modern Real-Time Gross Settlement (RTGS) system. A W-CBDC has the same status as central bank reserves. However, an account in a central bank's RTGS is typically limited to domestic banks. This limitation has created the need for a correspondent banking model where foreign banks (and in some cases small domestic banks) hold funds with a domestic bank that is connected to the RTGS. This means that the foreign bank doesn't hold legal tender and this in turn increases risk, slows down settlement and increases cost, particularly for cross-border payments. A W-CBDC changes this dynamic assuming the foreign bank is allowed to hold CBDC directly. With W-CBDC, any bank can hold any currency (available as CBDC) as legal tender. This reduces risk, speeds up settlement and reduces cost.

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Figure (5) RTGS vs. W-CBDC



source: M10 Networks, Inc. (2020)

Retail CBDC

The purpose for a R-CBDC is for use as a payment instrument between individuals and businesses. The idea is that it's similar to cash in terms of settlement finality and legal tender. There are a number of important considerations when designing a CBDC for retail use:

- Structure of legal claim
- Security
- Resilience
- Privacy
- Performance
- Accessibility [universal access]
- Ease of use

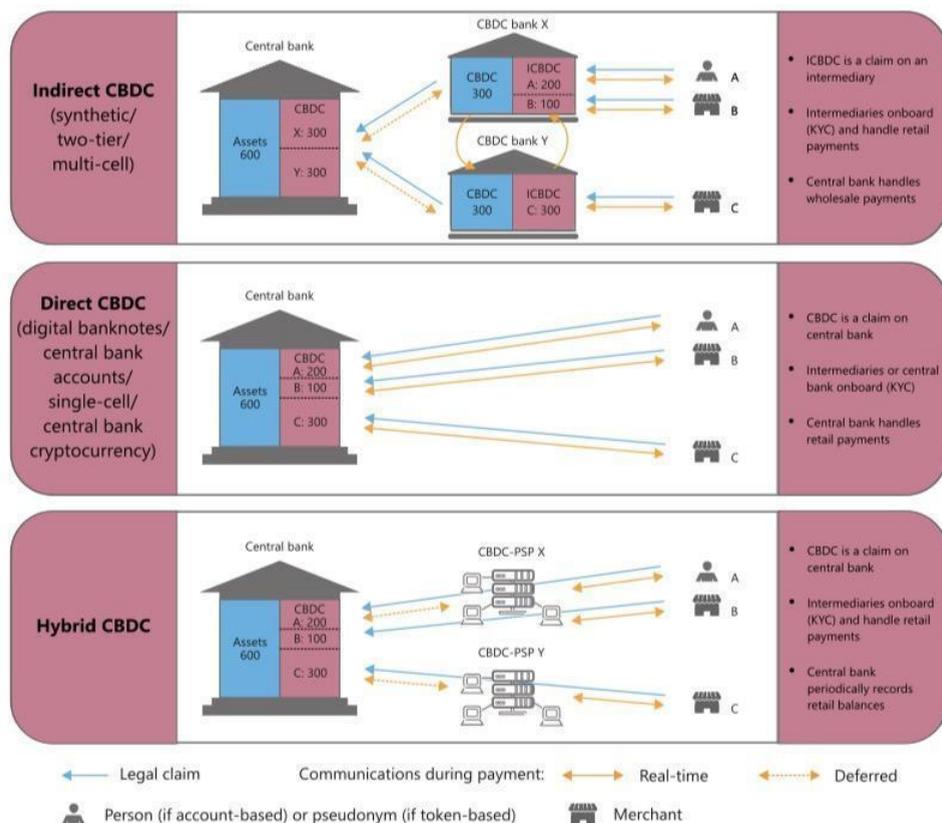
Structure of legal claim

A CBDC is by definition issued by the central bank and thus serves as a legal claim on the central bank. The challenge with this model is that central banks aren't designed to serve millions of individuals or households directly. For cash, this was resolved by using commercial

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banks as distributors of coins and bills. The commercial banks perform KYC, AML/CFT and other customer services. To address these challenges, BIS has identified three architectures to consider for R-CBDC²⁷ and the IMF has recommended the indirect/synthetic CBDC²⁸:

Figure (6): “An overview of potential retail CBDC architectures”



source: BIS Quarterly Review (March 2020)

If a country determines that it wants to adopt a retail CBDC, it needs to decide on the role of the central bank and the role of commercial banks.

If the central bank is issuing CBDC directly to its citizens, the bank is responsible for KYC, AML and customer services. This might be ideal in a country where the commercial bank sector is underdeveloped.

²⁷ BIS Quarterly Review, March 2020.

²⁸ “Stablecoins, Central Bank Digital Currencies, and Cross-Border Payments: A New Look at the International Monetary System” (IMF, May 2019).

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If the commercial banks are acting as a second tier to connect to consumers, then the question is whether the commercial banks will distribute M0 digital currency issued by the central bank (hybrid CBDC) or the commercial banks issue M1 digital currency to their customers, backed by their reserves on the M0 ledger (synthetic CBDC). In both cases, the commercial bank is responsible for KYC, AML and customer service.

Security

A CBDC (like any other payment system) must follow the highest standards of cybersecurity against fraud and cyber attacks to protect holders of CBDC from theft and preserve integrity of the system as a whole. This means that transactions must be end-to-end secure and rely on public key cryptography vs shared secrets such as passwords. Security relies on proper architectural and operational design and execution.

Resilience

Payment systems cannot go down without undermining public confidence and impeding with commerce. Systems must be sufficiently fault tolerant so errors or incidents will not cause the payment system to crash.

Privacy

The issue of privacy relates to transaction data being shared between counterparties and private data exposure at breaches.

Transaction privacy

Payers should be able to pay for goods and services without having to disclose personal identifiable information (PII). This is how cash works today and should also be offered in the context of a sCBDC.

At the same time, banks and regulators should have access to detailed transaction data in order to comply with AML/CFT/screening regulations. Given the digital nature of a CBDC, it's possible to program exemptions for transaction data access by regulators (e.g. no data access for transactions below a predefined value threshold).

Data protection

If the system as a whole is breached, PII should still be protected from being viewed, updated or deleted. Further, the system must accommodate local data privacy legislations such as GDPR (e.g. "the right to be forgotten") in the European Union.

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Performance

There are far more retail transactions than bank-to-bank transactions. Any payment system intended for retail transactions must be able to scale to support this greater number of transactions, especially at times of peak usage. Additionally, the speed of transactions matters. Bank-to-bank transactions have historically been designed to accommodate system latency and delays. Any R-CBDC must execute transactions at speeds which compare well with cash transactions.

Scalability

The CBDC solution is scalable in response to changes in use, whether in terms of number of users, user group composition, volume or response times, throughout the operating life of the solution. Also, the solution to be modularised in such a way that it is possible to upscale and downscale both the entire solution and individual components.

Universal access

A R-CBDC is meant to serve all citizens of a country. Thus, use of the R-CBDC must be possible in both online and offline situations. Further, while smartphone penetration is high in many countries, it's not ubiquitous. Therefore, the R-CBDC must be usable with a smartcard and/or "feature phone"²⁹.

Open, secure APIs is a key component to providing universal access. With APIs, third party developers can build the applications that are best suited for a particular use case.

Ease of use

To ensure adoption of the R-CBDC, a smooth overall customer experience is critical. Customer onboarding, sending and receiving money, interoperability with existing payment/banking systems, customer support - all must be optimized for the least possible friction.

Interoperability

The CBDC solution to be usable without restriction across all unit types and user operating systems, and as possible be adaptable to future technological changes. The solution must employ publicly approved standards and formats to ensure promotion of cooperation, innovation and information exchange.

Flexibility

The design of the CBDC solution should not limit changes to functionality, organizational structure, ownership and infrastructure. The design must take into account the possibility of

²⁹ A mobile phone that retains the form factor of earlier-generation phones, with button-based input and a small display.

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changes in the supplier market, amendment of laws and regulations relevant to responsibility and ownership, and updates of information-exchange standards.



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STEPS TO DESIGNING CBDCs

The Bank of England in its paper published in March 2020, used an illustrative model to structure principles around CBDC. This approach is intended as a basis for further discussion and research, to illustrate the choices and the impacts, rather than a blueprint for a design. More detailed analysis would be required before the Bank could make a confident decision on whether to introduce CBDC, and if so, in what form³⁰.

Step 1: Understand the opportunities and challenges of CBDC: to develop a clear understanding of the opportunities that the introduction of CBDC could offer, and the challenges that would need to be managed.

Step 2: Set an overall objective that any design of CBDC would need to meet: This objective should follow the central bank objectives and mandate, taking into account other public policy objectives, and will inform the design principles around which CBDC should be designed.

Step 3: Design CBDC. There would be two main elements to any CBDC: (1) the CBDC itself (i.e. access to a new form of central bank money) and (2) the CBDC infrastructure that allows CBDC to be transferred and used for payments. There are three principal aspects of design to consider, and decisions taken in one area will affect choices that need to be made in other areas: (a) Provision concerns choices around who would do what in providing CBDC. The responsibilities and functions involved in providing CBDC could be allocated in different ways between the public sector (e.g., the central bank and other authorities) and the private sector (e.g. financial institutions, payment providers, fintechs and technology firms). Decisions around provision would have a significant impact on whether CBDC as a whole is resilient, open to competition, interoperable, and designed around the comparative advantages of the private and public sector. (b) Functional design is about ensuring that the payments function of CBDC provides a clear benefit and utility for users. It concerns the types of payments that could be made using CBDC, how users would interact with CBDC, and whether the functionality of CBDC could be extended if payments needs were to change in future. Decisions taken here would have a particular impact on whether CBDC is user-friendly and widely accessible, and on the level of privacy in the system. (c) Economic design concerns aspects such as access (who could hold CBDC?), remuneration (should CBDC bear interest?), limits (should there be limits on the amount of CBDC that can be held?), and convertibility (should CBDC be freely convertible for other forms of central bank money, and for bank deposits?). See [“Structure of Legal Claim.”](#)

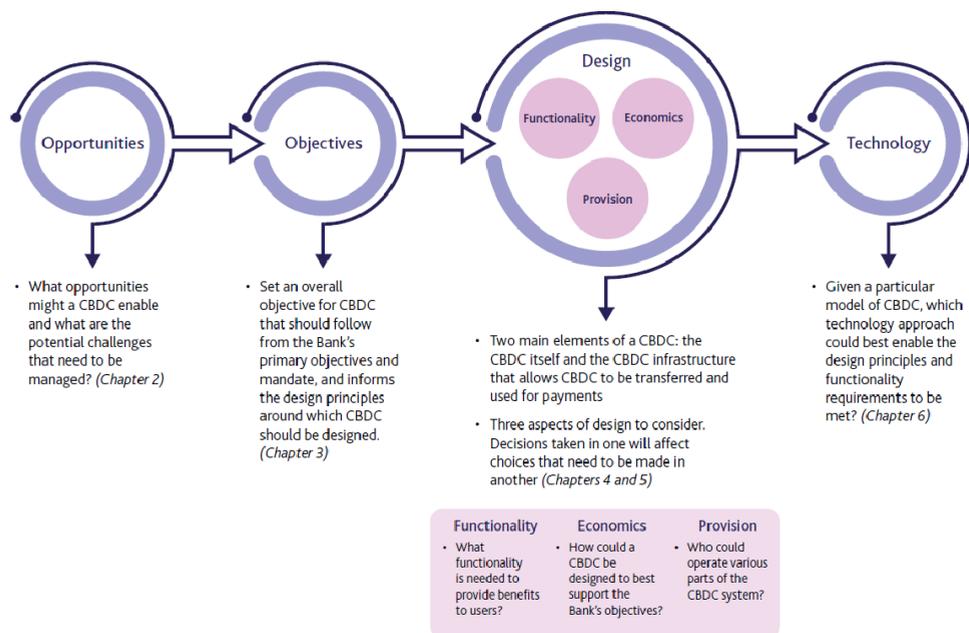
Step 4: Technology: Given a particular model of CBDC, it is important to assess which technology could best support the design principles and functionality requirements to be met. Also, the technological trade-offs involved between different design principles should be

³⁰/ Bank of England (2020). “Central Bank Digital Currency: opportunities, challenges and design”, discussion paper, Bank of England, March 12, 2020. <https://www.bankofengland.co.uk/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design-discussion-paper>.

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considered. Decisions taken here have a particular effect on the extent to which CBDC could be resilient, secure, fast, efficient, extensible, available and scalable. See [“CBDC - Underlying Technology.”](#)

Figure (7): Bank of England approach to design CBDCs



Source: Bank of England “CBDC-Opportunities, challenges and design”, March 2020.

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CBDC ECOSYSTEM

Summary

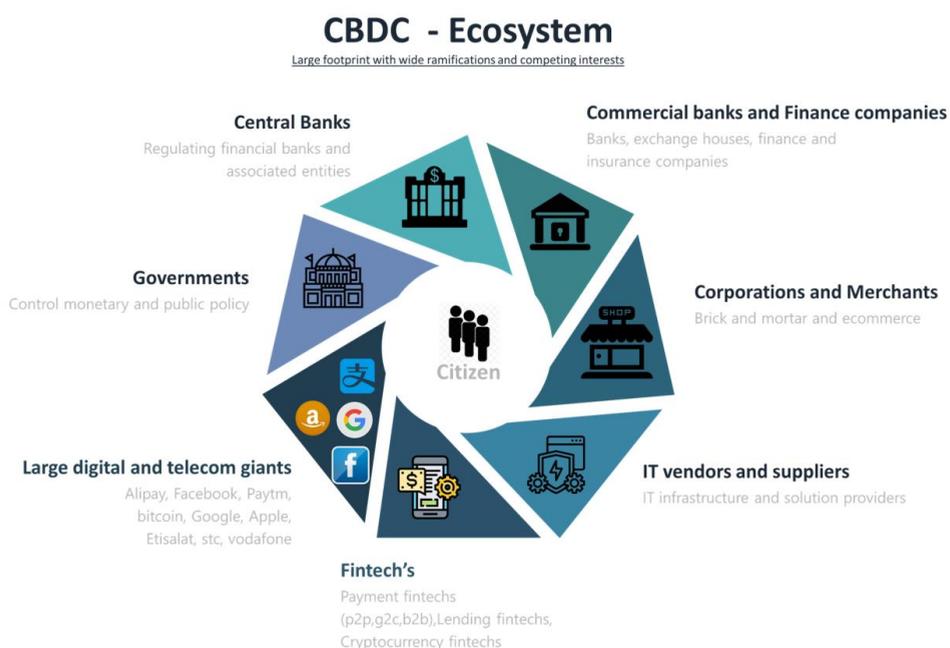
CBDCs involve complex ecosystems with multiple players each with competing interests.

Specifying the roles and responsibilities of the players prior to inception is critical to the well-functioning of the CBDC.

In a retail CBDC, the ultimate beneficiary of the system are citizens. Central banks must design their CBDC with this audience in mind.

Central bank digital currencies involve several constituents who are driven by their own interests and many of these interests also compete with each other. The following graphic illustrates the overall ecosystem involved in CBDC's and digital currencies (Retail or Wholesale CBDCs)

Figure (8): CBDCs Ecosystem



Source: Saleem Ahmed, Sharjah Islamic Bank (2020).

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The citizen at the center of this complex ecosystem will be the most affected by this ecosystem and is and should be the key constituent in framing a CBDC regime and structure involving these ecosystem players.

Each of the players in the ecosystem play a role in the successful running and operation of a CBDC. Each government and geography consortium will need to establish clear governance models which demand and dictate the nature of the engagement and operating models between these constituents. The key objective should also be to incentivize usage of the CBDC by the citizenry and end users which will only further the associated monetary, fiscal and economic objectives of the respective economies and consortia.

Different technology components will play a role in underpinning a successful CBDC and will range from core infrastructure and platform components (DLT, Databases etc.) and end user interface touch points including banking mobile and internet banking, ATMs, POS machines and the merchant ecosystem. Also, in addition the above, government authorities and telecom providers establishing digital identity (for example, UAE's UAEPASS, Pakistan's NADRA, KSA's Absher, as well as Kuwait Mobile ID) will also play a key role in the various use cases which will utilise and 'transact' in CBDC including digital onboarding, exchange of tokens/value, transfer of 'funds ownership' etc.

Needless to say, the core systems of the central bank and the commercial banks will need to accommodate the necessary changes to deal with CBDCs (shared, hierarchical ledger) and the satellite services like RTGS, AML and Sanctions screening, financial reconciliation applications etc. will also have to undergo changes to deal with the unique but similar nature of CBDCs.

Digital giants such as Facebook, Amazon, Alibaba have made inroads into the territory of digital currencies and a case in point is Libra which threatens to upend the current financial system and potential disintermediate commercial banks in the process.

IT solution and service providers will also seek to establish a foothold in this ecosystem by seeking to promote (directly or indirectly) usage of their core platforms – especially DLT. It is imperative to understand and evaluate technologies against the core objectives to ensure there is adequate scalability, future-proofness and flexibility in accommodating changes.³¹

CBDCs are intended to serve as legal tender. Because they are pegged to existing banknotes, they provide a risk-free alternative to private bank deposits. The first generation of CBDC, introduced roughly a decade ago, had limited interoperability and programmability. The next generation, known as CBDC 2.0, will likely work on a national or supranational level (in the case of the European Central Bank). These currencies could help to automate monetary policies, which could mitigate the risk of hyperinflation in emerging economies and reduce purchasing

³¹ As noted in "CBDC - Underlying Technology," many experts believe that a general purpose DLT cannot achieve the speed necessary to support a retail CBDC. This is why China choose to use a conventional RDBM for their eCNY. Special purpose DLT designed specifically for payments, such as the M10 blockchain, can achieve throughput rates an order of magnitude greater than general purpose DLT from R3 Corda or IBM Hyperledger.

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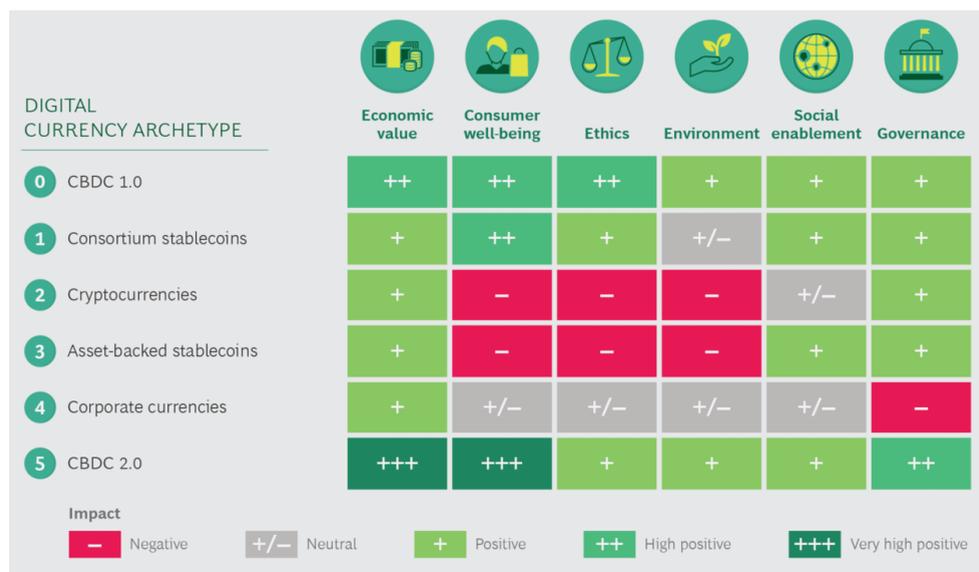
power inequality. Better traceability would allow nations to curb criminal activities, tax evasion, and drug trafficking. See [“CBDC Global Initiatives.”](#)

Societal Impact

How a currency is designed can also have societal impacts, which can influence a currency’s longer-term competitiveness and value. As International Monetary Fund analysts Tobias Adrian and Tommaso Mancini-Griffoli noted in a September 2019³² post to IMFBlog, “Payments are more than the mere act of transferring money. They are a fundamentally social experience linking people.”

BCG’s analysis³³ finds that economic, consumer, ethical, environmental, social enablement, and governance factors can impact a currency’s risk and return. For example, CBDCs and consortium stablecoins are likely to open up more sources of value and generate the most positive societal impact, while the more anonymous or closed nature of cryptocurrencies and asset-backed stablecoins raises ethical concerns that can constrict value.

Figure (9): Societal Impact of CBDC



*Source [Kaj Burchardi](#), [Igor Mikhalev](#), [Bihao Song](#), and [Steven Alexander Kok](#), *Get Ready for the future of money*, May 2020.

³² Tobias Adrian and Tommaso Mancini-Griffoli, Digital Currencies: The Rise of Stablecoins, Sep 19, 2019, <https://blogs.imf.org/2019/09/19/digital-currencies-the-rise-of-stablecoins/>

³³ [Kaj Burchardi](#), [Igor Mikhalev](#), [Bihao Song](#), and [Steven Alexander Kok](#), *Get Ready for the future of money*, May 2020.

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A currency's worth will surely grow in proportion to its use. According to BCG, whether an organization or a central bank is creating its own initiative or participating in a broader ecosystem, digital currencies require scale to succeed. Building a critical mass of early adopters requires committed collaboration among a broad group of participants. Establishing trust, addressing inevitable tensions, and managing cooperative competition, or "coopetition," among close rivals takes strong leadership. Decision-makers for the group and their delegates must have the clout and expertise needed to push through learning-curve challenges and identify needed partners, data, talent, and other foundational elements.

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Building the CBDC Ecosystem

As has just been discussed, to implement a CBDC an ecosystem with various components is needed.³⁴

Comprehensive Digital Infrastructure: CBDC requires digital infrastructure; it is an ineffective solution in cash-based economies with poor internet connectivity, low smartphone penetration, and general inability to access technology. For CBDCs to be realized, a dominant share of the popular places need access to digital infrastructure. Additionally, CBDCs have technological requirements that must be met.

A Well-Functioning Central Bank: CBDCs give central banks new responsibilities that add considerable costs and risks. If the central bank adopts a Retail Direct CBDC (as compared to a hybrid or synthetic CBDC), the central banks will have to take on a number of new operations such as interfacing with customers, maintaining technology, being responsible for anti-money laundering, avoiding human errors, etc. Additionally, the central bank may need to intervene on behalf of the banking sector if CBDCs replace the use of retail bank accounts (banking-sector disintermediation). Lastly, retail direct CBDCs would cause a central bank's balance sheet to grow significantly.

Financial Technology Knowledge by the Central Bank and Government: CBDC development requires technical expertise. While the creation of digital notes, user interfaces, digital wallets, and payments infrastructure can be outsourced to government contractors, members of the central bank and government officials will need to understand the implications and risks of the technical design. By understanding the design, the central bank and government can put in place appropriate policies and regulations to manage the payments infrastructure and create a system that promotes economic prosperity.

Effective Governance: CBDCs will involve new forms of digital payments and change the role of central banks and private financial institutions. New policies and regulations will be needed for: consumer protection, financial stability, anti-money laundering and know your customer frameworks, cybersecurity, etc. Government entities, therefore, will need to be capable of taking on this new challenge to promote a financial and payments system that benefits the country.

³⁴ Atlantic Council (2020). Nikhil Raghuvveera, GeoTech Center, Atlantic Council, April 23rd, 2020. <https://www.atlanticcouncil.org/blogs/geotech-cues/design-choices-of-central-bank-digital-currencies-will-transform-digital-payments-and-geopolitics/>

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CBDC - UNDERLYING TECHNOLOGY

Summary

Because of the need for resilience and security, CBDC systems are generally built using distributed ledger technology.

Retail CBDC will generate a significantly higher volume of transactions. General purpose DLT may not be able to support these high throughput and low latency requirements, accordingly, special purpose DLT designed for bank payments may be required.

For sCBDC or hybrid CBDC, the ability to support multiple tiers of linked, hierarchical ledgers will be required.

Distributed ledger technology and blockchain

At the heart of a CBDC is a ledger that tracks issued currency and its transactions. The ledger can be built using conventional database technology such as RDBMS, but a more common approach when it comes to digital currency is the use of distributed ledger technology (DLT), or blockchain. The two terms, DLT and blockchain are often used interchangeably, but there are important differences to be aware of.

From a technical perspective, a DLT is a decentralized database that is managed by multiple parties. There is no central authority that acts as arbitrator or monitor. This provides greater transparency – making fraud and manipulation more difficult and is more difficult to compromise. The decentralized nature of the system also provides greater resilience.³⁵

Blockchain is a type of DLT with a specific set of features. It is also a shared database – a log of records – but in this case shared by means of blocks that, as the name indicates, form a chain. The blocks are closed by a type of cryptographic signature called a ‘hash’; the next block begins with that same ‘hash’, a kind of wax seal. That is how it is verified that the encrypted information has not been manipulated, and that it can’t be manipulated. Blockchain provides immutability, meaning transactions can’t be tampered with after they’ve been committed to the database. Blockchain is of course the technology behind the famous Bitcoin cryptocurrency, but a blockchain can be beneficial for other digital currencies.³⁶

Typically, DLT and blockchains means that customers must trade off between immutability and resilience vs. throughput. The mechanism for providing immutability and resilience can be resource intensive and as a result the number of transactions that can be processed during a given time frame (typically measured in seconds) suffers. Earlier blockchain were “public” --

³⁵ The Internet, which was originally developed for military purposes, utilizes a distributed architecture to provide resiliency. Enemies do not have a single point to attack the system.

³⁶ For more information on DLT vs. blockchain, see <https://www.bbva.com/en/difference-dlt-blockchain/>

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open to all users. Examples are Bitcoin and Ethereum. These systems were designed to protect the user's identity. Many cryptocurrencies are supported by public blockchains. Later, permissioned or private blockchains were introduced³⁷. Examples are R3 Corda, IBM Hyperledger and M10. These permissioned systems control who can write data on the blockchain. Identity is required for permissioned systems. In a permissioned blockchain, fewer nodes in the blockchain have to be processed. This results in significantly greater performance. New permissioned blockchains have been introduced that can process tens and hundreds of thousands, or even millions of transactions per second while maintaining resilience and immutability.³⁸

On-premise vs. cloud

There are two basic modes to operate a CBDC system (or any other computer system). The system can run on a central bank's premises, or in a cloud environment, which in turn can be a private or a public cloud from such providers like Google, Microsoft or Amazon. Operations in a public cloud often delivers cost efficiencies since resources are shared across multiple parties. However, there are important issues to consider when deciding on whether to outsource and if so, which provider to select:

Regulatory. Are there regulatory mandates for the operations of financial market infrastructure?

Data off/on-shoring. Are there regulatory mandates for how personal identifiable, or transactional data need to be stored within the country's borders?

Security. How does the hosting mode support the required security needs and processes?

Resilience. How is resilience provided in a natural, or man-made disaster?

Disaster recovery. What are the methods for recovery and how long would recovery take?

Public key cryptography

Distributed ledger technologies use public key cryptography (PKC) to generate digital signatures. PKC is an encryption technique that uses a paired public and private key (or asymmetric key) algorithm. The digital signature is unique and can be verified using the key pair's public key to have been generated by a private key belonging to a specific individual and/or device. Digital signatures can be used for both authentication (identifying oneself to gain access to a system) and authorization of transactions and are safer than "shared secrets" such as passwords.

A number of PKC algorithms exist. It's important that a CBDC system supports the upgrade of the PKC algorithm used as new, more sophisticated algorithms become available in the future.

³⁷ Prior to the introduction of full permissioned blockchain, semi-permissioned systems were tested. Ripple is the best known example.

³⁸ Massessi, Coinmonks (2018). "Public Vs Private Blockchain In A Nutshell", December 2018. <https://medium.com/coinmonks/public-vs-private-blockchain-in-a-nutshell-c9fe284fa39f>

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Account-based vs. token-based

In several analyses of CBDC infrastructure, the issue of whether to use an account-based or token-based model is discussed. For practical purposes of a CBDC there is no difference. Both models can provide the same functionality and both require transaction validation by a third party, or the update of a centralized ledger to preempt the double spend problem and ensure robust security.

This notion is supported by a recent paper by the Bank of England where they noted: “We do not see any inherent reason that token-based systems would automatically provide anonymity. Both account-based systems and token-based systems can be configured with various identity solutions, ranging from fully anonymous to pseudonymous [I]n a token-based system, in order to prevent double-spending, ownership of tokens needs to be recorded in a ledger, which will need to be updated to reflect any changes in ownership.”

In a very thoughtful analysis, Milne concludes digital currencies and “cryptocurrencies and other crypto assets are account-based financial assets, they are neither tokens nor objects.”³⁹

³⁹ Alastair Milne, “Argument by false analogy: the mistaken classification of Bitcoin as token money.” (Feb 2020)
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3290325

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CBDC - FUNCTIONAL REQUIREMENTS

Summary

A retail CBDC must support monetary functions such as issue money, destroy money, role-based access control, and real-time payment functions such as credit and debit transfers, confirmation of funds and payee and robust real-time and offline reporting.

Retail payment systems must be available 24*7*365 and be highly resilient. The system must be highly secure and resistant to compromise, or intrusion. Data must be stored securely.

Because of the higher number of retail transactions (as compared to wholesale), retail systems must provide high throughput, low latency, and be scalable.

A retail CBDC system is essentially a real-time payments system which offers instant settlement. Therefore, it must support the following functions:

Issue money. Create digital currency on a ledger.

Destroy money. Destroy digital currency on the ledger.

Role-based access control. Ability to restrict access at a granular level based on the roles of individual users.

Real-time payment status. Payer and beneficiary can retrieve payment status at any time during, or after the transaction.

Real-time reporting/alerts. Real-time reports must be accessible for predefined events and alerts sent for time-critical events.

Offline reporting. Access to detailed system reports, transaction reports, etc. for system health checks and regulatory compliance.

Instant settlement. Payments settle within a second. Includes interbank settlement in central bank money and settlement of cross-border payments.

Immutability. Transactions cannot be reversed or cancelled. Refunds can and should be processed but as linked transactions, without impairing the integrity of the original transaction.

Credit transfer. Payments can be pushed by the payer to the account of the beneficiary. This is the most common type of transaction.

Debit transfer. Payments can be pulled by the beneficiary from the account of the payer.

Request-to-pay. A message from the beneficiary that requests the payer to push a payment from the payer's account to that of the beneficiary.

Confirmation of payee. Validates the beneficiary's ability to receive funds before the transfer is performed.

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Confirmation of funds. Validates that the payer has sufficient funds in their account to complete the payment.

Atomic payments. Conditional payments must pass or fail on an all-or-none basis. Especially important for smart contracts or where netting algorithms are used in conjunction with liquidity saving mechanisms.

Offline payments. Complete payments without online access to the payment system.

M2M payments. Allow machines to pay other machines without human interaction.

End-to-end fee transparency. Prior to payment execution, payer and beneficiary should have access to information about any fees levied.

Availability and resilience. System is available 24x7. System upgrades can be performed without downtime. The system must be able to recover from operational disruption, for example from hardware or software failures.

Throughput and latency. In a wholesale CBDC, the number of transactions processed per second is typically low. A retail CBDC involves high-volume, low-value transactions and the number of transactions processed per second can become exponentially higher. Considering future payments use cases including micropayments will add growth.

Scalability. The system should be horizontally (add more servers) and vertically (add more server capacity such as CPU and RAM to a server) scalable. Elastic scalability optimizes cost.

Open APIs. For wholesale or retail CBDC, well defined programmatic interfaces (APIs) must be available for third parties to develop added value services and applications. APIs must be well documented and should be accessible to any authorized party.

Security. Authentication and transaction authorization must be performed using public key cryptography to ensure **end-to-end security**.

Interoperability. The CBDC system must work seamlessly with existing systems such as RTGS, Real-Time Payment systems, other CBDC systems for cross-border payments and potentially other digital asset ledgers.

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OPEN APIs AND NEW BANKING APPLICATIONS AND SERVICES

Summary

Open APIs enable the development of new banking applications and services.

A CBDC can facilitate the development of common and open APIs, thereby facilitating interoperability and the development of new payment applications and services.

These new use cases may spur adoption of digital currency and encourage financial inclusion.

Open banking is the use of open APIs that enable third-party developers to build applications and services that access financial institutions. Key capabilities include access to account data and initiation of payments. These power various use cases including personal financial management (PFM) applications, electronic wallet load, bill pay, and P2P payments. Allowing third parties to build value added services enables the provision of new services or the expansion of existing services. In turn, these new or enhanced services may better meet the needs of new and existing customers. In developing markets, this results in more citizens accessing the banking system, thereby promoting financial inclusion. In India, the Unified Payment Interface (UPI) has been a great open banking success. UPI provides access to the instant real-time payment system in India developed by National Payments Corporation of India (NPCI) using an Application Programming Interface (API). In only three years, it has grown to process more low-value payments (over 1 billion payments per month) than any other system in India. Nearly 50% of all consumer payments in India are made with UPI.

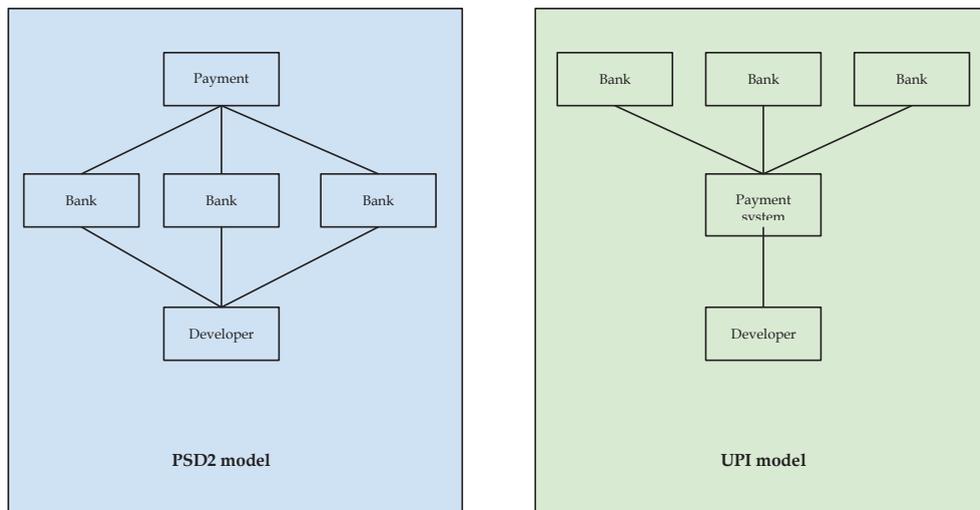
In Europe and several other countries following the same model, open banking has been mandated by law - the second Payment Services Directive (PSD2)⁴⁰ that affects all banks operating payment accounts in the European Economic Area.

The fundamental difference between a system such as UPI in India and PSD2 in Europe is whether programmatic access is given directly to the payment infrastructure, or to banks that then field the request as an intermediary.

⁴⁰ https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en

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Figure (10): Third party developer access model



source: M10 Networks, Inc.

As can be seen in Figure 10 in the PSD2 model the developer must access each bank individually. Each bank may use a different access method. In the UPI model, the developer accesses the payment system directly. Thus, only has one point of integration to perform. This is a significant advantage for developers and lowers the barriers to entry.

Providing open APIs to access a CBDC similar to the UPI model in Figure 10 would likely create a rich ecosystem of applications and services provided by third parties that will drive usage of the CBDC. This would ultimately benefit the customers of the CBDC and increase a nation's economic growth.

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CBDC - LEGAL REQUIREMENTS

Summary

Any central bank that decides to issue CBDCs needs to first tackle the legal challenges and hurdles it may encounter. Central banks around the world are still investigating CBDCs and the related legal challenges depend greatly on the final CBDC design, therefore it is impossible at this point to give a full view of all legal challenges.

It is essential to start by legally defining a CBDC in order to determine the applicable laws and regulations. At this point, the legal definition of CBDC is still work in progress and is currently a mosaic of the various concepts found in the main publications exploring CBDCs.

However, tackling the concept of legal tender when issuing CBDCs is inevitable. In order to legally qualify as a currency and to achieve wide acceptance, a CBDC should have legal tender status under the law.

It is also fundamental that central banks have in their statutory mandates the legal and exclusive authority to issue CBDCs and if not, necessary amendments and adjustments need to be brought to the relevant existing texts.

Furthermore, in order for a CBDC to be established and widely used, it should be assigned a cash-like finality and ensuing adjustments to existing texts, whether by legal amendments or contract, need to be introduced.

Finally, there is a list of additional obligations (and potential resulting liabilities) that would be imposed on central banks issuing CBDCs based on applicable legal framework. Applicable laws to the issuance of CBDCs and the parties involved would include both public law and civil law provisions.

Legally defining CBDC

It is important in this space, where taxonomy is tricky and terms are used interchangeably to define what a CBDC is. Furthermore, finding the right definition is a crucial first step to identifying the applicable set of laws and regulations and the specific needs for statutory adjustments if any.

If we flesh out Central Bank Digital Currency, we would have to look into the definition of its main component which is “currency”. Economists around the world have long agreed that currency is defined by the three functions it offers in an economy. A currency is a mean of exchange, a store of value and a unit of account. In the legal world, however, such a generally accepted definition still needs to be established. In the strict sense, currency refers to the banknotes and coins that are issued by a central authority that has the exclusive right to do so and currencies are given the status of legal tender under the state’s legal framework.⁴¹

⁴¹ International Monetary Fund, 2016, “Virtual currencies and beyond: Initial considerations”.

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Therefore, digital transfer mechanisms for currency, such as electronic money as defined in the European legal framework⁴², can be clearly distinguished from CBDC as electronic money represents claims on private electronic money issuers and not on the central bank.

A digital currency would then be the representation of currency in the form of digital data. If we turn to the definitions of CBDC used in the industry, we find that even economists are struggling to come up with a specific definition for CBDC and the mostly referred to is a definition by default: CBDC is “digital form of central bank money that is different from balances in traditional reserves or settlement accounts” as set by the Bank for International Settlements paper of 2018. This paper distinguishes CBDC from existing central bank digital money which would be the balances of wholesale accounts held at central bank of monetary policy counterparties as well as other counterparties (e.g. foreign central banks, treasury, public institutions, and financial markets infrastructures)⁴³. Another definition by default could be drawn from the Financial Action Task Force guidances where CBDC would be the digital representation of value that digitally fulfills all three economic functions of a currency by law, has legal tender status and is issued and guaranteed by a jurisdiction⁴⁴. In sum, a CBDC, as per the International Monetary Fund, would be a digital form of existing fiat money, issued by the central bank and intended as legal tender⁴⁵, more precisely it is “a digital representation of a sovereign currency issued by and as a liability of a jurisdiction’s central bank or other monetary authority”⁴⁶.

Providing for a clear definition in the law of CBDC would help determine important civil law processes such as those governing CBDC issuance, transfer, pledging, ownerships rights (e.g. is the transfer of token-backed CBDC is also transfer of token?) or those related to the applicable dispute resolution regime and proceedings (civil or administrative)⁴⁷.

Legal tender status

In order to legally qualify as a currency as discussed earlier, CBDC should be given the status of legal tender under the law. Moreover, if CBDC is provided with this cash-like attribute, such would help push for its faster acceptance and establishment in the market.

As per the European Commission 2010 Recommendation⁴⁸, the concept of legal tender should rely on three main elements (a) mandatory acceptance by the creditor of the payment made in

⁴² The European Parliament and Council of the European Union, 2009, European directive 2009/110/EC.

⁴³ Bank for International Settlements (CPMI), 2018, “Central Bank Digital Currencies”.

⁴⁴ Financial Action Task Force, 2015, “Guidance for risk-based approach to virtual currencies”.

⁴⁵ International Monetary Fund, 2018, “Casting light on central bank digital currency”.

⁴⁶ International Monetary Fund, 2020, “A Survey of Research on Retail Central Bank Digital Currency”.

⁴⁷ Swiss Federal Council, 2019, “Central bank digital currency, Swiss Federal Council report in response to the Postulate 18.3159, Wermuth, of 14.06.2018”.

⁴⁸ European Commission, 2010, “Report of the Euro Legal Tender Expert Group on the definition, scope and effects of legal tender of euro banknotes and coins”.

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legal tender unless the parties agreed otherwise, (b) acceptance by legal tender should be at full face value and (c) the legal tender having the power to discharge the debtor from payment obligation once it is transferred to the creditor. As per the recommendation, legal tender status should also be attributed by a law. This component distinguishes CBDC from electronic money as the latter is only accepted by agreement of the parties involved and not by power of the law.

If the law does not expressly give CBDC legal tender status, it might be argued that CBDC would be equivalent to commercial bank money or promissory notes (that technically do not have to be accepted by the force of law). Therefore, legal certainty can be better achieved by clearly specifying the legal tender status of CBDC (e.g. in Switzerland, the law expressly gives legal tender status, in addition to coins and banknotes, to Swiss franc denominated sight deposits at the Swiss National Bank).

Another issue to resolve is to decide on the extent of the mandatory effect of legal tender status. The concept of legal tender varies slightly among jurisdictions. Not all jurisdictions make it simply unlawful to refuse legal tender in payment. Some jurisdictions allow valid tender from the debtor end but sets no legal obligation on the creditor to accept it. Other jurisdictions have declaratory provisions that allow legal tender status to be contractually waived (e.g. by an agreement to settle a debt in a foreign currency or an agreement not to pay with physical currency).

Legal tender status is ultimately a political decision of the legislator. If CBDC are to be given legal tender status, (i) legislations limiting legal tender status to physical cash should be amended to include digital currency, (ii) the definition of legal tender concept should be technically neutral⁴⁹ in order to be future proof and (iii) there should be a decision on the extent of mandatory effect of the legal tender status to be adopted.

Central bank mandate to issue CBDC

It is necessary for central banks to review their statutory mandates to find out if they have the legal and exclusive authority to issue CBDC. Legal basis for CBDC issuance could be drawn from the objective of maintaining price stability on one hand and the functions and powers related to issuing currency and implementing monetary policy on the other hand. In particular, the function of issuing currency could be expanded to include issuing CBDC if the latter is viewed as just the digital representation of physical currency.

However, the legality general principle in administrative law dictates that there should always be a balance between the power given to the public entities (in this case the central banks) and the rights of citizens to avoid any situation of abuse of power. For that purpose, mandates of public entities should be narrowly interpreted and limited to the enumerated objectives, functions and powers in the legal framework or else decisions could run the risk of being considered ultra vires.

⁴⁹ “We think that the concept of legal tender should be technically neutral so that it fulfils a function even in a digital future”, Sveriges Riksbank, April 2019.

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Furthermore, a clear and express mandate to issue CBDC would achieve legal certainty. Finally, such mandates should be brought in line with and not be counter-productive to any other central bank objectives. For example, some have argued that issuing CBDC may result in banking instability as it would create a “run risk” in times of crises or could cause banking sector disintermediation.

In sum, ideally, texts should be amended, when necessary, to give central banks express and exclusive right to issue and regulate CBDC. It should also provide that CBDC will be a complement to the physical currency as central banks will probably continue to issue physical currency in the near future. Supervisory authorities’ mandates should also be amended to expand their functions and powers (e.g. In a token based design, supervisors will need to have the power to automatically monitor market ledgers to check for compliance and regulatory goals).

Transaction finality

It is important to introduce the necessary adjustment whether by legal amendments or contract to ensure CBDC transactions have a cash-like finality. Here clarity over the legal nature of CBDC that would help define the applicable civil law rules as discussed above enhances the trust and finality of CBDC transactions.

Furthermore, central banks should ensure that CBDC transactions enjoy the same legal finality protection as conventional payment system transactions in the event of insolvency. In particular, in some jurisdictions, this protection is only awarded to system participants, it is important to include the new participants with CBDC accounts (i.e. private individuals). Moreover, the validity and enforceability against third parties of netting and settlement of payments, the irrevocability of payment orders and the enforceability of collateral arrangement should be upheld. This also includes neutralizing any “zero hour” and amending the application of any *Periode Suspecte* rule. In case of a CBDC hybrid model, it has been recommended in order to protect CBDC holders from the intermediary’s creditors in case of insolvency to include in the legal framework that the claims of CBDC holders be segregated on the balance sheet of the intermediary.

Finally, if a jurisdiction chooses to adopt an open distributed ledger technology solution (i.e. solution that would allow anyone to read, transact on, and participate in the validation process) legal certainty in the transfer of value challenges should be tackled either by the law or by contract. In those solutions, as the ledger of transactions is managed by the different nodes and before a transaction is added to the ledger with finality, there is broadcasting and a wait of replies. This creates a risk of modification of ledger and “probabilistic finality” need to be mitigated. Furthermore, the timing of the discharge of obligations and liability in case of errors and unauthorized payments could be challenged especially in solutions where there is irreversibility of transactions.

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Legal liabilities resulting from applicable legal framework

For legal certainty purposes, it is important to identify the applicable laws that would govern CBDC issuance and the parties involved. Applicable laws would include both public law (e.g. central bank law) and civil law provisions (e.g. contract law and insolvency law). As mentioned earlier, finding the right definition for CBDC is a crucial step in that direction but there are other variables that would impact which texts would govern this space. Indeed, legal implications will also vary greatly depending on the CBDC design (e.g. account-based or token-based; technology used such as DLT...), whether the CBDC will be available to the general public, the degree of involvement of the central bank in the operation of the system and whether the CBDC is a direct or indirect claim on the central bank.

In the case the CBDC will be accessible to the general public and individuals, the later could be qualified as customers and would trigger the application of laws governing market participants and consumer protection (e.g. central bank could qualify as supplier of CBDC related payment services to the general public and might be subject to the framework governing the relationship between payment services providers and their customers (e.g. information requirements and risk management, security)). Issuing CBDC may make the central bank subject to data privacy and protection laws in connection with the administration of the CBDC. The central bank might have to ensure it abides by the different protections depending on the data market.

CBDC issuance would trigger the application AML/CFT provisions (the extent of requirements would mostly depend on whether it is token-based/account-based design and on the degree of anonymity). Central banks would need to introduce AML/CFT procedures and to examine their activities. This will probably be the case even if a central bank is not expressly covered by AML/CFT framework in order to mitigate any reputational risk of being involved with money laundering or financing terrorism activities. In particular, two important issues need to be tackled; First who has the ultimate responsibility for ensuring compliance (and whether the law allows outsourcing of this responsibility) and second who will carry out the screening and monitoring of customers.

In particular, the issuance of CBDC involves several operational steps (operation and technical choices, customer relationship (interface, messaging, record...), regulatory compliance, data management (storage and update) and customer screening and monitoring (AML/CFT)). Failure to satisfy any of these functions could not only undermine the central bank reputation but also result in liability claims (e.g. in case of outages, cyber attacks, data protection or privacy shortcomings). Currently most of the central banks running CBDC pilots all have a public/private partnership component in the supply chain of CBDC. In any case, there should be, in the law or by contract when possible, a clear and express distribution of roles and responsibilities as well as related costs and liabilities in connection with the CBDC issuance when any step of the chain is commissioned to third parties.

Another design choice that has significant legal implications is whether to allow direct claim on the central bank or an indirect claim via intermediaries. Here some have argued, based on

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the CBDC definition discussed above where a CBDC must be a claim against the central bank, that synthetic CBDC architecture cannot be qualified as CBDC as there is no direct central bank liability but rather it is a method of payment (such as electronic money). The hybrid CBDC model also raises questions around this choice and whether the central bank is obligated to honor claims of holders although the central bank has no record of the owners and it is not sure if the later are entitled to any claims as they are not allowed to hold CBDC to start with⁵⁰.

Right of public to open an account at the central bank

An additional legal challenge arises, for CBDC account-based access, in the jurisdictions where only banks and other regulated entities or monetary policy counterparties can hold electronic money from and take up electronic debt to the central bank or even open accounts at the central bank. In order to expand account access and authorize the central bank to open accounts in its books for the general public in order to hold CBDC the law in those jurisdictions should be amended. This decision is mainly a political decision as it relates to the policy of whether to allow the general public to have direct claims against the central bank or not.

⁵⁰ Bank for International Settlements, 2020, "The technology of retail central bank digital currency".

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CBDCs FOR DOMESTIC PAYMENT SYSTEMS

Summary

Though CBDC experiments for domestic payments were successful, the legacy National Payment Systems still remain efficient and reliable for money transfer in a timely manner and with low amounts of errors.

CBDC can be used to modernize older RTGS systems or as an RTGS substitute in countries or regions where there is no RTGS.

CBDC can also modernize retail payment systems. Where a country already has a modern retail payment system, care should be taken that the CBDC works synergistically with the existing system. For example, if mobile wallets are popular in a county, the CBDC could be designed as a new currency in the existing mobile wallet.

To start with, we will first explain in the following lines the existing payment systems infrastructure.

The Payment Systems are of two kinds, Settlement System (Real Time Gross Settlement - RTGS) and Retail Payment Systems (RPS). The RTGS system requires direct participants (banks or non-banks) to hold a pre-funded account in the system “Settlement Account”, in order to make payments from one participant to the other, and to settle payment files generated by RPSs in a process called Settlement Process. The Retail Payment Systems support exchanging different types of retail payments (like salary payments, cheques payments, mobile payments, etc). The systems operates by switching payment messages between the respective systems’ participants, calculating net position of each systems’ participants (Debit position or Credit position) at a pre-defined point of time in a business day and finally push the Net Clearing Position file to RTGS, in order for the real money transfer between the settlement accounts to take place.

Both systems replace the bilateral arrangements that each participant should have with all other parties (spaghetti model), to one connection between each system participant and the payment system (centralized model). However, this arrangement exposes the settlement system, being a systematic important payment system, to certain risks. The CPMI-IOSCO has identified these risks and suggested 24 principles (in an international guidelines called Principles for Financial Market Infrastructure - PFMI) to manage and minimize these risks, such legal risks, credit risk, liquidity risk, etc.

As discussed in this report, once central banks find its motivations to issue CBDC, the latter should choose the right CBDC type that suits its objectives. However, like any other technology, there are some risks that need to be minimized by following the relevant international standards, in our case it is PFMI. Project Jasper is one example of a CBDC that was assessed in accordance with the PFMI. A partial assessment was done and it was sought

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that only 7 principles are related to the scope of experiment, and other 11 principles will be related at production phase⁵¹.

In this context, we draw the reader's attention to two CBDC experiments that have tested the CBDC to be used for domestic payment systems. Firstly, Project Jasper⁵² (Canadian Experiment): the experiment was to replicate a RTGS system using DLT platforms, and the PFMI was used as a guide to design and assess the platform. The report concluded that DLT could perform the functionalities that RTGS is providing. However, DLT still requires further developments before being fully used in the financial industry. Secondly, Project UBIN⁵³ (Singaporean experiment): The report shares the same outcome with the above mentioned experiment, that DLT over different platform providers can perform the same RTGS functions. One more interesting outcome, though the DLT establishes a decentralized payment system, the role of central banks and regulatory authorities remains, including managing the cloud environment, governance aspects and putting the rules & regulations in place.

Though the above experiments have shown that DLT may be developed and used for domestic payments, the legacy national payment systems still remain efficient and reliable for money transfer in a timely manner and with low amounts of errors. The benefits & efficiencies seen in CBDC related experiments, are already realized in some countries by depending on the technological developments on the existing payment related infrastructure.⁵⁴

CBDC and the impact on domestic payments in digital /tokenized world

CBDC is not required for digital money. Most countries today have various forms of digital money, years before they have adopted CBDC. The extent of digital money varies from country to country.

Digital payments require a number of elements: Digital identities authenticated for buyers and sellers (or senders and recipients). Access to accounts or payment instruments. Tokenized identity and/or payment instruments for better security.⁵⁵ Ability to verify the parties' intentions securely and without significant delay. In some countries, these requirements are already in place and digital payment service providers can leverage the infrastructure to offer new payment services. In other countries, some of these elements are missing or not generally available and digital payments are therefore less common.

⁵¹ Payments.ca. (2017). Project Jasper: A Canadian Experiment With Distributed Ledger Technology For Domestic Interbank Payments Settlement. https://www.payments.ca/sites/default/files/29-Sep-17/jasper_report_eng.pdf

⁵² Payments.ca. (2017). Project Jasper: A Canadian Experiment With Distributed Ledger Technology For Domestic Interbank Payments Settlement. https://www.payments.ca/sites/default/files/29-Sep-17/jasper_report_eng.pdf

⁵³ Deloitte, Monetary Authority of Singapore (2020). The Future Is Here. Project Ubin: SGD On Distributed Ledger: MAS. <https://www.mas.gov.sg/-/media/MAS/ProjectUbin/Project-Ubin--SGD-on-Distributed-Ledger.pdf>

⁵⁴ Natarjan, Harish (2020). 'CBDC in the rapidly evolving payment system landscape' [PowerPoint presentation].

⁵⁵ In the case of Paytm or AliPay, the wallet is tokenized and the payment instrument is held on file with the service provider. In the case of ApplePay or GooglePay, the payment instrument is tokenized and delivered into the transaction.

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Where common infrastructure can be shared and used by multiple service providers, development and deployment is easier and innovation can happen more quickly. For example, where there are agreed conventions for authenticating wallet holders or aliasing recipients or accessing bank accounts.

While CBDC is not required for digital money, it can provide a framework for these shared conventions and thereby accelerate the deployment of novel payment services. Particularly in a sCBDC implementation with open APIs to allow banks, e-wallet providers and payment service providers to connect to the digital banking infrastructure. Additionally, key services like KYC or AML/CFT or key management HSM can be offered by third parties to payment service providers using standard protocols from the sCBDC provider for communication and data sharing. Many of these payment service providers may themselves offer services on a white label basis - so a hotel booking app or online gaming app or ride sharing can incorporate payments into their apps quickly and inexpensively.

Approaches to technical, commercial and regulatory validation

We believe that an incremental or phased approach to implementing a CBDC is generally advisable. We start with the core wholesale CBDC to create an M0 ledger run by the central bank or its agent, and onboarding a handful of commercial banks. This allows for the real-time settlement of payments between the banks. Initial testing is functional in nature and allows the central bank, the commercial banks and the platform operator to test the system for fidelity, reliability and performance. The second half of phase 1 involves adding the second tier of M1 accounts. This allows commercial banks to practice onboarding customers and test sending money from one customer account to another.

Phase two involves scaling and use case testing. The number of transactions and number of users increases. Specific key use cases are implemented and tested. This may include cross-border transactions which may require the use of an FX service. Phase one and two also allows for user testing and focus groups - is the system usable? What are the common user errors and how can they be eliminated?

Finally, in phase three, the full production system is launched, and actual commercial transactions commence. This will provide the first real commercial data on user adoption and usage and provide data on the efficacy of the CBDC vis-a-vis traditional payments.

From a regulatory framework, we distinguish between *internal* and *external requirements*. Internal regulatory deals with the responsibilities of each party on the CBDC platform and the rules governing their interactions. This must be determined before the commencement of phase 1. We would suggest this not be contractual, since new parties to the scheme have to be added. Rather, internal rules should be like organizational bylaws. Each party joining the organization agrees to abide by the rules. And the rules can be changed as the program grows and more is learned. Changes apply to members old and new. The rules should also have enforcement mechanisms and provide an adjudication process for dispute resolution and a governing body composed of members.

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External regulatory deals with the CBDC vis-a-vis the larger financial and monetary infrastructure of the country as described above in CBDC - Legal Requirements. This can include statutory authority for issuance account opening. It may create power to regulate or oversee the CBDC. And it may include statutory authorization for the central bank with respect to the CBDC. This can be deferred in phases one and two because the transactions are only test transactions and do not involve the exchange of real value. However, external regulations must be decided before phase three.

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CBDCS FOR CROSS-BORDER PAYMENT SYSTEMS

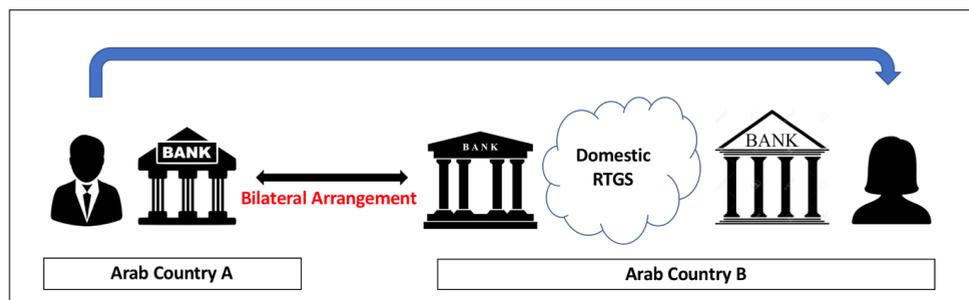
Summary

Using CBDC for cross border payments is a valid use case to eliminate existing arrangements inefficiencies. However, the associated challenges need to be addressed and solved uniformly, in order to have an efficient CBDC based cross border payment system.

With the lack of dependence on a centralized regional Settlement System within the Arab Region, correspondent banking has been the traditional model used to transfer money between countries.

The following diagram is an illustrative scenario that shows a high level process of cross border money transfer.

Figure (11): Transaction Process for Cross Border Money Transfer



source: Al Lawati (2020).

Ahmed (A father) who lives in country A, wants to transfer money to Maryam (A daughter) who is a university student studying at country B. To initiate the transfer, Ahmed travels to his bank (Payer bank) requesting it to initiate a cross border payment to Maryam's bank (Beneficiary Bank) for an amount of 1000.00. Unfortunately, the payer bank (at country A) has no relation with beneficiary bank (at country B), but the former has a relationship with a third bank (at country B). So the transaction process flow will be: the payer bank will transfer money to the third bank via the bilateral agreement, and the latter will transfer the money to the beneficiary bank via the domestic RTGS.

As a customer right, Ahmed enquired about the transaction fees for transferring the amount 1000.00, and the time it takes for the money to reach his daughter. However, his bank could not provide a precise answer, as the bank has no control on what happens in country B. These challenges are more apparent for corporate payments than low value remittances, but the

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principle problem is the same. It is worth to mention that the above example may be contracted or extended depending on the parties involved in the process.

In an analysis done by the Project UBIN team⁵⁶, it was realized that there are three main stakeholders in the scheme of cross border payment value chain, end-users, commercial banks and central banks.

End users face different challenges with current arrangement, like the speed transaction, cost of transaction, difficulties in tracing the transactions and probable lack of innovations. commercial banks difficulties lie in establishing bilateral arrangements with other banks and managing it, handling regulatory requirements (eg: conducting proper AML/CFT requirements) and working on having common payment messages standards to ensure proper interoperability. From the central banks perspective, must ensure proper governance of the industry including setting proper business hours to allow communication with different countries, and to ensure proper abidance of PFMI guidelines.

The issuance of global CBDC will allow for a better cross border transaction flow, without the need for the correspondent banking arrangement⁵⁷. The above challenges can be smoothly addressed by using CBDC for cross border payments. The DLT will provide the facility to ensure all stakeholders requirements are met like, proper tractability of transaction, transparency of transaction cost, standardized payment messages, and in general the flexibility to program the CBDC in a way that meets any requirements.

Regulators will need to implement proper policies and regulations to control the associated risks with accepting using CBDCs for cross border payments. For example, an international CBDC available in certain countries, may cause people to substitute the usage of their domestic currency with the international currency which may have an effect on its monetary policy⁵⁸.

At the same time, many challenges related to cross-border payments may arise such as heterogeneity of domestic systems, which can be encountered by setting a common set of standards and interfaces which will facilitate an easy integration. This is in addition to the sovereignty, oversight and governance due to the lack of common payment standards and regulatory requirements across jurisdictions. Then, CBDC reference architecture will need to address the divergent privacy regimes across jurisdictions. Also, there are dissimilarities in

⁵⁶ Bank of Canada, Bank of England, Monetary Authority of Singapore (2018). Cross-Border Interbank Payments and Settlements: Emerging opportunities for digital transformation : MAS. <https://www.mas.gov.sg/-/media/MAS/ProjectUbin/Cross-Border-Interbank-Payments-and-Settlements.pdf?la=en&hash=5472F1876CFA9439591F06CE3C7E522F01F47EB6>

⁵⁷ Natarjan, Harish (2020). 'CBDC in the rapidly evolving payment system landscape' [PowerPoint presentation].

⁵⁸ Bank for International Settlements (2018). Central Bank Digital Currencies, : BIS. <https://www.bis.org/cpmi/publ/d174.pdf>

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CBDC design across jurisdictions which should be accommodated by the reference architecture while maintaining smooth interoperability, which is crucial for cross-border payments⁵⁹.

Moreover, combining technical requirements with different regulatory standards across jurisdictions further complicates the access to settlement accounts in different countries simultaneously. In addition, the CBDC reference architecture will need to define mechanisms to balance privacy, transparency, and compliance in a flexible manner across the requirements of different jurisdictions.

⁵⁹ International Telecommunication Union (2019). "Reference Architecture and Use Cases Report", July 2019, ITU-T Focus Group Digital Currency including Digital Fiat Currency. https://www.itu.int/en/ITU-T/focusgroups/dfc/Documents/DFC-O-014_RA%20Deliverable_Reference%20Architecture%20and%20Use%20Cases%20Report.pdf

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CBDCs FOR SECURITIES SETTLEMENT SYSTEM (SSS)

Summary

In DvP model, it is crucial to eliminate “principal risk” by ensuring the completeness of the two transaction legs, delivery leg and payment leg. Trading securities on DLT, by either having a single ledger for securities and payments or linking two different ledgers, have added value and minimizes risks.

Securities are financial assets issued for different purposes, including raising funds from investors. Securities related deals/transactions settle in two legs, securities leg and payment leg (DvP). Securities leg is exchanged through the SSS, and recorded with the Central Securities Depository, where all accounts & ownerships are kept. On the other hand, the payment part settles in another system (typically RTGS) operated by another institution. The settlement of securities take place usually in T+3 time interval, in which payments should be made first then Securities ownership transfers later. In this scheme of transaction, a risk known as “Principals risk” might occur if one leg happens but the other leg didn’t complete, due to the failure of the initial security holder, hence the security holder will end having both the security and the money. Therefore, ensuring completeness of the two legs through proper arrangement is necessary.

A suggested innovation has been tested through different projects in several countries using DLT, in which tokenization of securities and currency is required. As this type of transaction includes two types of financial assets (securities & money), some projects tested the possibility and feasibility of having one DL for securities and currency (i.e. CBDC), other projects tested an integration of two separate DLs together. In either cases, there are several benefits realized from tokenizing securities and currency for securities settlement. Firstly, with the implementation of a smart contract (digital contract) in this arrangement, policies and procedures can be automated and no need for back office checks and supervision. Secondly, the risks might be minimized, like principal risk as the transaction can be programmed in way that one leg will only be completed if the second leg is completed as well⁶⁰. On the other hand, there are risks realized in any development, so implementing a new platform might bring some legal risks, especially in the short term, due to the uncertainty associated with this arrangement.

To present an example here of one project that tested DvP model, without having a centralized management system. Project Stella was tested for single ledger model & cross-ledger models, has successfully been implemented and proven that technically & conceptually this can be done. However, the legal aspect of this arrangement was not part of the project scope⁶¹. The project

⁶⁰ Bech, M., Hancock, J., Rice, T. and Wadsworth, A., (2020). BIS Quarterly Review, March 2020: On The Future Of Securities Settlement. [online] Bis.org. Available at: https://www.bis.org/publ/qrtpdf/r_qt2003i.pdf

⁶¹ European Central Bank and Bank of Japan (2018). Securities Settlement Systems: Delivery-Versus-Payment In A Distributed Ledger Environment: Project Stella, ECB. https://www.ecb.europa.eu/pub/pdf/other/stella_project_report_march_2018.pdf

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concluded with some findings, including that this arrangement may be applied in different designs (i.e. through single ledger or cross ledgers), however full synchronization is required to avoid any risk, like principal risk.

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CBDC GLOBAL INITIATIVES

Summary

There are many CBDC pilots which have recently been conducted or are in planning.

Most of these are really only proof of concept or functional tests. None have gone into full scale production yet.

China's eCNY is perhaps the most significant project underway and a number of design decisions made by the People's Bank of China bear noting by Arab region central banks.

Initiatives across the globes are growing as the number of central banks have set up dedicated wings to research distributed ledger-based and digital currency technology — also known as Central Bank Digital Currencies or CBDCs.

A recent survey from the BIS with 66 central banks globally identified that a large number of central banks are currently actively developing CBDC's with 1/3rd clearly stating that issuing a CBDC is near-term or medium-term possibility.⁶²

As per the study we identified 30 central banks across the world that are currently actively, researching or published their researches, engaged in third party consultation, preparing for a pilot, in between a pilot or have successfully completed a pilot and studying the impact of the new payment technologies and its applications. In the present central banks based on their motivations, design type and existing infrastructures are carefully weighing the implications for financial stability and monetary policy of issuing digital currencies.

To categorize some of the design choices from the global initiatives - many central banks are still considering multiple options. As per our discussion with central banks some of them started with cross border but are now focused towards financial inclusion.

In specific to the focus on cross-border interlinkages, till date there are no CBDC projects with specific focus on payments outside the central bank's jurisdiction. Numerous central banks are currently acting on cross-border payment tests with a consumer focus parallel to the CBDC efforts. Whereas, wholesale efforts such as Project Jasper (Bank of Canada), Project Stella (ECB and Bank of Japan), Project Ubin (Monetary Authority of Singapore) and Project Lion Rock-Inthanon (Hong Kong Monetary Authority and Bank of Thailand) shall most likely support in more effective retail transactions through the banking system.

⁶² Boar, C., Holden, H. and Wadsworth, A., (2020). Impending Arrival - A Sequel To The Survey On Central Bank Digital Currency. [online] Bis.org. <https://www.bis.org/publ/bppdf/bispap107.pdf>.

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The below table summarizes some of the CBDC Initiatives around the world⁶³:

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Country	Central Banks	Type	Name	Status	Motivation
Bahamas	Central Bank of The Bahamas	General purpose	Project Sand Dollar	Launched	Provide a seamless digital payment infra.
Brazil	Central Bank of Brazil	Synthetic		Pilot Completed	April of 2020, BCB conducted the first transaction settlement test on PIX. Banco do Brasil, Caixa Econômica Federal, BPP, Sicredi, and Bancoob all participated in the test. The platform is currently undergoing final testing with key financial stakeholders
Cambodia	The National Bank of Cambodia (NBC)	Retail	Project Bakong	Pilot Completed	Support Cambodian riels and USD and offer 24/7, 365 transfer capabilities, with eventual support for cross-border payments using the Bakong CBDC.
Canada	Bank of Canada	Synthetic	Project Jasper	POC	Response to Libra and International Settlement
Caribbean	Eastern Caribbean Central Bank	General purpose	EC dollar	Launched	Financial inclusion. Provide competitive payments systems.
China	People's Bank of China	Synthetic	Digital Yuan	Live	Respond to Libra. Challenge EUR and USD as global currencies
Ecuador	Banco Central Del Ecuador	General Purpose		Pilot Completed	Means of payment available to all Ecuadorians. Continued from 2014-16 and discontinued now.
Egypt	Central Bank of Egypt			Evaluation	Help in keeping issuance and transaction costs to a minimum compared to banknotes.
European ⁶⁵ Union	European Central Bank (ECB)	Wholesale	EUROchain	POC	Improve cross-border payments. Protect against Libra, etc
France	Banque de France	Wholesale & general purpose		Successful POC in 2020	Successful POC conducted. With motivations of modeling CBDC- based interbank settlement, Settlement of financial assets. More tests being conducted with the digital Euro
Ghana	Central Bank of Ghana			June 2020 that they are actively	Financial inclusion in the country given the large percentage of the population that is unbanked

⁶³ MENA Fintech Association, June 2020. c

⁶⁴ Ravi Rathi, CBDC Tracker”<https://gomedici.com/updated-cbdc-visual-tracker-central-bank-digital-currencies-globally>.

⁶⁵ Auer R., Böhme R. (2020), “The technology of retail central bank currency”, BIS Quarterly Review, March, 85-100, https://www.bis.org/publ/qrpdf/r_qt2003j.pdf.

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				exploring a CBDC solution	
Hong Kong	Hong Kong Monetary Authority (HKMA)	Wholesale	Project Inthanon-LionRock	Prototype	Improve cross-border payments. In collaboration with Thai.
India	National Institute for Smart Government (NISG)	Synthetic	CBDR (Rupee)	Draft proposal	Address unbanked.
Iceland	CENTRAL BANK OF ICELAND	General Purpose	Rafkróna?	Pilot	Research; aims to address “steadily diminishing use of banknotes and coin”; “many issues have yet to be clarified, and they must be dealt with appropriately before a position can be taken”.
Japan	Liberal Democratic Party of Japan.	General purpose		Draft proposal	Counter Chinese CBDC
Mauritius	The Central Bank of Mauritius (BoM)	Retail & Wholesale			No other details disclosed apart from the types of CBDC's being pursued
Norway	Norway Central Bank	General Purpose		Draft Proposal	It is anticipated that the NB working group will complete its third research phase in 2020. With focus on independent backup solutions, credit-risk free alternatives to bank deposits, competition and legal tender.
Pakistan	State Bank of Pakistan (Central Bank)	General Purpose	Digital Rupee	Evaluation	Driven by the Payments System Department: Financial inclusion / address unbanked and improve cross border payments
Saudi Arabia	Saudi Arabian Monetary Authority (SAMA)	Wholesale	Aber	POC	Improve cross-border payments. In collaboration UAE
Senegal	Sénégal The Banque Centrale des États de l’Afrique de l’Oues (BCEAO)		eCFA	Pilot Live	To promote financial inclusion, greater transparency with controls for the currency, and the digitization of the financial system in West Africa.
Singapore	Monetary Authority of Singapore (MAS)	Wholesale	Project Ubin	Prototype	Settlement of financial assets.
South Africa	The South Africa Reserve Bank (SARB)	Retail		Pilot Completed	The currency will enable instant person-to-person transfer of value without clearing and settlement,
Sweden	Sveriges Riksbank	General purpose	e-krona	Pilot	Address CB’s mandate in cashless society
Switzerland			E-Franc		Examine the opportunities and risks of introducing crypto franc (e-franc) CDBC goals are

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Thailand	Bank of Thailand (BoT)	Wholesale	Project Inthanon-LionRock	Prototype	Improve cross-border payments. In collaboration with Hong Kong.
Tunisia	Banque Centrale de Tunisie	General purpose	e-dinar	POC	Internal tests to further evaluate the technology and benefits of a CBDC
Turkey	Central Bank of the Republic of Turkey	General purpose	Digital lira	Pilot (2020)	Government wants to develop a platform for instant payments
Ukraine	Central Bank of Ukraine & The National Bank of Ukraine (NBU)	General Purpose	e-hryvnia	Pilot Completed	Payment market and redistribute the existing roles of market participants.
United Arab Emirates	CBUAE	Wholesale	Aber	POC	Improve cross-border payments. In collaboration KSA
Uruguay	Banco Central del Uruguay	General purpose	e-peso	Post-pilot evaluation	E-payment alternative to cash/cheques

With many countries currently assessing the impact of CBDC's in their jurisdictions we have observed that the motivations differ from country to country.

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What can we learn from China?

According to Gartner⁶⁶, “Financial institutions in China are likely to be first to face a new central bank digital currency. The Chinese market is bracing itself for announcements concerning the final version of its CBDC, the Digital Currency and Electronic Payments (DC/EP) system, with ongoing pilots in Shenzhen, Suzhou, Chengdu and Xiong’an. One key objective is to improve visibility and control over citizen and commercial transactions by the People’s Bank of China. The DC/EP is expected to rely on a two-tier hybrid CBDC system, where the central bank issues the digital currency, which is distributed by accredited financial institutions.”

Central Bank Digital Currencies Do Not Always Use Blockchain

Commentators often conclude that central banks will use blockchain to support their digital currencies because of the need for resiliency. But the digital currency electronic payment (DCEP) system planned by the Peoples’ Bank of China (PBoC) will have nothing to do with blockchain technology.

According to Gartner, “China has promoted the DCEP as supporting financial inclusion. It forms part of China’s effort to rebalance domestic growth, which is skewed toward the large cities in China’s east and south. To achieve that objective, Gartner expects the DCEP to be a tokenization of the M0 money supply — a fiat token.”

Chinese regulators have worked on centralizing payment flows in the last few years, notably between third-party payment providers and commercial banks, with the creation of the NetsUnion Clearing Corp. Control is also a driving design principle behind DCEP. The DCEP would improve visibility and control over monetary flows and citizen and commercial transactions — especially important for maintaining control over China’s exchange rates, as well as autonomy of its monetary policy.

Digital Yuan is significant because it is not just for using within China but also for cross border interbank payments. There is a suggestion for issuing digital Yuan to banks in the Greater Bay Area (GBA, including Hong Kong, Macao and nine other Mainland cities in the Pearl River Delta Area). For Mainland banks in GBA, PBoC may just do the same as for other banks in Mainland, debiting the GBA Mainland Bank’s settlement account with PBoC in return for giving them digital Yuan. For banks in Hong Kong and Macao, they can pay HKD or USD to PBoC for buying digital Yuan from PBoC⁶⁷.

⁶⁶ Gartner (2020). How Banks should Prepare for Central Bank Digital Currencies: Early Lessons from China”, Christophe Uzureau, David Furlonger, 26 May 2020.

⁶⁷ Esmond Lee (2020). Elaboration made in the discussion panel at the Arab Regional Fintech WG webinar on Tokenization and new Alternative Finance - June 2020

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This suggestion has got the following advantages:

- By issuing digital Renminbi to banks in Hong Kong and Macao, the offshore RMB pool in Hong Kong and Macao will be further enlarged.
- GBA can be used as a pilot ground for cross border interbank payments when the digital Renminbi is used as a means of payments between banks in the GBA.
- As banks in Hong Kong and Macao need to use HKD or USD to buy digital Renminbi from PBoC, China's foreign exchange reserves will be increased as a result.

Digital Renminbi and Hong Kong⁶⁸

Digital Renminbi created by the People's Bank of China (the "PBoC") can be issued to banks and third party payment service providers and can serve as a means of payments for interbank as well as inter-system transactions (i.e. between a bank and a third party payment service provider or between two third party payment services providers). Potentially it can also be made available to individuals through personal digital wallets. While digital Renminbi is definitely a means of payment and can be used to discharge obligations through the interbank or inter-system channels, digital Renminbi can also be regarded as a central bank monetary system, according to the European Banking Institute (EBI) Working Paper Series 2020 – no.65.

To the extent that digital Renminbi is a central bank monetary system, digital Renminbi should be assessed in the context of high-power money M0 which usually comprises only conventional paper currency. Digital Renminbi is fungible with paper Renminbi, though there is one important difference. Digital Renminbi is on-line and its circulation channel is transparent to the PBoC – the central bank of issuance. Paper Renminbi is off-line and its circulation channel is at best only a guesstimate. Due to the information on the logistics and circulation channel, the usefulness of digital currency as a monetary tool has a lot more to explore while paper currency as a monetary tool is almost useless in a modern economy.

Would the PBoC be interested in extending the digital Renminbi beyond the onshore Mainland for cross border payments vis-à-vis Hong Kong? We do not have the answer, though technically this should be possible if the PBoC allowed banks in Hong Kong to receive the digital Renminbi and to make use of the digital Renminbi for discharging payment obligations between two market participants in Hong Kong as well as for cross border transactions between two market participants, one in the onshore Mainland and the other in Hong Kong. Presumably an alternative channel (other than SWIFT) developed by the PBoC would be used for transmitting and recording these cross border interbank payments by digital Renminbi. It might be possible that PBoC could use Hong Kong and the Greater Bay Area as a pilot ground for such cross-border payments using digital Renminbi.

Besides a payment system, digital Renminbi could also be a monetary system. If banks in Hong Kong were allowed to use HKD to buy digital Renminbi from PBoC, such a monetary system could be extended beyond the onshore Mainland. Interestingly such digital Renminbi issued to banks in

⁶⁸ / Esmond Lee, 2020. Speech at Hong Kong Treasury Market Association, July 28th, 2020.

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Hong Kong would further substantiate the pool of offshore Renminbi in Hong Kong.

All the above are possibilities which may attract people's imagination and arouse people's interest to think more on this digital Renminbi and the potential opportunities embodied in this new form of an existing currency.

N.B: Greater Bay Area includes Hong Kong, Macao and nine Mainland cities in the Pearl River Delta Region.

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DEVELOPMENT IN THE ARAB REGION

Summary

There have been a number of digital currency initiatives in the Arab region.

Of note is the CBDC of the Central Bank of Tunisia. Since 2018, the CBT has been examining the opportunity to issue a digital dinar by exploring the technical feasibility and the potential impact of such innovation on the accomplishment of its statutory missions.

Digital ledgers may link RTP systems in Saudi Arabia and the UAE.

BUNA is a regional RTGS currently being designed.

Any central bank considering a CBDC will want to consider how the CBDC connects to and leverages these other systems.

Central Bank of Tunisia Digital Dinar

The concept of Digital Currency issued by Central Banks is a common topic of discussion among specialists, central bankers and academics. In 2018, the Central Bank of Tunisia (CBT) started studying the opportunity and experiment feasibility of issuing a digital currency as a new and relatively unexplored project.

Thus, within the framework of the Central Bank of Tunisia's "decashing" strategy, a working group was set up to analyze the opportunity for the CBT to issue the Tunisian Dinar in a digital form. The objective of this initiative was to carry out a study, demonstrate the experimental feasibility and evaluate the potential impact of such innovation.

This task has been led by the CBT involving the entire financial ecosystem stakeholders. The sub-Committee was composed of experts from the Central Bank, Tunisian Fintech mastering the Blockchain technology, academics and experts from Fintech, with the presence of representatives of the Tunisian professional association of banks, financial institutions, banks, telecom operators and professionals from the private sector.

The said working group discussed the advantages, opportunities, challenges and possibilities of innovations or disruptions that may emerge following the issuance of a digital version of the Tunisian Dinar and which would be based on Distributed Ledger Technologies or Blockchain.

The project consists in the introduction by the Central Bank of a digital form of Central Bank money, which would be issued to the general public to be held and used to pay for products and services, similar to payments settled in cash through a digital wallet mainly on mobile phones.

The CBT has made progress regarding the study of the digitization of the national currency following the recommendations of the "Digital Dinar" committee. However, the issue of regulation needs to be further explored.

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Deciding whether or not the Central Bank should offer a digital alternative to cash is particularly crucial in cash-rich countries such as Tunisia. This project is still under examination by the CBT teams.

Other countries in the region have also been assessing the opportunity of setting up projects related to Digital Transactions using new technologies. The most relevant projects mainly focus on cross-border payments based on DLT technologies.

Those initiatives may serve as a stepping stone to larger CBDC projects as they provide an opportunity to set the foundations for Central Banks to understand how a Digital Currency can work in the real world, and also prepare the market readiness along all the stack: Central Bank, Financial Institutions, End Users. They will allow them also to master the use of new technologies and ensure the availability and readiness of the infrastructure.

Aber Project

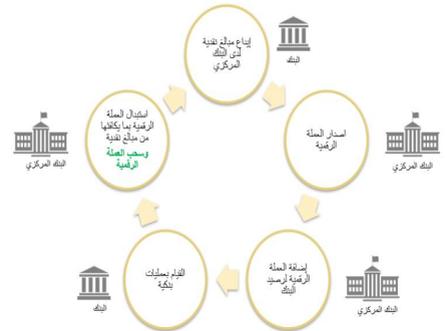
Project Aber was an initiative launched by the central banks of Saudi Arabia (SAMA) and United Arab Emirates (CBUAE) to explore the viability of a single dual-issued digital currency as an instrument of domestic and cross-border settlement between the two countries through a proof of concept (POC) project.

The below figure illustrates the life cycle of ABER CBDC, which is a typical lifecycle of a digital currency as described below:

1. commercial bank will pledge cash collateral in an account held by central bank;
2. central bank converts cash collateral to generate new digital currency;
3. central bank funds the newly created currency in the commercial bank's account on the ledger;
4. The commercial bank transfers the new currency to an account belonging to the Counterparty on the ledger;
5. The Counterparty redeems the currency for cash collateral via the central bank in its jurisdiction;
6. The central bank destroys the created currency for this transaction.

While all digital currencies go through this cycle, step 4 can be repeated as many times as needed when the digital currency is exchanged between participants. Finally, the issued currency is destroyed as part of a redemption request in which it is converted, by the central bank, back to cash and deposited back with the commercial bank.

Figure (11): ABER Project Components



Source: Central Bank of UAE

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BUNA - The Regional Payment Platform

Another Development within the Arab Region is Buna, the region's first cross-border payment platform, which was initiated by the Arab Monetary Fund and the Council of Central Bank Governors in 2014 and launched the implementation program in 2018.

Buna as an efficient financial market infrastructure, also aligns well with the Central Banks' agenda to account for the rise of digital and virtual currencies. Yet, Buna does acknowledge and appreciate the emergence of accessible technologies that are shaping the future of financial services; not only that, Buna's motivation is to contribute and to be prominent.

It is envisioned as a simple, low-cost and risk-controlled payment system that would bolster Arab economic development and expand trade and investment activities by streamlining the clearing and settlement of cross-border payments in real-time, thus expanding access and integrating digital financial services in the Arab World.

Participants can exchange payment transactions with each other in real-time, and once settled by Buna, these payments are final and irrevocable in a click of a button. To maximize the platform's benefits for all participants alike, Buna aims to support all eligible Arab currencies as well as key foreign currencies in the system. Most recently, Buna has announced the inclusion of six currencies, the United Arab Emirates Dirham, the Saudi Riyal, the Jordanian Dinar, the Egyptian Pound, the U.S. Dollar and the Euro, and is currently cooperating with central banks to gradually include their respective currencies in the platform. With the U.S. dollar and Euro on board, Buna will facilitate the expansion of participants' reach towards a wider geographical span and into dynamic markets, thus enhancing trade and enabling business opportunities.

Buna's centralized model with exceptional features catalyzes a great responsibility to protect the safety of the platform and its ecosystem of participants. Consequently, the platform adopts a pre-funded model which eliminates credit risk and requires participants to maintain sufficient liquidity in their accounts.

Buna offers attractive fees to all cross-border transactions settled through the platform. By the same token, Buna adopts a simple and flexible "Pay As You Go" plan with additional incentives available to early adopters which helps further reduce ongoing costs on participants while lowering barriers to entry.

Buna enables participants to submit payments around the clock, 7 days a week in any supported currency of their choice. Respecting the schedule of the domestic RTGS operating hours of the currencies it supports, the platform provides a substantial 14x6 operational window for settlement of submitted payments.

As Buna is founded based on enabling economic recovery in the face of uncertainty for the Arab region. Buna's ambitions range from enabling instant payment across the Arab region, to bridging with major global trade partners as well as introducing new use cases such as:

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- Instant Payments, enabling instant payments with end to end tracking and monitoring of payments and in line with best practices and messaging frameworks
- Payment vs Payment (PvP), enabling foreign exchange settlement of transactions and linking with other systems for the PvP settlement of foreign exchange transactions with one of the currencies
- Trade Finances, authenticating Letters of Credit (LOCs), informing the seller of the arrival of the LOC, and guaranteeing the payment to the beneficiary by obligating the payment once all conditions are met
- POS/ ATM, connecting to both regional and international (e.g. Maestro) POS / ATM systems to clear and settle card payments
- and Delivery vs. Payment (DvP), enabling the real time settlement of the payment leg of securities and debt instruments, and reducing or even eliminating the principal risk in the settlement of such products

Buna is also exploring additional products and offerings that would foster regional access for FinTechs and provide them with a platform to innovate and create exclusive additional use-cases. With this and more, Buna aims to develop into a hub for innovation and an exemplary Financial Market Infrastructure.

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CONCLUSION AND RECOMMENDATIONS

Wholesale CBDC in countries with less developed financial markets can bring great efficiency improvements. Securities trading and cross-border payments can be streamlined, significantly reducing cost and settlement risks. In countries with already well-established financial markets, the overall financial system improvements brought by W-CBDC are marginal.

Retail CBDC has the possibility of addressing financial inclusion, improving domestic payment systems and streamline retail remittances. For most central banks, serving the general public directly would be a massive operational undertaking. That combined with the risk of disintermediating commercial banks speaks for an indirect/synthetic, or hybrid R-CBDC as the preferred architecture.

Can Wholesale CBDC and Retail CBDC be combined? Yes. Many developing economies suffer from inefficiencies in securities settlement (wholesale) and retail payment and a need to improve financial inclusion (retail). A single system that addresses W-CBDC and R-CBDC is feasible and most likely less costly and more efficient to operate. If and when selecting a CBDC platform, central banks should take this into account.

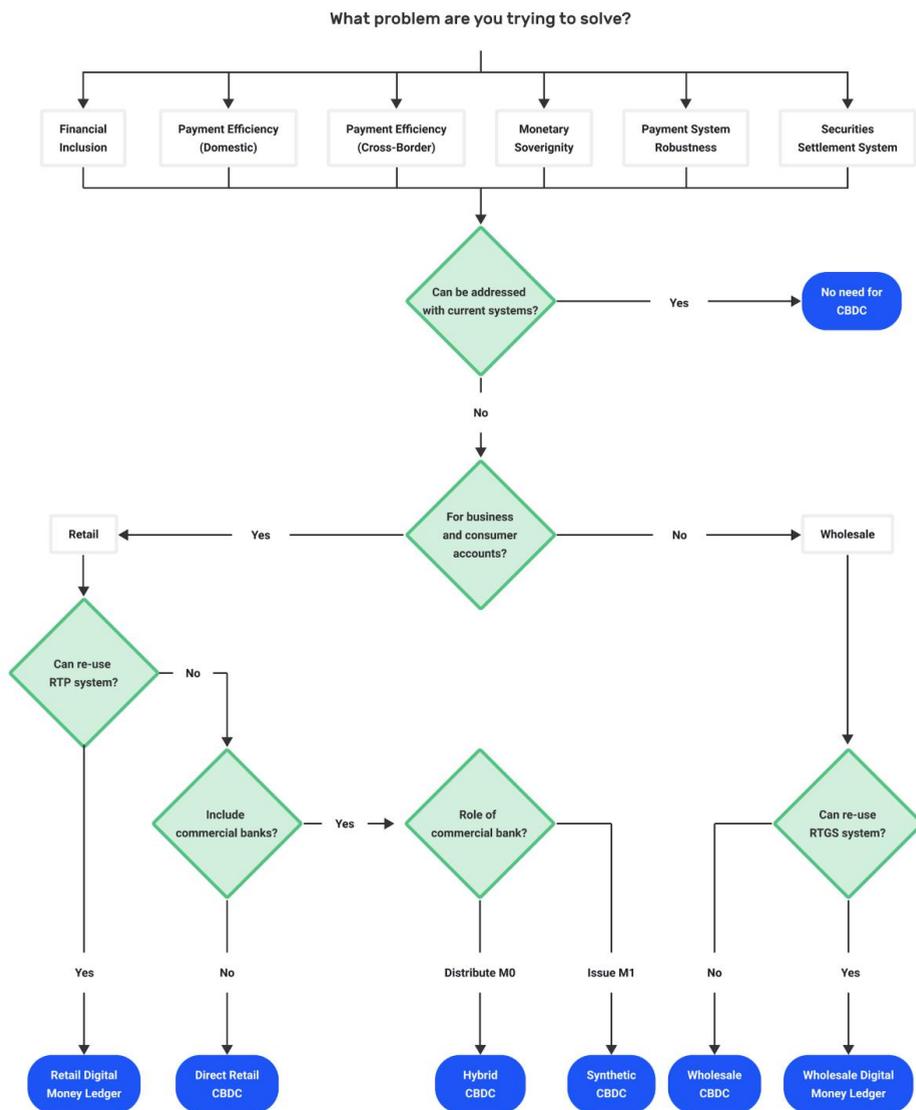
For retail CBDC, we recommend central banks in the Arab Region consider a synthetic CBDC. This allows central banks to delegate KYC, AML/CFT and customer service to commercial banks and minimizes the risk of marginalizing or destabilizing commercial banks. Central banks can focus on the issuance of the CBDC portion and have commercial banks take responsibility for managing bank money backed by the CBDC. An alternative, but more complex approach would be the hybrid retail CBDC.

We recommend any central bank considering a CBDC begin by reviewing their objectives and priorities. See “Motivations for Issuing CDBD.” The using the diagram below, make decisions regarding accessibility of the CBDC for consumers and businesses (i.e., retail versus wholesale), the desired role of commercial banks in the CBDC, and the desire to re-use existing RTP or RTGS systems (or make a clean break). These considerations are described in “Different Approaches and Designs for Issuing CBDC.” By making decisions to prioritize goals and objectives and respond to monetary and payment resources and infrastructure, a central bank can arrive at the form of CBDC best suited for them.

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The CBDC decision tree

Figure (12): CBDC Decision Tree



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Once the CBDC has been selected, the central bank will then have to consider the associated system requirements:

Figure (13): Systemic Requirements

	Retail digital money ledger	Hybrid CBDC	Synthetic CBDC	Direct retail CBDC	Wholesale digital money ledger	Wholesale CBDC
Availability and resilience	critical	critical	critical	critical	important but system down time can be dealt with using store-and-forward mechanisms	important but system down time can be dealt with using store-and-forward mechanisms
Security and data protection	probably key, depends on use case	key for consumer confidence	key for consumer confidence	key for consumer confidence; somewhat easier because fewer players have access to the system	critical but easier if limited to M0 for commercial banks	critical but easier if limited to M0 for commercial banks
Throughput and low latency	may vary depending on use cases	retail transactions require support for higher volumes of transactions at lower latency	retail transactions require support for higher volumes of transactions at lower latency	retail transactions require support for higher volumes of transactions at lower latency	lower volume transactions - less critical	lower volume transactions - less critical
Scalability	probably key, depends on use case	critical	critical	critical	less important, depends on the use case	less important, depending on volumes anticipated
Privacy and data protection	depending on use cases, could be complex	most complex because commercial banks will have consumer facing responsibilities	most complex because commercial banks will have consumer facing responsibilities	easier to achieve if central bank controls all access and reporting	easier to achieve if only commercial bank transactions are involved	easier to achieve if only commercial bank transactions are involved
Universal access	probably key, depends on use case	critical	critical	critical	N/A	N/A
Interoperability and open APIs	probably key, depends on use case	critical, enable e-Wallet and PSPs to build apps that drive consumer	critical, enable e-Wallet and PSPs to build apps that drive consumer	critical, enable e-Wallet and PSPs to build apps that drive consumer	probably key, depends on use case	depends on whether 3rd party developers will build for

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		adoption	adoption	adoption		commercial banks
Central banks management tools	depends on use case. Central bank may not be involved at all in this scenario.	complex because central bank should be able to view consumer accounts (consumers have claim on M0), even though distribution is done by commercial banks.	simplest. Central bank only needs to operate commercial bank accounts.	Most important because the central bank is administering consumer accounts directly. But because of centralized nature, no need to accommodate variation between commercial banks.	simplest. Central bank only needs to operate commercial bank accounts.	simplest. Central bank only needs to operate commercial bank accounts.
Commercial banks management tools	depends on use cases supported. Probably need to manage commercial bank account and consumer accounts.	required to manage both commercial bank account and consumer accounts	required to manage both commercial bank account and consumer accounts	not needed	more limit set required to manage commercial bank's accounts	more limit set required to manage commercial bank's accounts
Support for hierarchical ledgers	probably needed	critical	critical	not needed	not needed	not needed

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These system requirements are described in greater detail in “[CBDC - Underlying Technologies](#).”

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List of recommended actions

- Determine your priorities and motivations. Determine your existing resources. They will determine the type of CBDC best suited for your country.
- Where applicable, consider the benefits for underserved, and unbanked communities to ensure that new payment designs promote financial inclusion.
- Explicitly define international values for a digital payments ecosystem that protects users and ensures financial stability
- Complete an overview analysis of the current legal framework to identify the legal requirements and consequences resulting from CBDCs issuance. In particular central banks need to further examine the concept of legal tender within their jurisdictions, the extent of their statutory mandates and the potential operational risks. Furthermore, CBDC transactions should be given a cash-like finality in order to gain trust and wide acceptance.
- Craft clear policies and regulations that describe the role of private sector and public sector innovation in payments systems
- Explore public-private partnerships to coordinate innovation and ensure that advancements support central bank efforts to manage the monetary system.
- Engage stakeholders from commercial banks, payment service providers and the general public (end-user representation).
- For retail payments, consider synthetic CBDC (sCBDC). It provides the most value to an economy, cost less to implement and is safer from a financial market infrastructure perspective.
- Evaluate blockchain-based solutions that meet high throughput and scalability requirements, are highly secure and fault tolerant, are easily interoperable and can enable a strong ecosystem of financial solutions through open, secure APIs.
- Run a phased approach validation with clearly defined entry and exit criterias.
- Establish cross-border collaboration across central banks and government agencies on CBDC design, and bring in other countries currently not exploring CBDCs

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ANNEX A

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