



CBDC

Central bank digital currencies: foundational principles and core features

Executive paper

Bank of Canada

European Central Bank

Bank of Japan

Sveriges Riksbank

Swiss National Bank

Bank of England

Board of Governors Federal Reserve System

Bank for International Settlements

Background

In January 2020 governors tasked this group with sharing and developing our analysis of central bank digital currency (CBDC). Safeguarding public trust in money, maintaining price stability, and ensuring resilient payments infrastructure are among the core means through which central banks support public welfare. Central banks' interest in CBDC has increased as a potential means of delivering their public policy objectives. Profound, ongoing changes across finance, technology and society, as well as the ongoing Covid-19 crisis, provide additional impetus for research and experimentation related to CBDC.

This report focuses on a publicly available “general purpose” CBDC (a digital payment instrument, denominated in the national unit of account, that is a direct liability of the central bank). A “wholesale” CBDC, restricted to financial institutions, is also an active area of exploration for central banks but one that carries different opportunities, challenges and risks. The report explores the use cases for, and challenges and opportunities arising from, the possible issuance of a general purpose CBDC. It is an exploration and does not imply that the central banks in this group are actively considering issuance.

Key messages

CBDC issuance and design is a sovereign decision for each jurisdiction based on an assessment of how CBDC could support public policy objectives through the provision of a safe means of payment.

Central banks' common mandates for stability mean that any CBDC would represent an evolution of their current functions, within existing mandates. Diversity in use cases, existing financial and economic structures and legal frameworks mean that **CBDC designs will vary**. Notably, monetary policy is a national issue driven by national context. The monetary policy implications of CBDC are not the focus of this report but are an area of continuing research for central banks.

This group has outlined “foundational principles” and “core features” of a CBDC, which recognise the points above, to guide exploration and support public policy objectives (Table 1).

Given this agreement, there is considerable common ground for future international collaboration, knowledge-sharing and experimentation. These principles emphasise that, in order for any jurisdiction to consider proceeding with a CBDC, certain criteria would have to be satisfied. Specifically, authorities would first need to be confident that issuance would not compromise monetary or financial stability and that a CBDC could coexist with and complement existing forms of money, promoting innovation and efficiency.

A CBDC robustly meeting these criteria and delivering the features set out by this group could be an important instrument for central banks to deliver their public policy objectives.

A CBDC could promote more resilient, efficient, inclusive and innovative payments, depending on jurisdictional circumstances and if risks are effectively overcome. In jurisdictions where cash use is declining and digitalisation is increasing, **CBDC could also play an important role in maintaining access to, and expanding the utility of, central bank money.** A convenient and accessible CBDC can also serve as an alternative to potentially unsafe forms of private money. Furthermore, all the central banks who have contributed to this work remain committed to providing and supporting access to cash.

The potential financial stability implications of CBDC need to be considered carefully. There are two main concerns: first that, in times of financial crisis, the existence of a CBDC could enable larger and faster bank runs; and second, and more generally, that a shift from retail deposits into CBDC (“disintermediation”) could lead banks to rely on more expensive and less stable sources of funding. These risks are inherent in making a safe central bank money available to the public (a central purpose of a CBDC) and are already present with the existence of cash, although a CBDC could bring new structural challenges. Before launching a CBDC, a central bank would need to make an informed judgment that risks were identified and would remain manageable. This could require an appropriate combination of safeguards incorporated in the economic and functional design of the CBDC and financial system policies more generally. The intent would be to allow public and robust private money to continue to coexist, including through convertibility and interoperability. This group plans further work in this area.

CBDC issuance has cross-border implications. Unintentional barriers to transfers between CBDCs could be avoided from the outset through international collaboration. The G20 roadmap on cross-border payments will include work on factoring an international dimension into CBDC designs. The contributing central banks and BIS will all play an active role in this collaboration.

Further development requires a continued and deepened shift in commitment towards practical policy analysis and applied technical experimentation. This shift has already begun, yet the speed of innovation in (payments and money-related) technologies requires collaborative experimentation to be further prioritised.

Opportunities and risks

For the central banks contributing to this report, a common motivation for exploring CBDC is its use as a means of payment. Providing trusted money is a core way in which central banks deliver their mission and support wider public policy objectives. A decline in the use of cash for transactional purposes (as experienced by several members of this group) could challenge public access to central bank money and raise concerns about financial inclusion and rights to privacy. Even in jurisdictions in which cash continues to be used frequently, a CBDC could support a more resilient and diverse domestic payment system.

CBDC may offer opportunities that are not possible with cash. A convenient and accessible CBDC could serve as an alternative to potentially unsafe forms of private money, offer users privacy, reduce illegal activity, facilitate fiscal transfers and/or enable “programmable money”. Yet these opportunities may involve trade-offs and unless these have a bearing on a central bank’s mandate (eg through threatening confidence in the currency), they will be secondary motivations for central banks.

Introducing a CBDC could have financial stability implications that would need to be assessed and managed carefully. These include first, the potential for digital bank runs in times of stress and second, longer-term consequences for bank funding. While system-wide bank runs into cash are now very rare, given deposit insurance and bank resolution frameworks, there is the possibility that a widely available CBDC could make these events more frequent and severe, by enabling “digital runs” towards the central bank with greater speed and scale than is possible with cash. The second set of concerns is that the introduction of a CBDC could erode banks’ retail deposits, resulting in a less stable funding mix. Any assessment of the materiality of these sources of financial stability risk, and the effectiveness of possible mitigants, would depend on the specific design of a CBDC and the structure of the financial system in which it might exist. Given designs and systems will differ by jurisdiction, so will the broad financial system structural effects and risks, which will require significant research by a central bank to completely understand. Further research into the implications of CBDC for financial stability, and the possible safeguards and mitigants that might be put in place, will be a priority for this group.

Principles and features

The central banks contributing to this report agree on the foundational principles that will guide CBDC exploration. Those are that a CBDC should: (i) “do no harm” to monetary and financial stability; (ii) coexist with cash and other types of money in a flexible and innovative payment ecosystem; and (iii) promote broader innovation and efficiency.

Based on these three principles, there is considerable common ground amongst the central banks in this group on the core features of any future CBDC system. It must be resilient and secure to maintain operational integrity. To provide utility to users, a CBDC must be convenient and available at very low or no cost to end users. Furthermore, the CBDC system should have an appropriate role for the private sector and be set up to promote competition and innovation. A clear legal framework must underpin the system. Table 1 outlines these principles and core features in further detail.

Design and technology

Developing a CBDC with the core features outlined in Table 1 requires central banks and other public authorities to make design choices and decide on related trade-offs. There will be no “one size

fits all” CBDC; national priorities and domestic circumstances will determine designs. Key options and trade-offs are set out in Table 2. Further collaborative research on technology options can help identify the merits of alternative approaches. Specifically, work could focus on balancing privacy and combating illegal activity; security and availability; resilience and interoperability; universal access and costs; and programmability and system performance.

International cooperation

Central bank innovation is an opportunity for cooperation. Simultaneous research and exploration of CBDC by central banks could inform ways to improve cross-border payments, as part of the G20 roadmap. This opportunity was acknowledged by the CPMI as one of 19 building blocks for improving cross-border payments (CPMI (2020)).¹ Specifically, building block 19 focuses on factoring in an international dimension should central banks decide to design a domestic CBDC for their respective jurisdictions.

The potential for cross-border interoperability should be considered by central banks from the outset of research on CBDC (focusing on broad harmonisation and compatibility between currencies to encourage safe and efficient transfers). The central banks in this group are therefore committed to coordinating as we move forward with our own domestic choices, exploring practical issues and challenges.

Next steps

A CBDC could be an important instrument for central banks to fulfil their public policy objectives and to evolve in step with the wider digitalisation of people’s day-to-day lives. Public trust in central banks is central to monetary and financial stability and the provision of the public good of a common unit of account. To maintain that trust and understand if a CBDC has value, a central bank should proceed cautiously, openly and collaboratively.

Further development requires a continued and deepened shift in commitment towards practical policy analysis and applied technical experimentation. This shift has already begun, yet the speed of innovation in (payments and money-related) technologies requires collaborative experimentation to be further prioritised. To further mutual understanding, we propose:

1. This group of central banks, together with the BIS, will continue to work actively and collaboratively on CBDC, without prejudging any decision whether or not to introduce CBDC in our jurisdictions. We will further explore:
 - a. the practical implications of the core features set out in this report while advancing our understanding around other open questions (eg the trade-offs in CBDC designs that aim to mitigate financial stability risks); and
 - b. practical issues and challenges for cross-border transfer of domestic CBDC;

¹ Committee on Payments and Market Infrastructures, Enhancing cross-border payments: building blocks of a global roadmap, July 2020.

and contribute to these international workstreams. In particular, we support the G20 roadmap on cross-border payments and subsequent work on building block 19 on CBDC (“factor an international dimension into CBDC designs”), led by the CPMI and the BIS.

2. We invite the BIS to continue promoting information-sharing and collaboration between central banks on CBDC research.
3. We invite the BIS Innovation Hub to explore further technological experiments that could support our work and we support their plans to explore the technologies that could enable interoperability and cross-border transactions between domestic CBDCs.
4. This group of central banks will continue domestic outreach efforts to foster an open and informed dialogue on CBDC in our jurisdictions. We will provide domestic stakeholders with opportunities to participate in this dialogue. We will reach out to other central banks, including in developing economies, and to international organisations.

Foundational principles and core CBDC features

Table 1

Foundational principles

There are three common guiding principles for central banks’ consideration of CBDC issuance that flow from their mandates.

1	<p>Do no harm to wider policy objectives</p> <p>New forms of money supplied by the central bank should continue supporting the fulfilment of public policy objectives and should not interfere with or impede a central bank’s ability to carry out its mandate for monetary and financial stability.</p>
2	<p>Ensure coexistence and complementarity of public and private forms of money</p> <p>Central banks have a mandate for stability and proceed cautiously in new territory. Different types of central bank money – new (CBDC) and existing (banknotes, reserve or settlement accounts) – should complement one another. In addition, they should coexist in a wider payment ecosystem that supports public policy objectives and will include and support robust private money (eg commercial bank accounts).</p>
3	<p>Promote innovation and efficiency</p> <p>Without continued innovation and competition to drive efficiency and effectiveness of a jurisdiction’s payment system, users may adopt other, less safe instruments or currencies, leading to less reliable payments, economic and consumer harm, and the potential erosion of monetary and financial stability. The payment ecosystem is comprised of public authorities (in particular the central bank) and private agents (eg commercial banks and payment service providers), both of which have roles to play in ensuring a high level of innovation.</p>

Core features

Meeting the basic principles requires a CBDC to have certain core features covering the CBDC instrument, the underlying system and the broader institutional framework in which they exist.

Instrument features

Convertible: To maintain singleness of the currency, a CBDC should exchange at par with cash and private money.

Convenient: CBDC payments should be as easy as using cash, tapping with a card or scanning a mobile phone to encourage adoption and accessibility.

Accepted and available: A CBDC should be usable in many of the same types of transactions as cash, including point of sale and person-to-person. This will include some ability to make offline transactions (possibly for limited periods and thresholds).

Low cost: CBDC payments should be at very low or no cost to end users, who should also face minimal requirements for technological investment.

System features

Secure: The CBDC system should be extremely resistant to cyber attacks and other threats. This should also include ensuring effective protection from counterfeiting.

Instant: The system should offer instant or near-instant finality of settlement of transactions.

Resilient: The system should be extremely resilient to operational failure or disruption.

Available: The system should be available 24/7/365 for use by the end user.

Throughput: The system should be able to process a very high number of transactions per second.

Scalable: The system should be able to expand to process potentially much larger additional volumes in the future.

Interoperable: The system should offer sufficient interaction mechanisms with private sector digital payment systems and arrangements to allow easy flow of funds between systems.

Flexible and adaptable: Every effort should be made to make the CBDC system flexible and adaptable to changing conditions and policy imperatives.

Institutional features

Clear and robust legal framework: The central bank should have clear authority underpinning its issuance of a CBDC.

Standards: The CBDC system and participating entities should conform to the appropriate regulatory standards.

Controls design	
Interest-bearing and limits/caps	Two fundamental and complementary design features for a CBDC are whether and how to make it interest-bearing and to impose a cap or limit on individual holdings. CPMI-MC (2018) explored the implications of these choices, noting that interest could play a role in controlling demand for CBDC and facilitate pass-through of interest rate decisions.* Yet designing a "deposit-like" CBDC could hasten any disintermediation of existing deposit takers. Limits could mitigate the financial stability impact of such disintermediation, including by impeding a possible "run to CBDC" during a crisis, but they would also limit the effectiveness of making a CBDC interest-bearing and come with a wider set of potential drawbacks. Understanding of the interactions between these design features and the potential trade-offs involved is in its relatively early stages. A central bank should have robust means to mitigate any risks to financial stability before any CBDC is issued.
Technical design	
Ledger design	The design of a transaction ledger has implications for the governance structure of a CBDC ecosystem as well as how competition and innovation will take place within it. A ledger could be centralised, decentralised (eg through use of distributed ledger technology) or a combination. Ledger functionality and access will hinge on ledger designs and how payments are authenticated.
Ledger functionality	The functionality of the ledger will determine the basic functions available for all payments and therefore constitutes an important policy choice. More sophistication (eg enabling synchronised payments) could drive initial adoption but also increase costs and limit differentiation between service providers, depending on other design choices.
Ledger access	Deciding on the access requirements, for example which entities can read (ie provide supporting services) and write (ie settle payments) on the ledger will have a bearing on the safety and efficiency of the entire ecosystem. A balance will need to be struck between encouraging diversity and competition within the ecosystem, and maintaining sufficient regulatory standards for private service providers. A service role for public sector entities (and potentially the central bank) will need to cohere with the wider ecosystem.
Authentication requirements	Payment authentication designs (eg identity-based, token-based or multifactor) will have a significant bearing on the underlying data structure of a CBDC system and consequently its integration with others (eg for digital identity verification as part of KYC or transaction monitoring requirements). How payments are authenticated will also be driven by the level of privacy afforded to users within compliance with the law (eg for anti-money laundering).
Transfer and storage	A token-based CBDC could be stored on a physical device (eg a smartphone or card). A payment would represent a movement of this local "store of value" and would not require an intermediary. A payment using an account-based CBDC would be a transfer of the rights or liability (as for traditional bank accounts), requiring an intermediary to process the payment. Hybrid arrangements could exist but their complexity could create a significant burden on the functioning of a system. A token-based system could make a CBDC more amenable to offline use (ie when connectivity to the ledger is not available), which is a core feature of a CBDC. However, this functionality may give rise to fraud and other security risks (which could require caps on the number or value of offline transactions permitted).
Governance	A CBDC system will require a rulebook formalising the roles and responsibilities of the operator(s), participants and potentially other service providers and stakeholders. Beyond the rulebook, other governance arrangements will also need to be considered (eg clarifying a central bank's discretion in modifying elements of the system, how data-sharing and privacy will be structured and the organisation of any interoperability arrangements).
Incentive design	
CBDC funding	Issuing a CBDC will require capital expenditure and impose running costs. Deciding who should pay will have implications for ecosystem efficiency, competition, innovation and inclusiveness. Directly recovering costs from the public users would be transparent but could be a disincentive to adoption. Charging service providers will require them to have a viable business model to recover their costs. Public subsidies could reduce or eliminate the need for charges but could impact private payment providers.

Intermediary business models	How and where private sector intermediaries in a CBDC system can generate revenue will have a significant impact on competition, innovation and privacy within the system. Decisions will be required on whether all costs are transparently charged through fees (and whether these are borne by merchants, users or both) or if some subsidisation through public funding, private cross-subsidy or allowing access to consumer data is permitted.
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Design and technology trade-offs

Security/ offline transactions	There may be a desire for a CBDC to enable users to settle transactions peer-to-peer, similarly to banknotes. This heightens the need for fraud protection and other security features. Depending on the features, the number or value of transactions permitted offline could be capped (before being reset by a verified online transaction).
Cost of service provision/ universal access	Banknotes create the same user experience for all users. CBDC, assuming multiple devices are available, can create differing experiences. For example, smartphone users will have greater functionality than those with stored value cards. Active dedicated devices can close that gap, albeit at a higher cost.
Privacy/ compliance	Privacy is designed to hide information and compliance to reveal it as required. A combination of cryptography and operational or institutional arrangements may enable both features and satisfy users that privacy is well preserved. As an example, multiple agencies could hold fragments of decryption keys that are only brought together after due process to reveal information.
Privacy/ capacity and scalability	Privacy techniques that are computationally demanding may be costly and impose limits on a system's capacity and scalability.
Programmability/ performance	Heavy use of programmable functions will require a higher level of technical performance from the system, adding costs or reducing operational resilience.

* Committee on Payments and Market Infrastructures and Markets Committee, Central bank digital currencies, March 2018.
