

**Central bank digital currency**

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* Central bank digital currencies ("CBDCs") have gained traction in recent years and have been on the agenda of central banks worldwide. According to the Bank for International Settlements ("BIS"), 86% of the central banks globally are engaged in work related to the development and use of CBDC, with 14% of them already launched pilot tests. CBDC is more than application of advanced technologies that can complement physical cash; it may have profound implications by becoming a viable payment system and a tool for implementing regulatory oversight as well as fiscal and monetary policies.
* Hong Kong has been examining the feasibility of CBDC and conducting related studies since 2017. Recently, the Financial Secretary has indicated that the Government would continue with the trial use of CBDC in cross‑border trade payment and step up preparation for the use of CBDC in Hong ‍Kong at the wholesale and retail levels (including studying the feasibility of retail digital Hong Kong Dollar, "e-HKD"), as well as conducting technical testing of digital Renminbi ("e-CNY") in Hong ‍Kong.1
* This issue of ***Essentials*** provides an overview on CBDC, including its (a) ‍features and ‍potential benefits, (b) ‍approaches to designing CBDCs, by reference to the Mainland and some overseas places with noticeable CBDC progress such as the Bahamas and Singapore; (c) ‍CBDC development in Hong ‍Kong; and (d) ‍issues and potential challenges in developing CBDC.

**What is CBDC?**

* Central bank money traditionally takes two forms – cash and reserves held at the central bank.2 CBDC is essentially a third version of central bank money that uses an electronic record or digital token to represent the digital form of an official currency. It is a direct liability of the central bank, in the same way that physical banknotes are, and can be used to perform all the basic functions of money, i.e., payment, storing value, and as a unit of account. CBDC is distinct from nonofficial cryptocurrenciessuch as bitcoin, which represent claims on the intermediaries, thus subject to credit risks, or are altogether not backed by the issuing parties.3
* CBDCs can be designed either for **retail**, i.e. for use by the wider economy including businesses and individuals; or **wholesale**, i.e. for use among financial institutions, such as settlement of interbank transactions. In a CBDC system, a digital **ledger** is required to keep a record of CBDC transactions.4 There are currently no international standards nor consensus on the appropriate ledger infrastructure for CBDCs. The ledger for a CBDC can be based on a conventional **centralized database**, in which data updating is controlled by a single authoritative entity, or a **distributed ledger** usingdistributed ledger technology ("DLT")5, in which the authority to update the database is delegated to a network of identified and vetted entities.6

**The advent of CBDC**

* CBDCs is part of central banks' response to developments in payment and financial technology. In recent years, there has been a growing adoption of privately-issued cryptocurrencies. On one hand, some segments of the public appear receptive to the proposition of digitalized currencies and readily appreciate the technical potential behind them; on the other hand, cryptocurrency-related activities often give rise to various concerns such as fraud, money-laundering and tax avoidance. Meanwhile, disruptions caused by the COVID‑19 pandemic and the consequent rise in digital payments and e-commerce have further bolstered central banks' interest in exploring whether digitalized currencies can become additional low-cost and effective alternatives to complement existing payment methods.
* Central banks are considering **retail CBDCs** for various potential benefits, such as enhancing the public's access to low-cost financial services, as well as prospective uses by the governments in risk monitoring and macroeconomic management. Some of such benefits are highlighted below:

1. Payment markets in many places tend to be concentrated due to economies of scale and strong network effects. Retail CBDCs could promote **diversity and competition in payment options**, providing open payment platforms that would foster competition and innovation, which would benefit retail users;7
2. Access to CBDCs may contribute to **financial inclusion** especially in developing countries where the population is largely unbanked, through offering value storage, payment and other simple banking services in a low-cost manner;8
3. Compared with existing payment systems, CBDC provides a more **resilient means of digital payment** in times of crisis. For example, the need for a disaster-resilient system is a major motivation behind the advanced CBDC development in the Bahamas, a hurricane-prone country, as mobile phone coverage is much quicker to restore than bank branches and ATMs. In addition, CBDC could be set up for use in the offline mode, allowing access to payment services during power outages;
4. From the regulatory oversight perspective, CBDCs might allow central banks to keep track of the precise location of every unit of the currency and thereby **tackle tax evasion and financial crime**. On macroeconomic management, some consider that CBDCs could be used to facilitate **fiscal transfers**, allowing governments to distribute money directly to individuals more quickly and safely especially in emergency situations. There have even been discussions that CBDC issuance can be an alternative means for central banks to manage money supply,9 though the operation is still not discussed in depth.

* Meanwhile, **wholesale CBDCs** would mainly be used for interbank settlement. Although the function can be fulfilled by the current systems, comprising banks' clearing accounts with the central bank and real-time gross settlement systems, wholesale CBDCs may offer improved efficiency over existing systems on domestic or international payments, as follows:

1. **enhance efficiency for cross-border payments**: central banks have joined hands to explore using wholesale CBDCs to improve cross-border payments by replacing/competing with the current system involving multiple intermediaries (e.g. correspondent banks), which resulted in higher cost, limited transparency (e.g. on foreign exchange rates in transactions and status of payment), restricted operating hours and delays; and
2. **explore additional functionality for supporting automation and mitigating risks**: for example, in their cross-border and cross-currency settlement experiment, Singapore and Canada used smart contracts (with predetermined conditions set) to synchronize all the actions making up a transaction in delivery-versus-payment10 settlements with a view to reducing settlement risk by completing the exchange of payment and corresponding asset simultaneously across different silos.11

**Recent CBDC development/experiences on the Mainland and in overseas places**

* Many central banks in large and small economies demonstrated keen interest in CBDC development. Yet it is observed that they are making different degrees of progress, and the level of technological advancement does not necessarily dictate their positions in the development pathway. Indeed, **emerging markets and developing economies** are considered more motivated generally to develop CBDCs, accounting for seven out of eight ‍CBDC projects in advanced stages according to the latest BIS survey. On the other hand, large and developed economies such as the **United ‍States** ("US") appear more hesitant in CBDC development. The US Federal Reserve is expected to publish a discussion paper soon on the benefits and costs of creating a CBDC, aiming to spur discussion over whether and how it should issue CBDC.12 In the **United ‍Kingdom** ("‍UK"), while the Bank of England has invested considerable effort in research on CBDC, it has not yet made a decision on whether to introduce CBDC. It intends to engage widely with stakeholders on the benefits, risks and practicalities of doing so.13 Likewise, the **European Central Bank**, having announced in July ‍2021 the start of a 24-month investigation phase, has yet to decide on whether to develop a digital Euro.14 Therefore, it appears that factors such as the perceived advantage of CBDC systems vis-à-vis the current regimes and stakeholders' interest could be more crucial determinant of progress rather than strictly on the technological know-how.
* Among places with more advanced progress in developing CBDC, the **Bahamas** officially launched its retail CBDC, the Sand ‍Dollar, in October ‍2020. It amended the Central Bank of The Bahamas Act 2020 to provide the central bank with the legal authority to issue the Sand Dollar and to make both notes and digital currency legal tender. The Sand Dollar became available for domestic use by all Bahamian residents upon initial launch, while integration with the commercial banking system is being completed gradually. The **Mainland**, another early mover on CBDC, has conducted pilot tests of e-CNY in various cities since ‍2019, and is expected to make the digital currency available for use by visitors to the Winter Olympics in Beijing in 2022.15 As for wholesale CBDCs, **Singapore** has conducted experiments on cross-border payment with other countries including Canada and France, and has published detailed reports after completing different phases of testing.
* The salient features of CBDCs being piloted/launched on the Mainland, in the Bahamas and Singapore are highlighted below:

Retail CBDCs – the Mainland and the Bahamas

1. **Non-interest bearing**: as an initial trial or first launch, both e-CNY and Sand ‍Dollar pay zero interest (i.e. a feature that is seen in physical cash), which may aim to keep the design simple and to avoid undue competition with bank deposits;
2. **Caps on CBDC transaction and balance**: in the Bahamas, there are different caps on transactions and balance for different types of Sand ‍dollar wallets. For example, the maximum transaction limit per ‍month is B$10,000 (HK$77,700) for individuals, and B$20,000 (HK$155,400) or one-eighth of annual revenues (whichever is greater) for businesses, and there were B$130,000 (HK$1.0 ‍million) Sand ‍dollars in circulation in early ‍2021. On the Mainland, while the way e-CNY is piloted with users may differ from city to city, in its official design, a cap on transactions and balance is introduced for different types of e-CNY wallets.16 Reportedly, the smallest-value e-CNY wallet (named "‍Type ‍4" wallet) has a maximum balance of RMB10,000 (HK$11,920), with transaction amounts capped at RMB2,000 (HK$2,380) per ‍transaction and RMB5,000 (HK$5,960) per day.17 It is further noted that in both places, transactions in smaller-value wallets are anonymous, since identification of the user is not required, while wallets with a higher spending limit would have to be linked to bank accounts;
3. **Two-tier system and risk monitoring framework**: both e-CNY and Sand ‍Dollar are issued by the central bank to authorized financial institutions, which will then manage the digital currency's circulation to the public. By leaving user-facing activities to banks, the central bank can lower its burden of executing transactions and conducting user‑level due diligence as banks are responsible for actually handling retail users' CBDC business as well as enforcing anti-money laundering and counter‑financing of terrorism regulations and ensuring ongoing compliance.18 Nevertheless, the People's Bank of China ("PBoC") has also established a framework for big data analysis that could, among other things, help risk monitoring and macroprudential oversight regarding the use of e-CNY on the Mainland;
4. **Accessibility through a physical payment card**: to ensure that the CBDC does not exclude residents based on access to technology, age or abilities, both e-CNY and Sand ‍Dollar are also available in the form of physical payment cards, in addition to access through a mobile wallet application. Meanwhile, Bahamians can convert the Sand Dollars in their accounts instantaneously into physical cash at designated cashout locations;

Wholesale CBDCs – Singapore

1. **Cross-border payment through a common multiple-CBDC network**: Singapore and France announced in July ‍2021 the successful completion of an experiment on cross-border and cross-currency transactions for Singapore Dollar CBDC and Euro CBDC. The design of a common multiple CBDC network enabled the two central banks to have visibility on cross-border payments while retaining independent control over the issuance and distribution of their own CBDC; and

Collaboration with private sector

1. **Private sector participation to support wider usage**: the private sector assumes an important role in e-CNY, with e-CNY wallets and related ecological platforms being jointly built, owned and shared by PBoC and authorized operators. Singapore also involves the industry not just in experimenting CBDC technology, but in exploring business opportunities related to CBDC as well. For example, the Monetary Authority of Singapore has made technical specifications of the CBDC prototype network publicly available in order to spur further industry development on CBDC solutions. Meanwhile, the Bahamas authorized one of the licensed payment platforms to partner with Mastercard to issue a Sand Dollar prepaid card, enabling Bahamian residents to convert their Sand Dollars in the prepaid card instantly, which can then be spent at any shops where Mastercard is accepted.

**CBDC development in Hong Kong**

* Hong Kong has so far largely focused its efforts on **wholesale CBDC**, especially on its cross-border application. In fact, Hong ‍Kong's CBDC project is considered one of the most mature globally among wholesale CBDC initiatives.19 The Hong ‍Kong Monetary Authority ("HKMA") began researching on CBDC in 2017 under Project LionRock and subsequently joined forces with the Bank of Thailand in 2019 to study the use of CBDC in cross-border payments by banks and corporates. They were joined in February ‍2021 by the BIS Innovation Hub20, the Mainland and United Arab Emirates, expanding the project into the **Multiple Central Bank Digital Currency Bridge initiative**. Making use of DLT, the initiative involves developing a proof of concept prototype to support cross-border foreign exchange payment-versus-payment21 transactions in multiple jurisdictions.
* At the same time, the Government and HKMA maintains communication with PBoC on the possibility of **cross-border application of e-CNY**. Although e-CNY is currently designed mainly for domestic retail payments, PBoC noted that it would explore pilot cross-border payment programmes. In particular, HKMA has been working with PBoC in supporting the technical testing of e-CNY in Hong Kong. According to the Government, the Financial Services Development Council has formed a working group to study how Hong Kong can seize the opportunities from e-CNY's development.22
* Meanwhile, HKMA also announced in June ‍2021 that it would begin a study on the prospect of issuing a retail CBDC, e-HKD, in Hong Kong, covering both technical and policy considerations. HKMA just released a technical whitepaper in October ‍2021, summarizing part of the research findings on the technical front, and is expected to present its initial view on the feasibility of e-HKD by mid-2022.23

**Issues and potential challenges**

* Notwithstanding the potential benefits of and global enthusiasm on CBDCs, some issues have to be considered by governments when deciding on whether, how and when to launch a CBDC.
* For **retail CBDCs**, notwithstanding the official backing for such digital currencies, CBDCs are still liable to potential **loss, theft and fraud** like other digital forms of assets and payment systems.Mitigation of such risks using technology is thus one of the key focuses of central banks' CBDC research. While identity tracking is crucial for integrity of digital payments and could help reduce fraud and other risks, the authorities need to strike a fine balance with the countervailing **concerns on data privacy** by stakeholders.24
* Another concern from central banks and banking regulatory authorities is ‍that the launch of retail CBDCs may have **negative impact on banks**. If ‍retail CBDCs, be it interest-bearing or not, are attractive substitutes to bank deposits, CBDCs may crowd out deposits at commercial banks and displace commercial banks' role in retail payments.25 Moreover, the role of commercial banks in credit and money creation under the current fractional reserve banking system in most economies would be radically impacted, and the implications on the administration of **monetary policy** by monetary authorities would need to be studied in more details.
* On the other hand, if a CBDC fails to attract a significant number of users and payment volume, it would become a waste of public resources. For instance, although Ecuador launched the world's first retail CBDC in 2015, Ecuador's ‍National Assembly decided in 2017 to abolish the digital currency due to **low usage**.
* As for **wholesale CBDC**, advanced economies have tended to utilize it in cross-border use for efficiency enhancement. Yet, cross-border use of CBDC is highly dependent on cooperation among central banks to make the frameworks underlying their CBDCs **interoperable internationally**. These include building consensus on legal framework, governance framework, common standards, and cybersecurity requirements. As such, it is necessary to have close cooperation and agreement between the involving jurisdictions in the course of developing an efficient infrastructure with broad geographical coverage.
* Hence, **design** of a CBDC system is a major consideration in CBDC development, as it may affect public receptiveness, payment operation, financial stability, cross-border interoperability etc. For instance, the division of responsibilities between the central bank and financial intermediaries in a CBDC system may have implications on the risk of disintermediation of banks;26 the choice of different identification settings for a CBDC would imply different levels of user privacy and traceability of CBDC transactions;27 and failure to reach a wide consensus on specifications for cross-border wholesale CBDCs may result in low usage or even multiple parallel systems where each has limited coverage. All these may have a bearing on whether a CBDC can deliver the desired benefits.

**Concluding remarks**

* Central banks around the globe are studying the CBDCs as they have the potential of providing advanced yet low-cost digital payment systems, the demand for which has surged amidst the current pandemic. The prospect of leveraging CBDCs to enhance the implementation of regulatory oversight as well as fiscal and monetary policy provided further impetus for monetary authorities to invest resources into thoroughly exploring CBDCs' potential. Though large economies overseas are undecided about introducing CBDCs, various other places have piloted CBDCs for retail and/or wholesale use, and the Bahamas has even launched it in a small scale with a range of use cases. For Hong ‍Kong, authorities have started studying the feasibility of e-HKD regarding retail CBDC use. At the same time, Hong ‍Kong is expected to play a key role in promoting e-CNY as the Mainland plans to expand its application, potentially further fortifying the city's position as the premier offshore Renminbi centre. The potential of CBDC in enhancing cross‑border settlement appears strong as well, although the realization of such promise hinges upon collective action of central banks across jurisdictions.



Prepared by Denise CHEUNG

Research Office

Information Services Division

Legislative Council Secretariat

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**Endnotes:**

See Financial Secretary (2021) and South China Morning Post (2021).

In many economies, commercial banks are required to place deposits at the central bank, which form the central bank reserves. In Hong Kong, however, there is no such reserve requirement for banks. Yet there is a statutory liquidity ratio for them to meet. To facilitate interbank settlement, banks in Hong Kong maintain Hong ‍Kong ‍dollar settlement accounts with HKMA.

CBDCs are also different from stablecoins, a type of nonofficial cryptocurrencies backed ‍by a physical currency, as stablecoins do not constitute money creation by the central bank and are therefore in effect payment systems and investment vehicles. See [Bank for International Settlements (2021a)](https://www.bis.org/publ/arpdf/ar2021e3.pdf).

The ledger can, among others, prevent users from sending the same unit of CBDC to different recipients (so-called "double spend") and help keep track of the overall stock and supply of CBDC.

DLT is capable of a number of functions that are potentially useful for CBDC, such as programmability and peer-to-peer payment on a decentralized platform. DLT features can potentially be adopted independently of each other. At the same time, programmability can also be deployed on a ledger created using centralized database technology. See Bank of England (2020).

As data updates on distributed ledgers are more time and energy consuming – each update has to be harmonized between all entities – some central banks noted after their pilot tests that DLT had inadequate performance and scalability, and that it may not have fundamental advantages over centralized databases in the case of direct CBDCs. See Bank for International Settlements (2020).

This could potentially lower the cost of digital payments to merchants, which reach over 3% in the case of credit cards. See[Daly](https://www.fool.com/the-ascent/research/average-credit-card-processing-fees-costs-america/), L. (2021).

For example, Cambodia's DLT-based interbank payment platform launched in 2020 provides individuals with an e-wallet, giving them access to mobile payments and online banking free of charge. This is distinct from earlier forms of mobile money such as M‑Pesa in Kenya and Ant Group (螞蟻集團) on the Mainland, which have significant contributions in financial inclusion (e.g. M-Pesa helped increase the proportion of Kenya's population with access to formal financial services from about 20% in 2007 to more than 60% over a 10-year period). However, the dominance of private sector players in these earlier systems has given rise to near monopolies, which has become a regulatory concern. See Foster, K. et al. (2021).

See Davoodalhosseini, M. et al. (2020) and Bank Policy Institute (2021)*.*

Delivery-versus-payment refers to a securities settlement mechanism that links a securities transfer and a funds transfer in such a way as to ensure that delivery occurs if and only if the corresponding payment occurs. See Bank for International Settlements (2016) and Reserve Bank of Australia (2019).

See Bank of Canada and Monetary Authority of Singapore (2019).

See Wall Street Journal (2021) and Waller, J. (2021).

See Bank of England (2021).

See European Central Bank (2021).

Pilot test sites include Shenzhen, Suzhou, Xiong'an, Chengdu, venues for the 2022 Beijing Winter Olympics, Shanghai, Hainan, Changsha, Xi'an, Qingdao and Dalian. So far, cumulative transactions volume and value totalled over 70 million and RMB34.5 ‍billion (HK$41.1 ‍billion) respectively have been recorded for all e-CNY wallets as at end June ‍2021.

See 中國人民銀行數字人民幣研發工作組(2021年).

Information is based on 央視網(2021年). Full details on the caps for each type of e‑CNY wallets appear yet officially published.

See Allen, S. et al. (2020).

See PwC (2021).

BIS Innovation Hub is an initiative of BIS aiming to foster innovation and collaboration among central banks.

Payment-versus-payment refers to a settlement mechanism that ensures that the final transfer of a payment in one currency occurs if and only if the final transfer of a payment in another currency or currencies takes place. See Bank for International Settlements (2016).

It has issued a brief on CBDC, giving an overview on the development on the Mainland and Hong ‍Kong. See Financial Services Development Council (2021).

See Hong Kong Monetary Authority (2021b) and NFCW (2021a).

In an opinion survey conducted in the European Union region, data privacy is the top concern of their residents when being asked their views on the introduction of digital Euro. See CPO Magazine (2021).

An investment bank estimated that a US digital dollar would lead to a 20% – 30% drop in the funding base of commercial banks, while another investment bank estimated that a digital Euro would attract 8% of European commercial bank deposits. See Bank for International Settlements (2021c) and Ledger Insights (2021b).

CBDC can be operated under a single-tier system (i.e. direct CBDC), two-tier system (i.e. indirect CBDC), or a hybrid of both. This is often referred to as the "architecture" of the CBDC system. In a single-tier system, the central bank keeps a record of all individual balances and updates it with every user transaction. In a two-tier system, financial intermediaries are delegated by the central bank to handle CBDC transactions with the public, and users have a claim on the intermediaries.

1. Retail CBDC can broadly be classified as account-based or token-based. In an account‑based CBDC, ownership is tied to an identity, and transactions are authorized via identification of the person. In a token-based CBDC, transactions are verified based on authenticity of the token, making it possible to maintain full anonymity. In some papers, token-based CBDC and value-based CBDC are interchangeable. It is also possible to implement hybrid systems combining features of account-based and token‑based CBDCs. See Shirai, S. (2019).

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