

How Central Bank Digital Currency Could Reshape Asia Pacific Economies



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Foreword

Globally, the digitisation of money continues to accelerate. Spurred by developments in payments, finance, and technology, and further hastened by the pandemic, there are now more digital ways to transact than ever before. We believe digital currency — digital bearer assets that represent a shift in the way payments are made compared to the existing electronic payment system — will play a pivotal role in this digitisation. In particular, there has been significant interest among central banks in issuing sovereign-backed Central Bank Digital Currency (CBDC). Asia Pacific is one of the most advanced regions, with a broad range of countries and territories having commenced collaborative wholesale and retail research efforts and pilots. In our view, CBDC will be a key feature of the payments landscape in the region over the next decade.

As a world leader in digital payments, Visa's network encompasses 3.6 billion Visa accounts, processes more than 65,000 transaction messages a second, facilitates the clearing and settlement of payment transactions, and provides numerous security and risk services. Visa aims to become a network of networks by enabling the movement of money for everyone, everywhere for any transaction. Supporting CBDC is a natural extension of our commitment to evolve and support new forms of payments. We are excited to extend our trusted standards and expertise to this new space.

This paper discusses Visa's observations, areas of focus and investments in the CBDC space. There are 3 sections for your consideration — an introduction to CBDC and motivations spurring the global developments; CBDC types and considerations (i.e. retail versus wholesale, system design, and implications on the ecosystem); and Visa's expanding expertise through research, products and partnerships, and a collaborative innovation hub. We believe CBDCs will complement the existing payment ecosystem and look forward to partnering with and supporting central banks as they consider the possibilities. 🌐

1.0

Introduction to Central Bank Digital Currency (CBDC)

Digital currency, a digital version of cash, is a bearer asset represented by private cryptographic keys, which are typically transferred over dedicated networks. The IMF defines Central Bank Digital Currency (CBDC) as “a digital representation of sovereign currency that is issued by a jurisdiction’s monetary authority and appears on the liability side of the monetary authority’s balance sheet”¹. Essentially, CBDC represents a digital form of central bank liability issued by a central bank and intended as legal tender.

Generally speaking, there are two types of CBDCs — wholesale and retail. Wholesale CBDCs are mainly used for interbank transfers and are therefore restricted in use to certain players, such as financial institutions. Retail CBDCs are used for everyday consumer to merchant transactions and are available to the general public.

Within the context of retail CBDC, there are two broad categories — an account-based CBDC and a token-based CBDC. In an account based system, the central bank would offer an account directly to the population to move digital cash balances for making payments. In a token-based CBDC, the central bank would create a digital bearer instrument for which the central bank can distribute these digital tokens to the citizens through some form of digital wallets that are directly provided by the central bank, or indirectly by its

financial intermediaries. Token-based CBDC would represent a significant change to the way payments are made versus the existing electronic payment system today. Electronic payments today are typically messages transmitted on payment networks that instruct participants to credit or debit accounts on an institution’s balance sheet. However, payments with CBDCs (and digital currencies more broadly) represent the digital asset itself moving on the network. This paper focuses on token-based CBDC implementations, which in certain markets may be layered with account-based features to form a hybrid instrument.

The development of CBDCs has been accelerated by strong momentum in two non-sovereign digital currencies — cryptocurrencies and stablecoins. Cryptocurrencies (e.g., bitcoin, ether, etc.) are non-sovereign digital currencies unlinked to any assets or other stores of value, typically operating on permissionless distributed ledger technology, while stablecoins (e.g., Centre’s USDC) are private sector-issued digital currencies backed by fiat reserves held at commercial banks, typically operating on permissioned blockchain networks. While cryptocurrency has gained exponential momentum in recent years, usage as a payment method remains limited in part due to its high price volatility, low transaction throughput and limited merchant acceptance. Stablecoins were developed by the private sector to mitigate the volatility and other challenges of cryptocurrencies, and have also seen significant growth. 🌐

1 A Survey of Research on Retail Central Bank Digital Currency. International Monetary Fund. <https://doi.org/10.5089/9781513547787.001>, Jun 2020.

1.1 Global Developments

- SUMMARY**
- 86% of central banks globally are actively assessing CBDCs
 - First live CBDC globally is the Sand Dollar in the Bahamas
 - Nearly a third (32%) of the world's most mature CBDC projects are in Asia Pacific (e.g. Mainland China, Hong Kong SAR, Thailand)

The majority (86%) of the world's central banks, including the Federal Reserve, European Central Bank, Bank of England, Bank of Japan and the People's Bank of China, are now actively assessing CBDCs, compared to 80% in 2019 and 70% in 2018².

The world's first live CBDC, the Sand Dollar, is intended for retail use and was launched by the Bahamas in October 2020. Globally, most central banks are either exploring both wholesale and retail implementations, or narrowing their focus onto the retail version. While there are no live wholesale CBDCs yet, nearly 70% of wholesale projects are in the pilot phase³.

Zooming in, Asia Pacific is one of the most advanced regions for CBDC developments as it hosts a third of the world's most mature CBDC projects³. In particular, Mainland China, Hong Kong Special Administrative Region (SAR), and Thailand are all running CBDC pilots. The most advanced initiative in the region is Mainland China's eCNY. The People's Bank of China (PBOC) ran 13 eCNY consumer pilots across major cities in 2020 and 2021, and have issued more than CNY270 million (~USD40 million) of eCNY so far⁴. Hong Kong SAR is also investing efforts in CBDC through two parallel projects — one for wholesale CBDC with Project

LionRock in 2017, and another for retail uses through exploring the e-HKD with Project Aurum in recent months. In 2019, Thailand piloted Project Inthanon with eight banks to test out interbank use cases, and joined the effort with Hong Kong, creating Project Inthanon-LionRock⁵. This initiative was renamed to mCBDC Bridge (Multiple CBDC Bridge) as Mainland China and the United Arab Emirates (UAE) joined the effort⁶.

Aside from pilots, many other central banks are conducting research projects or proofs of concept as they explore whether CBDC is applicable for their market. Singapore has been assessing the suitability of a wholesale CBDC through Project Ubin since 2016 and has launched Project Dunbar this year to explore using multi-CBDCs for international settlements. Japan is also conducting various CBDC research projects and conversations with major central banks (e.g., Bank of England, Bank of Canada, European Central Bank, Riksbank) to explore the creation of the Digital Yen on both the wholesale and retail sides. South Korea launched a three-stage pilot trial for a retail CBDC in March 2020 to explore the technical requirements and operational procedures, as well as test in a pilot environment³. India and Australia have also announced an interest in digital currency in recent months as well⁷.

2 Ready, steady, go? – Results of the third BIS survey on central bank digital currency. Monetary and Economic Department, Bank for International Settlements. <https://www.bis.org/publ/bppdf/bispap114.pdf>, Jan 2021.

3 PwC CBDC Global Index. PwC. <https://www.pwc.com/gx/en/industries/financial-services/assets/pwc-cbdc-global-index-1st-edition-april-2021.pdf>, Apr 2021.

4 China focuses on green travel in two new CBDC trials. Ledger Insights. <https://www.ledgerinsights.com/china-focuses-on-green-travel-in-two-new-cbdc-trials/>, Jul 2021.

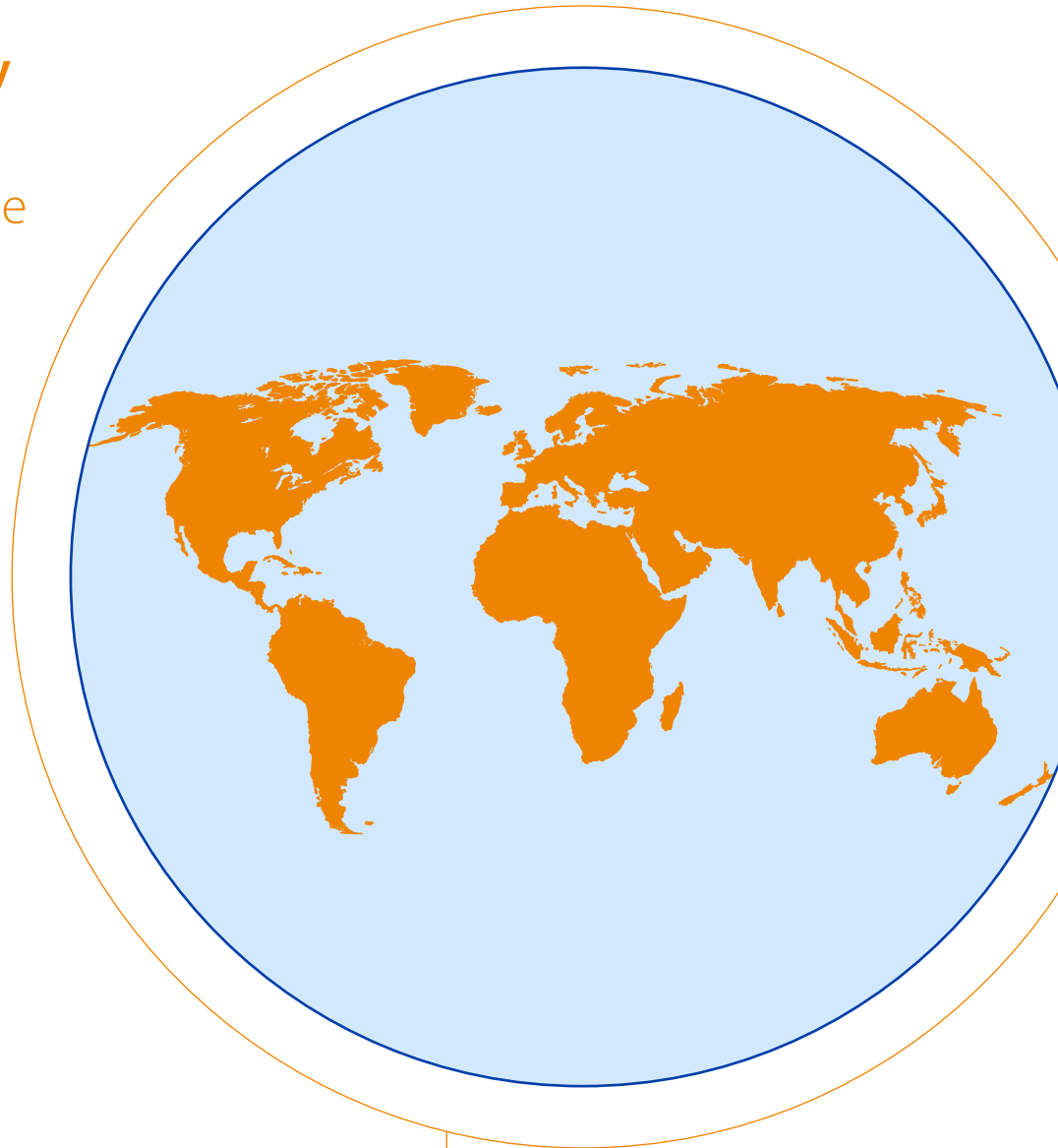
5 The Outcomes and Findings of Project Inthanon-LionRock and Next Steps. Hong Kong Monetary Authority. <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2020/01/20200122-4/>, Jan 2020.

6 Multiple CBDC (mCBDC) Bridge. Bank of International Settlement. https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm, Apr 2021.

7 India may pilot a CBDC soon, says central bank deputy governor. Ledger Insights. <https://www.ledgerinsights.com/india-may-pilot-cbdc-central-bank-digital-rupee/>, Jul 2021.

DIAGRAM A

Digital Currency Developments Around The Globe



LAUNCHED

- **Sand Dollar:** The Bahamas

PILOT / DEVELOPMENT

- **Digital Yen:** Japan
- **eCNY:** Mainland China
- **E-krona:** Sweden
- **mCBDC Bridge:** Hong Kong SAR, Thailand, Mainland China, United Arab Emirates (UAE)
- **Project Ubin:** Singapore

RESEARCH

- **Digital Dollar:** United States
- **Digital Euro:** European Union
- **Digital Pound:** United Kingdom
- **Digital Real:** Brazil
- **eAUD:** Australia
- **Project Aurum:** Hong Kong SAR

1.2 Rationale

SUMMARY ■ Six key motivations contribute to central banks' considerations of whether to issue a CBDC:

01.....
Protection of centralised monetary policy

02.....
Continued public access to central bank money

03.....
Increase operational resilience and security

04.....
Financial inclusion

05.....
Encourage competition and interoperability

06.....
Reduce costs associated with cash

Central banks' objectives will determine how they design and adopt CBDCs. We have identified six key motivations that factor into their assessments.

01 PROTECTION OF CENTRALISED MONETARY POLICY

Some central banks have argued that the momentum in private sector digital currencies such as cryptocurrencies and stablecoins could pose — depending on the design, regulation, and scale — a risk to a central bank's ability to execute monetary policy, and potentially to monetary sovereignty. Central banks have argued that if private sector

digital currencies gain sizeable share, the creation of a 'parallel' money supply could inhibit the transmission of monetary policy. Similarly, when at scale, using private digital currency to move value across borders could impact the efficacy of capital controls and the stability of exchange rates. This may have downstream effects on inflation and interest rates, potentially impacting monetary sovereignty. A creation of a central bank alternative can thereby help mitigate the perceived risk from global stablecoins and protect centralised monetary policy.

02 CONTINUED PUBLIC ACCESS TO CENTRAL BANK MONEY

For economies that are near cashless due to high digital payments maturity, or those that have leapfrogged plastic to digital payments, a significant concern revolves around maintaining public access to central bank money. With the increasingly marginalised role of cash, CBDC can become an effective way to ensure continued access to risk-free central bank money, thereby maintaining public confidence.

For instance, Sweden's central bank, the Riksbank — an early leader in CBDC exploration — is looking

to develop the e-krona in part as a response to the declining use of cash and is therefore piloting a digital solution which may ultimately complement cash⁸. Within the last decade, the percentage of people paying with cash in Sweden has decreased from 39% to 9%⁹, implying that direct access to risk-free central bank money is increasingly limited for citizens. e-krona could allow the Riksbank to continue to guarantee public access to central bank money especially in a crisis, and can limit the dependence on intermediary institutions to transmit monetary or fiscal policy, particularly in the backdrop of zero or negative interest rates. >

8 E-krona pilot phase 1. Sveriges Riksbank. <https://www.riksbank.se/globalassets/media/rapporter/e-krona/2021/e-krona-pilot-phase-1.pdf>, Apr 2021.

9 Payments in Sweden 2020. Sveriges Riksbank. <https://www.riksbank.se/en-gb/payments--cash/payments-in-sweden/payments-in-sweden-2020/1.-the-payment-market-is-being-digitalised/cash-is-losing-ground/>, Oct 2020.

03 INCREASE OPERATIONAL RESILIENCE AND SECURITY

With increasingly digitised economies, cash may become a less reliable large-scale backup method of payment in the event of an electronic system failure. In a digitised economy, CBDC could act as that backup payment method and help maintain operational resilience and

ensure business continuity. As compared to physical cash, CBDCs — particularly an offline tokenised version — can be a better way to distribute funds into geographically remote or dispersed areas. A key prerequisite to fulfilling this function lies in the ability to conduct CBDC payment without network access. Offline payment capability will ensure that transactions will be uninterrupted and resynced upon gaining network connectivity¹⁰.

04 FINANCIAL INCLUSION

CBDCs could improve financial inclusion, especially in countries where the formal financial system is underdeveloped. About 1.7 billion adults globally remain unbanked and lack proper access to financial services; yet, two-thirds of the unbanked population owns a mobile device¹¹. A digital currency that is distributed through a consumer-facing digital wallet can offer services for the unbanked or underserved to transact, invest, and store money using their mobile device.

Government-to-citizen direct payments in a crisis is one example. During the COVID-19, quickly getting stimulus

payments into consumers' hands could be costly and difficult without a bank account. This prompted the United States to explore the possibility of a digital dollar to distribute stimulus payments to unbanked Americans¹².

Further, the infrastructure to distribute physical currency may be inefficient, especially in rural areas. For instance, the Bahamas introduced the Sand Dollar to improve financial inclusion for its population of 390,000, spread across 30 inhabited islands¹³. Critically, a CBDC that integrates with a robust and licensed digital wallet ecosystem, can not only distribute funds effectively, but also help discourage the use of underground or illicit financial services.

05 ENCOURAGE COMPETITION AND INTEROPERABILITY

CBDCs can encourage competition and interoperability, especially in markets where consumer usage is concentrated within a few private payment systems. By leveraging public-private partnerships, central banks can issue a new centralised digital currency that facilitates

collaborative participation across financial institutions, fintechs, wallet players and others in the ecosystem. As an example, China's eCNY can be stored in a variety of wallet types and co-exist with existing online payment platforms (e.g. Alipay, Wechat Pay)¹⁴. To further encourage innovation, central banks may develop common standards and a developer-friendly ecosystem to stimulate the growth of valued-added services on existing infrastructure.

06 REDUCE COSTS ASSOCIATED WITH CASH

The push towards digitisation with a CBDC may reduce costs associated with minting, distributing, and managing physical cash. IMF has cited that the private costs of using cash across countries like Uruguay, Norway, Canada,

Albania, and Guyana ranged between 0.2% to 2.5% of GDP. While the initial setup for CBDC may incur substantial fixed costs, the subsequent operational costs would likely be lower. However, managing a digital currency will likely bring complexity as central banks evaluate the costs surrounding labour, infrastructure, software, cybersecurity, and customer support¹⁵. 🌐

10 Central bank digital currencies: foundational principles and core features. Bank of International Settlements. <https://www.bis.org/publ/othp33.htm>, Oct 2020.

11 The Unbanked. Global Findex World Bank. https://globalfindex.worldbank.org/sites/globalfindex/files/chapters/2017%20Findex%20full%20report_chapter2.pdf, 2017.

12 House Democrats Counterproposal For Stimulus. Mar 2020.

13 Ready, steady, go? – Results of the third BIS survey on central bank digital currency. Monetary and Economic Department, Bank for International Settlements. <https://www.bis.org/publ/bppdf/bispap114.pdf>, Jan 2021.

14 China's Digital Yuan Wallets Are 'Inclusive,' PBOC Official Says. Bloomberg News. <https://www.bloomberg.com/news/articles/2021-06-11/china-s-digital-yuan-wallets-are-inclusive-pboc-official-says>, Jun 2021.

15 A Survey of Research on Retail Central Bank Digital Currency. International Monetary Fund. <https://doi.org/10.5089/9781513547787.001>, Jun 2020.

2.0

CBDC Types and Considerations

In addition to the motivations behind implementing a CBDC, central banks must explore several considerations:

- **CBDC TYPES**
- **SYSTEM DESIGN**
- **ADOPTION ENABLERS**
- **ECOSYSTEM READINESS**

This section explores the key characteristics and considerations around CBDC. 🌐



2.1 Common Types

- SUMMARY** ■ CBDC models generally fall under two broad types – retail and wholesale CBDC
- Retail CBDC, for everyday business and consumer transactions, is often pursued in markets looking to increase stability, efficiency and accessibility of the financial system
 - Wholesale CBDC, for institutional transactions, is often pursued by advanced economies with a more established interbank system

CBDC models are diverging towards two common types — retail and wholesale CBDC. Retail CBDC is a consumer and merchant facing variant that can be used for general purpose retail transactions, whereas wholesale CBDC is an interbank variant intended for use by financial institutions to conduct bank to bank transfers. It is important to note that these types are not mutually exclusive, as central banks may explore just one, both, or sequentially.

RETAIL CBDC

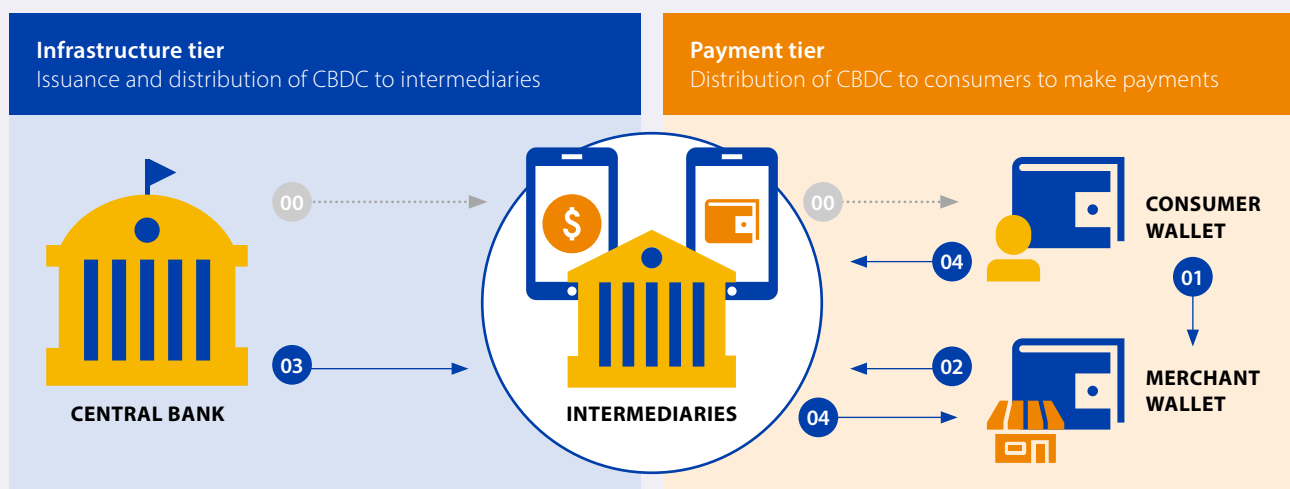
Retail CBDC is a consumer and merchant facing type that can be used for general purposes like everyday transactions. This implementation will likely adopt a ‘two-tier’ approach to include a mix of public and private participants such as the central bank, financial institutions, fintechs, and wallet apps. One commonly discussed type of implementation involves using public-key infrastructure with the central bank as the root certificate authority for generating digital signatures, and other financial institutions as intermediate certificate authorities. In most implementations, central banks would handle the infrastructure tier and be responsible for the mint and burn of the digital currency, though the intermediaries could also play these roles. The private sector then handles the payment tier and facilitates customer-facing activities like currency distribution and transactions¹⁶. Diagram B details out a hypothetical payment flow that involves the central bank, intermediaries, and consumer/merchant facing wallet players.

When CBDCs were first conceived, ‘one-tier’ or direct implementations were primarily considered, where central banks would be responsible for the consumer facing activities (e.g., hold the consumer accounts), account administration, as well as the mint and burn of the currency. However, there are several challenges with this model. Technically, building scalable infrastructure to enable every citizen to access central bank systems is likely to be expensive and time intensive. Operationally, the effort required for a central bank to manage account services, AML/KYC monitoring, transaction verification, dispute resolution and provision of any mobile banking applications is resource intensive. Lastly, the reduction of deposits at financial institutions will decrease the availability of bank credit and pose risks to overall financial stability. With these challenges, there is now a growing consensus across central banks to leverage a two-tier model with public-private partnerships. >

16 Towards a Two-Tier Hierarchical Infrastructure: An Offline Payment System for Central Bank Digital Currencies. Visa. <https://arxiv.org/pdf/2012.08003.pdf>, Dec 2020.

Retail CBDC

DIAGRAM B



Develops system rules and typically issues the CBDC tokens, though some may choose to outsource

Banks, fintechs and consumer tech platforms etc.; responsible for distribution and issuance in some cases

Consumers/merchants access CBDC via intermediaries' digital wallets; may be interoperable across wallets

Hypothetical payment flow

00

Central bank mints CBDC tokens and distributes to consumers via intermediaries

01

Payment initiated via consumer wallet; request is digitally signed with payer's cryptographic private key

02

Merchant wallet receives request, signs with payee private key and passes on to intermediary

03

Intermediary validates; system burns the payer's CBDC token, and mints new tokens with payee ownership

04

CBDC is transferred from consumer wallet to merchant wallet in real time

The motivation driving central banks to explore retail CBDC is varied. Some as noted earlier include increasing public access to central bank money, driving interoperability and competition between consumer interfaces, and increasing visibility and traceability of transactions.

WHOLESALE CBDC

Wholesale CBDCs are designed to facilitate secure interbank transfers and settlements between financial institutions. While retail CBDC may likely adopt a two-tier model by leveraging intermediaries, the wholesale type takes a one-tier structure as it does not involve consumers or merchants, and hence does not require intermediaries to distribute the currency.

The BIS indicates that the key arguments for wholesale CBDCs revolve around improving efficiency of domestic interbank settlement infrastructure and increasing security of transactions. When compared to traditional central bank reserves, a wholesale CBDC may improve the settlement efficiency and

risk management aspects¹⁷. Counterparty credit and liquidity risks could also be reduced as wholesale CBDC transactions will be directly facilitated by the central bank rather than intermediaries. In markets where Real-Time Payment (RTP) rails are not established or are concentrated on consumer use cases, this implementation could also allow countries to streamline interbank transfers and experiment with digital currency. For markets adopting a wholesale approach, central banks may mandate participation to drive significant network effects.

Lastly, cross-border payments is another key driver for wholesale CBDC that central banks are exploring. For instance, The mCBDC Bridge by Bank of Thailand (BOT), Hong Kong Monetary Authority (HKMA), People's Bank of China and the Central Bank of the United Arab Emirates considered the application of digital ledger technology (DLT) to facilitate real-time cross-border bank payments¹⁸. Similarly, the Jasper-Ubin project by the Monetary Authority of Singapore (MAS) and The Bank of Canada (BOC) experimented with using two DLT platforms to perform cross-border, cross-currency, cross-platform high value payments¹⁹. 🌐

¹⁷ Central bank digital currencies - Committee on payments and market infrastructures. Markets Committee, Bank of International Settlements. <https://www.bis.org/cpmi/publ/d174.htm>, March 2018.

¹⁸ Multiple CBDC (mCBDC) Bridge. Bank of International Settlements. https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm

¹⁹ Jasper-Ubin Design Paper. Bank of Canada, Monetary Authority of Singapore, Accenture, J.P.Morgan. <https://www.mas.gov.sg/-/media/Jasper-Ubin-Design-Paper.pdf>, May 2019.

2.2 Design Considerations

SUMMARY ■ Central banks are factoring three main design considerations into CBDC development:

01.....
Architecture

02.....
Economic model

03.....
Impact on financial system

Beyond the choice of the CBDC type highlighted above (retail versus wholesale), there are a few additional considerations central banks are factoring into CBDC system design.

01 ARCHITECTURE

As identified by the BIS, there are three primary questions central banks are looking to address vis a vis system architecture²⁰:

a. Operational role for the central bank: In a one-tier model, the CBDC represents a direct claim on the central bank, who keeps a record of all balances and transactions; this is generally not being pursued by central banks given technical and operational complexity. In a two-tier model (as per Diagram B), the consumer has a claim on the intermediary, and the central bank only keeps a record of the wholesale balances.

b. Centralised versus Distributed Ledger Technology (DLT) backbone: Today, central banks' infrastructure typically employs a centralised ledger, with data storage across multiple data centres or stored in the cloud to allow for business continuity. In a DLT architecture, multiple decentralised nodes maintain the ledger jointly and simultaneously update the ledger via consensus mechanisms, which typically results in lower throughput.

c. Token versus account-based infrastructure: As mentioned previously, an account-based system directly provides accounts from the central bank to the population to move digital cash balances. Subsequently, this structure would link user identity and record the value being stored in conjunction with an identity. In contrast, a token-based model is a claim on the central bank, creating a digital bearer asset. This allows the digital currency to be easily circulated in the economy, and by leveraging public-key infrastructure to safeguard the tokens, can grant access to any individual or business. The token model offers greater operational simplicity as it enables universal access (similar to cash), and can offer greater privacy; however, the risk of funds loss if private keys are lost is high, and additional AML/CFT frameworks need to be established given the potential for anonymity (similar to cash). ➤

²⁰ Central bank digital currencies - Committee on payments and market infrastructures. Markets Committee, Bank of International Settlements. <https://www.bis.org/cpmi/publ/d174.htm>, March 2018.



02 ECONOMIC MODEL

Given that CBDCs are intended to serve as 'digital cash', most implementations are likely to have low or no explicit fees, which are typically associated with electronic payments today. However, most central banks expect to leverage the existing payment infrastructure by utilising private participants to issue or distribute the digital token, enable payments via these tokens, and provide enhanced consumer protection such as wallet recovery, fraud check and dispute resolution. Central banks may need to define the appropriate incentives for private sector players to participate in and maintain the infrastructure. As private sector players develop business models that leverage CBDC, e.g., by harnessing transaction data to provide value-added services, central banks may need to develop a regulatory framework that balances the economic incentives of the players with privacy and security concerns.

03 IMPACT ON THE FINANCIAL SYSTEM

Given the wide-ranging implications, central banks and multilateral organisations are studying the impact of a CBDC on macroeconomic stability. The introduction of a general purpose CBDC could have significant impact on bank funding sources, with resultant effects on credit creation and monetary policy transmission. Even if a CBDC is introduced primarily as a payment mechanism, its status as a legal tender and wide monetary base (i.e. M0 money) means it can be a new source of competition for bank deposits, and may cause some shifts from bank deposits to the new asset. In turn, this could both limit the availability of bank lending, as well as increase the cost of funds. Specific issues need careful consideration in the context of the relevant market. 🌐

2.3 Adoption Enablers

SUMMARY ■ Central banks should consider some key enablers to curate the right environment for CBDC and drive adoption:

- Interoperable standards
- Security
- Developer-friendly ecosystem
- Merchant acceptance
- Customer value proposition and experience

Regardless of the models of CBDC, several adoption enablers may drive the usage and scalability of a new payment solution.

INTEROPERABLE STANDARDS

Ecosystem participants rely on standards to set rules and best practices. A common approach at the physical and technical levels can spur innovation through a developer-friendly ecosystem, drive seamless merchant acceptance and interoperability with existing payment systems, provide flexibility to preserve vigorous competition, and pave the way for cross-border use cases.

Cross-border payments will be a natural challenge for CBDC as developments are likely to prioritise domestic environments²¹. Individuals will expect to be able to use their CBDC for cross-border payments, just like they can with other digital payments, and may not accept the friction that comes from different local systems or compliance requirements. These issues can be mitigated by considering cross-border use cases in the initial designs of CBDC systems. Central banks can consider partnerships with international organisations to establish interoperable global standards.

SECURITY

Consumers expect any form of new money they use to be secure and trustworthy. Therefore, the issuance of a CBDC calls for sophisticated and advanced risk management capabilities and investment spanning fraud, AML/CFT, operational resilience and cybersecurity. An integrated approach to fraud prevention, cybersecurity and cyber risk management will enable optimal data sharing to mitigate and defend against increasingly sophisticated attacks from nation-states and transnational organised criminal and terrorist organisations. ➤

²¹ Central bank digital currencies for cross-border payments. Bank of International Settlement. <https://www.bis.org/publ/othp38.htm>, Jul 2021.

DEVELOPER-FRIENDLY ECOSYSTEM

Encouraging innovation and promoting competition is in the best interest of the consumer experience, and central banks are in the best position to facilitate this. Maintaining a resilient payments network will also require continuous innovation and investment in technology.

Promoting a developer-friendly ecosystem will allow ecosystem players to openly contribute and build on top of existing

infrastructure. Central banks can focus on foundational enablers like interoperable standards, security, and certainty of acceptance, while intermediaries can deliver innovative services to provide user experiences and consumer choice. This can help decrease the burden for central banks to become the sole innovator for the infrastructure. The private sector has continuously provided its users with payments innovations that meet their needs, and that are increasingly interoperable with other platforms and devices. With a developer-friendly ecosystem, they can continue to create value-added services for new use cases and business models.

MERCHANT ACCEPTANCE

Adoption of retail models by the end consumer will largely depend on two factors — merchant acceptance and consumer usage. On merchant acceptance, CBDCs should be well-integrated and interoperable with the existing payment system to ensure it can be easily accepted at acceptance points for cash and non-cash payments. Especially for a new currency and

experience, consumer adoption may largely depend on the robustness of the acceptance network.

Further, merchants currently benefit from digital payments in ways such as improved cash flow, transaction processing time, security, resilience, and consumer convenience and protections. CBDCs that can match or become even more attractive than existing payment experiences can motivate merchant acceptance.

CONSUMER VALUE PROPOSITION AND EXPERIENCES

Complementing merchant acceptance, consumer usage will be key for retail adoptions. As payment platforms and choices proliferate, consumers now demand high quality and streamlined digital experiences as baseline offerings. As retail CBDCs may not represent a material improvement over existing payment systems, a strong value proposition and complementary high-quality experiences should be created and clearly communicated to consumers. In fact, depending on the execution, consumers may notice little difference between CBDC and the existing electronic payment system. Especially in markets where access to the financial system is limited, CBDC transactions and features should be easily accessible to the unbanked and underbanked population.

Consumers also need to have a choice between payment methods and networks, enabling them to make use of the features most important to them at any point in time. For instance, the irrevocable nature of instant settlement may introduce significant risk for consumers in the absence of fraud detection and dispute resolution mechanisms, and is therefore not likely to be appropriate for all payments. Therefore, it would be essential for CBDCs to be distributed across all payment networks, such as cards and instant payments, to offer both choice and larger scope for additional functionalities and use cases.

Private entities responsible for the consumer-facing activities have a critical role to encourage user adoption. They will need to provide an intuitive, frictionless, and integrated experience for consumers to understand and utilise a new currency. 🌐

2.4 Ecosystem Readiness

- SUMMARY**
- Public-private partnerships can decrease the burden of the central bank and delegate the operation and maintenance of the CBDC network across the payment ecosystem
 - Roles can be considered from three perspectives — central banks, intermediaries, and end users

Especially for retail use cases, central banks can establish public-private partnerships to encourage a two-tiered CBDC infrastructure. An efficient operational structure can designate private sector players for the design and distribution of the digital currency while the central bank can focus on core functions of regulation, risk mitigation, and supervision. This can retain the comparative advantages of the public and private sectors and cultivate a space for payments innovation and financial stability.

Below is an illustration of potential ecosystem player roles:



DIAGRAM C

3.0

How Visa Can Support

As a world leader in digital payments, Visa's strategy is to evolve beyond the card into a [network of networks](#) by enabling the movement of money and data for everyone, everywhere for any transaction, on and beyond the Visa network.

Digital currency, and particularly CBDC, complements our commitment to evolve and support new forms of payments. Visa aims to become a valuable partner by investing efforts and expanding expertise across three areas of focus: researching digital currency topics such as offline capabilities and privacy; applying that research in building new products to support digital currencies and actively participating in retail CBDC pilots; and jointly evaluating the path forward with central banks and partners in our Digital Currency Innovation Hub. 🌐



3.1 Research and Thought Leadership

- SUMMARY** ■ We are helping to develop and promote best practices for digital currency across five broad areas — security, interoperability, scalability, privacy, and offline capability
- Highlights include developing an offline payment system protocol, exploring sharding protocols, and researching the interoperability between cross-border payments

As an established expert in the payment space, Visa continues to expand knowledge in digital currency through rigorous research. We are helping to develop and promote best practices across five broad areas — security, interoperability, scalability, privacy, and offline capability.

SECURITY

Visa has established itself as a leader in tokenisation with established experience in tokenising Primary Account Numbers (PANs) and account information. We have made investments to ensure the safety and security of cryptographic keys, which are in continuous use to protect the communication between issuers, acquirers, and the network. For instance, in 2019, we co-led investments with a leading cryptographic custodian provider to support custody for digital currencies. Furthermore, the requirements of tokenisation and mobile/internet-

of-things payments mean that we have built the infrastructure to secure, manage, and revoke keys at scale, including those that validate billions of account holders.

We recognise that enterprise adoption of blockchain technology can improve several core functions in financial services by providing tamper-evident and tamper-resistant digital ledgers. However, absent further innovations, inherent challenges with respect to improving scalability, security and device usage, can limit consumer adoption and fail to meet regulatory standards.

INTEROPERABILITY

As central banks globally develop individual CBDC systems, it's likely there will be a range of choices in terms of technology, governance, market requirements, and levels of monitoring and compliance standards for the design of CBDC. These differences could limit the interoperability of CBDC networks, adding friction to future cross-border CBDC payments.

As a global network, Visa understands the importance of interoperability and is actively researching the technical and policy challenges of cross-border payments in the emerging age of CBDCs. We are commencing projects on how to apply cryptographic primitives in CBDC networks to support interoperability between different payment systems to support digital money movement. As with all considerations regarding CBDC, these decisions will be based upon the unique policy objectives of the central bank and how it envisions the future CBDC ecosystem. ➤

SCALABILITY

Visa has deep expertise in building robust networks that can facilitate secure transactions globally. Now, we are translating this expertise to the digital currency space by building resilient digital currency payment protocols that are capable of handling a large amount of transaction flows into digital ledgers while achieving faster settlement speed. We are exploring the blockchain technology and proposing solutions like sharding, a mechanism to split and store a single database

into multiple sets, which divides computational and storage workload across the nodes and increases the scalability of the network. For instance, we have proposed a sharding protocol called RapidChain that improves the scalability and security limitations of the existing blockchain network²². We have also partnered with other research centres to propose protocols such as FlyClient that lays out the applicability of a transaction verification light client, which would decrease the amount of time and computational power needed to verify transactions²³.

PRIVACY

CBDC-issued digital tokens bring new capabilities that both promise to improve the current situation of privacy and potentially impact it negatively. On the positive side, CBDC tokens can be programmed to record basic transaction data, including information on amount, time, receiver, and sender. A CBDC network built around digital ledger technology, as is sometimes proposed, can enable the effective recording of such transaction data in a way that is easily available to central banks and perhaps other

government agencies. At the same time, CBDC tokens are likely to be widely accepted and used on many networks, not only on the originating network on which they were issued. This includes the use of CBDC tokens for cross-border transactions. This means that the transaction history including user information will be split across many financial institutions and network providers, multiple jurisdictions, and with varying rules and regulations on privacy and security — even when CBDC tokens are involved. Visa is researching into privacy preserving mechanisms to balance the token based capabilities with consumer protection.

OFFLINE CAPABILITY

Digital payments traditionally rely on online communications with several intermediaries such as banks, payment networks, and payment processors in order to authorise and process payment transactions. While these communication networks are designed to be highly available with continuous uptime, there may be times when an end-user experiences little or no access to network connectivity.

To allow CBDC to be broadly accessible and transferable in real-time without continuous dependency upon digital connectivity, an “offline” capability to create secure point-to-point payments through the use of authorised hardware will be critical. An offline capability for CBDC as digital cash can create a resilient payment system for consumers and businesses to transact in any situation.

Visa recently published a technical paper where we proposed an offline payment system (OPS) protocol for CBDC that allows

a user to make digital payments to another user while both users are temporarily offline and unable to connect to payment intermediaries (or even the Internet)²⁴. OPS can be used to instantly complete a transaction involving any form of digital currency over a point-to-point channel without communicating with any payment intermediary, achieving virtually unbounded throughput and real-time transaction latency. In addition, our OPS protocol is designed to address the need to ensure funds cannot be double-spent during offline payments given that no trusted intermediary is present in the payment loop to protect against replay of payment transactions. This is achieved through reliance on digital signatures generated by trusted execution environments (TEEs) which are already available on most computer devices, including smartphones and tablets. While a TEE brings the primary point of trust to an offline device, an OPS system requires several cryptographic protocols to enable the secure exchange of funds between multiple TEE-enabled devices, and hence a reliable financial ecosystem that can securely support CBDC at scale. 🌐

²² RapidChain: Scaling Blockchain via Full Sharding. Visa Research, Dfinity, Yale University. <https://eprint.iacr.org/2018/460.pdf>, Oct 2018.

²³ FlyClient: Super-Light Clients for Cryptocurrencies. Stanford University, Northwestern University, Kyber Network, Visa Research. <https://eprint.iacr.org/2019/226.pdf>, Aug 2020.

²⁴ Towards a Two-Tier Hierarchical Infrastructure: An Offline Payment System for Central Bank Digital Currencies. Visa. <https://arxiv.org/pdf/2012.08003.pdf>, Dec 2020.

3.2 Products and Partnerships

- SUMMARY**
- Visa has partnered with over 50 of the leading crypto platforms on card programs that make it easy to convert and spend digital currency
 - We are the first major network to receive settlement in stablecoin
 - We are offering plug and play digital currency APIs

Building on top of our research initiatives, Visa has invested in a variety of new technologies and solutions that enhance our digital currency capabilities. We look forward to expanding our private sector digital currency investments to the public sector space to assist and accelerate CBDC developments.

01 PARTNERSHIPS

Visa has established over 50 partnerships with digital currency wallets to issue Visa credentials and enable digital currency for payment at 70 million merchants worldwide. In the first half of 2021, more than USD 1 billion was transacted on crypto-linked cards²⁵. These collaborations facilitate a fiat transaction with a digital currency funding

source, and span across the consumer and business use cases. For the former, Visa partners with digital currency players like Coinbase, Bitpanda, and Fold, to allow consumers to spend cryptocurrency at point of sale and provide digital currency rewards. For the latter, we are partnering with private entities like Circle to allow business payouts in stablecoin (USDC), which can then be used for transactions at Visa acceptance points.

02 NON-TRADITIONAL PAYMENT FLOWS

Visa has deep expertise in enabling non-traditional payment flows, including person-to-person (“P2P”), business-to-consumer (“B2C”), business-to-business (“B2B”) and government-to-consumer (“G2C”). Our robust set of networks across VisaNet, Visa Direct, Visa B2B Connect, and Visa RTX expand and enhance the ability to facilitate more transactions globally. The reach and capability of these networks can be replicated for the digital currency space to encourage adoption.

Visa is one of the few global commercial entities that has built a blockchain network from scratch. The Visa B2B Connect network is built upon enterprise blockchain infrastructure that facilitates financial transactions on a private, permissioned blockchain network. Leveraging our expertise and commitment to uphold the ecosystem, Visa networks will evolve to be not only scalable, but more importantly, designed to meet and exceed high standards for compliance, control, governance, and security. ➤

²⁵ Visa says spending on crypto-linked cards topped US\$1 billion in first half this year. Channel News Asia. <https://www.channelnewsasia.com/news/business/visa-says-spending-on-crypto-linked-cards-topped-us-1-billion-in-first-half-this-year-15174520>, Jul 2021.



03 SETTLEMENT

At the start of 2021, Visa became the first major network to directly accept a stablecoin (USDC) to meet settlement obligations. Our standard settlement process requires partners to convert their digital currencies into a traditional fiat currency, which adds cost, time, and complexity to their daily business processes. This new

process required a number of key functions; support reconciliation and currency conversion for the selected digital currency; integrate Visa's global treasury systems with digital asset custodians; and support a new Visa settlement report that includes settlement obligations along with public blockchain addresses for account management of crypto wallets and issuers.

04 VISA CRYPTO API'S

To expand the accessibility of digital currency for consumers and enable our clients to more easily offer related services, Visa is creating a set of Visa Crypto

APIs. These APIs add significant utility to existing digital currency wallets by expanding digital currency acceptance and usage. Financial institutions and fintechs can leverage this integrable solution to transform their digital experience into a digital currency access point.

05 FINANCIAL INCLUSION

Besides increasing utility, we also envision digital currency as a means to foster economic empowerment and financial inclusion of underserved communities.

For instance, we have partnered with First Boulevard, a US-based neobank focused on the Black community, to enhance financial literacy using this new asset class and empower customers to buy and sell digital currencies. 🌍

3.3 Innovation Hub

SUMMARY ■ Visa welcomes central banks to ideate, co-create, and test CBDC models in our innovation hub

Visa has established a platform for partners to ideate, co-create, and test on the expansive opportunities in the CBDC space.

Central banks can leverage Visa's Digital Currency Innovation Hub and exploration expertise to jointly assess the market landscape, determine the appropriate types of CDBC, and pilot interested models. In the innovation hub, central banks can learn more about the trends in the digital currency space and assess the appetite and applicability of CBDC for respective markets.

We can then co-create concepts for new digital currency technologies. With an iterative discover, design, and develop approach, we can test concepts in an agile, flexible way. Once solution concepts are formulated, we can build proof of concepts and pilots with our Visa payment engineering experts. Our existing efforts across research and thought leadership, and products and partnerships are testaments to the potential of our partnership together. 🌐

Conclusion

CBDC has been gaining significant interest and momentum in recent years, with 86% of central banks now actively assessing a digital version of central bank money. Yet, it's key to note that the introduction of a CBDC is a complex and nuanced undertaking with a wide range of implications for the financial system. To properly assess these implications, central banks are grappling with several considerations such as type, system design, and impact on the wider payments ecosystem.

Visa has been extending our expertise, investments, and platforms to ensure that we will be a trusted and experienced partner for CBDC conversations. Central banks are invited to discuss their interest and partner on potential pilots with with our Asia Pacific Digital Currency team. 🌐

Case Study: Mainland China



Project started
in **2014**



13 pilots
across major
cities



2 million
participants
across the nation



Enabling international
users by **2022**

China began developing a digital version of the yuan in 2014. Formally known as Digital Currency Electronic Payment (DCEP) and now called eCNY, China's CBDC project is the most advanced in the Asia Pacific region. As of July 2021, there have been 13 pilots across major cities such as Shenzhen, Suzhou, Beijing, Chengdu, Changsha, and Shanghai, offering over 270 million digital yuan to more than two million people across the nation²⁶. Trials involve digital red packet giveaways, where residents can sign up for a lottery and winners can receive the digital yuan by downloading and registering on the digital yuan app. The digital yuan can then be spent in various form factors (e.g., bar code, contactless) at eligible merchants across the cities. Cross-border trials are also commencing; in the April 2021 Luohu Shenzhen pilot, Hong Kong residents who visit Luohu can use a Hong Kong mobile number or Chinese ID to download and register on the digital yuan app²⁷. Several new regions such as Hainan, Xi'an, Qingdao and Dalian have been confirmed to join the pilot²⁷. China is working towards enabling eCNY for international users during the 2022 Beijing Winter Olympics²⁸.

In keeping with the global trend, eCNY leverages a two-tier model with partnerships between public and private entities. Currently, seven commercial banks are participating in the pilot programs to offer testing of digital yuan. Many are offering front

-end digital wallets that are compatible with eCNY. Similarly, private sector entities are beginning to play intermediary roles. Third party platforms such as Didi Chuxing, Meituan Dianping, Bilibili have been reported to begin exploring applications of eCNY²⁹, while JD.com became the first digital platform to accept digital currency as a payment option³⁰.

Currently, retail payments in China are mostly conducted on private sector closed-loop wallets (Alipay, WeChat Pay), which are not compatible with one another. A key objective of eCNY is to promote greater interoperability between payment solutions by enabling digital yuan to be accepted wherever electronic payments are available³⁰. Private sectors have begun to develop front end solutions for this. For instance, JD Technology launched a B2B payment solution, Yiqipay, which supports digital yuan payment between various digital wallets³⁰.

Some of the other cited motivations include diversifying the forms of cash available to the public, supporting financial inclusion, and improving cross-border payments³¹. It's also suggested that eCNY can increase the liquidity of M0 supply by retaining the characteristics of a physical currency while reducing the cost related to minting and distributing. 🌐

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30 JD.com demos digital yuan interoperability as Ant, Tencent share their work. Ledger Insights. <https://www.ledgerinsights.com/jd-com-demo-digital-yuan-interoperability-ant-tencent-huawei/>, Apr 2021.

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