



CBDC

Central bank digital currencies: user needs and adoption

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If potential central bank digital currencies (CBDCs) are to achieve their policy goals, they would need to be adopted by users and accepted by merchants. This report outlines the considerations for central banks in designing a CBDC that might fulfil user needs both now and in the future. Learning from past payment innovations, considering the features most valued by users, investigating incentives for adoption and carrying out consultations could all play an important role in CBDC design. The next steps for this work will be to continue research on the impact user requirements and financial stability safeguards on system design, and the range of approaches to public engagement and consultation on CBDC.

1. Introduction and general overview

A central bank digital currency (CBDC) would need to be adopted and used if it is to fulfil public policy goals that motivate its issuance.¹ Integral to achieving adoption and use of a general purpose CBDC in a jurisdiction would be understanding and serving current and future user needs in a fast-changing payments landscape. This report examines what drives user adoption of digital payment services, referencing the use-cases and design choices envisaged for CBDC. Without being prescriptive or precise about a specific level of adoption that might ensure success of a CBDC project, this report presents issues that jurisdictions may wish to consider in their own evaluations.

Key messages:

- **CBDC adoption would likely be driven by its future usefulness to users and acceptance by merchants.** Central bank money is the safest form of money available. Yet beyond security, other valuable features of CBDC could include lower cost to consumers and merchants, offline payments, a higher level of privacy in comparison to commercial options and multiple accessibility features.
- **A CBDC would need to anticipate the needs of future users and incorporate related innovations.** Central banks might accommodate evolving user needs by designing a flexible core system, supporting a diverse ecosystem of intermediaries delivering choice, competition and innovation. As payments become increasingly integrated into digital living, a CBDC available to innovators could combine innovative features into a single product in a new and unique way.
- **Strategies for CBDC adoption would need to be tailored to the diverse economic structures and payment landscapes in individual jurisdictions,** but experience points to some common factors. Specifically, adoption may be more successful if it fulfilled unmet user needs, achieved network effects, and were implemented with the use of existing, accessible technology and infrastructure (eg at the point of sale). Additional measures that some jurisdictions might consider for a potential CBDC adoption strategy include the use of CBDC by public sector authorities, requiring some minimum level of acceptance and supporting future payment needs. Not all strategies would be desirable in all jurisdictions.
- **A CBDC adoption strategy in a fast-changing payments landscape would require balancing the needs of the majority of consumers with reaching smaller parts of the population.** Different users and needs would need to be defined and addressed in the system's design. The analysis of specific market segments through user personas and stories could provide an important method for investigating user needs and designing informative consultations with prospective end-users.

¹ Central bank digital currency is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts ie a digital payment instrument, denominated in the national unit of account (Group of central banks (2020)).

- Further exploration will involve considering how financial stability safeguards might allow the CBDC adoption needed to meet public policy objectives and user needs, how user requirements could impact system designs, and the approach to public consultation and communications on CBDC

Section 2 provides some context on CBDC adoption. Section 3 then identifies key features of the experience with implementation of previous payments innovations (both successful and failed) and the lessons that may be drawn for CBDC. Section 4 then examines user needs followed by a discussion on strategies for designing a CBDC. The last section concludes.

2. Context on CBDC adoption

For a discussion of CBDC adoption, there are two important contextual elements from the preceding report published by this group of central banks and the BIS (Group of central banks (2020)).

First, for the central banks contributing to this report, the common motivation for exploring a general purpose CBDC is its use as a means of payment. “Use” in this report should be understood in this context. Adoption of CBDC as a means of payment would likely present the most value for public policy objectives.

Second, without continued innovation and competition to drive efficiency in a jurisdiction’s payment system, users may adopt other, less safe instruments or currencies, potentially leading to economic and consumer harm. If user needs emerge in the future, unserved by safe payment instruments, the chance of this risk materialising arguably increases.

CBDCs that support innovation and competition may play a role in supporting future user requirements for payment services. Digital payments are already rapidly changing in response to an increasing integration into evolving digital services (BIS (2020)). It is likely that these evolutions will continue and catalyse an even broader diversity of novel use cases and payments requirements than today. Central banks may therefore need to consider current and possible future user demands in their CBDC system designs, understanding where new technologies might be harnessed (eg programmable money) and through encouraging innovation and competition among intermediaries, while incorporating sufficient flexibility to evolve with digital economies (Group of central banks (2021b)).

Finally, there are broader considerations for central banks arising from user “take-up” of CBDC (ie the use of CBDC as a means of payment and potentially a store-of-value). The speed of user take-up and the potential need for transition arrangements as well as other potential safeguards are beyond the scope of this report but are necessary issues for central banks to consider in designing a potential CBDC that enhances monetary and financial stability (Group of central banks (2021a)).

3. Lessons for CBDC adoption

- Strategies for adoption would need to be tailored to the diverse economic structures and payment landscapes of individual jurisdictions, but experience points to some common factors that are relevant across jurisdictions.
- CBDC adoption may be more successful if it fulfilled unmet user needs, achieved network effects, and were implemented with the use of existing, accessible, technology and infrastructure (eg at the point of sale).

Technological innovation has been transforming the markets for retail payments at pace over recent years, with many new payment methods, platforms and interfaces evolving to become faster, cheaper and safer. These new non-financial market players have shown a strong understanding of what users need from their payments products and what conditions are necessary to facilitate adoption. Central banks would need to take into account this evolving context if they choose to launch a CBDC.

Users' needs and the strategies for ensuring successful CBDC adoption would vary from jurisdiction to jurisdiction, reflecting different economic structures, varied forms of economic activity as well as diverse payments landscapes. However, there is also significant common ground to build on. Reviewing experience with both successful and failed payments initiatives (Box 1) is a first step to identify possible lessons for CBDC implementation and adoption. Although not all of the lessons from private sector payment methods may carry over to CBDCs, which would be issued by the public sector, such lessons are nevertheless useful to understand broader questions about success factors and design choices in novel payment methods.

Experience from previous implementation of payments innovations suggests three factors that might make CBDC adoption successful. These factors are consistent with the wider literature on payment innovation and implementation.²

Fulfils unmet user needs. CBDCs would offer, in digital form, the unique advantages of central bank money: settlement finality, liquidity and integrity (BIS 2021). In addition, it would be important for CBDC to meet consumer or merchant demand that might not currently be met by existing payments products and services (see Section 3). Part of meeting these needs would be through encouraging private innovation in CBDC ecosystems (Group of central banks (2021b)). To better meet future payments needs, CBDCs might be integrated into the broader services of private intermediaries.

Achieves network effects. CBDCs might aim to achieve network effects by targeting one-sided market segments. Consumers would only use CBDC if there were merchants willing to accept it, but merchants would only accept CBDC if there were sufficient consumers who want to use it. Any central bank introducing a CBDC would need to think carefully about how to take account of such network effects. Research indicates that payment mechanisms may be more successfully adopted in a one-sided market like the person-to-person (P2P) payments market (Van der Heijden (2002) and BIS (2012)). CBDC design might therefore choose to emphasize 'peer to peer' (P2P) functionality in order to facilitate adoption. Once used for P2P payments, merchants may then have greater incentives to accept CBDC. Interoperability could also play a role in reducing frictions to user and merchant adoption (Group of central banks (2021b)).

Does not require all users to buy new devices. If a CBDC built on technology already in use, users may be more able to easily set up the account, service, app, or device they would use to hold a CBDC, and merchants may be more able to accept CBDC. However, some users, especially those without smartphones and bank accounts, may require additional hardware. In these scenarios, it may become more important for merchants to integrate CBDC into their existing payment infrastructure. If some merchants had older technology and could not add CBDC payment functionality through new software, CBDC payments might potentially be enabled through the existing infrastructures and networks. This approach might lead to near-instant adoption by the majority of merchants, using systems already integrated with their existing accounting and point of sale (PoS) systems. However, this approach would also build in a reliance on existing networks and infrastructures, with potential negative impacts on resilience and competition.

² Mallat (2007) identifies the lack of other payment methods as a critical factor in the user acceptance of mobile payments. Au and Kauffman (2007) point to unmet demand as facilitating successful innovations. Gowrisankaran and Stavins (2004) suggest that pricing below marginal costs is necessary to overcome network externalities. Van der Heijden (2002) identifies both pricing and ease of use as critical factors for consumer acceptance. Shin (2009) presents evidence that in addition to the perceived usefulness and ease of use, users' attitudes towards mobile payment solutions are influenced by perceived security and trust.

Lessons from past adoption of payment services

Long-term CBDC adoption would likely depend on the benefits of using CBDC outweighing the costs. Yet there are many examples of products that failed to become widely adopted despite long-term benefits clearly outweighing the costs – pointing to the significance of short-term frictions or barriers to initial use of any CBDC. These might include a time-consuming process for opening an account, difficulty in finding places where CBDC could be spent or, for merchants, the need to invest in new hardware. Case studies of successful and unsuccessful implementations of new payment methods, services, or instruments emphasise the importance of providing the right incentives and reducing potential frictions.

Mobile money initiatives showcase many successful implementations. **Swish**^① is a mobile phone app launched in 2012 in Sweden and used by about 80% of the population. While initially only instant P2P transfers were offered, services have expanded to online and point-of-sale payments (with QR codes). Key success factors include an initial focus on a market where no convenient digital alternative existed, easy onboarding and a strong push from banks to encourage their customers' use (to reduce the use of cash). Similar applications in Denmark (**MobilePay**^②) and Norway (**Vipps**^③) have had comparable success. Elsewhere, **M-Pesa**^④ is a mobile money platform launched in 2007 in Kenya and used by more than 95% of the population. Based on short-message-service (SMS) technology, the platform provides the unbanked population access to basic banking-like services. Similarly to Swish, key success factors appears to be that it offered a service in a market where no convenient digital alternative existed and that onboarding was easy.

Yet not all mobile payment services have been successful. **Paybox**^⑤ offered a mobile phone payment platform in Germany in 2000. Similarly to Swish, Paybox intended to facilitate payments between bank accounts. Yet insufficient advantages over established systems, high costs for users and a lack of cooperation to encourage customer use meant that adoption never managed to achieve a sustainable level.

Beyond mobile payments, some consider **DigiCash Inc**^⑥ from the early 1990s to be the world's first digital currency. Yet by 1998 it was bankrupt, having failed to see significant adoption. Working against its success were: (i) consumers not valuing its unique selling point (anonymous payments); (ii) banks hesitant to enable the service for their account holders as existing card-based electronic payments were lucrative; and (iii) a lack of partnerships with existing customer bases. Also in the early 1990s, the **Avant smart card system**^⑦ was introduced by the Bank of Finland. A digital version of cash but based on (at the time) cutting edge smart card technology, the system also provided anonymity but achieved wide acceptance. After three years in operation, the Bank of Finland sold the system to commercial banks. Yet when debit cards upgraded with technology like that in Avant, it was shut down. Decline followed merchants' unwillingness to support multiple payments hardware (for Avant and debit cards), a related loss of acceptance for stored funds and a loss of advantage over other payment alternatives (or even a disadvantage, as loss of a stored value card resulted in a loss of funds).

Finally, beyond domestic services, new cross currency transfers, like **Wise**^⑧ and **Revolut**^⑨, have grown in recent years. Successful companies typically compete with traditional service providers on price and speed while also provide easy onboarding via mobile phone apps.

① <https://www.swish.co.zm/>; ② <https://mobilepay.dk/>; ③ <https://www.vipps.no/>; ④ <https://m-pesa.org/>; ⑤ Ondrus et al (2015); ⑥ <https://en.wikipedia.org/wiki/DigiCash>; ⑦ Grim et al (2017); ⑧ <https://wise.com/>; ⑨ <https://www.revolut.com/en-US>

4. Users' needs and strategies for adoption

- A CBDC would need to support users' payment needs. In an increasingly digital economy, the assessment of user needs would need to be forward looking and take account of both present and possible future demands of users.
- CBDC adoption would likely be driven by its future usefulness to users and acceptance by merchants. Central bank money is the safest form of money available. Yet beyond security, other valuable features of CBDC could include lower costs for consumers and merchants, offline payments, a higher level of privacy in comparison to commercial options and multiple accessibility features. As payments become increasingly integrated into digital living, a CBDC available to innovators could combine innovative features into a single product in a new and unique way.
- Payments are a two-sided market: The use of a new service depends both on consumer adoption and merchant acceptance.
- Additional measures that some jurisdictions might consider for a potential CBDC adoption strategy include the use of CBDC by public sector authorities and imposing some minimum level of acceptance. Not all strategies would be desirable in all jurisdictions.

The core features of any CBDC instrument and its underlying system include ease of use³, low cost, convertibility, instant settlement, continuous availability and a high degree of security, resilience, flexibility and safety (Group of central banks (2020)). Central banks, through their current payment systems, already promote interoperability, support competition and innovation, and operate public infrastructures - all essential for easily accessible, low-cost and high-quality payment services (BIS (2020)). In addition, CBDC could offer the unique features of central bank money in digital form relative to other forms of money: settlement finality, liquidity and integrity (BIS (2021)). In this way, a CBDC could combine features to form a unique product.

Several central banks contributing to this report have already engaged in public consultations and other methodologies to understand in more depth the payment attributes that could be valued by consumers and merchants.

4.1 Consumers

The principal reason to use CBDC would likely be its safety and security in a convenient form that could be integrated into innovative private sector products and services. As central bank money, CBDC would be the safest form of money available. The other features that a CBDC might offer include a lower cost to consumers and merchants, offline payments (useful during outages and in remote locations without connectivity), a higher level of privacy in comparison to commercial options, and a design with multiple accessibility features (Table 1).

In an increasingly digital economy, the assessment of user needs should be forward looking and take account of both present and future payments needs. For example, CBDC might be designed to facilitate programmability of payments and the use of micro-payments. This might in turn enable new applications and digital functions (eg programmability could support automatic routing of tax payments to tax authorities at point of sale, or electricity meters paying suppliers directly based on power usage), and business models conducive to innovation (eg micropayments might enable alternative revenue models for digital media) (Bank of England (2020)). To accommodate these evolving user needs, a diverse ecosystem of intermediaries may be required to deliver innovation, choice and competition (Group of

³ See Koulayev, S et al (2016), Esselink, H et al (2017), Huynh, K et al (2020), Stavins, J (2017), Schuh, S and J Stavins (2010).

central banks (2021b)). A core feature of CBDC systems should be flexibility and adaptability, which could support intermediaries in evolving their services to meet future user requirements (Group of central banks (2020)).

End-user consultations and research¹

CBDC features

Table 1

Safety of funds	In normal and crisis periods, this distinguishing feature of central bank money relative to other forms of money could make a difference for users' adoption. The physical nature of cash helps support the identified difference between central bank and private money.
Reduced costs	Consumers' utility is affected mostly by the transaction cost of the payment instrument. Although the overall cost of a CBDC system could increase with the complexity of its design, there should be little or no (explicit) cost to the CBDC end user.
Offline	A CBDC could allow users to maintain the cash-like experience they are familiar with, together with the additional benefit of participating in the digital economy. This feature might be particularly relevant in environments where internet availability is limited or unreliable.
Security	Several factors affect an end-user's overall perception of security: the reputation of (and trust in) the issuer, intermediaries, and the underlying technology; whether the involved entities are regulated; the level of fraud protection and end-user liability; and the quality of education and marketing campaigns. A CBDC might seek to adhere to a higher security standard to address these concerns.
Privacy	Protecting an individual's privacy from both commercial providers and governments has the attributes of a basic right (BIS (2021)). CBDC could be designed to offer more privacy to users because the central bank would not have incentives to monetise the data (for more see Group of central banks (2021b)).
Accessibility	Accessible design is fundamental for both specific user groups (eg people with sensory, motor, and cognitive challenges) and the general population. CBDC end-user devices could be designed to improve on accessible digital interactions.

¹ This table summarises some reflections from findings of the selected central banks of this group. Not all the jurisdictions in our group have engaged already in end-user consultations.

4.2 Merchants

On the merchant side, it would likely be necessary to quickly onboard a large merchant base in order to drive acceptance of CBDC and therefore make the CBDC useful enough from the beginning that consumers would want to participate. When considering what payment instruments to accept, the merchant is primarily concerned with the breadth of adoption by consumers and the cost of acceptance (onboarding and ongoing). Merchants are interested in new payment instruments that could broaden their customer base because it is used by an extensive pool of consumers or reduces their costs of transacting relative to payment methods currently accepted.

4.3 Additional incentives for CBDC adoption

Differences between jurisdictions could affect strategies for adoption based on different consumer needs. Where the market lacked a material gap that CBDC could fill, both the public policy case for CBDC and the incentives for users to adopt it would likely be weaker. Under such conditions, if launching a CBDC were nonetheless judged desirable on public policy grounds, it would be particularly important to avoid frictions in its design. Conversely, in jurisdictions where there were evident gaps in the market for digital payments, there may be stronger forces favouring the adoption of CBDC as it could provide a service that is needed and exploit existing network effects.

While lessons learned from previous payment implementations may provide certain insights for potential CBDC adoption, some jurisdictions might also consider additional elements for a potential adoption strategy.

Consumers who receive payments in CBDC may be more likely to use CBDC. Public authorities might therefore be able to incentivise consumer use of CBDC by disbursing social benefits and transfers to individuals in CBDC and allowing employees to receive their salaries in CBDC. Allowing consumers to pay their taxes in CBDC may also provide a stable, concrete example for consumers to use CBDC.

Alternatively, in certain jurisdictions, legislators may consider requiring some minimum level of acceptance, eg some governments authorities such as tax authorities, some healthcare providers and pharmacies might be required to accept CBDC. This would ensure that consumers in these jurisdictions could use CBDC to satisfy some basic, but important needs. Other jurisdictions may consider such an imposition overreaching and would choose not to force private businesses to accept CBDC.

5. Designing a CBDC

- A CBDC adoption strategy in a fast-changing payments landscape would require balancing the needs of the majority of consumers and reaching smaller parts of the population.
- Different users and needs, both current and future, would need to be defined and considered in the system's design. The analysis of specific market segments through user personas and stories could provide an important method of investigating user needs and designing informative consultations with prospective end-users.

To meet its intended public policy objectives, a CBDC would need to be adopted and used at sufficient scale. The CBDC system would require some capital investment, including the costs of the central bank to set up the core system as well as some costs borne by the private sector to interoperate and provide services on top of the core system (Group of central banks (2021b)). These investments would likely be predicated on a level of adoption sufficient to achieve a scale that allows network effects. A CBDC ecosystem that was ubiquitous would also allow it to operate more efficiently and to be offered at a low cost to its users. To incentivise adoption of CBDC as a means of payment, policy levers that were carefully designed for that purpose could be used. Central banks have a variety of options for levers and safeguards as well as different system designs (Group of central banks (2021a and 2021b)).

Designing a CBDC would require a detailed understanding of the future needs of, and alternative payment options available to, users in various segments of the population. These start with, but are not limited to, the mainstream consumer who may be able to choose among a wide array of current, privately and publicly provided payment methods and future innovations.

For the mainstream consumer, a CBDC combining the safety, security, privacy and low cost of cash with the ability to be used online, may still be attractive at least for some range of purposes. In addition, it would be important to carefully explore the needs of other specific user segments, in line with the commitment of this group of central banks to provide universal access to a safe and low cost means of payments. The decision to launch a CBDC and its design would thus need to consider both the needs of the majority of consumers and smaller parts of the population. Developing this knowledge may be achieved via surveys and more precise design work with target customers.

As specific user needs evolve a CBDC would need to adapt to meet them. A flexible and extensible core CBDC system would enable innovators to identify and offer new services that meet those future needs.

Market segmentation, user personas and stories could be useful constructs to investigate user needs and design informative end-user consultations. They present a unique set of opportunities and challenges for a CBDC relative to competing payment alternatives.

The *market segments* that could be potentially relevant for CBDC are, for example, domestic retail payments, cross-border payments, and fiscal transfers. These market segments might encompass a large variety of payment use cases (eg paying a friend to split a restaurant bill, a small merchant paying staff wages, a welfare payment by the government, an international remittance). Segmentation identifies the set of variables that best differentiate end-users in terms of their needs and potential to adopt and use a CBDC.

A *persona* represents a larger customer segment. The frictions, needs, considerations and priorities of one segment could markedly differ to those of other segments.

A *user story* is a short narrative of a particular user (Table 2). It captures the user’s experience, the tasks they need to accomplish, the pain points they encounter and what motivates their choices and preferences under the scenario that is described. The story raises questions that need to be addressed by the CBDC ecosystem and highlights how an end-user expects to interact with a CBDC and supporting services. A user story considers the steps that occur before a payment interaction (eg learning about CBDC, accessing and configuring a CBDC device, adding funds), steps required to complete the payment (eg identifying a payer or payee, specifying payment information), and post-payment activities (eg viewing transaction history, processing a refund, troubleshooting and cancelling a device). Each step in the sequence raises questions and brings forward requirements that highlight a variety of implementation challenges (eg technical feasibility, costs, viability of an inferred business model).

Example of user stories		Table 2	
	Persona and pain point	CBDC motivation/need	CBDC design concept to gain the adoption by this type of user
A well-connected consumer	Consumer with bank account and several options for digital payments	Highly interoperable CBDC	Enhanced interoperability and privacy features, offline functionality, new features (eg programmable payments)
User with no/limited internet	Consumer on limited budget who lives in a remote region without reliable internet	Low-cost/free payment method with offline capacity	CBDC universal access device with both online and offline functionality
Unbanked person	Consumer who does not have/desire a bank account	A CBDC to make digital payments without having a bank account	Low-cost, dedicated, universal access device with a variety of easily accessible end-point solutions / a CBDC supported by institutions other than banks
User with accessibility needs	Consumer who is partially sighted	Accessible mean of payment	Single-purpose payment device with large fonts and haptic feedback
User that prioritises privacy	Consumer who does not want commercial banks to know his or her identity or track his or her spending	A CBDC universal access device	Unregistered wallet at a money service business (with limits for compliance)
The small merchant at the PoS	Retailer who wants to accept CBDC payments in store	A way of accepting non-cash payments that is cheaper and more flexible than current solutions	A CBDC designed with low onboarding cost and that does not depend on existing (costly) point-of-sale hardware

Further consultation with end-users is required to identify the payment needs and motives of consumers so that a CBDC could be designed to best match the demands of a wide set of users.

6. Concluding thoughts and next steps

As economies become increasingly digital, user needs are rapidly evolving, and innovation is reshaping user services. These developments have accelerated since the onset of the Covid-19 pandemic. To meet their intended public policy objectives, CBDCs would need to be adopted and used at sufficient scale in this fast-changing payments landscape. The weight of the different factors at play in determining whether users would adopt and use CBDCs would largely depend on the public policy objectives and future market conditions in each jurisdiction.

Experience with the introduction of previous payment innovations suggests that there is no “one-size-fits all” approach for ensuring adoption. Nevertheless, these experiences suggest some key lessons that are likely to be applicable in the future, such as satisfying user needs, harnessing network effects and not requiring new devices. Central banks should consider how the payments landscape is evolving, focusing on future innovation and demand to identify future user needs. They could accommodate evolving user needs by designing a flexible core system, and integrating a diverse ecosystem of intermediaries delivering choice, competition and innovation.

A roll-out strategy for a CBDC would require balancing the needs of the majority of consumers and reaching smaller parts of the population that could be less well served. Understanding how the future landscape is evolving would require extensive and in-depth consultations with end-user groups, identifying payment needs and monitoring innovations in payments as they arise. Designing a CBDC that optimises adoption across groups through meeting a diversity of user needs would likely require a diversity of private intermediaries in CBDC ecosystems (Group of central banks (2021b)).

The next steps for this work are to continue research on and the impact of user requirements and financial stability safeguards on system design, and the range of approaches to public engagement and consultation on CBDC.

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