

Possible Characteristics of a TIPS-Based Digital Euro

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Introduction

On 2 October 2020, the European Central Bank (ECB) published a report on a digital euro (European Central Bank, 2020). The report examines the necessity to issue a central bank digital currency (CBDC) in the euro area. To this end, the ECB formulates seven scenarios under which a digital euro would become relevant. Based on these scenarios, it derives seven requirements for a digital euro. In this paper, we examine if the ECB can use existing technology and payments infrastructure in order to develop a CBDC that fulfils these requirements. More precisely, we propose an account-based version of the digital euro that is deployed on the TARGET Instant Payment Settlements (TIPS) system and we examine if this CBDC would meet the requirements set out by the ECB in its report.

It is important to evaluate the usability of existing technology and infrastructure for the digital euro. Deploying available and proofed technology comes with several advantages: Digital accounts are well known and tested for years. Even though TIPS is a rather new payment system, it exists since 2018 and provides a safe, stable, scalable, and user-accepted real-time payments and processing environment. A CBDC on TIPS would ensure pan-European reach and acceptance from day one. Additionally, TIPS addresses several potential disadvantages of a token-based CBDC, such as settlement finality, scalability, and the implementation of ceilings or tiering, which might become necessary to prevent the disintermediation of the banking (Bindseil, Tiered CBDC and the Financial System, 2020).

We propose an account-based CBDC that is deployed on TIPS. The proposal contains two variants of a hybrid CBDC, which enables users to transact funds pseudonymously between personal accounts in real-time with immediate finality. Accounts are held at the central bank but managed by private intermediaries. In Variant 1, clearing and settlement takes place between intermediaries, which hold clearing accounts at the ECB. Therefore, at the central bank level, transactions only take place between intermediaries. In Variant 2, each end-user possesses an account at the central bank that is managed by intermediaries. In this case, every single transaction is recorded at the central bank.

We find that our proposed CBDC fulfils many but not all requirements for a digital euro. It would include competitive technological features (requirement 3) and expand the monetary policy toolkit of the ECB (requirement 4). Additionally, it could save resources because it does not require building new payment rails. Its maintenance cost and carbon footprint are comparable to existing digital payment systems and are smaller than those of a cash-based system (requirement 7a and 7b). However, since a CBDC deployed on TIPS is account-based, it would hardly possess any cash-like features (requirement 2). Indeed, the only similarity to cash is that it would be a liability of the central bank. Apart from that, it neither enables full anonymity nor offline payments. One important finding is, that our TIPS-based CBDC faces a trade-off between privacy and safety: Variant 1 has a higher level of privacy than Variant 2 because end-users do not hold individual accounts at the ECB and hence transactions only take place between intermediaries. However, this privacy comes at the

expense of safety because if private intermediaries fail, the ECB cannot take over because it has no access to the history of transactions.

The paper is structured as follows: We first introduce TIPS and different possible CBDC architectures. Based on this, we develop a concrete proposal of an account-based hybrid CBDC that is deployed on TIPS and test this CBDC against the requirements of a digital euro communicated by the ECB.

TARGET Instant Payment Settlements (TIPS)

In recent years, global demand for faster payments due to the acceleration of international trade and digitalization – especially in the retail segment – forced traditional payments systems to develop further and provide innovative but standardized payment rails. In addition, new payment methods emerged that found ways to simplify and accelerate the process from a user's perspective. Consequently, a global trend followed, whereby new real-time settlement systems – also called Instant Payments – were established. Instant Payment settlement mechanisms are traditional (domestic) payment systems that are able to exchange information and finalise the settlement of a transactions between bank accounts within only a few seconds. The systems are available 24/7 and do not need any downtime/maintenance window. Moreover, contrary to traditional domestic and international payment systems, users receive an immediate information if their payment was successfully made. Today, Instant Payments settlement systems are available already in 56 countries (FIS, 2020).

In 2014, the Euro Retail Payments Board started the creation of the SEPA Instant Payment Rulebook, which was published in 2016 (European Central Bank, 2014). Under this rulebook, (private) Clearing and Settlement Mechanisms (CSM) were able to offer real time payment services to its consumers. Since then, the usage of Instant Payment settlement mechanisms has grown continuously according to data provided by the European Central Bank: 7,4% of all euro transactions were executed as Instant Payment in September 2020.¹

In November 2018, the ECB started to offer its own CSM called TARGET Instant Payment Settlement (TIPS). TIPS can be considered as an extension of the TARGET2 system, which requires participating credit institutions (hereafter banks) to fulfil the same requirements as for a participation in TARGET2 in order to be applicable to join the Instant Payment system. The adoption among PSPs is growing and is expected to be fostered by the decision of the ECB, that all banks that adhere to the SEPA Instant Payment scheme have to be connected to TIPS by 2022. Moreover, all clearing mechanisms are supposed to use the TIPS accounts of banks as settlement accounts. The TIPS platform is currency agnostic and can be deployed for other schemes. In 2020 the ECB announced that the Swedish Instant Payment system will be hosted by TIPS by 2022.

Instant Payments workflow and real-time settlement clearing mechanism workflow

Figure 1 summarized the workflow of an Instant Payment. A transaction via TIPS starts with the communication between a client and its bank (Level 1). In order to initiate a transaction, a user instructs a payment through the interface of its bank (a). The user has to authenticate, determine the beneficiary, and legitimize/authorise a payment. The bank – which has to be a formal member of the Instant Payment scheme – checks the legitimacy of the payment request (sanction, embargo, fraud, AML checks), reserves the funds on the user's account, and

¹ See,

[https://www.ecb.europa.eu/paym/integration/retail/instant_payments/html/index.en.html#:~:text=To%20speed%20up%20the%20development,Credit%20Transfer%20\(SCT%20Inst\).](https://www.ecb.europa.eu/paym/integration/retail/instant_payments/html/index.en.html#:~:text=To%20speed%20up%20the%20development,Credit%20Transfer%20(SCT%20Inst).)

starts the process (b) by sending the payment message in a standardised format to the CSM (Level 2). The CSM validates the message, reserves the funds on the TIPS account (c) and forwards the message to the beneficiary bank (d). The beneficiary bank repeats the required validations and security checks and confirms/rejects the payment back to the CSM (e). If the feedback is positive, the conditions are accepted by all parties and a claim is created between the two banks, that can be settled accordingly. This settlement process is executed in real time by the CSM. Therefore, all participating banks must prefund their TIPS account at the central bank. Banks have to ensure that the account is always sufficiently funded. If a bank runs out of funds, it cannot participate in the payments processing any longer. The funds at TIPS can be considered as central bank money. Between the accounts, the CSM orchestrates the movement of funds in real time and therefore ensures the settlement (Level 3). Once this activity is successfully completed, the payment is final (f). The CSM reports this back to the bank (h), which informs the initiating user accordingly (i). Informing the beneficiary about the receipt of funds is optional and not mandatory (g).

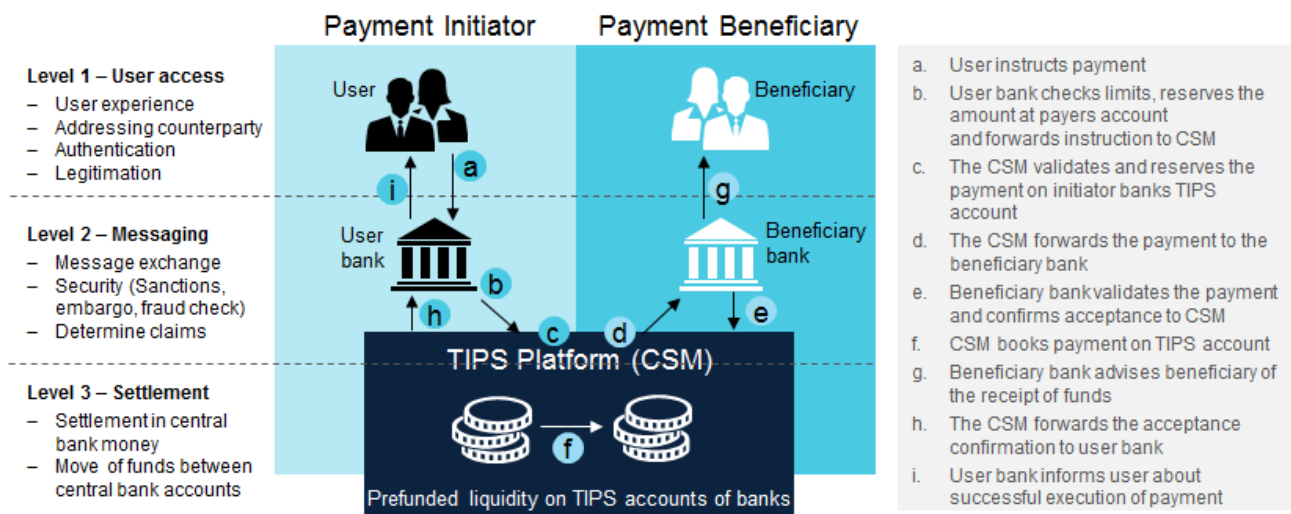


Figure 1: Schematic workflow of an Instant Payment transaction via TIPS

Three forms of an account-based CBDC

Before we propose a concrete example of an account-based CBDC that is deployed on TIPS, we provide an overview of different CBDC architectures that are currently being discussed. To this end, we follow Auer and Böhme (2020) and distinguish between three different architectures for a retail CBDC: direct, hybrid, and indirect. Generally, these architectures allow for account- or token-based versions of a CBDC. We focus on an account-based version. Our definition of “account-based” follows the classical definition of accounts in the legacy banking system. Accounts are offered by intermediaries, which ensure that only eligible parties are able to move funds in and out of these accounts. It is worth mentioning this definition because there is an ongoing discussion about how to distinguish between tokens and accounts in relation to digital currencies. Lee, Malone, and Wong (2020) summarize this debate. In what follows, we introduce the concept of a direct, hybrid, and indirect account-based architecture for a CBDC that is deployed on TIPS.

First, in the case of a direct architecture, each euro area citizen is entitled to open a TIPS account at the ECB, which allows for direct access to digital central bank money, including real-time gross settlement. This architecture works without intermediaries. The advantage of a direct architecture is its simplicity and feasibility. There are no major technical hurdles that would prevent the ECB from offering a TIPS account to all euro area citizens. However, managing more than 300 million clients is unattainable. The ECB neither has the necessary expertise nor resources to onboard and serve end-users of a digital euro. Additionally, bypassing private financial institutions could stifle innovation and lead to a disintermediation of the banking sector. Based on comments from the ECB, including its official report, it seems unlikely that a digital euro will be issued based on a direct architecture (European Central Bank, 2020).

Second, in the case of a CBDC based on an indirect architecture, end-users hold an account at a commercial bank. The account is backed 100% by central bank money, deposited in an escrow account at the ECB. Since end-users do not directly hold and transfer central bank liabilities, the International Monetary Fund (IMF) coined the term synthetic CBDC (Mancini Griffoli, et al., 2018). The concept of fully backing bank accounts is also known as narrow banking and goes back to a memo written by a group of economists from the University of Chicago during the Great Depression in 1933. In an indirect architecture, the banking sector takes over most of the responsibilities, including onboarding customers, implementing KYC, managing accounts, and ensuring compliance with AML and CFT requirements. Moreover, banks have the full control over the design of the accounts and related payment features, allowing them to be innovative and build products along the needs of their customers. Nevertheless, central banks are strongly opposing the indirect architecture as underlying infrastructure for a CBDC. The main point of critique is that money in a narrow bank account is not a CBDC because it is not a direct liability of the central bank. In a speech at the Bundesbank on 27 November 2020, Fabio Panetta, member of the executive board of the ECB, clearly stated that an indirect architecture “would not be acceptable, however, as it would be tantamount to outsourcing the provision of central bank money” (Panetta, 2020).

Finally, a CBDC based on a hybrid architecture is a public-private partnership between the central bank and the private sector. It is a compromise between the direct and indirect approach. Private intermediaries do not need to hold a banking license. Therefore, also PSPs can serve as account managing intermediaries. The hybrid infrastructure combines the relative advantages of both approaches: the credibility and stability of a direct liability of the central bank and the ability of the private sector to offer innovative and convenient payment services. The private sector is responsible for innovating and building intelligent solutions for end users. This includes the technology choice, data management, regulatory compliance as well as customer onboarding, management, screening, and monitoring (including KYC and AML/CFT). The central bank focuses on regulation, supervision, and financial stability. In other words, the central bank supports innovation, but it makes sure that it happens within the borders of a regulated environment. Since a hybrid CBDC is a direct liability of the central bank, end-users are protected from the insolvency of the intermediating PSP. Conceptually, a hybrid CBDC is more complex than a direct or indirect architecture because PSPs need to manage accounts that are not on their balance sheet. Moreover, fully licensed banks might be degraded to PSPs and face additional competition, which could affect other parts of their business. Following current debates among central bankers in the euro area, it seems very likely that a potential euro CBDC would be based on a hybrid infrastructure. Therefore, our proposed TIPS-based CBDC also follows this model.

Direct		Hybrid		Indirect	
<u>Pro</u>	<u>Con</u>	<u>Pro</u>	<u>Con</u>	<u>Pro</u>	<u>Con</u>
Conceptually and technologically simple	ECB does not have the necessary resources nor the expertise to offer accounts to end-users	Private sector manages customer relation (onboarding, KYC, AML, etc.)	Complex: PSPs need to manage accounts that are not on their balance sheet	Banks have full control over the design of the accounts and can leverage their full innovative potential to build an efficient and intelligent	Not a CBDC, but rather narrow banking Money is not a direct liability of the ECB
Close to current system	ECB is less innovative and	Private sector can innovate on top of ECB baseline	Banks might be degraded to PSPs, which could have a		

agile than the private sector and hence a direct CBDC could stifle innovation in payments	architecture and develop intelligent produces for end-users	negative effect on other banking services	product for their customers	Strongly opposed by central banks
Danger of disintermediating the banking sector			No disintermediation of the banking sector	

Table 1: Advantages and disadvantages of direct, hybrid, and indirect architectures

Main characteristics of an account-based hybrid digital euro built on TIPS

We outline the design and functionalities of an account-based hybrid CBDC deployed on TIPS. The two most important stakeholders of this system are the central bank – that is, the ECB – and private PSPs. The ECB is responsible for the issuance and the withdrawal of the digital euro as well as managing and hosting the settlement process within the TIPS infrastructure. The PSPs manage and maintain the relationships to end-users. They are responsible for creating as well as providing and managing access to digital money accounts (DMA), which allow end-users to hold and transact CBDC. Furthermore, they take care of the communication to the central settlement system and process payment messages. As in the traditional payment processing, PSPs are responsible for regulatory checks (sanctions, embargo, fraud, and AML) as well as Know-Your-Customer (KYC) processes.

Figure 2 shows how the division of work between the ECB and PSPs can be organized: Either the PSP holds only one TIPS account for all its customers (Variant 1), or it opens and manages individual TIPS accounts for each of its customers (Variant 2). In the case of Variant 1, the PSP has only one digital account with the central bank that consolidates the funds of all its clients. This account is an escrow account that is insolvency-protected. If a transaction is being instructed by a user and forwarded to the TIPS platform, the claim is settled between two PSPs. The messages on the platform are encrypted, that is, the central bank does not see any data and transaction details. It can only observe the movement of funds between the two PSPs. The TIPS messages are stored in the disaster-recovery facility of the TIPS platform and can only be decrypted by the PSPs. If a transaction takes place between two customers of the same PSP, there is no net change of the PSP’s account at the central bank; therefore, there would be no external backup storage of this transaction. Variant 1 has some similarities with the “two dot model”, proposed in the (Korfiatis, 2020).

In the case of Variant 2, the central bank does not only maintain one account for each PSP, but it holds a copy of all pseudonymised end-user account balances. In this scenario, the PSP forwards all transaction messages to the TIPS platform for the settlement process. The central bank records a copy of the account balances as well as the account IDs. Other information such as supplementary data and reference information is still encrypted. The transactions take place at the level of the account system of the PSPs, but copies of all transactions are recorded at the central bank level. One advantage of this solution is that end-users could access their account at the central bank through multiple PSPs. If one PSP fails, end-users could still access and use their funds via another PSP. This decentralised record keeping could reduce exposure to operational risk. Moreover, since the settlement mechanism knows which accounts exist, the process of confirming the acceptance of a payment through the beneficiary PSP could be skipped. With respect to resilience of the system, the documentation at the central bank level would serve as an additional security mechanism in case of default of private sector intermediaries.

From an end-users' perspective, a transaction via our proposed account-based hybrid CBDC system would look as follows: First, the user needs to open a DMA at a PSP. In Variant 1, the DMA is part of a joint escrow account of the PSP at the ECB. In the case of Variant 2, the PSP opens a dedicated TIPS account for each individual end user at the ECB. Hence, each DMA is mirrored 1-to-1 at the ECB. The user can then transfer money from its conventional bank account to the DMA. In this case, the bank would transfer money from its reserve accounts onto the TIPS escrow account of the PSP. The central bank issues the requested digital euros free of charge and at par. If the digital euro is withdrawn from the DMA, the process will be reversed. With money on the DMA, the user can instruct payments to other DMAs. At this stage of the process, the PSP could do required regulatory checks. To what extent they are required to conduct these checks has to be a weighted decision and depends on the final use case of the CBDC. For instance, these checks are not applicable in the current cash-based payment system. If the result of the checks is positive, the PSP sends the instruction to the TIPS platform for messaging to the beneficiary PSP and final settlement. In the case of Variant 2, the confirmation of acceptance of the beneficiary PSP could potentially be skipped because the central bank knows that the account is active and in place. However, this only applies if no additional real-time sanction/embargo/fraud/AML checks would be required on the side of the PSP of the beneficiary.

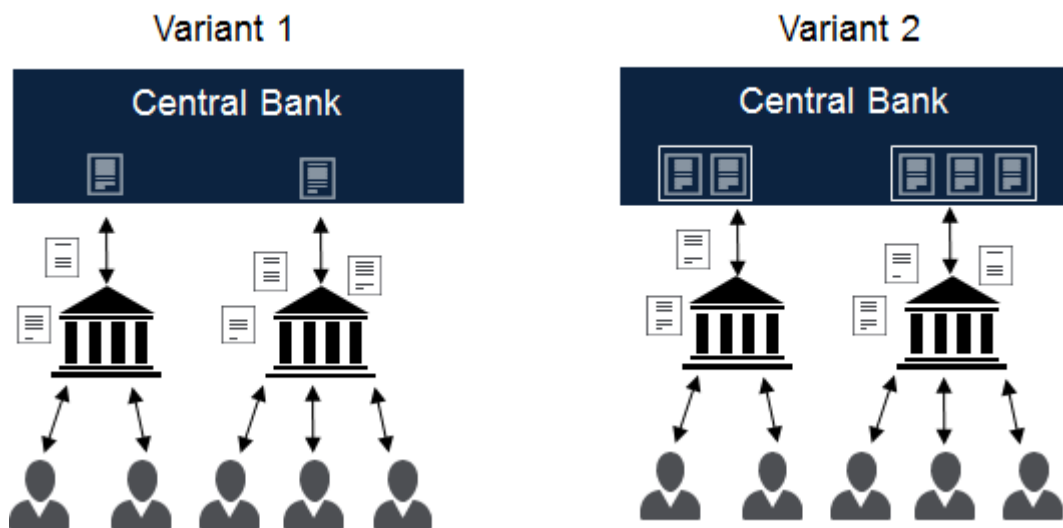


Figure 2: Proposed solutions for an account-based hybrid CBDC

Does our TIPS-based digital euro fulfil the design guidelines set by the ECB's report on a digital euro?

In its report, the ECB derives seven design requirements for a digital euro. In what follows, we examine if our proposal for an account-based hybrid digital euro deployed on TIPS could fulfil these requirements. Table 2 summarizes our results.

Requirement 1 (R1): enhanced digital efficiency. *The digital euro should keep pace with state-of-the-art technology at all times in order to best address the needs of the market as regards, among other attributes, usability, convenience, speed, cost efficiency and programmability. It should be made available through standard interoperable front-end solutions throughout the entire euro area and should be interoperable with private payment solutions.*

The TIPS settlement platform is built with the help of high-performance streaming technology, which can be considered state-of-the-art. This technology allows transactions that enable settlement finality in less than 10 seconds. The cost of a TIPS transaction is 0.002 EUR, excluding additional cost from the PSP. Interoperability with existing private payment solutions would be guaranteed. However, TIPS is not interoperable with smart

contracts that are based on distributed ledger technology (DLT). This interoperability – and thereby the programmability of payments – can only be achieved through the introduction of bridge or trigger solutions that connect the smart contract with the TIPS settlement platform.

Against this background, transactions based on TIPS are capable of addressing most of the existing use cases. However, in particular payments in the Industry 4.0, which require microtransactions, machine-to-machine payments, high frequency, and short settlement times, might require token-based solutions for the digital euro. In particular, full and seamless interoperability with DLT and smart contracts can only be achieved by token-based versions of a CBDC.

Requirement 2 (R2): cash-like features. *To match the key distinctive features of cash, a digital euro aiming to tackle a decline in the acceptance of cash should permit offline payments. Moreover, a digital euro should be easy for vulnerable groups to use, free of charge for basic use by payers and should protect privacy. It should have a strong European branding.*

Since account-based payments, such as TIPS transactions, require the approval of one or even several intermediaries, neither full anonymity nor offline payments are possible. However, depending on which of our variants we consider, different levels of privacy can be implemented. In the case of Variant 1, the central bank only gets insight into transactions conducted between PSPs because end-users do not own individual TIPS accounts. In contrast, Variant 2 would give the central bank full access to all transactions data (potentially in a pseudonymous form) because each individual end-user possesses one TIPS account. Consequently, the level of privacy is higher in Variant 1. However, both cases do not offer a level of privacy or even anonymity that is comparable to cash payments.

Whether the ease of use of a digital euro is higher or lower than that of cash is probably a matter of opinion. People who are used to pay by card, smartphone or even smart watch might take the view that electronic payments are simpler and more convenient than cash payments. However, especially elderly people may be more comfortable using physical cash. In order to make TIPS payments free of charge, either the central bank would have to waive the transaction fee and/or the merchant has to take over the cost. Banks are currently subject to regulation that requires them to do embargo, sanctions, fraud, and AML checks. It would need to be thoroughly discussed if similar activities are required in the processing of the digital euro. Cash payments are only subject to checks if they cross a certain threshold (for instance, 10,000 EUR in Germany). Hence, applying these checks to digital euro transactions for amounts below these thresholds would move the digital euro even further away from cash. This could lead to a situation, in which people on sanctions or embargo lists could be fully excluded from the system and lose their ability to transact. While this might be desirable from the perspective of the regulator, it opposes the idea that the digital euro possesses cash-like features. Finally, financial inclusion is smaller in a TIPS-based system than with cash because in order to open an account, end-users have to go through a KYC process.

Requirement 3 (R3): competitive features. *The digital euro should have features which are at the technological frontier. It should offer the basis for providing functionalities that are at least as attractive as those of the payment solutions available in foreign currencies or through unregulated entities.*

A CBDC deployed on TIPS allows for many innovative features such as overlay services (sending transactions to e-mail addresses, requests to pay, etc.). With the help of a bridge or trigger solution, account-based payment systems are even interoperable with DLT-based smart contracts. Consequently, a TIPS-based CBDC can also be used for programmable payments. (Bechtel, Ferreira, Gross, & Sandner, 2020) provide an overview of how bridge or trigger solutions can be used for programmable payments. Moreover, the Bundesbank has published a report on money in programmable payments comparing bridge or trigger solutions with token-based forms of the digital euro (Bundesbank, 2020).

Requirement 4 (R4): monetary policy option. *If considered to be a tool for improving the transmission of monetary policy, the digital euro should be remunerated at interest rate(s) that the central bank can modify over time.*

The ECB could directly steer the interest rates paid on TIPS accounts. These rates could even become negative, creating an additional tool for monetary policy for the ECB. Bindseil and Panetta (2020) argue that in a world with low or even negative interest rates, a CBDC would have to pay negative rates, at least after a certain threshold. They call this concept “tiering” and suggest 3,000 EUR as a possible threshold. CBDC holdings above this threshold would be remunerated negatively to create an incentive for end-users to convert their CBDC into other forms of money. Without such an incentive, the CBDC might become too attractive as an investment, which could lead to a disintermediation of the banking sector and an exploding ECB balance sheet. Ultimately, it is a political question, if negative interest rates on digital cash should be possible and how high a potential threshold should be.

Requirement 5 (R5): *back-up system. In order to improve the overall resilience of the payment system, the digital euro should be widely available and transacted via resilient channels that are separate from those of other payment services and can withstand extreme events.*

In Variant 1 of our TIPS-based CBDC, there exists no back-up of individual transactions at the central bank. Consequently, the ECB is not able to recover individual transactions if private intermediaries fail. One possibility to mitigate this risk is to use the TIPS disaster and recovery system. However, in our proposal, this data is encrypted in order to guarantee a certain level of privacy for the end-user. It can only be decrypted with the help of private intermediaries. In the case of Variant 2, the central bank possesses a full back-up of all individual transactions, which enables it to recover and take over if private intermediaries fail.

Consequently, there is a trade-off between privacy and safety. Variant 1 guarantees a higher level of privacy at the expense of safety because disaster recovery is more difficult to achieve for the central bank. Variant 2, on the other hand, enables the central bank to step in if private institutions fail. However, in return, the central bank owns the full history of transactions conducted by end-users.

Requirement 6 (R6): *international use. The digital euro should be potentially accessible outside the euro area in a way that is consistent with the objectives of the Eurosystem and convenient to non-euro area residents.*

Currently, it is not possible to open a TIPS account without being a licensed credit institution residing in the euro area. Since both variants of our CBDC require to hold a TIPS account, either indirectly (Variant 1) or directly (Variant 2), under current regulation, it would not be possible to offer digital euro accounts to non-euro area residents. This does not exclude making cross-border payments with the digital euro. Moreover, given that it is possible to hold a conventional bank account as a non-euro area resident, it stands to reason that similar regulation will be implemented if TIPS will indeed be used as a base layer for a retail CBDC.

Requirement 7a (R7a): *cost saving. The design of the digital euro should achieve a reduction in the cost of the current payments ecosystem.*

First, a TIPS-based digital euro would not require building any major new payments infrastructure, saving potentially significant amounts of resources. Moreover, compared to existing electronic payment systems, a TIPS-based CBDC would have similar maintenance cost. Compared to a cash-based payment system, the cost is lower. Handling physical notes and coins is resource-intensive: Banknotes need to be printed, coins need to be minted, and both need to be distributed across the currency union. At the point of sale and from the view of an end-user, a TIPS-based CBDC could be cheaper than existing debit- and credit-based means of payment. This cost saving originates from a potential reduction in intermediaries involved in the payments process.

Requirement 7b (R7b): *environmentally friendly. The design of the digital euro should be based on technological solutions that minimise its ecological footprint and improve that of the current payments ecosystem.*

According to a DNB working paper, debit card payments have a lower impact on the environment than cash payments (Hanegraaf, Jonker, Mandley, & Miedema, 2018). The ecological footprint of a cash payment is 36% higher than that of a debit card payment. It seems likely that the carbon footprint of CBDC payments is close

to the one of debit card payments and hence a CBDC should be more environmentally friendly than cash. One major advantage of a centrally organized account-based digital payment system is its scalability. Compared to cash, as well as payment systems based on decentral and permissionless networks, TIPS can easily scale without requiring significantly more resources.

Requirement	Fulfilled by hybrid account-based digital euro on TIPS	Comment
(R1) Enhanced digital efficiency	Partially	Addresses many use cases by providing a fast and cost-efficient settlement layer. However, some features of token-based money – such as micropayments – are not available in an account-based system.
(R2) Cash-like features	No	The only similarity to cash is that an account-based digital euro would be a liability of the central bank. It is neither a token nor would it be possible to replicate other important functions of cash such as full anonymity or offline payments.
(R3) Competitive features	Yes	Overlay functions and integration with DLT-based smart contracts via bridge or trigger solutions are possible, enabling programmable payments.
(R4) Monetary policy option	Yes	The ECB can determine the interest rate paid on TIPS accounts. This interest rate could theoretically also be negative.
(R5) Back-up system	Partially	If the full transaction history is shared with the ECB (Variant 2), the system is resilient and does not break down in case of a failure of private intermediaries. This does not apply to Variant 1.

(R6) International use	No, but possible	Currently, non-euro area residents cannot open a TIPS account. This could be changed if TIPS serves as underlying infrastructure for a retail CBDC.
(R7) Cost saving and environmentally friendly	Yes	A TIPS-based digital euro would save resources because it does not require building new payment rails. Its maintenance cost and carbon footprint are comparable to existing digital payment systems. The cost and impact on the environment are smaller than in a cash-based system.

Table 2: Hybrid account-based CBDC deployed on TIPS and ECB requirements for a digital euro

Conclusion

We have proposed a model of an account-based hybrid CBDC deployed on TIPS. Using existing infrastructure to build a CBDC brings about several advantages including technological resilience and resource efficiency since no new payment rails need to be established. We showed that our CBDC is able to fulfil many but not all requirements for a digital euro set out by the ECB in its report on a digital euro. For instance, a TIPS-based CBDC does not possess cash-like feature because neither full anonymity nor offline payment capabilities can be integrated. Additionally, there exists a trade-off between privacy and safety: In order to increase the level of privacy, individual transactions should not be recorded at the central bank level. However, in this case, a breakdown of private sector intermediaries would not allow the ECB to take over because it does not have access to the records of historical transactions.

This paper focused on the advantages and disadvantages of an account-based CBDC deployed on TIPS. In this regard, it is supposed to contribute to the discussion about the design of a CBDC. It seems unlikely that there will be a one size fits all solution. In other words, it is extremely difficult to design a CBDC that meets all requirements set out by the ECB. Instead, it seems likely that there will be trade-offs that need to be balanced. How to balance these trade-offs is ultimately a political decision.

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