EUROPEAN CENTRAL BANK
EUROSYSTEM

Progress on the investigation phase of a digital euro – second report

The European Central Bank (ECB) and the euro area national central banks launched the investigation phase of the digital euro project in October 2021. The investigation phase aims to address key issues relating to the design and distribution of a digital euro. This report sets out the progress made during the investigation phase of the digital euro project and elaborates on a second set of design and distribution options that were recently endorsed by the Governing Council.

A collaborative approach is key to the preparation and eventual success of a digital euro. The endorsement of design and distribution options by the Governing Council thus followed extensive engagement with external stakeholders, including the European Commission, the European Parliament and euro area finance ministers. A regular dialogue on a digital euro also takes place with market stakeholders through the Euro Retail Payments Board (ERPB), so that all sides of the market, including banks, payment service providers, consumers and merchants, can provide their views on the design and distribution options identified by the Eurosystem.

The Eurosystem has always made it clear that the digital euro should be available through supervised intermediaries. In the light of this, this report outlines the respective roles of the Eurosystem and of intermediaries, such as credit institutions and payment service providers, in the digital euro ecosystem. Holding a digital euro would amount to a direct claim against the central bank – as is the case with banknotes today. This means that the digital euro would be a liability on the balance sheet of the Eurosystem. The Eurosystem must therefore retain full control over digital euro issuance and settlement. The best way to achieve this would be to have the Eurosystem perform the settlement activities for the supervised intermediaries that are to distribute the digital euro to end users. The digital euro would be designed in a way to minimise Eurosystem involvement in the processing of user data, whilst allowing it to perform its tasks. The Eurosystem would not be able to infer how much digital euro any individual end user holds nor to infer end users' payment patterns.

Supervised intermediaries would, in their turn, have the contractual account management relationship with end users and be the direct contacts for individuals, merchants and businesses using the digital euro. Supervised intermediaries would perform all end user facing roles such as opening digital euro accounts or wallets and associated payment operations, as is currently the case for the bank accounts and services that customers are already used to. They would offer user-facing services, including conducting know-your-customer and anti-money laundering checks, and would provide devices and end user interfaces to pay with a digital euro. They would also perform tasks related to the funding and defunding of users' digital euro accounts or wallets. Users would be able to choose whether the conversion of commercial bank money or cash into digital euro, and vice versa, should take place

manually or automatically. Funding and defunding functionalities would need to be available 24 hours a day, 365 days a year.

Paying in digital euro should always be an option, irrespective of the entity with which end users open digital euro accounts or wallets and of their country of origin. Against this background, this report describes a digital euro scheme for the distribution of the digital euro. A digital euro scheme appears to be the best option for ensuring that everyone in the euro area could pay and be paid in digital euro and for achieving the objectives of a digital euro as a monetary anchor, securing its strategic autonomy and economic efficiency. To this end, a digital euro scheme would establish a set of common rules, standards and procedures that would need to be adhered to by supervised intermediaries in distributing the digital euro and that would ensure a balance between the respective roles and responsibilities of the Eurosystem and supervised intermediaries. It would facilitate a homogenous end

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Market practitioners in the Digital Euro Market Advisory Group (MAG) are providing advice on the design and potential roll-out of a digital euro. At the Member State level, euro area national central banks are engaging with domestic stakeholder groups and fora to ascertain their views on a digital euro. The European Commission intends to propose a regulation to establish a digital euro in the second quarter of 2023[5] and has started preparations, including a public consultation, with a view to legislative proposals.[6]

Several further design options will be considered over the course of the investigation phase. Agreement on the second set of design options described in this report would provide the necessary foundation for the investigation to proceed with analysis of these subsequent options. By the second half of 2023, the Eurosystem decision-making bodies are expected to confirm a high-level design of a digital euro that will incorporate all the design choices made up to then and make it possible to conduct a comprehensive review of possible interdependencies among design choices. The approval of this second set of design options does not prejudge any decision to move to a realisation phase, scheduled for autumn 2023, nor the ultimate decision on whether to issue a digital euro.

1 Design options

A digital euro would leverage the strengths of both the Eurosystem and private-sector entities to satisfy user needs in a fast-changing payments landscape. Cooperation between the public and private sectors proved instrumental in building the European payments market in the past.[7] The close involvement of the private sector is seen as a key factor for successful implementation of a digital euro. A digital euro will need to draw on the experience and best practices used in the market, as well as on the end user focus of supervised intermediaries, something that is not available in central banks. The following sections detail the respective roles and responsibilities of the Eurosystem and supervised intermediaries in the digital euro ecosystem.

Holding a digital euro would mean holding a direct liability of a central bank – as is the case with banknotes today. This means that a digital euro would be recorded as a liability on the balance sheet of the Eurosystem and the Eurosystem would be liable for any digital euro settlement errors. It is therefore of utmost importance that the Eurosystem retains full control over digital euro issuance and settlement. The best way to achieve this would be to have the Eurosystem perform the settlement activities on behalf of the supervised intermediaries that distribute the digital euro to end users.

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5 See Commission work programme 2023 – A Union standing firm and united, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission, COM(2022) 548 final, European Commission, 2022.

6 See Targeted consultation on a digital euro on the European Commission's website.

7 See The Eurosystem's retail payments strategy, ECB, 2021.

Supervised intermediaries[8] would be responsible for all end user facing roles in the digital euro ecosystem. They would be the direct counterparts for individuals, merchants and businesses using the digital euro and would perform the user and transaction management tasks involved (see Section 1.1, "Roles of intermediaries"). Supervised intermediaries would also perform funding and defunding-related tasks (see Section 1.3, "Funding and defunding"). The Eurosystem would be responsible for the onboarding[9] and for management of the supervised intermediaries as well as for the settlement of digital euro transactions (see Section 1.2, "Settlement model").

1.1 Roles of intermediaries

Supervised intermediaries would be the direct counterparts for individuals, merchants and businesses using the digital euro. Building on their experience with end users, supervised intermediaries would be responsible for distribution of the digital euro (see also Section 2, "Distribution model")[10]. Their responsibilities would include offering user-facing services, such as opening accounts or wallets, payment instruments and onboarding and offboarding, encompassing know-your-customer and anti-money laundering checks. They would also provide devices or interfaces to pay with a digital euro in physical stores, online or person-to-person.[11]

Supervised intermediaries would also be responsible for transaction management tasks.[12] These would include initiation, authentication, validation and post-settlement activities, including reconciliation. It should be noted that the settlement of digital euro transactions would be performed by the Eurosystem (see Section 1.2, "Settlement model").

8 In the context of a retail central bank digital currency (CBDC), intermediaries are entities, such as credit institutions or payment service providers, acting between a central bank and end users in a retail environment. Supervised intermediaries are entities that are supervised or overseen by a designated public authority ensuring that the business of intermediaries is conducted in accordance with the relevant regulatory framework. See Digital euro glossary, ECB, 2022.

9 Onboarding of an intermediary means "a set of activities conducted by a back-end infrastructure operator to enable an intermediary to access the infrastructure". See Digital euro glossary, ECB, 2022.

10 See Report on a digital euro, ECB, October 2020.

11 Ibid and Roles of the Eurosystem and intermediaries in the digital euro ecosystem, Eurogroup, 3 October 2022.

12 Ibid.

Transaction management and settlement

Proposed roles of intermediaries and Eurosystem

	Intermediaries	Eurosystem
User management	Management of digital euro accounts/wallets Provision and management of payment instruments	Management of supervised intermediaries
Transaction management	Transaction initiation Authentication Validation Post-settlement	Settlement Post-settlement
Liquidity management	Funding and defunding	Issuance and redemption

1.2 Settlement model

Settlement is defined as the completion of a payment transaction with the aim of irrevocably discharging all payment obligations between a payer and payee through the transfer of funds.[13] The two technical tasks that enable transactions to be settled are: i) settlement verification – checking that the payer has the money available, thus confirming the integrity of the transaction, to assess whether that money can be transferred from the payer to the payee; and; ii) settlement recording – bookkeeping for the money, that is to say keeping a record of the actual transfer of money from payer to payee. Every settlement recording would constitute a snapshot of the digital euro amounts held by users and therefore contribute to determining the liabilities of the Eurosystem at any point in time.

For an online digital euro solution[14], Eurosystem central banks would perform the settlement tasks, including the recording and associated verification tasks.[15] The main reason for this is that holding a digital euro would mean holding a direct liability of the central bank – as is the case with banknotes today. This means that a digital euro would be recorded on the balance sheet of the Eurosystem which would be liable for any mistake made. Consequently, the Eurosystem would need to be able to correctly record (hence also to verify) all settlements of its own liabilities.

13 See "Building on our strengths: the role of the public and private sectors in the digital euro ecosystem – Introductory statement by Fabio Panetta, Member of the Executive Board of the ECB, at the Committee on Economic and Monetary Affairs of the European Parliament", *Speeches*, Brussels, 29 September 2022.

14 See Progress on the investigation phase of a digital euro, ECB, 2022. As regards the design of the transfer mechanism used to validate transactions, the Governing Council approved further exploration by the Eurosystem of a digital euro solution whereby transactions would be made online and would be validated by a third party ("online third-party validated solution"). The Governing Council also approved the continued exploration of a peer-to-peer validated solution for offline payments ("offline peer-to-peer validated solution"). A potential peer-to-peer validated solution for online payments with no third party involved is a more experimental alternative. While it deserves monitoring, it does not warrant further dedicated analysis in the investigation phase.

15 Ibid and Roles of the Eurosystem and intermediaries in the digital euro ecosystem, Eurogroup, 3 October 2022.

Supervised intermediaries, and not the Eurosystem directly, would have a contractual account management relationship with the end user. Supervised intermediaries would validate their clients' payments and have immediate access to the record of the digital euro amounts held by their clients (the "golden copy").

The Eurosystem would not be able to infer how many digital euro any individual end user held nor to infer end users' payment patterns.[16] The digital euro would be designed so that it minimised Eurosystem involvement in the processing of user data, while ensuring the smooth functioning of the digital euro and the ability of the Eurosystem to perform its tasks. Moreover, the design of the settlement solution would seek to simplify the settlement process flow, particularly for transactions between the digital euro users of the same intermediary.

For an offline peer-to-peer validated digital euro, settlement in a local storage device would be a suitable solution. In the absence of a network or internet connection, it would be impossible to contact a third party and request the verification and recording of digital euro transactions. Consequently, transactions and holdings of a digital euro available offline would need to be verified and recorded through secure elements in hardware devices possessed by end users[17].

The Eurosystem could rely on either traditional technology, distributed ledger technology or a combination of both for settlement activities.[18] The Eurosystem has not yet taken a decision on the technology that would be best suited for a digital euro. Efficiency, security and integration with customer-facing services, as well as the environmental impact will be considered. The technology should follow functionality.

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16 Ibid and Roles of the Eurosystem and intermediaries in the digital euro ecosystem, Eurogroup, 3 October 2022.

17 A secure element (SE) is a tamper-proof chip with pre-installed software that can store confidential and cryptographic data and run secure applications. See Digital euro glossary. ECB, 2022.

In an offline digital euro solution, the settlement would happen between the two hardware devices of the end users which function as the wallets for the offline digital euro and facilitate transactions. Any rules related to the settlement and any other legislative considerations (for example, anti-money laundering and terrorist financing requirements, user identification criteria) would be enshrined in the secure elements of these hardware devices. The monetary value relating to the payment would be exchanged between the secure elements in accordance with the rules set.

18 See "Building on our strengths: the role of the public and private sectors in the digital euro ecosystem – Introductory statement by Fabio Panetta, Member of the Executive Board of the ECB, at the Committee on Economic and Monetary Affairs of the European Parliament", *Speeches*, Brussels, 29 September 2022.

1.3 Funding and defunding

Funding and defunding functionalities would enable the end user to top up or withdraw digital euro holdings by transferring money from/to private money[19] or with/into cash. Users would either fund their digital euro holdings accounts or wallets with cash, or convert private money into digital euro ("funding"). Conversely, they could convert digital euro into cash or into private money ("defunding")[20].

A seamless funding and defunding experience is essential to support the successful uptake of the digital euro; the ease with which such functionalities could be used would significantly affect end users' willingness to adopt a digital euro and to use it over time. The set of funding and defunding functionalities to be offered by supervised intermediaries would need to ensure a common baseline end user experience, irrespective of the supervised intermediary that provides them with the digital euro.

Users would be able to choose whether the conversion of private money or cash into digital euro, and vice versa, should take place manually or automatically.[21] Supervised intermediaries would offer manual funding and defunding options in both their online and offline digital euro solutions. For the automated option, which would be applied at the discretion of the end user, a waterfall functionality would be introduced that would allow users to make or receive payments in digital euro in excess of any holding limit set by the central bank to limit the amount in circulation.[22] When receiving a payment, liquidity exceeding the holding threshold would be automatically pushed to a linked private money account chosen by the end user. This would ensure a seamless payment experience even if there were quantitative limits on the holdings of individual users.

Similarly, at the discretion of the end user, a reverse waterfall functionality would ensure that end users could make a payment even if the amount exceeded their current digital euro funds.[23] Additional liquidity would be pulled from the linked private money account and the transaction would be completed in digital euro at its full value. Transaction limits might need to be applied, for example to limit the impact of potential fraud. For both the waterfall and reverse waterfall functionalities, the end user would be explicitly invited to take up the option of a link with a private money account on onboarding.

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19 Private accounts refer to private sector-offered payment solutions – for instance giro payments or cards – that are based on commercial bank money, such as deposits. See, for example, Lagarde, C. and Panetta, F., "Key objectives of the digital euro", *the ECB Blog,* 13 July 2022.

20 Ibid.

21 Ibid.

22 For a description of limit and remuneration-based tools that are intended to be incorporated into the design of a digital euro to control the amount in circulation, see Progress on the investigation phase of a digital euro, ECB, 2022.

23 See "Building on our strengths: the role of the public and private sectors in the digital euro ecosystem – Introductory statement by Fabio Panetta, Member of the Executive Board of the ECB, at the Committee on Economic and Monetary Affairs of the European Parliament", *Speeches*, Brussels, 29 September 2022.

Waterfall and reverse waterfall might result in end user digital euro holdings deviating temporarily from the holding threshold. Any such deviations would need to be minimised. In any event, should such deviations be warranted for a longer period of time in order to meet requirements arising from the technical components of specific use cases, they would need to be limited to a single calendar day.

Funding and defunding would be available around the clock. Funding and defunding functionalities for private money should be available to end users 24 hours a day, 365 days a year. Funding and defunding with cash should be available where an intermediary already provides cash services and where it is in line with local cash availability policies.

An offline digital euro device would need to be online for funding and defunding. It could be funded or defunded either from/to a user's online digital euro position, private money or cash. The device would then need to be brought online so that the funding/defunding transaction could be validated by a third party, similar to the need for an ATM to be online when customers want to withdraw or deposit cash from/to their commercial bank account using their bank card. Transactions could, however, be performed offline without network/internet connectivity of the device.

2 Distribution model

To achieve the objectives of a digital euro and ensure that everyone in the euro area could pay and be paid in digital euro, a digital euro scheme would appear best suited for the distribution of a digital euro.[24] Paying with digital euro should always be an option, irrespective of the entity with which end users open digital euro accounts or wallets and irrespective of their country of origin. Likewise, a digital euro payment instrument provided to end users by one intermediary in one country should be usable without barriers to pay any merchant in the euro area, irrespective of the intermediary and the country in which the merchant is located. A digital euro should also be available to people who currently have no, or limited, access to digital means of payments, in order to improve financial inclusion. It should foster innovation in the payments market, enabling supervised intermediaries to develop novel solutions rather than discouraging or crowding out private payment solutions.

[24] Compared with alternative models considered in the analysis, a model based on a digital euro scheme is seen as the most appropriate for the initial roll-out of the digital euro. For instance, with an "issuance model", the Eurosystem would only be responsible for issuing the digital money, without providing the settlement infrastructure or intervening in distribution. Alternatively, in an open access model, the Eurosystem would only provide the settlement infrastructure and set access rules; every entity that fulfilled these rules could then use the infrastructure in their own way. While they give the market room to innovate, these two models might not achieve widespread distribution to end users or sufficient interoperability, which would hamper the end user experience and act as a barrier to financial inclusion. An alternative distribution model could be imagined in which the Eurosystem would provide the full payment product in an end-to-end solution. While this model would ensure a homogenous end user experience and widespread distribution, it would reduce the role of intermediaries and could pose challenges in terms of meeting end user demands and keeping up with innovation.

A digital euro scheme would establish a set of common rules, standards and procedures that supervised intermediaries would need to adhere to in order to distribute the digital euro. Establishing a set of common rules, standards and procedures would ensure pan-euro area reach and promote a harmonised end user payment experience, as certain requirements on commercial elements (for example the form factors[25] to be used) could be specified.

This approach can provide the flexibility to respond to end user preferences and specificities. The scheme-based distribution approach would provide the market with the most freedom in distributing the digital euro and developing innovative front-end solutions, without compromising the key objectives of the Eurosystem: the digital euro as monetary anchor, and supporting strategic autonomy and economic efficiency.[26]

A digital euro scheme would give significant flexibility to the market, while also ensuring the Eurosystem's overall responsibility for the digital euro. The Governing Council will consider, at a later stage, scheme-access criteria, that is to say the set of supervised intermediaries that would be eligible as participants. In developing the scheme, the Eurosystem aims to maximise the reuse of, or to build on, the existing components and standards currently available in the market.

As it is crucial for the market to have a set of rules in place at an early stage in order to be able to develop digital euro solutions, the Eurosystem is already looking to work on a possible rulebook for the digital euro scheme. In so doing, the Eurosystem will collaborate with all market participants to ensure that everyone, - including intermediaries, consumers and retailers - can bring their views to the table. To facilitate the drafting and development of the digital euro scheme rule book, a Rulebook Development Group will be set up. This group will consist of representatives from Eurosystem national central banks and market participants, overseen by a scheme rulebook manager appointed from the market.[27] Work on the digital euro scheme rulebook, which forms an integral part of the digital euro project, is expected to commence in January 2023.

3 Next steps

The design choices discussed in this report are embedded in the broader context of the ongoing digital euro investigation phase. In the remainder of the investigation phase, work will continue on assessing a number of design and distribution options for a digital euro, including advanced functionalities for digital euro payments (programmable payments, cross-currency payments), and additional aspects of the digital euro distribution model. The latter include matters relating to supervised intermediaries and scheme access criteria, form factor and how end users could access the digital euro customer interface, core services and value-

[25] Form factor refers to the combination of a consumer device with an end user interface and a communication technology. It supports the exchange of payment information between payer and payee for payment initiation and authentication.

[27] See ECB seeks scheme rulebook manager for the digital euro, MIP News, ECB, 10 October 2022.

added services, end user onboarding, digital euro access and holdings, and issuance and redemption. Work on the digital euro project will also include assessment of a compensation model for a digital euro. In the second half of 2023 the overall digital euro high-level design will be presented for approval to the ECB's decision-making bodies. The high-level design will comprise the final set of all design choices, including those elements discussed in this report and in the previous report issued in September 2022. The investigation phase also includes a prototyping exercise to test how well potential back-end solutions developed by the Eurosystem could be integrated with front-end prototypes.[28] The prototyping exercise is expected to be completed in the first quarter of 2023, when the ECB will also publish its findings.

The Eurosystem will continue to actively engage with a large number of stakeholders throughout the remainder of the investigation phase.[29] This will include dialogue with the European Commission, the European Parliament and the finance ministers of the euro area countries. In addition, there will be broad engagement with market stakeholders to ensure that a digital euro meets users' needs.

The Governing Council will review the outcome of the investigation phase in autumn 2023 and decide, on this basis, whether or not to move to a realisation phase in which the appropriate technical solutions and business arrangements necessary to provide a digital euro would be developed and tested. A decision on the possible issuance of a digital euro would not come until a later stage and would also depend on legislative developments in terms of a regulation to establish and govern essential aspects of the digital euro to be adopted by the European Parliament and the Council of the EU, on a proposal by the European Commission.

28 For more information on the prototyping exercise, see The Eurosystem's technical onboarding package for digital euro prototyping, ECB, December 2022, and other documents available on the ECB's website.

29 See Stakeholder engagement on the ECB's website.