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Technical note on the provision of multiple digital euro accounts to individual end users

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Executive summary

The proposal for a regulation on the establishment of the digital euro (hereafter the “proposed regulation”) states that digital euro users¹ may have one or several digital euro accounts with the same or different payment service providers (PSPs).² During the investigation phase of the digital euro project, the Eurosystem based the design of the digital euro on the assumption that users would only be able to open one digital euro account. In its opinion on the proposed regulation, the European Central Bank (ECB) made a commitment to “conduct and share with the co-legislators an in-depth technical analysis of the interplay between multiple accounts and the management of an individual holding limit” with a view to supporting the legislative debate.³ This note is intended to fulfil that commitment by analysing this interplay from the following perspectives: (i) privacy and data protection; (ii) user experience; (iii) enforcement of holding limits; (iv) management of offline holding limits; and (v) joint accounts. The main findings are as follows.

1. **A multiple account scenario would not require the Eurosystem to process more personal data than in a single account scenario. In either case, the Eurosystem would not be able to identify an individual user.** In a single account scenario, PSPs would only need to verify, via the single access point maintained by the Eurosystem, whether or not each user has already opened a digital euro account. In a multiple account scenario, additional information would be needed at the single access point to make PSPs aware of each user’s available online and offline holding limit capacity.
2. Regarding user experience, the analysis shows that, in a multiple account scenario, exercising the option to open an additional digital euro account would require **the user to make several choices, across multiple steps, on how to allocate their online/offline holding limit capacity potentially between more than one PSP. PSPs would need to dedicate resources to their service desks to explain these choices.** Moreover, they would not have information regarding the allocation of the user’s holding limits with other PSPs. The proposed regulation provides for the possibility for users to allocate **their individual holding limit across three interrelated dimensions: (i) online and offline holdings, (ii) multiple offline devices, and (iii) multiple accounts with different PSPs.** While opening more than one digital euro

¹ For the purposes of this note, the term “user” refers to natural persons only. Businesses would have a zero holding limit, so there would be no issues concerning the distribution of digital euro holdings across multiple accounts.

² Article 13(7) of the Proposal for a Regulation of the European Parliament and of the Council on the establishment of the digital euro, European Commission, COM (2023) 369 final, 28 June 2023.

³ Opinion of the European Central Bank of 31 October 2023 on the digital euro (CON/2023/34).

account would be the individual user's choice, **there is a risk that the processes involved in adjusting multiple holding limits could lead to the digital euro being perceived as a complex product.**

3. **A multiple account scenario requires a coordinated effort to ensure that, if a user's identity attribute changes, all PSPs become aware of the change and can perform know your customer (KYC) checks in order to avoid the duplication of that user's holding limit.** PSPs enforce holding limits based on a hashed user identifier which is derived from identity attributes. As some personal data (such as a user's last name) may be subject to change, it is possible that, at some point, a user may obtain two user identifiers, thereby doubling their holding limit. **This risk could arise in both multiple and single account scenarios but would be more complex to mitigate if users could have multiple accounts with different PSPs.** This is because all PSPs would ideally need to become aware of any changes in a user's identity attributes within a short period of time, which may prove challenging.
4. **In a multiple account scenario, offering users the ability to flexibly adjust offline holding limits would require PSPs to update the single access point every time the user makes such an adjustment.** This is because other PSPs need to become immediately aware of changes in a user's available online and offline holding limit capacity.
5. **The provision of joint digital euro accounts is possible in both a single account and a multiple account scenario.** However, having a joint digital euro account and an individual digital euro account at the same time is only possible in a multiple account scenario.

This analysis shows that it is technically feasible to provide users with multiple accounts in conjunction with an individual holding limit. That being said, the conclusions outlined above indicate trade-offs would be necessary, mainly in terms of user experience as well as technical and operational implementation for PSPs.

Against this background, this note highlights the value of the digital euro's unique "switch-and-port" functionality, which might bring some of the same benefits as allowing users to hold multiple accounts. This functionality would allow users to easily change PSP, while maintaining their digital euro account number (which is not possible with the IBAN⁴), including transaction history and information on recurring payments. It would also facilitate switching of digital euro accounts in exceptional circumstances.⁵ The note considers the factors which might influence whether users prefer to a) switch the existing digital euro account to a new PSP and port the account number, or b) add a new digital euro account with a different PSP and have an additional digital euro account number. Similarly, it

⁴ The IBAN (International Bank Account Number) embeds both a country code and the PSP code, preventing the account number from being ported.

⁵ Article 31(2) of the proposed regulation.

considers what factors might motivate PSPs to actively offer users one or the other option.

2 Introduction

Under the proposed regulation, users have the option to hold one or several digital euro accounts with the same or different payment service providers (PSPs).⁶ During the investigation phase of the digital euro project, the Eurosystem based the design of the digital euro on the assumption that users would only be able to open one digital euro account, not multiple.

The ECB argued in its opinion on the proposed regulation⁷ that a design allowing multiple digital euro accounts may lead to technical and operational difficulties, especially regarding the interplay of these accounts and the aggregated holding limit. In the opinion, the ECB invites co-legislators to consider the following two elements when assessing whether or not to place a limit on the number of accounts a user can hold: “First, the freedom of PSPs to provide digital euro services would not be constrained by a limitation to one account per user. It would be easier to switch a digital euro account than it currently is to switch a commercial bank money account, since the International Bank Account Number (IBAN) is not portable. Second, the complexity for the user in managing a consolidated holding limit across multiple accounts may warrant applying a different approach at the launch of the digital euro, when people are not yet familiar with it.”

In the opinion, the ECB made a commitment to co-legislators that it would conduct and share “an in-depth technical analysis of the interplay between multiple accounts and the management of an individual holding limit”. This technical analysis explores that interplay from the following perspectives: (i) privacy and data protection; (ii) user experience; (iii) enforcement of holding limits; (iv) management of offline holding limits; and (v) joint accounts. Finally, the value of the novel “switch-and-port” functionality (already provided for in the design of the digital euro and in the proposed regulation) is considered, including how it could act as a mitigating measure and ensure competition among PSPs, even in a single account scenario.

3 Impact on privacy and data protection

A multiple account scenario would not require the Eurosystem to process more personal data than in a single account scenario. In either case, the Eurosystem would not be able to identify an individual user.

As stated in the proposed regulation, a single access point (“SAP”) which acts as a repository for digital euro user identifiers and other related data, and which is accessible to all PSPs, is necessary to ensure the efficient functioning of the digital

⁶ Article 13(7) of the proposed regulation.

⁷ Opinion of the European Central Bank of 31 October 2023 on the digital euro (CON/2023/34).

euro.⁸ The SAP is needed irrespective of whether a single or multiple account approach is adopted, as it would enable PSPs to enforce the holding limits and facilitate emergency account switching.

When establishing the SAP, the Eurosystem will ensure that the processing of personal data is minimised to only what is strictly necessary, and that data protection is embedded by design and by default. The user identifiers will be pseudonymised with a strong hash. The latter will consist of multiple elements of identity attributes and will be created in such a way that it is not possible to use the hashed user identifier to identify a specific digital euro user or obtain any personal data.

Tables 1 and 2 illustrate the data elements required in the SAP in a single and a multiple account scenario, respectively. The corresponding data accessible to PSPs in the latter scenario are illustrated in Table 3.

Table 1

Possible architecture of the SAP in a single account scenario: information accessible to the Eurosystem and the PSP “EU3724”

User identifier	Hashed technical proof	User type	PSP identifier
#rT9jjA2*(Ltd	7a3119bd2e32cc883a	Individual	EU478821

Note: In a single account scenario, information related to the offline devices could be managed by the PSP.

⁸ Recital 77 of the proposed regulation.

Table 2

Possible architecture of the SAP in a multiple account scenario: information accessible by the Eurosystem

User identifier	Hashed technical proof	User type	Holding limit	Holdings type	PSP identifier
#rT9jjA2*(Ltd	7a3119bd2e32cc883a	Individual	800	Online	EU4788
#rT9jjA2*(Ltd	38aaa311c294a4313a	Individual	600	Online	EU2457
#rT9jjA2*(Ltd	41a55b3ac19c1d1221	Individual	1300	Online	EU3724
#rT9jjA2*(Ltd	a5sdf11bb03cca781d	Individual	300	Offline	EU3724

Table 3

Possible architecture of the SAP in a multiple account scenario: information accessible by the PSP "EU3724"

User identifier	Hashed technical proof	User type	Holding limit	Holdings type	PSP identifier	Sum of online holding limit allocation	Sum of offline holding limit allocation
Anonymised						2700	300
Anonymised							
#rT9jjA2*(Ltd	41a55b3ac19c1d1221	Individual	1300	Online	EU3724		
#rT9jjA2*(Ltd	a5sdf11bb03cca781d	Individual	300	Offline	EU3724		

In a single account scenario, the SAP will be used by onboarding PSPs to verify that the user does not already hold another account, since this is sufficient to ensure that the individual holding limit is not exceeded. In a multiple account scenario, data would be required on the allocation of the user's holding limit across different PSPs and across online and offline holdings, in addition to user identifiers. This would enable PSPs to ensure that the regulatory individual holding limit is not exceeded. Given that PSPs would need to know the online and offline holding limit capacity that they must individually enforce, they would need to be able to check the holding limit capacity that a user has already allocated to other PSPs, without being able to identify those PSPs. This would enable a PSP to infer the customer's available headroom and, on that basis, grant or refuse the right to adjust their holding limit capacity.

As shown in Tables 1 and 2, the provision of multiple accounts would increase the amount of data that need to be stored in the SAP. However, information on holding limit allocations and types is not critical from a privacy perspective. In both the single account and multiple account scenarios, the data processed by the Eurosystem could not be used to infer the identity or the holdings of any individual user.

Therefore, the SAP could also be established in a multiple account scenario without infringing privacy or data protection.

4 Impact of multiple accounts on user experience

Regarding user experience, the analysis shows that, in a multiple account scenario, exercising the option to open an additional digital euro account would require the user to make several choices, across multiple steps, on how to allocate their online/offline holding limit capacity potentially between more than one PSP. PSPs would need to dedicate resources to their service desks to explain these choices, Moreover, they would not have information regarding the allocation of the user's online/offline holding limits with other PSPs.

The decision to open more than one digital euro account would be at the discretion of individual users. However, the processes that need to be completed to open additional digital euro accounts with a new PSP would be more complex than those required to open a commercial bank money account, because they would require adjustments in the user's holding limit capacity with any PSP(s) with which they already have a digital euro account. Even if the decision to open an additional account is optional, it cannot be excluded that an unexpectedly complex experience in exercising that option could lead to users perceiving the digital euro as a complex product, negatively affecting the overall perception of the product. PSPs will need to dedicate resources to their service desks to explain these choices.

Table 4 describes the steps involved in onboarding a user (KYC processes, establishing holding limits and potentially splitting the individual holding limit across online/offline holdings and across different PSPs) in both the multiple account and single account scenarios.

Table 4

Illustration of steps involved in onboarding process in both the single account and multiple account scenarios

Individual steps	Description	Single account	Multiple accounts	
			First account	Additional accounts
Collecting KYC information*	A user seeking to open a digital euro account would be onboarded by a PSP, which would gather the information needed to identify the user and confirm their eligibility to open a digital euro account. The information collected would be used to derive the user identifier.	X	X	X
Action A: Establishing the holding limits of a digital euro account across one/several PSPs	The user would be required to assign a holding limit to the newly opened account. In the initial stage of onboarding, this step could be bypassed by setting the default holding limit as the maximum amount the user is legally entitled to hold.	A1	A2	A3
Action B: Splitting holding limits between online and offline holdings and across offline devices and PSPs	If the user opts to use one or more offline devices, they would need to (i) split the overall holding limit between their online and offline holdings and (ii) split the offline holding limit across several offline devices, potentially provided by multiple PSPs.	B1	B2	B3

* This step may be skipped if (i) the user already has a payment account with the PSP and (ii) the PSP already has the personal data needed to derive the user identifier.

Analysis of action A

In both scenarios (single account and multiple account), the initial user onboarding does not require users to set a holding limit for the first account, as this limit could be automatically set, by default, to the maximum amount a user is legally entitled to hold (scenarios **A1** and **A2**). However, when it comes to opening additional digital euro accounts, the user would need to set the holding limit for the new account and potentially reallocate the holding limits assigned to the former account to ensure that their aggregate holding limit does not exceed the maximum (**A3**).

Analysis of action B

Likewise, in both the single and multiple account scenarios, the user would need to allocate the holding limit between online and offline holdings and potentially across several offline devices (**B1** and **B2**). In a scenario where a user opens additional accounts, the degree of complexity would be higher, with the user having to first adjust online/offline holding limits with their existing PSP(s) (**B3**).

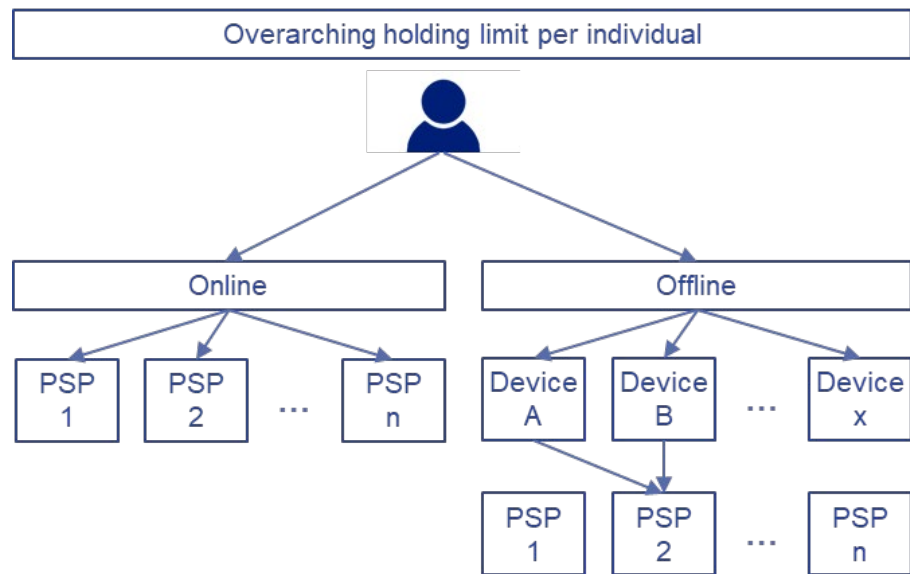
As shown in Table 4, managing and adjusting the holding limit in a multiple account scenario could involve more complexity, depending on the number of digital euro

accounts a user decides to open. The rest of this section focuses on that specific aspect.

Figure 1 displays the three interrelated dimensions across which a user might need to split their holding limit under the proposed regulation as it currently stands: (i) online and offline holdings, (ii) multiple offline devices, and (iii) multiple accounts, potentially provided by multiple PSPs.

Figure 2

The three dimensions that users might need to take into consideration when managing their holding limit in a multiple account scenario

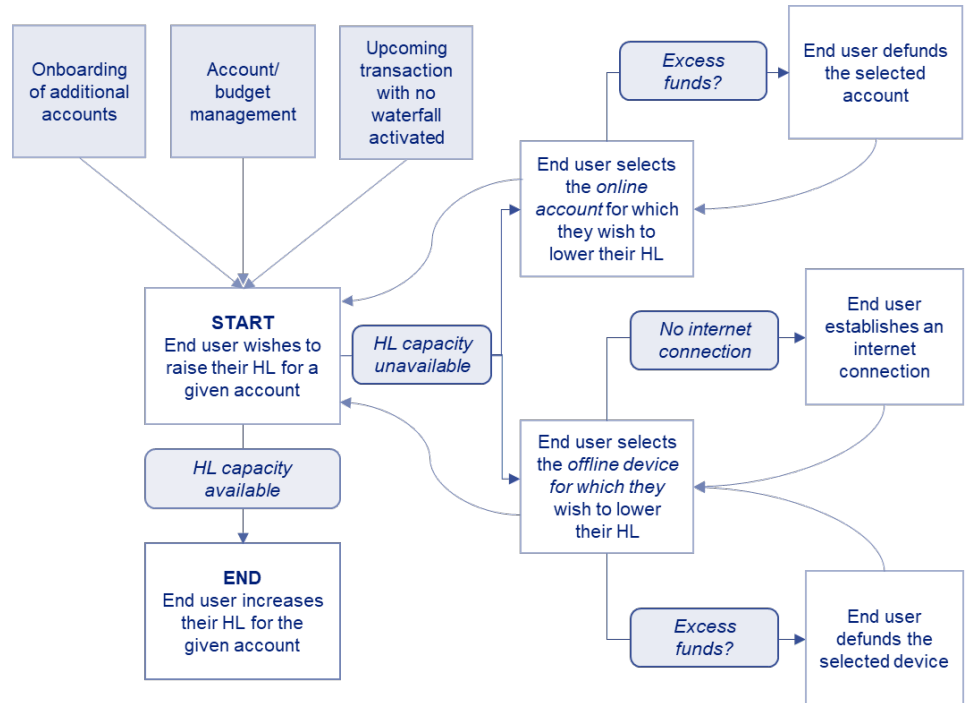


To increase their holding limit (abbreviated to HL in Figure 2), users with more than one account would need to follow a complex path resulting in a cascade of operations as illustrated in Figure 2. The more the user splits their holding limit across accounts and offline devices, the greater the number of steps. The number of steps also depends on whether the user has to defund an account or a wallet before adjusting the holding limit.

From a PSP perspective, this complexity would require resources to be allocated to the service desk to provide explanations and clarifications to digital euro users.

Figure 2

Flow chart for adjusting holding limits in a multiple account scenario



In a multiple account scenario, PSPs would not know which other PSPs their customers have digital euro accounts with. Consequently, if a user forgets which PSP(s) they initially opened a digital euro account with, they would not be able to follow the steps outlined in Figure 2 above. The ECB would need to conduct a further investigation into possible ways to address such cases.

5 Enforcement of holding limits

A multiple account scenario requires a coordinated effort to ensure that, if a user's identity attribute changes, all PSPs become aware of the change and can perform KYC checks in order to avoid the duplication of that user's holding limit.

As described in Section 1, irrespective of whether a single or multiple account approach is adopted, the SAP would enable PSPs to enforce holding limits based on a user identifier. In a multiple account scenario, the SAP would also provide PSPs with information on their customers' available holding limits (see Table 3 in Section 3).

The user identifier is the primary key for the digital euro user and is derived from pieces of personal data (i.e. identity attributes). However, it cannot be excluded that some of the identity attributes (such as a user's last name) which might be used to

obtain the hashed user identifier change during a user's lifetime.⁹ It is therefore possible that, at some point, a user may obtain two user identifiers.

Such a change in an identity attribute could make it possible for a user to open an additional account with a new user identifier at another PSP. This would double that user's individual holding limit for a certain period of time until KYC checks are performed. **This risk could arise in both multiple and single account scenarios but would be more complex to mitigate if users can have multiple accounts.** In a multiple account scenario, only once all PSPs involved detect the change through the relevant KYC checks and update the SAP in a consistent manner could a normal situation be restored, i.e. one in which the person cannot exceed the holding limit. Given that PSPs would not know which other PSPs their customer has digital euro accounts with, the ECB should study how best to support PSPs in these cases.

6 Maintaining offline holding limits

In a multiple account scenario, offering users the ability to flexibly adjust the holding limit for an offline device would require PSPs to update the SAP every time the user makes such an adjustment.

As it currently stands, the proposed regulation lets digital euro users customise their offline holding limit across two dimensions. Users may (i) set the offline holding limit to any amount between zero and the holding limit set for offline digital euro by the European Commission and (ii) split the overall limit across multiple devices, potentially across multiple PSPs.

As regards the capability of PSPs to manage offline holding limits that can be changed by users, technical calls and investigations with market participants indicate that it should be possible to set a customisable parameter stored in the secure element of the device. However, adjusting a parameter of an application installed within a secure element may be challenging. Secure elements are deliberately configured to impose strict access restrictions. This is to prevent any potential corruption or theft of the sensitive data they safeguard. To assess the additional complexities involved, both for PSPs and for secure element providers, the ECB will need to conduct further investigation into potential technical solutions.

In a single account scenario, these adjustments would not require the PSP to update the SAP, because the SAP would not need to distinguish between the online and offline holding limit capacity. In a multiple account scenario, these adjustments would require the PSP to update the SAP, because other PSPs need to become immediately aware of changes in a user's available online and offline holding limit capacity.

⁹ In creating the hash, there is a trade-off between strength and stability: using more identity attributes helps to make a stronger hash so that the user is not identifiable, but the user identifier also needs to remain as stable as possible throughout the user's lifespan.

7 Joint accounts

The provision of joint digital euro accounts is possible in both a single account and a multiple account scenario. However, having a joint digital euro account and an individual digital euro account at the same time is only possible in a multiple account scenario. It would still be possible in a single account scenario to have both an individual digital euro account and a commercial bank money joint account, or vice versa.

A digital euro joint account would have one digital euro account number (DEAN) shared by two or more users onboarded with the same PSP. In a single account scenario, if a user decided to opt for a joint account instead of an individual account, they would have to allocate their holding limit capacity to the shared account. In a multiple account scenario, each user that legally holds the shared account could allocate a portion of their holding limit capacity to the joint account and another portion to their individual account, thus offering more flexibility.¹⁰

The ECB will need to conduct further investigation to explore how some of the features envisaged for the digital euro would work in a joint account scenario. For example, associating an offline device to a joint account would need to be subject to a clear operational and legal framework.

8 Switching and porting an existing account compared with adding a new account

This analysis shows that it is technically feasible to provide users with multiple accounts in conjunction with an individual holding limit. That being said, the conclusions outlined above indicate trade-offs, mainly in terms of user experience as well as technical and operational implementation for PSPs. Against this background, this section discusses the value of the digital euro's unique "switch-and-port" functionality, which might bring some of the same benefits as allowing users to hold multiple accounts.

Indeed, a digital euro would offer the unique functionality of carrying over, or "porting", the account number when the user switches from one PSP to another. This differs from current IBAN system, which embeds both the country code and the PSP code, preventing the account number from being ported. For digital euro accounts, switching between PSPs would be as easy as switching from one mobile phone provider to another. It could be argued that the ability for the user to keep their mobile phone number when switching providers has been a key factor in fostering competition among providers.

This section addresses the following questions.

¹⁰ Recital 39 of the proposed regulation.

1. User experience: how easy or complex would the process of switching and porting digital euro accounts be compared with the process of adding a new digital euro account as described in the previous section?
2. Value for users: what would be the pros and cons of switching an account compared with adding?
3. Value for PSPs: what factors may lead PSPs to actively offer users one possibility over the other?

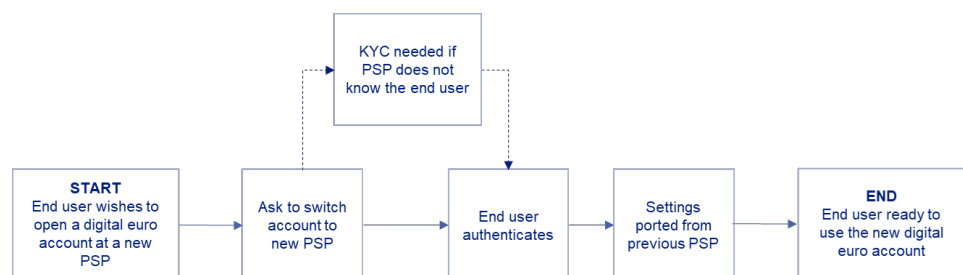
The point is ultimately to feed the legislative debate and help assess the extent to which, assuming the “switch-and-port” functionality is available from the launch of the digital euro, (temporarily) restricting users to a single digital euro account would be effective in preserving competition and freedom of choice. In particular, the below analysis demonstrates that, within the wider digital euro context:

- it is always possible to hold one digital euro account (to which a holding limit applies) and multiple commercial bank money accounts (to which no holding limit applies);
- as the digital euro’s “switch-and-port” functionality is not currently available in the marketplace, it is worth evaluating whether or not it satisfies the user needs that are currently met by the possibility of opening of more than one commercial bank money account.

8.1 User experience: process for switching and porting a digital euro account

The process of switching and porting a digital euro account is much simpler than the process of adding a new account. Figure 3 shows that the “switch-and-port” functionality provides a more straightforward user experience, because the user only needs to confirm to the existing PSP their intention to switch.

Figure 3
Illustration of steps that a user would need to take when switching to a new PSP



In a “switch-and-port” process, users would not need to adjust their holding limit allocations. In addition, they would not have to change their settings, as transaction history and standing orders would be ported automatically from the previous PSP (if

the user opts to also port these).¹¹ The ECB is currently investigating whether or not the switching process could also include the porting of offline devices, which would avoid the need for users to defund the old offline device and activate the new offline device.

8.2 Value for users: switching and porting compared with adding an account

Table 5 shows possible factors and situations that could lead a user to prefer switching and porting¹² between accounts over adding a new account. These factors would be further investigated by carrying out research among potential users in the preparation phase.

Table 5
Factors that could lead a user to choose either switching an account or adding an additional account

Possible preference for switching and porting	Possible preference for adding an additional account
No need to split liquidity in order to stay within the holding limit. The lower the holding limit, the higher the value of switching over adding	If it is difficult for the user to choose a PSP. The availability of a wide range of different value-added services among different PSPs could increase the value of adding an account.
A simpler process for the user and for the PSP compared with adding (see Figure 2 and 3).	A user wishes to hold both an individual digital euro account and a joint digital euro account.
A user wants to close an account at the previous PSP instead of just adding an additional account.	A user prefers to spread their digital euro transactions among several PSPs.

To gain an additional perspective, it is worth considering why currently, in the absence of a digital euro, users may prefer to hold more than one account in commercial bank money, and what customer needs are met in this way. Table 6 assesses the extent to which the same needs can be met by a digital euro with an easy “switch-and-port” functionality.

¹¹ Porting of transaction history and standing orders would not be possible in emergency switching for privacy reasons.

¹² Consumer associations such as the European Consumer Organisation BEUC strongly support the envisaged switching functionality. See, for example https://www.ecb.europa.eu/paym/digital_euro/investigation/governance/shared/files/ecb.degov230123_writtenfeedback.en.pdf?627ae19ade82e57f5b2365cdacf9b509.

Table 6

Overlaps between the benefits of the digital euro's "switch-and-port" functionality and the current possibility of having several commercial bank money accounts

Possible reasons for holding multiple commercial payment accounts	Covered by switch-and-port functionality?	Covered by possibility of adding an account (in a multiple account scenario)?
Diversify fraud risk (holding all money in one place)	Not applicable	Not applicable
Increase coverage of deposit guarantee beyond €100,000	Not applicable	Not applicable
Obtain access to better/more PSP services	Yes, but (*)	Yes, but (**)

(*) Yes, but the user needs to give up "current PSP" digital euro services in order to access "new PSP" digital euro services. The user can of course continue to use "current PSP" commercial bank money services.

(**) Yes, but the friction costs of adjusting holding limits and the need to split the limited amount of liquidity allowed for by the holding limit may provide a significant disincentive to adding an account. These friction costs do not apply when holding multiple commercial bank money accounts, where the main friction cost is the know-your-customer (KYC) process.

8.3 Value for PSPs: switching and porting compared with adding an account

PSPs might prefer to invite a user to switch and port their existing account rather than encouraging them to add a new digital euro account. It enables the PSP to maintain the full customer relationship and to obtain revenue from all the digital euro payments that the user makes in physical shops or via e-commerce. PSPs and their associations are well positioned to assess this.

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