Mastercard response to ECB public consultation on a digital euro

Mastercard welcomes the opportunity to share our views in the ECB's public consultation on a digital euro. The rapid pace of technological change, including the advent of crypto-currencies and stablecoins, has led policymakers around the globe to consider the impact of this transformation on the future of payments and to ask themselves how to best safeguard the interests of consumers and businesses.

Mastercard is committed to supporting central banks in their chosen path to payment system modernisation; including the development of a central bank digital currency (CBDC) where this is relevant. Having operated multiple secure, safe, scalable payment networks around the world for many years, Mastercard is investing in a range of cutting-edge approaches to payment infrastructure and services, including the use of blockchain. We are committed to bringing that expertise to bear in support of the design, testing, and deployment of CBDC networks where central banks choose to pursue their development.

We have responded to the questions raised by the ECB in the document below. In summary:

- We strongly concur with the ECB's stated view that "*supervised private intermediaries should have the opportunity to use their expertise and participate in the provision of [digital euro] payment services*." Open and competitive payment ecosystems are critical to enabling access, adoption, and use of payment options that serve a wide range of user needs and preferences. Moreover, ongoing payments innovation, expanded financial inclusion, and the efficiency of national and international payment flows all depend on vibrant private sector competition in the provision of payments.
- A 'two-tier' or 'platform' model will provide a secure, fast, and resilient technology environment that avoids the unnecessary expense of parallel infrastructure and ensures that compliance requirements remain primarily with industry. This approach ensures that the ECB retains institutional governance over core monetary infrastructure, while relying on private sector competition to drive innovation, efficiency, and a diversity of offerings.
- Enabling acceptance points is one of the greatest challenges to driving mass adoption of a new payment solution. Consumers will be more likely to adopt a digital euro if it can be used on existing acceptance infrastructure and is supported by known and identifiable payment form factors (physical and digital) that are linked to the user's existing devices and accounts. Therefore, linking the digital euro to existing private payment networks with broad merchant acceptance would make adoption easier for both consumers and merchants.
- Interoperability between payment systems avoids closed loops that reduce the fungibility of money, fragment liquidity, and limit competition. In the case of a digital euro, interoperability with other stores of value (e.g. commercial bank deposits, e-money etc.) would play an important role in strengthening the domestic payment ecosystem and reinforcing the role of central bank money at its core.
- We share the ECB's excitement for the value-added offerings that future payment systems – including real time payments, card networks, and a potential digital euro – will provide. However, we do not believe that it will be possible to determine in advance the full suite of value-added services that it may prove valuable to layer on top of a digital euro. Therefore, we recommend that the design of a digital euro should be structured to embrace the necessary scalability, extensibility, and flexibility to accommodate the needs of a rapidly changing payments landscape.
- Mastercard can bring experience from operating critically important retail payment infrastructure across both card and real-time payment systems. A CBDC is a new type of central bank money that will need an effective and resilient payment system. Mastercard has deep expertise in building and operating successful, high-performance, and secure commerce and payment networks. We govern and operate the world's fastest payments processing network (capacity of > 20,000 transactions per second), connecting consumers, financial institutions, merchants, governments and businesses in more than 210 countries and territories.

ECB question	Mastercard response
5 What role do you see for banks, payment institutions and other commercial entities in providing a digital euro to end users?	We strongly concur with the ECB's stated view that "*supervised private intermediaries should have the opportunity to use their expertise and participate in the provision of [digital euro] payment services.*" Open and competitive payment ecosystems are critical to enabling access, adoption, and use of payment options that serve a wide range of user needs and preferences. Moreover, ongoing payments innovation, expanded financial inclusion, and the efficiency of national and international payment flows all depend on vibrant private sector competition in the provision of payments. The design of a digital euro should seek to capitalize on the complementary capabilities of both the ECB and the private sector. A 'two-tier' or 'platform' model will provide a secure, fast, and resilient technology environment that avoids the unnecessary expense of parallel infrastructure and ensures that compliance requirements (as per Requirement 10) remain primarily with industry. This approach ensures that the ECB retains institutional governance over core monetary infrastructure, while relying on private sector competition to drive innovation, efficiency, and a diversity of offerings. Under a 'two-tier' approach we envision the private sector supporting the digital euro in a variety of ways, including but not limited to: **User Experience:** Consumers expect payment journeys to be recognizable, intuitive, and in some cases tailored to their unique needs. These are areas where both incumbent financial institutions and emerging fintechs have a demonstrable fluency. **Customer Identification:** Supervised private intermediaries are well positioned to onboard new users (e.g. sign-up, KYC, funding of accounts, etc.), conduct ongoing AML/CFT monitoring, and provide user education. **Acceptance:** For a CBDC to provide consumers value as a payment mechanism, it must be usable for a wide variety of in-person and digital transactions. However, enabling acceptance points is one of the greatest challenges to driving mass adoption of a new payment solution. Consumers will be more likely to adopt a digital euro if it can be used on existing acceptance infrastructure and is supported by known and identifiable payment form factors (physical and digital) that are linked to the user's existing devices and accounts. Therefore, linking the digital euro to existing private payment networks with broad merchant acceptance would make adoption easier for both consumers and merchants. Commercial incentives could then encourage the private sector (wallet providers, merchants, etc.) to further expand the reach of those networks and better meet the objective of Requirement 12 (Easy accessibility throughout the euro area). **Interoperability:** Interoperability between payment systems avoids closed loops that reduce the fungibility of money, fragment liquidity, and limit competition. In the case of a digital euro, interoperability with other stores of value (e.g. commercial bank deposits, e-money etc.) would play an important role in strengthening the domestic payment ecosystem and reinforcing the role of central bank money at its core. Sustained collaboration between ECB and private sector participants will be critical to delivering this interoperability and achieving the objectives of Requirements 11 (Safety and efficiency in the fulfilment of the Eurosystem's goals) and 12 (Easy accessibility throughout the euro area). **Consumer Protection:** Consumer trust is at the heart of payments. Individuals must have confidence that they are getting what they pay for and that they are protected in the event of fraud, disputes, refunds, or data misuse. Gaining and keeping that trust requires a framework of standards and rules that safeguard the security of every transaction while ensuring that all parties are treated fairly and equitably. The private sector could play a variety of roles in ensuring that a digital euro protects consumers interests and gives them the confidence necessary for in-person and online transactions. These activities range from consulting on the development of scheme rules to offering first or second lines of cyber/fraud defense to the central bank or supervised private intermediaries. Private sector participants might also provide consumers with additional protections for certain transactions as part of a value-added service offering **Value Added Services:** We strongly concur with the ECB's stated view that "*A digital Euro [...] could feature advanced functionalities and provide opportunities for supervised private intermediaries to offer value-added services.*" The potential span of these services is explored in greater depth in our response to question 6. **Settlement:** As articulated in the ECB's 'Report on a digital euro', private sector entities could "*execute digital euro transactions on behalf of their customers and may provide storage facilities (akin to digital vaults) for digital euro holdings*" We encourage the ECB to actively explore these 'intermediated models,' including the potential value that could be created by allowing the formation of multiple competing networks of approved digital euro settlement agents (in much the same way numerous competing networks exist today for the settlement of commercial bank money).

6 A digital euro may allow banks and other entities to offer additional services, on top of simple payments, which could benefit citizens and businesses. What services, functionalities or use cases do you think are feasible and should be considered when developing a digital euro?

We share the ECB's excitement for the value-added offerings that future payment systems – including real time payments, card networks, and a potential digital euro – will provide. However, we do not believe that it will be possible to determine in advance the full suite of value-added services that it may prove valuable to layer on top of a digital euro. The continued digitisation and miniaturisation of payments driven by increased e-commerce activity and the rapid evolution of parallel technologies like 5G, mean that the future demands on payment systems will evolve in unpredictable ways. Therefore, we recommend that the design of a digital euro should be structured to embrace the necessary scalability, extensibility, and flexibility to accommodate the needs of a rapidly changing payments landscape.

That said, one example of a value-added service that may deserve particular attention is programmability of payments; the ability for users to build simple conditional obligations (popularly but somewhat inaccurately referred to as 'smart contracts'), into a payment. It is theorized that programmability could support a wide variety of use cases, including escrow services, automated insurance claims, and the provision of installment loans at the point of sale. Given the strong interest in this functionality we encourage the ECB to explore the potential for a digital euro to support programable payments.

N.B. Programmability is most often discussed within the context of blockchain based systems and more recently in the context of CBDCs. However, there is no reason programmability cannot be enabled on payments funded by commercial bank deposits via centralized systems. In coming years, we expect RTP, card, and CBDC networks to all explore the development of programable payment services.

7 What requirements (licensing or other) should intermediaries fulfil in order to provide digital euro services to households and businesses? Please base your answer on the current regulatory regime in the European Union.

We believe that there are several regulatory issues that would need to be addressed in order to establish the appropriate framework to mitigate and balance the risks identified by the ECB, while also ensuring a level playing field for all participants. Please note that our below responses are all based upon an assumption that - within the EU - a digital euro would have the same status as fiat.

Legislative framework: The EU has an extensive framework for the authorisation of non-bank firms that provide payment services and/or issue electronic money, most notably the Payment Services Directive (PSD2) and the Electronic Money Directive (EMD2).

To the extent that a Digital Euro would be enabled for individuals to make and receive retail payments, we believe that the provisions of PSD2 and EMD2 are well-equipped to be extended to cover the provision of payment services in a CBDC. However, this would require updating the text of these Directives to expressly apply to a Digital Euro. For example, the definition of 'funds' in PSD2 may need to be clarified to specifically include CBDC, since the current definition is limited to banknotes and coins, scriptural money or electronic money as defined in point (2) of Article 2 of Directive 2009/110/EC.

In addition to technical clarifications to the legislative framework, we believe there are significant regulatory considerations that would need to be evaluated prior to the issuance of a Digital Euro:

Authorisation and Supervision: The two-tier model proposed by the ECB assumes that intermediaries (bank and non-bank firms) will be involved in the distribution of digital euro and would provide payment services to consumers and businesses. This introduces several activities that need to be considered in terms of authorisation and supervision of the intermediary firms:

- **Payment services**: Following from our position above that PSD2 and EMD2 can be extended to cover payment services involving a Digital Euro, we believe that the authorisation and supervision provisions of supervised intermediaries could likewise be extended to provide for the authorization and supervision of firms providing payment services in the digital euro.

- **Distribution**: Assuming the distribution of a digital euro would follow the current structure, whereby access to central bank money is provided and made available via credit institutions, the applicability of the associated regulatory frameworks to a digital euro depends on the form such would take – that is, whether the digital euro is account-based or token based. Consideration will need to be given to the suitability of these frameworks for new types of participants (e.g., non-banks), or whether new rules would be required to address varying risk profiles of such firms when compared with credit institutions. Either way, the applicable supervisory regimes would need to apply proportionately to bank and non-bank firms that have access to central bank money in the form of a digital euro. We believe that the ECB should endeavor to apply the principle of same activity, same risk, same regulation, while acknowledging that some activities or risks may be new and require new treatment.

  Regardless of the path chosen by the ECB, regulation should always be proportionate to the risks. Accelerated digitalization of payments and its rapidly evolving market landscape highlight the importance of ensuring that any regulation prioritizes the safeguarding of competition and preventing the imposition of unnecessary barriers to entry.

- **Custody**: Requirements around the custody a digital euro is one of the most critical areas of regulation that will need to be clarified. For example, existing regulatory frameworks such as PSD2 do not currently apply expressly to custodial wallet services. Furthermore, while the European Commission's recent proposal to regulate Markets in Crypto Assets (MiCA) would introduce requirements for custodians of private crypto-assets, a digital euro appears to fall

outside that scope as well. Ultimately, for a token-based digital euro held in a digital wallet, the key management practices, security standards, and ability of the wallet to support payment functionality beyond the digital euro may all raise issues around the applicability of existing regulatory framework to the custody of a digital euro. We therefore believe a decision is necessary regarding a regulatory framework for custodial wallets with the necessary consumer and insolvency protections for custody of a digital euro.

Technology: Given the ECB's observation that *'Having a parallel infrastructure for the digital euro seems especially costly and unlikely if supervised intermediaries are involved not only in the onboarding of users but also in the processing of their transactions'* our response assumes that a Digital Euro will not employ DLT systems. However, thought should be given to how well existing regulation is equipped to address downstream applications of a digital euro via new technologies. We believe regulatory guidance in this area would be useful to help participants apply existing rules to innovative payment services involving a digital euro according to whatever technological form it, itself, is architected to function. For example, if parallel DLT infrastructure is required to support the ECB's goal of a digital euro that will function offline - consideration will need to be given to any additional regulatory requirements applicable to the use of this technology.

Deposit protection: Assuming a digital euro would be 100% backed by the ECB, it would provide protection greater than that of EU deposit guarantee. We believe it necessary to give careful consideration to the implications of this change; particularly in light of the range of potential bank, non-bank and payment services firms that might act as supervised intermediaries for a digital euro.

Open Finance: In light of the pending EU discussion on Open Finance, it would also be beneficial to consider how a digital euro account would fit into any future Open Finance ecosystem.

Settlement Finality: Payment systems in the EU are designated and recognized for the purposes of settlement under the Settlement Finality Directive. As a review of the provision of this Directive is already proposed in the Retail Payment Strategy, we would recommend giving consideration to the finality of digital euro transactions, particularly the finality of offline transactions.

Acceptance: We believe that adoption of a digital euro by consumers is more likely if the digital euro has the status of legal tender. Various mechanisms for achieving an appropriate legal framework for the issuance of the digital euro as legal tender are set out in detail in the ECB's report on a digital euro. Accordingly, it is our position that it is important for the digital euro to have the same status as euro banknotes and coins, to ensure that it is not 'second rate' form of central bank money.

Privacy: There has been considerable debate around the privacy regime that should apply to a central bank digital currency. We believe that digital euro transactions should be subject to the same KYC and AML obligations as all other electronic payments, and that the requirements on the flow of payments data for AML and CTF monitoring apply equally to digital euro transactions. By applying the principle of 'same risk, same rules' it is also possible to exempt certain low value transactions and permit anonymity. We discuss these issues in greater detail in our response to questions nine and ten.

8 Which solutions are best suited to avoiding counterfeiting and technical mistakes, including by possible intermediaries, to ensure that the amount of digital euro held by users in their digital wallets matches the amount that has been issued by the central bank?

Effectively mitigating the risk of counterfeiting and double spending for a digital euro will require consideration across a number of dimensions:

Governance: A two-tiered CBDC design, alongside a strong regulatory framework to provide and enforce operating rules and standards, will ensure that the central bank retains institutional governance and control over the core CBDC infrastructure; enabling it to implement and maintain strong protections against counterfeiting or double spend.

Technology: Appropriate technology can support a digital euro that provides traceability and proof of central bank issuance via cryptographical evidence. These technologies could ensure immediate reconciliation, immutability and auditability through cryptographic guarantees. Additionally, given the ECB's preference for a digital euro that supports offline transactions, the ability to create a secure bearer instrument that facilitates transactions while eliminating the risk of double-spend will be required. At Mastercard, we are exploring options to support offline CBDC transactions that can be used in parallel with, and in synchronization with DLT.

9 What technical solutions (back-end infrastructure and/or at device level) could best facilitate cash-like

Digital payments can be a useful complement to cash that mitigates fraud, tax evasion, and financial crime while also incorporating a range of privacy techniques. Capabilities strengthen cash-like features of digital payments include:

Personalized levels of privacy: Digital payments can provide personalized levels of privacy and optimize individual choice over how individual's personal information is used and shared. This can be done without compromising compliance regulatory and requirements (AML/CFT) while still preventing fraud and securing both the payment infrastructure and users and data against cyberattacks. In addition to well-

	features (e.g. privacy, offline use and usability for vulnerable groups)?	established existing privacy tools, a host of emerging technologies have the potential to offer even greater levels of user privacy without undermining the objectives of existing compliance regimes. These Include: • Zero-knowledge proofs (ZKP) guarantees that customers have sufficient tokens without revealing the balance to merchants • Shamir Secret Sharing (SSS) that reveals data details only if a pre-defined majority of nodes agree • Multi Party Computation (MPC) which supports wallet infrastructure where private keys reside across multiple locations and supports data processing (e.g. AML/KYC) while keeping details private • Anonymization techniques, such as differential privacy, that prevent consumer's personal data from being identifiable within large datasets **Offline transaction use:** A defining feature of cash is that it does not require network connectivity to function. In seeking to replicate these functions within a digital euro, existing card-based ecosystem's use of a of technology and business rules to define and limit liability may prove instructive. Mastercard makes use of counters on the payment card chip to manage offline payments risk. These can be set to allow offline transactions only when the number of offline transactions, or cumulative amount of offline spend, are below a certain threshold. These configurable risk parameters allow the convenience of offline transactions for consumers and merchants at a manageable level of risk that is tolerable for all entities in the ecosystem. **Usability for vulnerable groups:** As it relates to adoption of digital payments by vulnerable groups, we believe it is important to consider maintaining form factors that consumers are familiar with. Prepaid cards and simple mobile wallets that enable digital transactions will be key to achieving usability. Additionally, linking new forms of payments to existing networks with broad merchant acceptance would make adoption and acceptance easier for both consumers and merchants.
10	What should be done to ensure an appropriate degree of privacy and protection of personal data in the use of a digital euro, taking into account anti-money laundering requirements, and combating the financing of terrorism and tax evasion?	The underlying technology supporting digital currency innovations, and the rules created to govern them, continue to evolve at a rapid pace. In order for Europe to maintain payments leadership, we encourage the ECB to work alongside the European Data Protection Board (EDPB), national data protection authorities (DPAs) and the border industry to produce up-to-date, pragmatic and innovative guidance on the interplay between blockchain and the General Data Protection Regulation (GDPR). Especially in relation to innovative solutions that address deletion and rectification. While in Europe digital currency developments should be grounded in the GDPR, which imposes obligations and controls on parties who handle personal data and gives enhanced rights and choices to individuals over how their information is used. Legal and regulatory obstacles are likely to develop without clear guidance from regulators. Such guidance would help to facilitate the continued growth and exploitation of high potential technologies such as blockchain and those listed in our response to question 9. Moreover, it opens up doors for other underlying technologies to adhere to the same high levels of data protection. In the context of the potential application of blockchain technology to the enablement of a digital euro, we believe it is worth noting that the GDPR already qualifies hashing personal data as pseudonymized data, which is still considered personal data. As such, certain contractual, operational, and legal measures must be taken within any blockchain eco-system. Moreover, as the ECB is aware, blocks in the chain cannot be deleted or modified. While on the one hand this ensures the security and accuracy of records in the chain, on the other it does create regulatory uncertainty. For instance, under some privacy regulations, individuals have the right to request correction or even deletion of their personal data in specific circumstances (e.g. upon request or upon withdrawal of consent). This proves problematic in a blockchain environment where, for example, a transaction record may be needed for anti-money laundering requirements and combating financing of terrorism. We would happily contribute to the ECB's thinking on how to apply proper privacy protections to the underlying technology supporting digital currency innovations, whether by blockchain or otherwise. Such input, gathered either via public consultation, industry roundtable or other appropriate fora would help to develop practical Privacy Guidelines for CBDC and Blockchain, thereby enabling industry to continue to uphold high levels of privacy protections, while also taking into account anti-money laundering requirements, and combating the financing of terrorism and tax evasion.
11	The central bank could use several instruments to manage the quantity of digital euro in	We concur with the ECB's evaluation that "*[s]ubstantial demand for digital euro may have a negative impact on financial stability*" with potential implications for credit supply, funding costs, and even financial sector stability. Further complicating this challenge is the fact that - to cite research by the Bank of England - "*gauging the likely shift from deposits into CBDC is challenging because to date no major economy central bank has introduced a CBDC*"[1]. As such, it will be critical for the ECB to carefully examine the suitability of

[1] https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf?la=en&hash=DFAD18646A77C00772AF1C5B18E63E71F68E4593

circulation (such as quantity limits or tiered remuneration), ensuring that the transmission of monetary policy would not be affected by shifts of large amounts of commercial bank money to holdings of digital euro.

What is your assessment of these and other alternatives from an economic perspective?

a range of policy tools to ensure that a digital euro does not undermine European financial stability goals either in the course of its regular operations or during a crisis.

We further concur with the ECB's analysis that two high-level approaches exist to influencing the flow of funds between commercial bank money and a digital euro; limiting the absolute quantity of flows and adjusting the desirability of holding digital euros through a price mechanism. While further study of this issue is clearly required, it appears that each of these mechanisms have their own strengths and weaknesses.

Limits have the advantage of being easily understood by users and, if set at a reasonable level, have little or no impact on consumer usability. At the same time, they provide commercial banks with a strong understanding of their potential exposure to deposit out-flows. While a range of technical issues might need to be addressed – for example how inbound payments that would exceed a user's limit should be handled – these challenges appear tractable, particularly if addressed at the design stage.

However, it should be noted that research by the Swedish Riksbank suggests that the use of limits could have unintended consequence of disrupting parity between the market valuation of retail CBDC deposits relative to commercial bank deposits; particularly during a crisis. In their 2018 'e-Krona Project Report 2' the Riksbank notes that:

> *"It is the Project's assessment that limitations on access to e-krona may be associated with problems. For example, it may be difficult to maintain parity between Swedish krona in the form of cash, deposits in bank accounts and reserves. Assume, for example, that the e-krona becomes very popular but that there is a maximum limit imposed on each person's holdings. This could lead to the emergence of a market on which those who have not fulfilled their e-krona quota would be offering those who have the opportunity to buy e-krona in cash or by depositing money in a bank account at a higher than one-to-one price"*

While this should not eliminate the use of limits from consideration, it does suggest that their design will require close consideration to ensure that the use of limits does not have unintended consequences.

Alternately, the ECB could influence the desirability of holding a digital euro by adjusting its rate of renumeration – either on the entirety of a user's holdings or at different rates across two or more balance 'tiers'. While this approach would provide the ECB with greater discretion, some commentators – including Mr. Burkhard Balz, Member of the Executive Board of the Deutsche Bundesbank – have expressed concerns that this approach may not be enough to halt a 'digital bank run' during financial crisis[2]. Moreover, the use of highly negative rates to constrain deposit substitution during a crisis could face significant popular and political opposition.

Ultimately, it is our view that the design of any digital euro should provide the ECB with the capacity to both impose limits and adjust renumerations across a variety of dimensions. However, further study will be required to understand the best application of these tools. Put simply, we concur the analysis of De Nederlandsche Bank's April 2020 occasional paper on CBDCs which states that:

> *"Because CBDC does not as yet exist and because the behavioral response by the central bank and commercial banks is hard to anticipate, the uncertainty about the expected substitution is considerable. It therefore makes sense to introduce CBDC gradually, allowing time to gain knowledge on the extent to which CBDC operates in practice as an alternative for commercial bank money and to adjust the design and conditions if the demand for CBDC were to be either too low or too high[3]."*

If the ECB chooses to move forward with the piloting and deployment of a digital euro, we would suggest the following actions to improve our collective understanding of the risks of deposit substitution and the appropriate use of policy tools to mitigate those risks:

- Developing a scenario-based analysis of the operational, macro-economic and financial stability impacts of a CBDC that include an unusually broad range of calibrations for the rate of user-uptake and the degree of commercial deposit substitution
- Carefully analyzing, where possible, user behavior data from CBDC pilots and production deployments in comparable economies
- Conducting live controlled-access pilots of unusually large scale, breath, duration, and complexity (including the involvement of multiple supervised private intermediaries) in order to more effectively model consumer behaviors towards CBDCs, as well as the policy-levers that would permit the Bank to influence the rate of deposit substitution

12 What is the best way to ensure that tiered remuneration does not

The ECB's Report on a digital euro provides a thoughtful and comprehensive analysis of the challenge inherent in designing a digital euro that can simultaneously facilitate offline transactions, preserve user privacy, and maintain the ECB's recourse to a variety of policy tools – including tiered remuneration.

[2] https://www.bis.org/review/r201020g.pdf
[3] https://www.dnb.nl/en/binaries/Os%20Central%20Bank%20Digital%20Currency_tcm47-388408.PDF

	negatively affect the usability of a digital euro, including the possibility of using it offline?	We would advise the ECB to explore two possible approaches to reconciling these goals. The first would be the creation of two forms of digital euro with differing technical characteristics; a primary 'account-based' system and a secondary 'bearer token' narrowly designed to facilitate off-line payments. The relationship between these two forms of digital euro could be structured to 'nest' the bearer token within the account-based system. Under such a framework, users could be required to first onboard to the primary account-based system – undergoing all necessary KYC checks – before having the right to either convert their account-based holdings to bearer tokens or receive bearer tokens from a third party. When combined with technical solutions to limit individual holdings of bearer tokens and the size/frequency of an individual transfers of bearer tokens, this framework may be able to ensure that the majority of digital euro deposits would remain in the primary account based system where they could easily be made subject to tiered remuneration. An alternate, and significantly simpler, approach to reconciling these policy objectives would be to deliver offline payments as a value-added service, with risk underwritten by supervised private intermediaries, rather than as a feature of the core system. The handling of offline transactions by card-based ecosystems today provides an instructive model for how this could be accomplished by using a combination of technology and business roles to define liability and limit exposure. Mastercard makes use of counters on the payment card chip to manage the risks of offline payments. These counters can be set to allow offline transactions only when the number of offline transactions or cumulative amount of offline spend are below a certain threshold. These risk parameters may be set at a regulatory level or based on individual issuer risk tolerance. This allows the convenience of offline transactions for consumers and merchants at a manageable level of risk that is tolerable for all entities in the ecosystem. Within the context of the proposed digital euro, this second approach would have the added benefit of simplifying the ECB's ability to deploy policy tools – such as tiered remuneration – and obviating the need to develop costly parallel infrastructure to enable a bearer token the operates alongside the primary account-based system.
13	If a digital euro were subject to holding balance limits, what would be the best way to allow incoming payments above that limit to be shifted automatically into the user's private money account (for example, a commercial bank account) without affecting the ease of making and receiving payments?	As discussed in our response to question 11, the establishment of limits on individual's holdings of a digital euro may be necessary to avoid destabilizing levels of deposit substitution, particularly during periods of financial crisis. Where such limits are in force, we would suggest that the ECB establish a system whereby the balance of a transfer in excess of an individual's limit is allocated to a commercial bank account of their choosing. Such a system is technically feasible and would avoid the complications and uncertainty that often surrounds failed payments. Moreover, it may be possible to simplify the implementation of this capability by leveraging pre-existing payments infrastructure. That said, such a solution would need to be underpinned by appropriate mandates taken from customers during an onboarding process in order to permit the intermediary to perform this conversion and apply funds to a designated account. Due consideration would also need to be given to individuals who are unable to access a commercial bank account or choose not to have one. Close study will be required to identify the most efficient and effective means of shifting payments in-excess of any digital euro holdings limit to ensure that the chosen approach does not have unintended consequences on efficiency and stability of the European payments system, nor on the financial inclusion of its most vulnerable users.
14	What would be the best way to integrate a digital euro into existing banking and payment solutions/products (e.g. online and mobile banking, merchant systems)? What potential challenges need to be considered in the design of the technology and standards for the digital euro?	Should the ECB decide to proceed with issuing a Digital Euro, we would fully support the integration of a digital euro into existing banking and payment solutions. Integration will reduce cost, maximize acceptance and adoption, provide enhanced public choice and support robust standards of consumer protection. Moreover, this can be achieved while also maintaining the ECB and national authorities' role in strong institutional governance arrangements. In particular, we believe that a digital euro could, and should, be integrated closely with existing point of sale (POS) acceptance solutions; allowing consumers to utilize a digital euro in the widest possible set of circumstances. The re-use of POS terminals for digital euro acceptance can be easily achieved through the use of well-established governance and messaging arrangements that support existing card schemes and would reduce the burden of digital euro acceptance on merchants and other businesses. Payments utilizing existing acceptance solutions can be settled in digital euro, but card-accepting merchants could also maintain flexibility to settle in existing arrangements using well established settlement techniques. We fully believe a digital euro will have easier adoption if it can be used on existing acceptance infrastructure and is supported by well-known and identifiable payment methods (physical and digital) that are linked to the user's CBDC-based account. The use of well-established governance and messaging arrangements will support consumer protection while at the same time delivering instant payment authorization.

If a digital euro is issued alongside money held in commercial bank deposits, it will be critical to ensure the effective interchangeability between these two forms of money; providing consumers with maximum payments optionality and allowing payments to be initiated and terminated anytime, anywhere. Readily interchangeable forms of money would also allow customers and business to hold liquidity in the format that they want to, rather than needing ready liquidity in both CBDC and bank deposits.

Across the Eurozone, real-time payments infrastructure already supports billions of euros in daily transactions to consumers and businesses across a range of banking services, including online payments and mobile banking. In order to deliver the greatest interchangeability between a digital euro and commercial bank deposits, existing technologies used in RTP infrastructure could be used to process and settle account-based digital euro transactions, subject to appropriate limits imposed by the ECB. We believe doing so would reduce the operational and financial burden of duplicative, parallel infrastructure, as there would be no need to create a new set of payments rails. Moreover, this would rely on proven technology that is being used today to support critical payments infrastructure in many markets across the Eurozone and beyond, while also supporting robust standards for consumer protection and fraud detection.

15 What features should the digital euro have to facilitate cross-currency payments?

A digital euro could be used for cross border payments with the eurozone, both within the EU and globally. It could also be used for cross currency payments in all these jurisdictions. All these scenarios will need to be considered by the ECB as it determines the necessary features to support cross-currency payments.

We note that the ECB has highlighted a number of policy considerations in this area, including limitation on access and risks of currency substitution. In addition of these issues, cross-currency payments with a digital euro would face the same challenges as regular cross-currency payments today. All these challenges are well detailed in the FSB's Enhancing Cross-border Payments: Stage 3 roadmap.

Since we believe it is fundamental for a digital euro to be interoperable with other payments infrastructures and requirements like ISO20022, we caution firm decisions on design choices before the FSB work has had the opportunity to embed and better inform the needs and priorities of any such choices. Interoperability will also support innovation and allow industry to provide innovative value-added services for cross currency payments, building on the solutions that already exists in the market today. Additionally, we believe that an account-based system will be an easier solution to implement to support cross currency payments.

We are fully aware that the ECB is already supporting a move to instant payments with the migration to TIPS and undertaking a pilot with the Riksbank that will support the settlement of Swedish Krona within TIPS. To benefit from these initiatives, and the cost and transparency requirements already mandated within TIPS, we assume that a digital euro will be able to interoperate with the TIPS infrastructure.

The ECB has already stated that TIPS can accommodate non-EU currencies and the SWIFT GPI instant trial with TIPS has validated the benefit of extended opening hours for payment infrastructure to support immediate clearing and settlement of a payment from Australia to Spain.

We believe that work already in hand by the FSB and the ECB will be informative in shaping features that could enhance the use of CBDCs for cross border payments; both those that are cross border in the same currency and those that that are cross currency.

16 Should the use of the digital euro outside the euro area be limited and, if so, how?

We concur with the ECB's analysis that international spillovers of a digital euro could have serious unintended consequences on third-party economies, potentially driving the substitution of domestic money and amplifying "*the real and financial cross-border spillovers of domestic monetary policy shocks by creating a new channel for their propagation*". Moreover, we share the bank's concerns that the unintended negative macroeconomic consequences of such spillovers would be disproportionately borne by smaller, less developed and less financially stable economies. As such, we support the EBC's conclusion that mechanisms will need to be established that "*limit the scope of users of the digital euro when necessary – for example to exclude some non-euro area users*"

Further study is required to identify and develop the correct policy tools to mitigate these spillover effects. We applaud the ECB's recent efforts, including the recent working paper '*Central bank digital currency in an open economy'* as well as those of other leading institutions, such as the IMF in their October 2020 staff paper "*Digital Money Across Borders: Macro-Financial Implications*". Ultimately this is a complex issue and - while it is clear that some form of policy for controlling the size of non-European digital euro holdings is necessary - further study is essential to determine the best method of meeting this objective.

17 Which software and hardware solutions (e.g. mobile phones, computers, smartcards, wearables) could be adapted for a digital euro?

The software and hardware solutions that could be adapted for a digital euro would very much depend on the objectives of the ECB and the chosen approach to delivering the currency. In our view, these critical choices must precede any software and hardware decisions in order for the latter to be suitable. For example, if the ECB chooses to pursue a single tier, token-based digital euro, it is likely that DLT or blockchain technology should underpin the solution. However, if the ECB selects a multi-tier, account-based approach a more traditional centralised technology may be more appropriate.

Further, consideration should also be given to building a digital euro that could take advantage of the opportunity to incorporate new payment concepts, such as programmable money (i.e. building simple legal constructs into the payment network in order to support an array of use cases). At a minimum, we are of the view that it will be necessary to ensure that ease of use is foundational a cornerstone of any digital euro, and as such, it should fully interoperate with how consumers and businesses store value and make payments today.

18 What role can you or your organisation play in facilitating the appropriate design and uptake of a digital euro as an effective means of payment?

We firmly believe that Mastercard's position at intersection of retail payments and technology makes us ideally suited to work closely with the ECB as it explores the design and implementation of any digital euro. We have the breadth of expertise necessary to address every dimension of this challenge, and the depth of experience necessary to support the ECB through every stage of the digital euro's evolution.

Mastercard can support the ECB as it designs and tests configurations for the Digital Euro

Mastercard has convened its technological and payments expertise within a comprehensive CBDC testing platform that is available to support central banks as they explore a variety of design choices. This platform can be individually customized to the unique payment ecosystem in which the central bank operates, allowing them to:

- Simulate a CBDC issuance, distribution and exchange ecosystem with banks and consumers, including how a CBDC can interface with existing payment networks and infrastructures – e.g., cards and real time payments.
- Demonstrate how a CBDC can be used by a consumer to pay for goods and services anywhere Mastercard is accepted around the world.
- Examine various CBDC technology designs and use cases to more quickly determine value and feasibility in a market.
- Evaluate CBDC development efforts including the technical build, security and early testing of the design and operations.

Our CBDC expertise is supported by world-leading research into blockchain and digital currencies. As a technology company, we actively and continuously evaluate emerging technologies to explore how they can benefit our clients, and we have invested significantly in exploring the potential of blockchain. We have built our own permissioned blockchain technology from the ground up and integrated it with our core services to offer a unique and compelling value proposition for our clients. With over 100 blockchain patents, we are ranked third in the world by blockchain patents filed. We have innovated with the needs of financial services in mind, and our platform has several unique differentiating features. We can bring that experience to support the ECB as it analyses different technology choices.

Mastercard can bring experience from operating critically important retail payment infrastructure across both card and real-time payment systems

A CBDC is a new type of central bank money that will need an effective and resilient payment system. Mastercard has deep expertise in building and operating successful, high-performance, and secure commerce and payment networks. We govern and operate the world's fastest payments processing network (capacity of > 20,000 transactions per second), connecting consumers, financial institutions, merchants, governments and businesses in more than 210 countries and territories.

We have deep expertise and capabilities when it comes to hardening and securing mission-critical retail payments networks, as well as making them resilient to error and fraud. We can bring our experience and best practices with respect to securing the network and detecting and preventing fraud, to inform the design of the digital euro solution and to ensure that it is as secure as possible.

Running a highly resilient and successful global payments network requires effective policies and governance rules to cover thousands of participating entities. We understand what it takes to build the rules and governance structures behind running retail payments networks at scale.

Mastercard's experience is genuinely multi-rail and includes long experience of operating real-time payments infrastructure across the globe. As outlined in our answer to question 14, Mastercard is well placed to deliver effective integration between a digital euro and an infrastructure that supports real-time payments, which in turn will allow citizens to make transfers interchangeably between CBDC and commercial bank deposits.

Leveraging existing Mastercard value added service capabilities will help drive adoption

It is extremely important for the digital euro to be user friendly in order to drive adoption and foster transaction volume growth. We therefore believe it is essential to have well-designed, intuitive, and frictionless payment experiences for both merchants and consumers.

Mastercard excels in this area and leveraging the significant scale of the existing acceptance network would support uptake and bring digital euro payments capability to millions of merchants across the globe. Our innovation in digital payments continues to extend our network's function, allowing people to pay when, where and how they want. This ensures:

- **Better digital experiences**: We're working to deliver better payment experiences everywhere, on all devices and channels, including smartphones, wearables and internet of things.
- **More security**: We're leveraging tokenization, biometrics and machine-learning technologies in our push to secure every transaction.
- **New solutions**: We're developing new offerings that meet the needs of people and businesses, including peer-to-peer and business-to-business payments.

As part of our financial inclusion initiatives, we are also well-versed at designing simplified payment experiences for the unbanked, and for those who might not have ready access to Internet connectivity. Finally, we have experience in leveraging QR codes combined with USSD or SMS to enable payments in the absence of Internet connectivity, using basic mobile network services.