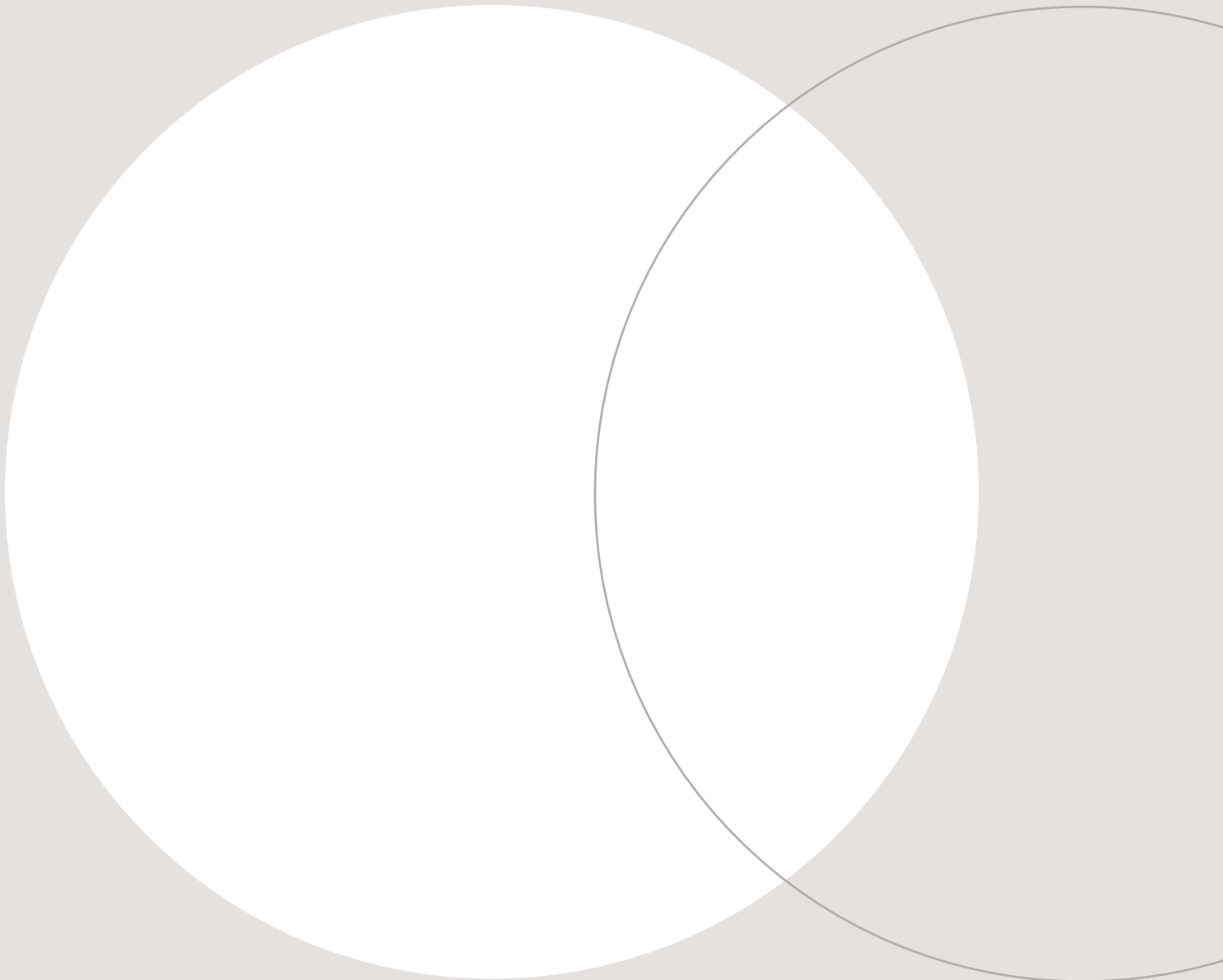




Unlocking the potential of digital asset innovation: Building a Mastercard Multi-Token Network™

WHITE PAPER

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Contents

2	Foreword
3	Executive summary
5	Introduction
7	Section 1: The opportunities and challenges in today's crypto landscape
11	Section 2: New technologies, similar problems
13	Section 3: Mastercard's vision for our Multi-Token Network
25	Section 4: Mastercard Multi-Token Network proofs of concept
27	Section 5: The role of the public sector in unlocking the potential of digital assets
31	Section 6: Next steps

Foreword

The innovations developed in the first decade of blockchain are staggering: thousands of new cryptocurrencies and a vibrant community of exchanges, custodians, developers and marketplaces moving trillions of dollars' worth of assets around the world. But this could be just the beginning. One can envision a not-too-distant future where the must-have digital products, services, and applications used by billions of people every day are built on the foundations of public and private blockchains. Mastercard imagines a future where digital asset use extends far beyond today's focus on financial speculation. This future could include novel applications in both consumer and business worlds, such as decentralized gaming ecosystems, creator-powered NFT platforms and cross border trade and trade finance where digital products and services are bought and sold using safe, secure and compliant blockchain-based forms of payment.

Mastercard is innovating to power the future of digital assets and digital commerce by combining cutting-edge technology with our expertise in enabling payments. We already provide a wide range of services to build a bridge between traditional finance and the world of digital assets, enabling new services and scale for both digital asset-native businesses and traditional financial institutions.

Mastercard's next step focuses on enabling the next generation of digital asset payments through an innovation we call the Mastercard Multi-Token Network™ (MTN). Though still in the early phase of its development, the MTN provides a set of foundational capabilities designed to make transactions within digital asset and blockchain ecosystems more secure, scalable and interoperable — ultimately enabling more efficient payment and commerce applications. It would seek to unlock the full potential of digital asset ecosystems by mitigating some of their most significant risks. We believe a network like the MTN could play a key role in assuaging the concerns of many financial institutions and consumers who have so far remained on the sidelines of the digital asset revolution.

Mastercard is well positioned to facilitate a secure ecosystem for businesses and consumers to transact using digital assets. For more than 50 years, Mastercard has been connecting, protecting and resolving disputes between tens of thousands of financial institutions and their customers to make card-based payments safe, simple, smart and accessible for 3 billion cardholders. More recently, we've diversified into bank account payments, powering domestic interbank networks globally.

We're creating mechanisms to underpin the global open banking ecosystem, allowing people to use their own data for their own benefit. With this strong track record and deep expertise, building the MTN is the natural next step in our evolution as a multi-rail company to enable competition and innovation in financial services.

We hope that regulators, banks, digital asset businesses and others engage with us in the development of the MTN, share their feedback and join us to bring the value of digital asset payments and empower people everywhere to transact with greater flexibility and control.



Michael Miebach
Chief executive officer of Mastercard

Executive summary

Mastercard is excited about the future of blockchain technology and digital assets. We believe that the application of digital assets can reach far beyond financial speculation and tangibly improve e-commerce, trade finance, cross border transactions and much more. Blockchain technologies hold potential to bring enhanced benefits over traditional payment channels, including 24/7 availability, faster cross border movement and the ability to program money through smart contract capability.

Despite these benefits, there remain unsolved challenges in blockchain-based ecosystems which limit mainstream adoption and the development of a broad set of commercial use cases that can support more effective and efficient payments transactions. To unlock the full potential of blockchain technology for payments, we must first address some of these challenges, including fraud, weak compliance practices, poorly defined governance rules and ensuring payment tokens are safe and scalable.

We believe that the key to mitigating these risks is integrating crypto ecosystems' cutting-edge innovations with a set of shared standards, governance procedures and compliance expectations that banks, virtual asset service providers (VASPs) and their users can opt into. Mastercard is developing a Multi-Token Network (MTN) to facilitate broader mainstream adoption of blockchain and digital asset technologies for businesses and consumers in a manner that is intended to preserve the integrity of today's regulated financial system. Our goal is for the MTN to include a group of validated counterparties that would form a secure network overlay on top of existing blockchains. All transactions within the MTN would be required to follow all applicable regulations and operate in accordance with predictable and clearly identified governance rules. Over the last year, we developed MTN proofs of concept and pilots with our partners, resulting in a set of capabilities offered via our MTN beta. Our hope is that the MTN beta, set up in select countries, will act as a testbed for new payments and commerce applications.

The MTN would create a more reliable and predictable way for consumers and businesses to interact with digital asset ecosystems. It would establish a secure space for highly regulated and systemically significant financial institutions, such as banks, to explore and deploy new applications and services. Meanwhile, it would pave the way for the adoption of a wide range of digital asset use cases, expanding choice for consumers, driving competition in digital markets and setting in motion a virtuous circle of innovation by the larger development community.

Our vision for the MTN is composed of four key pillars, each of which would directly address the four major challenges we believe hold back mainstream adoption of digital asset payments and allow significant benefits to be realized: a lack of confidence in counterparty compliance; a lack of trust in the underlying store of value; a lack of interoperability between networks; and a lack of clear governance procedures to set the rules of the road for participants.

Mastercard Multi-Token Network pillars

- **Enabling trusted identities and reinforcing compliance**

Banks and virtual asset service providers (VASPs) that join the MTN would need to meet stringent, use case-based onboarding standards for their clients, including ensuring a robust KYC process, risk-scoring the source of any pre-existing digital assets being brought into the network, as well as conducting rigorous and ongoing screening and transaction monitoring for money laundering, terrorist financing, sanctions violations and other illicit activity.

- **Enabling stable and regulated payment tokens**

The MTN would ensure stable and regulated money-like assets serve as the trusted store of value and medium of exchange transacted through the network. Such assets would include fully collateralized stablecoins, central bank digital currencies (CBDCs) and tokenized retail bank deposits.

- **Powering secure cross-chain interoperability**

Developing applications for payment tokens and tokenized digital assets is hampered by fragmented networks that host them and are constantly exposed to security vulnerabilities. The MTN would help users trade across blockchain ecosystems and traditional networks in a more secure fashion.

- **Creating a comprehensive governance framework**

The MTN would establish a set of rules designed to govern the interactions between network participants and enable a range of protections for consumers and businesses, including allocating liability among participants. Drawing on Mastercard's experience developing similar rules for card and real-time payment networks, these rules would govern who can participate in the MTN and the roles and responsibilities of its participants.

Once fully realized, the MTN could provide banks, VASPs, consumers and businesses with a new way of developing payments and commerce applications by:

- **Supporting banks' enablement of digital assets**

By establishing a trusted compliance framework, ensuring a high bar for the stability of payment tokens and enabling the tokenization of commercial bank deposits, the MTN would facilitate banks' ability to continue their core business of lending, while simultaneously allowing consumers to use their bank deposits for new digital commerce applications.

- **Providing consumers a simpler and safer way to access digital assets**

Consumers would have confidence in the stability of their payment tokens and be secure in the knowledge that they enjoy a clear set of protections against fraud and theft. Moreover, they would be able to conduct traditional and digital asset financial transactions from the same accounts.

- **Simplifying businesses' deployment of digital asset products and services**

As consumers become more comfortable with seamlessly moving between traditional and "on-chain" products and services, we expect a growing number of businesses to explore the potential for blockchain-based offerings and use cases to meet their clients' needs.

- **Accelerating the development of novel blockchain applications**

The MTN would provide businesses with turnkey standards for developing secure, compliant and interoperable blockchain-based applications that offer consumers robust data, privacy and consumer protections.

In the pages that follow, we detail the opportunities and challenges within crypto ecosystems, outline Mastercard's strategy for mitigating risk with the MTN, provide a detailed review of how the MTN would operate and invite partners to unlock the potential of digital assets together.

Introduction

Boom-and-bust cycles are nothing new for novel technologies. This was the case during the beginning of the internet, just as it is today in the emerging crypto economy. While the dot-com bubble-then-crash of 2000 cratered the valuation of many internet startups, it did little to slow consumer adoption of online services, and certainly did not hinder the emergence of today's digital giants. Future applications of blockchain and digital assets cannot be predicted, but the innovation and excitement they have already unleashed suggest their potential as another revolutionary technology, thanks in part to the rapid pace of development in permissionless systems and novel technologies like programmable "smart contracts."

Mastercard believes that to understand the potential of digital assets — and indeed any transformative technology — we need to look beyond the headlines and assess two things. First, we need to consider the consumer and business value propositions that these technologies might one day enable at scale. Second, we need to take a clear-eyed look at the serious and unresolved sources of risk that limit broader adoption. Blockchain clearly offers broad economic potential, particularly when combined with the innovation found in community driven digital asset ecosystems.

Yet these same ecosystems face serious barriers to establishing trusted payment instruments, instituting robust regulatory compliance, delivering secure interoperability and ensuring clear and reliable governance and dispute resolution systems. So, while the opportunities for digital assets are significant, these challenges weaken the potential for their adoption and narrow the set of viable use cases.

Put another way, the outsized risks faced by participants in crypto ecosystems make only those offerings with the potential to deliver outsized speculative rewards appealing. So long as this issue remains unresolved, broader commercial use cases will likely struggle to gain traction and highly regulated financial institutions, such as banks, may hesitate to fully participate. It is our view that the full potential of digital assets for payments can be unlocked only when the inherent risks are brought under control by providing a trusted environment for parties, and the promise of the technology is made accessible to traditional financial institutions and their billions of customers.

Early bank card programs (prior to the creation of payment networks like Mastercard) faced similar challenges, including barriers to establishing trust between counterparties, protections for consumers and reliable governance frameworks. Drawing on Mastercard's more than 50 years of experience ensuring trust, interoperability and governance across a variety of payment networks (alongside our considerable investments in blockchain technology), we propose the creation of a new network designed to unlock the expansive opportunities across public and private blockchain networks, while also mitigating their risks.

We are calling this new network the Mastercard Multi-Token Network™ (MTN), which would serve as an entirely new scheme composed of a group of validated counterparties that form a secure network overlay that sits on top of, and extends across, multiple public and private blockchains.

Transactions processed within this network could continue to be settled on those underlying public or private chains. However, transactions by participants in the MTN would differ from other transactions being settled by non-participants, in that each counterparty within the MTN could have confidence in the compliance of every transaction, and certainty that the rules governing that transaction are clear, predictable, consistent and enforceable.

INTRODUCTION

By establishing a shared set of commercial terms, transaction standards, remedies and technologies for digital asset payments, the MTN would enable banks, as well as crypto-native VASPs, to offer their customers — including consumers, governments, and businesses — the ability to seamlessly transact across multiple public and private chains throughout the eco-system in a safer, more secure and fully compliant manner. Additionally, the establishment of such a network would support the development of a wide variety of rich features, with the specific goal of building consumer confidence in, and adoption of, new use cases for digital assets, such as everyday payments for goods and services.

This white paper outlines Mastercard's vision for the Multi-Token Network and seeks to invite a wide range of stakeholders — including traditional financial institutions, crypto-native VASPs, businesses, policymakers and regulators — to collaborate on the development of this vision. In the first section of this paper, we outline our assessment of the challenges facing participants in today's digital asset ecosystem, before reflecting on relevant learnings from the development of past payment networks in section 2. In section 3, we move to a detailed description of our vision for the MTN, and an outline of a planned pilot. Section 4 describes the progress we have already made developing the MTN. In section 5 we discuss ways that regulators and the private sector can collaborate on constructive digital asset innovation, including the MTN, before concluding in section 6 with a few words on our planned next steps.

01

The opportunities and challenges in today's crypto landscape

Blockchain technology enables the creation of a shared database that is replicated and distributed across an ecosystem of participants which cannot have its history altered. Blockchains have the potential to provide irrefutable proof of the origination for any transaction processed on a given network. Since the knowledge needed to use and build on a blockchain is easily accessed in the public domain, businesses and individuals have rushed to deploy this technology against a range of applications, the most common being the creation of permissionless decentralized networks for the exchange of one or more digital assets.

Mastercard believes that blockchain technology has the potential to radically shift the landscape of digital commerce, enabling new decentralized ecosystems and the creation of innovative digital products and services. We are intrigued and excited by digital asset advocates who envision a future where consumers use blockchain-based social networks, messaging applications and cloud service providers, or employ non-fungible tokens to distinguish themselves in rich virtual worlds that are themselves the products of decentralized and creator-run communities.

But at the same time, it is undeniable that current practical applications of this technology are limited, revolving almost exclusively around the enablement of speculative trading. Moreover, these ecosystems often lack the procedures and controls to meet compliance obligations, ensure the security of users and manage unforeseen circumstances. We know from experience that these elements are critical to enabling trusted and secure digital commerce.

Careful analysis of the opportunities and challenges of today's crypto landscape will be critical to unlocking the full innovative potential of this technology. Beginning with opportunities, we believe that three attributes of blockchain technology, and the digital asset ecosystems it enables, deserve careful consideration.

Opportunity 1: Open innovation

As in the early days of the internet, where a central tenet of its appeal was that almost anyone could build their own website, the ease with which new blockchains can be spun up has attracted remarkable talent and fueled rapid innovation. Our experience of digital asset projects currently in-flight often sees brilliant minds working on new systems for everything from trade finance and identity to digital rights management and decentralized social media. As in the case of the internet, it is inevitable that many of these projects will fail, but those that succeed could transform how we live, work, shop and socialize.

Opportunity 2: A novel general-purpose technology

Digital asset ecosystems are powered by blockchains, an innovative "general-purpose" technology that can enable types of transactions that weren't previously possible. The most notable technical capabilities of blockchain technology include:

- the trusted transfer of value with irrevocable settlement and without the need for a central counterparty
- the execution of "atomic swaps" whereby one asset is swapped for another, with the secure guarantee that either both legs of the transaction would be completed or neither leg of the transaction would be completed
- the capacity for rich "programmability," potentially enabling the creation of range of applications including social networks, exchanges and lenders
- the "tokenization" of real-world assets whereby physical assets (e.g., invoices, real estate, art, etc.) can be represented, stored, fractionalized and transferred digitally, as a way to prove ownership and establish new ways to trade

Opportunity 3: Composable innovation

Within a given blockchain, new innovations are sometimes called "composable." This is another way of saying that digital asset innovations are like building blocks. Individual capabilities can deliver enhanced value but can also be combined to create something that is greater than the sum of its parts.

This is like what we saw in the early days of the internet, where the ability to combine online catalogs with secure online payments powered the e-commerce revolution. Digital asset innovators are trying to use composability in similar ways to unlock new value and deliver enhanced functionality for users, for example combining tokenization innovations with smart contract innovations that allow automated swaps between tokenized assets and payment tokens.

Despite all these reasons for excitement, we have not yet seen material levels of mainstream adoption of blockchain-based systems for everyday use cases for consumers and businesses. According to a 2022 study by the U.S. Federal Reserve, more than 90 percent of Americans who used digital assets in the past year were investing with the expectation of speculative gains. This is despite the existence of nascent blockchain-based social media, video games and other use cases. Thinking back to our analogy of the early days of the internet, this is almost as if – rather than chatting on early message boards, sending emails and building rudimentary websites – early adopters of the internet had exclusively used the technology to invest in dot-com companies through their online brokers.

To understand the driving forces behind this peculiar set of circumstances, we need to dig deeper into the challenges that are prevalent in crypto ecosystems. There are challenges that Mastercard believes must be resolved to unlock the full potential of this technology.

Challenge 1: A lack of counterparty trust and compliance

Transactions within the crypto ecosystem are frequently referred to as "trustless," which is true in the sense that one does not need to rely on a central party to execute a transaction on someone's behalf. But what about the person or business on the other side of the transaction? Modern, regulated financial services require a higher standard of trust, namely the confidence that the entity on the other side of the transaction is a legitimate counterparty playing by an enforceable set of common rules and not a criminal or terrorist.

SECTION 1: OPPORTUNITIES AND CHALLENGES

By design, crypto transactions are pseudonymous — meaning you can see the blockchain address you are transacting with but won't necessarily know who is behind that transaction. This makes it difficult to prevent illicit transactions and harder to track down perpetrators when digital assets are stolen from users' wallets (something that happened to the tune of \$14 billion in 2021). It's also one of the reasons that digital assets are so frequently used for ransomware. No entity applying robust AML and CFT controls would intentionally open a payment or banking account for a ransomware group, but the permissionless and pseudonymous nature of crypto transactions introduces new exploitable risks. All of this is particularly frustrating since the indelible ledger provided by a blockchain makes it much easier to track the flows of illicit funds than in the traditional financial system. Unfortunately, identifying who controls a blockchain address tends to be a costly and difficult process that may not be worth undertaking for all but the largest of thefts.

Challenge 2: A lack of trust in the underlying store of value

Money-like assets play a uniquely important role in any financial system. Money issued by central banks acts as a common unit for the pricing of other assets within the financial system, provides a "safe haven" as the lowest-risk store of value and — critically — acts as the medium of exchange for payments. Early digital asset markets faced a problem in that there was no "on-chain" form of fiat money that was consistently accepted by users. Using the on-ramps and off-ramps between digital assets and fiat money in bank accounts adds costs and delays to transactions.

The solution to this problem was the development of stablecoins, digital assets that promise a fixed peg to a real-world reference currency — most commonly the U.S. dollar. When they work as intended, these stablecoins serve as the primary source of liquidity in crypto markets. The introduction of a U.S. dollar-pegged stablecoin into a given blockchain's ecosystem allows its participants to freely price, buy and sell digital assets priced in U.S. dollars, or cash out of their digital asset positions into an asset that promises a stable peg to the U.S. dollar, without having to move those funds back into their bank account.

The challenge is that not all stablecoins are created equal, and some don't always work as advertised. Some stablecoins maintain their peg by holding reserves of the underlying reference asset or commodity in the traditional financial system (e.g., the U.S. dollars in a commercial bank account) and issue one stablecoin for every unit of the reference asset they hold. At present, the absence of established regulatory regimes for stablecoins means it isn't always easy to tell where these reserves are held (e.g., in a domestic bank or offshore), their risk and liquidity (e.g., bank demand deposits vs. risky high-yield bonds) or even if they exist at all (e.g., audited vs. unaudited).

To make things even more challenging, not all stablecoins even attempt to hold reserves on a one-to-one basis with their current circulation, instead choosing to rely on a system of algorithms to maintain a peg with the reference asset. Unfortunately, as recent experience has shown, these structures are highly susceptible to "bank run" dynamics. That was the case for the Terra USDT stablecoin, which fell in value from one U.S. dollar to effectively zero over the course of a few days of market volatility.

Challenge 3: A lack of interoperability between blockchains

One element of digital assets that is often overlooked is that each blockchain is effectively its own technical standards community. Participants align around a particular set of practices, such as the block size and validation methodology. While interoperability between different blockchains is clearly desirable, it is difficult to achieve in practice, since the consensus mechanisms used by two blockchains cannot simultaneously validate one another.

That means, in much the same way that a train built for one gauge of rail cannot run on a wider or narrower track, rich programmability and smooth atomic swaps largely work only within a given blockchain. One blockchain might create a standard that enables thousands of different digital assets to interoperate seamlessly within the ecosystem of that chain (as Ethereum has done in the case of the ERC20 token standard), but if you want to buy a token on one public blockchain using a stablecoin designed to function on an alternative public chain, an intermediary is needed to facilitate the exchange. This applies also to other forms of digital assets such as CBDCs, where central banks may choose to develop on private infrastructure but interact with the rich activity and innovation on public blockchains.

SECTION 1: OPPORTUNITIES AND CHALLENGES

Challenge 4: The lack of clear governance procedures and user protections

Mistakes can happen in the fast-moving world of crypto. People unintentionally send an asset to the wrong recipient, have their accounts hacked, are defrauded by sophisticated con artists or employ "smart contracts" with unforeseen security vulnerabilities.

None of these things are unique to crypto. Mistakes, fraud and cyberattacks happen in the world of traditional finance every day. The difference is what happens next. Traditional finance has strong governance procedures in place for unwinding mistakes, assigning responsibility for losses and managing disputes between parties. In the world of crypto, the rules of the road are still largely being made up. Users of crypto typically have limited recourse options available to them when mistakes, theft, or disputes arise. Processes for these cases are not standardized in the industry and can vary depending on the exchange or VASPs involved. There have been many cases in the history of crypto where users have lost funds through limited or no fault of their own due to underdeveloped safeguards.

Perhaps one of the clearest examples of this comes from the early days of the Ethereum blockchain and the unexpected hack of what was at that time a completely novel project called the decentralized autonomous organization (DAO). The DAO was a collection of smart contracts designed to function as a kind of autonomous venture capital fund for projects on the Ethereum blockchain.

The DAO generated enormous interest, collecting what was at that time over \$150 million in investments, but just three months after the project's launch a hacker stole almost half of these assets through an unexpected smart contract "loophole." The resulting fallout saw bitter debates between two camps — one that wanted all Ethereum transactions, even that hack, to remain unchangeable, and another that argued that these losses represented an unreasonable hardship for small investors and could even put the viability of the entire Ethereum ecosystem at risk (or, put another way, the DAO was "too big to fail").

The important issue here is not which of these two paths is correct (ultimately, the "revisionist" camp won, and the Ethereum blockchain was "rewound" to a state prior to the hack). Instead, the problem is that governance needed to be determined on the fly, rather than by following established rules and procedures.

Unfortunately, despite more than eight years having passed since the DAO hack, recent experience suggests that little has changed. How to compensate small holders of digital assets is still the subject of debate in the wake of collapses.

On their own, each of these challenges is significant, but their impact can become amplified when they are experienced together by participants in the crypto ecosystem. For example, a consumer or business might unknowingly interact with a pseudonymous counterparty that is a sanctioned entity. Such a situation presents legal and regulatory implications severe enough to make many banks think twice about facilitating their customers' crypto interactions.

At the same time, an individual might have their assets stolen, see supposedly stable assets collapse or fall victim to a compromised cross-chain bridge. To make matters worse, when these things happen there may be no established process and procedures for how to deal with them, and less digitally literate or more financially vulnerable people may be disproportionately impacted.

Navigating such outsized risks only makes sense where there is an expectation of the potential for outsized gains. For crypto to reach its full potential, its advocates must find a way to move beyond this relentless focus on highly speculative use cases in favor of powering a broader universe of commerce in digital assets. That could include, for example, enabling a not particularly crypto-savvy consumer to purchase an NFT seamlessly and securely on one blockchain using a stablecoin from another, while simultaneously providing that user with confidence that they would have appropriate protections if something were to go wrong with the transaction.

Resolving these challenges is possible. In fact, as we discuss in section 2, it's been done before and can be done again.

02

New technologies, similar problems

While the technology powering digital asset ecosystems is novel, most of the challenges plaguing them are not. Building a successful payment network has always demanded more than just the capacity to securely transfer funds from point A to point B. Whether we are talking about the development of the SWIFT network, the growth of global card payment networks, the creation of national real-time payment systems or the recent success of “mobile money” networks in emerging markets, the beating heart of every payment network is a set of shared rules, often called a “scheme.” These rules establish the relationship between the payers, payees and intermediaries within the network, providing certainty around questions like how a payment would be executed, the medium of exchange that would be used and what would happen if something were to go wrong. By aligning around a scheme, counterparties mitigate risks like those described in the previous section, unlocking the potential for new commercial interactions.

Digital asset ecosystems are no exception when it comes to the importance of a scheme. They may use new technologies and have nontraditional stakeholders (like the “miners” who validate transactions), but the protocols that govern things like miners’ rewards or the rate at which a blockchain adds new blocks is effectively a scheme by another name.

The trouble is that while today’s digital asset ecosystems enable counterparties to securely transfer funds from point A to point B, they often can’t provide counterparties with interoperability across ecosystems, certainty that their transactions are compliant or a clear process for handling mistakes, hacks or disputes between parties. The result is that digital asset ecosystems, despite incubating remarkable technical innovation and attracting significant investment, struggle to enable simple and secure digital commerce use cases.

The solution to this challenge is to build on top of the remarkable technical innovations already underway in digital asset ecosystems, convening incumbent and crypto-financial institutions around a new scheme that provides consumers and businesses with a more reliable, secure and compliant way to do business within those ecosystems. This new scheme would establish a trusted and scalable multi-token network that stakeholders could opt into, where each participant would have confidence that the necessary procedures were put in place to manage risks, safeguard consumers’ interests, eliminate illegal activity and manage transaction disputes.

Case study

How the creation of credit card networks in the 1960s addressed many of the same challenges facing digital asset ecosystems today

Every payment network has its own origin story about the parties that came together at its founding, the challenges they were trying to solve and the scheme rules they aligned around to make that possible. For obvious reasons, a story close to our hearts is how banks — seeking to give their customers a new and better way to pay — came together to create the modern credit card networks, of which Mastercard was one.

Throughout the 1950s and early 1960s, businesses, banks and consumers all had a growing appetite to see retail commerce unshackled by the limitations of cash. In response, banks began issuing charge cards to facilitate their customers' payment experiences. But all these early projects faced challenges parallel to those faced by the world of crypto today.

These challenges included:

Lack of trust between counterparties

Banks negotiated individual contracts with businesses to accept their cards, which meant that if a business didn't have an existing relationship with someone's bank, they could not accept the card for payment.

Lack of interoperability

The early card landscape was fragmented and offered little consistency in the payment experience. Cardholders were never sure whether a business would accept their card and couldn't expect a similar point-of-sale experience across businesses — further contributing to consumers' lack of adoption.

Lack of clear governance procedures

There was no uniform process for cardholders or banks to raise and resolve disputes, making fraudulent use of cards a particular area of concern.

The solution to these challenges was for banks to align around a shared set of rules — centered around a plastic card — that provided clear payment guarantees, protected consumers against fraud, established mechanisms to eliminate bad actors and minimize illegal activity and created binding mechanisms for the resolution of disputes.

While digital asset ecosystems involve the use of radically new technologies (far more advanced than the paper-based systems of early card networks), the need for a shared set of rules that establish trust, interoperability and strong governance is a requirement for any payment network seeking to be used by billions of people around the globe.

03

Mastercard's vision for our Multi-Token Network

Mastercard seeks to power the future of digital asset commerce and bring the technical advantages of blockchain to mainstream users, while incorporating critical lessons from our decades-long history of enabling payments. We already provide a wide range of services to crypto-native businesses, helping them bridge the gap between traditional finance and the world of crypto, by establishing secure on-ramps and off-ramps for funds, as well as crypto cards that enable individuals to seamlessly spend funds from their crypto accounts. We also recognize that legacy payment infrastructure may face certain limitations interacting with blockchain systems, e.g., that infrastructure may lack the same set of rich features for programmable smart contracts. That's why we are actively investing in blockchain research across a range of applications, including payments, provenance and identity verification.

Mastercard's vision for our Multi-Token Network is the product of embracing the new while respecting the value of experience. The MTN would serve as an entirely new scheme composed of a group of validated counterparties that form a secure network overlay sitting on top of, and extending across, multiple public and private blockchains. Transactions processed within this network could be settled on those underlying public or private chains, alongside transactions from outside the network. However, transactions on the MTN would differ in that each counterparty would have confidence in the compliance of every transaction, and certainty of the rules governing those transactions. By providing this framework, the MTN would enable highly regulated financial institutions, including banks and VASPs, to play a more active role in supporting their customers' interest in the world of digital assets — supporting the overall safety and security of those experiences and interactions with new applications.

The MTN would include a wide variety of features with the specific goal of lowering barriers to the broad public adoption of digital assets through ensuring a safe and trusted experience. These features could include the provision of various consumer protections (such as a zero-liability guarantees and reversals if required), standardization of the terms and conditions for certain programmable smart contracts and clear requirements around which tokens are permitted for use as payment on the network. The MTN aims to provide the building blocks and tools to enable Mastercard and our partners to build payment solutions on blockchain that address real-world pain points. Mastercard's ability to partner with start-ups, governments, financial institutions, and the like, coupled with the scale of our global network around the globe, puts us in a unique position to lead this effort.

Rather than restricting participants to a single form of payment, the MTN would establish a clear standard for various payment tokens. This would empower users to pay with their preferred well-regulated payment token, which could include stablecoins, CBDCs and "tokenized deposits" which are digital representations of a portion of a customer's deposit at their commercial bank that have been earmarked for use in transactions on the MTN.

SECTION 3: MULTI-TOKEN NETWORK

Unlike most existing deposits, which are recorded exclusively within the ledger of a commercial bank, this portion of a customer’s deposits would effectively have a digital twin – its tokenized deposits – that shares all the properties of other blockchain-based tokens. This would include the capacity to interact natively with other tokens and be used for programmable smart contracts on the MTN.

This concept could rapidly increase mainstream adoption of blockchain services. Commercial bank deposits serve as the source of funding for most payments made between individuals and businesses today, including almost every debit and real-time payment transaction. It is only natural that individuals would want to use that same source of funds when making a purchase in the blockchain world.

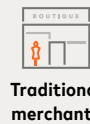
At a more macro level, we also believe that the creation of tokenized deposits could play an important role in ensuring the efficiency of capital allocation across the economy, as it avoids the challenge of “lazy money” created by the shifting of funds from bank deposits to stablecoin reserves.

We view the creation of networks like the MTN as a natural next step in the evolution of blockchain-based systems, with four key pillars of the network directly addressing the four challenges discussed earlier in section 1. In order to illustrate how this might work, we present several user stories aimed at bringing to life the concepts outlined in this document. Diagram 1 introduces a conceptual MTN structure that is replicated in illustrative representations of those user stories throughout this section. However, it is essential for readers to bear in mind that these narratives and diagrams are illustrations to support the underlying concepts and are neither a precise business proposition nor a technical architecture. It is almost certain that these flows would evolve and change significantly through the iterative process of prototyping, testing and learning.

Conceptual overview of Mastercard Multi-Token Network

USER LAYER

The envisioned Mastercard Multi-Token Network (MTN) ecosystem would serve a wide variety of retail and commercial users, including...



WALLET LAYER

Users would be able to hold a wide variety of assets in wallets verified for use on the MTN, including...



INSTITUTION LAYER

Members of the MTN could include (where permitted by regulation) a variety of supervised intermediaries, such as...



MASTERCARD MULTI-TOKEN NETWORK

MTN members would commit to a shared set of governance practices, commercial agreements, and transaction standards covering...



SETTLEMENT LAYER

Final settlement of transactions could be executed through a variety of different types of infrastructure, including...



Application developers from multiple organizations (Fintechs – traditional and Web3, corporates and banks) can build applications within the MTN framework.

MTN pillar 1: Verified credentials to establish compliance

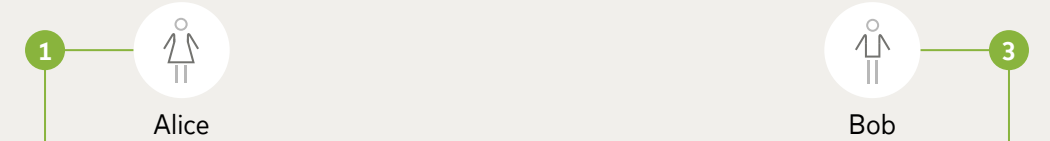
The first step to establishing a new scheme for digital asset transactions is the validation of user identities. This step lays the foundation of a robust compliance regime and establishes trust between institutional counterparties (those providing consumers and businesses access to digital asset services). Banks and VASPs that join the MTN would need to meet stringent onboarding standards for their clients. This includes ensuring a robust KYC process, risk-scoring the source of any pre-existing digital assets being brought into the network, as well as conducting rigorous and ongoing AML/CFT and sanctions screening for applicable use cases. These obligations would establish a secure environment in which counterparties would be able to have faith in the compliance of all transactions, significantly lowering a set of regulatory and risk-based hurdles that, to date, have limited the willingness of banks to facilitate their customers' interactions with digital asset ecosystems.

As illustrated in Diagram 1, with this new scheme customers' interactions would be facilitated through their MTN compatible wallet. This would be an interface and custody service provided by a bank, VASP or other licensed entity that would allow each user to interact with crypto assets from multiple public and private blockchains. For example, imagine a situation where a customer named Alice completes an MTN-compliant onboarding process with her VASP. As part of this process, she transfers \$100 in regulated stablecoins on public chain A to her newly created MTN compliant wallet provided by her VASP. From this interface she can view her aggregate holdings and conduct transactions with these assets via the MTN. Because users and the source of funds have been verified against a common set of standards, transactions between two users via the MTN would meet the same high standards of compliance, whether executed on a private chain or a permissionless public chain.

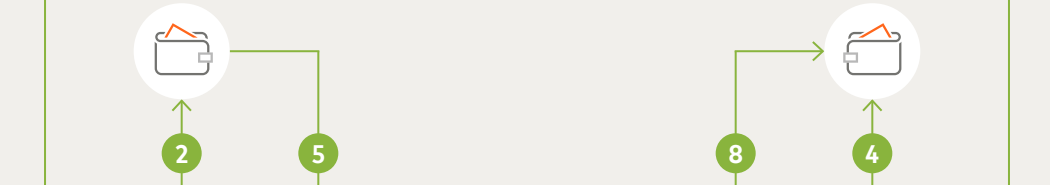
Now imagine a transaction where Alice holds \$100 in stablecoins on the public chain A at VASP A and wishes to send \$50 in value to Bob at VASP B. Both VASP A and VASP B are participants in the MTN and have validated Alice's and Bob's identities, as well as their sources of funds, in accordance with the standards established by the network. This means that, even though the transfer of assets would be accomplished via the permissionless and pseudonymous public chain, Alice, Bob and both of their institutions would be able to act with confidence that their transaction is fully compliant.

Onboarding and a simple validated ID transaction

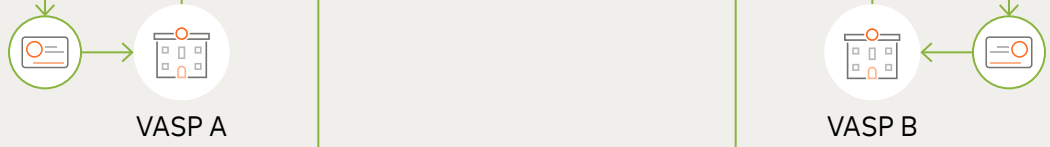
USER LAYER



WALLET LAYER



INSTITUTION LAYER



MASTERCARD MULTI-TOKEN NETWORK



SETTLEMENT LAYER



1. Alice provides ID and source-of-funds details, allowing VASP A to complete an onboarding process that meets MTN standards.
2. VASP A provisions an MTN wallet to Alice and facilitates the transfer of assets into the wallet.
3. Bob provides ID and source-of-funds details, allowing VASP B to complete an onboarding process that meets MTN standards.
4. VASP B provisions an MTN wallet to Bob and facilitates the transfer of assets into the wallet.
5. Alice initiates a transfer of \$50 to Bob, using a stablecoin on the public blockchain A.
6. The transaction is governed by MTN network rules and subject to appropriate compliance checks.
7. Settlement of the transfer of funds is executed via the public blockchain A (in the same way as any non-MTN transaction).
8. Bob receives \$50 of stablecoin in his MTN wallet.

MTN pillar 2: Enabling stable and regulated payment tokens

The second step to establishing this new scheme is ensuring access to stable and regulated money-like assets to serve as a trusted store of value and medium of exchange on the network. Today we envision three different versions of such assets, all of which could exist on the MTN simultaneously: fully collateralized stablecoins, CBDCs and tokenized deposits.

Fully collateralized stablecoins are an important medium of exchange and source of liquidity in digital asset markets and will likely continue to be over the medium term. Policymakers and regulators in many jurisdictions are working to outline operational, liquidity and capital standards that issuers would need to meet for their stablecoins to be considered money-like assets, as well as supervisory regimes to ensure these standards are met on a continuous basis.

CBDCs are currently under development by governments around the world, with many designed for retail use. Mastercard is actively working with central banks as they design, test and deploy these systems. Where central banks are open to CBDCs being used to facilitate payments within digital asset ecosystems, these inherently stable assets would have the potential to serve as an important medium of exchange within the network.

Tokenized deposits are currently being explored by Mastercard in conjunction with several bank partners. Many in the industry have expressed interest in these payment tokens. They reflect a portion of a customer's deposit account balance that is earmarked for transactions on the MTN to facilitate seamless "on-chain" purchases and payments.

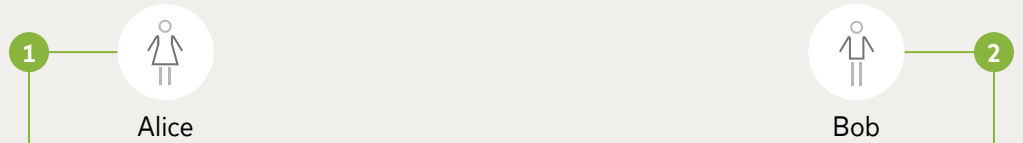
Establishing a high bar for the mediums of exchange on the network means that, whether an individual is paying with a regulated stablecoin, CBDC or tokenized deposit, the recipient can have faith they are receiving a fungible and trustworthy form of money (or money-like asset) as payment.

For example, let's imagine another transaction between Alice and Bob. Alice is an artist and placed an NFT of her art in her MTN wallet with Bank A. Bob would like to buy that NFT using funds from his deposit account at Bank B. Since both Bank A and Bank B are participants in the MTN, Bank B can tokenize a portion of Bob's deposits equivalent to the posted price of Alice's art and execute a swap of those funds for the NFT with Bank A. Alice is then able to receive payment in her preferred medium, which happens to be a stablecoin, as per prior agreement with her bank.

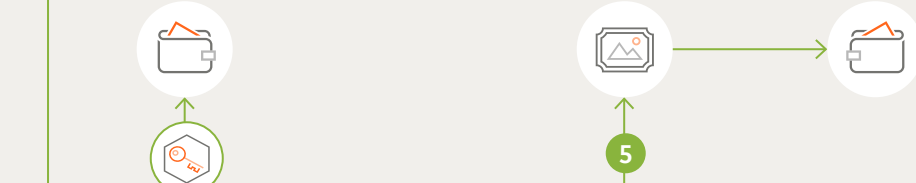
Reviewing this example, it's easy to see how quickly things can become complicated, even in the case of this simple transaction. But one of the key virtues of the MTN would be to handle this complexity for the end user, enabling Alice and Bob to seamlessly execute a transaction using their preferred store of value in a seamless, trusted and secure manner.

Swap of an NFT for tokenized deposits

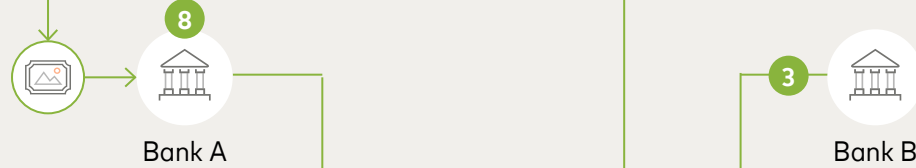
USER LAYER



WALLET LAYER



INSTITUTION LAYER



MASTERCARD MULTI-TOKEN NETWORK



SETTLEMENT LAYER



Settled on legacy payment infrastructure (or potentially via a wholesale CBDC)

1. Alice mints an NFT and makes it available for sale on an NFT marketplace for a posted price of \$100.
2. Bob decides to purchase Alice's NFT and asks Bank B to facilitate the transaction using fiat funds from his deposit account.
3. Bank B earmarks \$100 from Bob's deposit account and initiates the creation of a \$100 in tokenized deposits.
4. Bank A and Bank B conduct a swap of Alice's NFT for the \$100 in tokenized deposits via the MTN.
5. Alice's NFT is transferred to Bob's MTN wallet.
6. The deposit token is used to trigger a settlement of \$100 in fiat money from Bank B to Bank A using traditional settlement rails (e.g., card rails, ACH, RTGS, etc.) or possibly a wholesale CBDC.
7. Bank A's settlement account is credited \$100 from Bank B.
8. Bank A transfers \$100 in stablecoins to Alice's account (which she has previously specified as her preferred means of payment).

MTN pillar 3: Powering secure cross-chain interoperability

The combination of pillars 1 and 2 enables transactions in a trusted environment using a stable medium of payment within the ecosystem of a given blockchain. But what about the case of a more complex transaction where, for example, a consumer wishes to purchase a digital asset on one chain using digital assets on another?

While some commentators still talk about “the blockchain,” the universe of digital assets is in fact built on many public and private blockchains, with each one seeking to build a self-sustaining ecosystem with a distinct set of rules and standards. That means that even if two blockchains use the same underlying protocol, and are pursuing the same use case, the resulting systems are typically not natively interoperable. If users in blockchain ecosystem A want to move value to blockchain ecosystem B, the only way of doing so is via a shared VASP or a potentially cross-chain bridge without clear governance arrangements if things go wrong. The result is a fragmented, and largely non-interoperable, cluster of ecosystems. Similarly, if a CBDC were to launch on a private blockchain then it would not be readily able to enable payments or commerce in other public/private blockchain ecosystems.

The MTN can help users transact across blockchain ecosystems in a secure fashion without needing to share the same VASP or bank. Let’s imagine a transaction between Alice and Bob where Bob wants to purchase an NFT from Alice. Alice’s NFT is on public blockchain A, but Bob wants to pay using a CBDC that has been issued on a central bank’s private blockchain or centralized platform. Today these systems do not interoperate, meaning that in order to make this purchase Bob would likely need to exchange his CBDC holdings for traditional bank deposits, use those bank deposits to purchase stablecoins native to public blockchain A from a VASP, and finally use those stablecoins to purchase the NFT — making the transaction significantly more complex and potentially more costly. What if instead, Alice and Bob’s financial service providers worked with the MTN to enable a more seamless transaction?

There are multiple ways to deliver this kind of secure interoperability. In pillar 4 we will outline how the centralized enforcement of scheme-based rules can be leveraged to guarantee the atomicity of transactions (in other words ensuring that all legs of the transaction either succeed or fail). Here we explore a more technical solution wherein a CBDC on a private blockchain is “wrapped,” enabling it to be used to make a purchase on a public chain. In such a scenario Bank B could lock 100 units of CBDC in Bob’s wallet and then request the issuance of 100 units of “wrapped” CBDC native to public blockchain A from the MTN. Bob can then initiate a transaction via the MTN with Alice, exchanging his CBDC for her NFT, and Alice can subsequently redeem those “wrapped” CBDC tokens via her financial institution. In addition to enabling interoperability, this solution could be integrated with elements of pillar 1 to place limitations on the movement of the “wrapped token,” for example by adhering to limitations that the central bank might place on non-resident holdings of CBDCs.

Cross-chain NFT purchase with CBDC

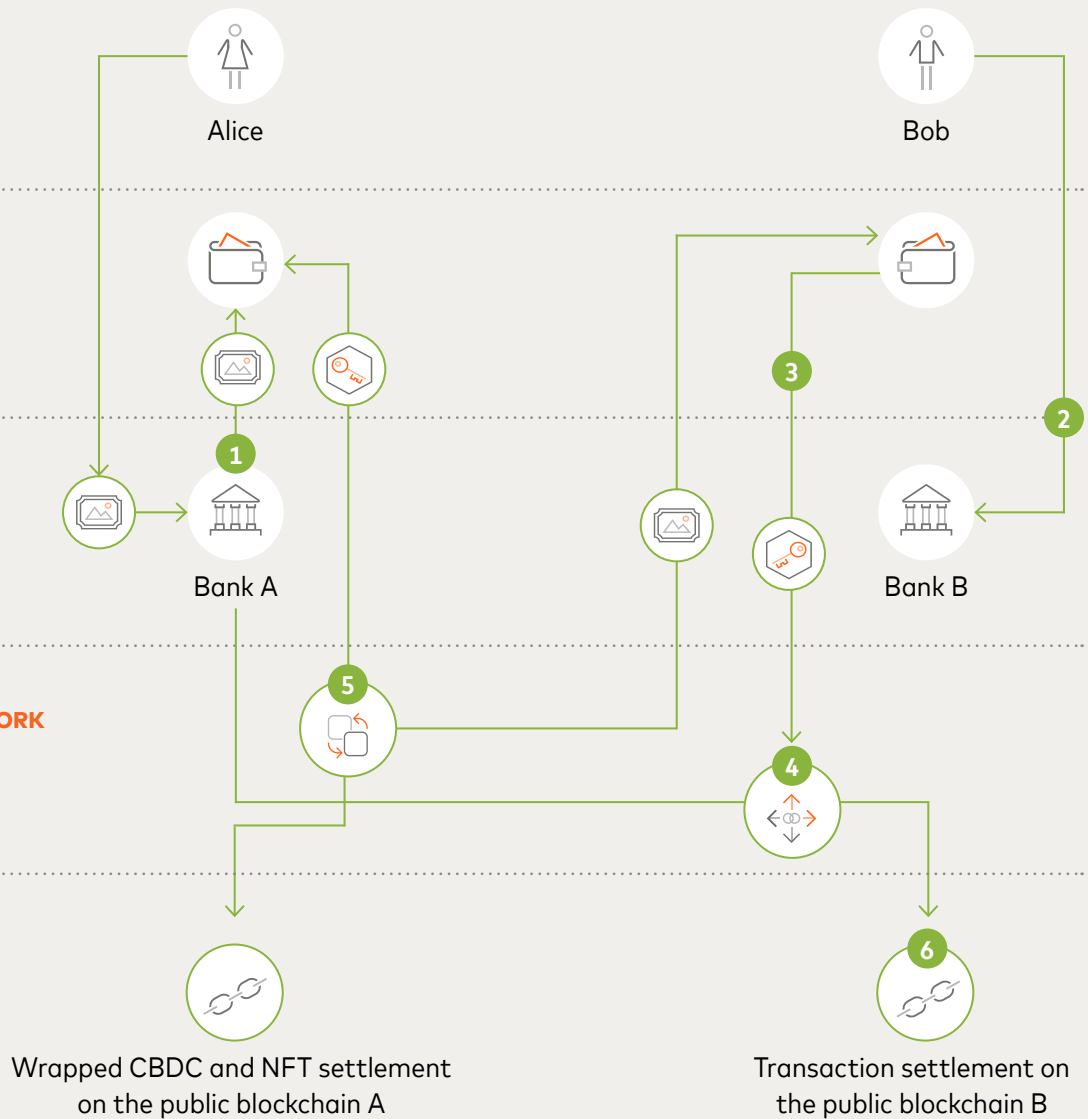
USER LAYER

WALLET LAYER

INSTITUTION LAYER

**MASTERCARD
MULTI-TOKEN NETWORK**

SETTLEMENT LAYER



1. With the assistance of Bank A, Alice mints an NFT on the public blockchain A and has the NFT placed in her MTN wallet.
2. Bob is holding 100 CBDC issued by the central bank. Via Bank B, Bob requests 100 wrapped CBDC that can move on the public blockchain A.
3. Bank B requests 100 wrapped CBDC from the MTN wrapping service.
4. The MTN wrapping service locks 100 CBDC on the private infrastructure and issues 100 wrapped CBDC on the public blockchain A.
5. Bob initiates the purchase of Alice's NFT. The wrapped CBDC is moved from Bob's MTN wallet at Bank B to Alice's MTN wallet at Bank A. Alice's NFT is moved to Bob's MTN wallet.
6. Alice via Bank A requests the redemption of 100 wrapped CBDC for 100 CBDC. The MTN wrapping service burns the 100 wrapped CBDC and unlocks 100 CBDC in Bob's wallet and immediately transfers it to Alice's wallet at Bank A.

MTN pillar 4: Creating a comprehensive governance framework

The fourth, and arguably most important, feature of the MTN would be the creation of a set of scheme rules to govern the interactions between network participants and enable a range of protections for consumers and businesses. Drawing on Mastercard's experience developing similar rules for card and real-time payment networks, these scheme rules would govern who can participate in the MTN and the roles and responsibilities of its participants. They could also enable consumers and businesses to benefit from the same types of protections they have using payment cards today. Consumers might, for example, be entitled to immediate transfer of digital assets they purchase or could enjoy zero liability in the event of fraud, theft or failure to deliver services.

Importantly, these scheme rules would also allocate liability among participants, with some rules potentially executed through smart contracts. While not contracts in the legal sense, these smart contracts could enable the efficient and automated execution of pre-programmed governance mechanisms. For example, they could dictate whether a token can move to a specific blockchain address, the sequence of token movements between the payer and the payee, and the release of a digital asset against payment. These smart contracts would, in essence, automate and operationalize the enforcement of the scheme rules, reinforcing the roles and relationships established under those rules.

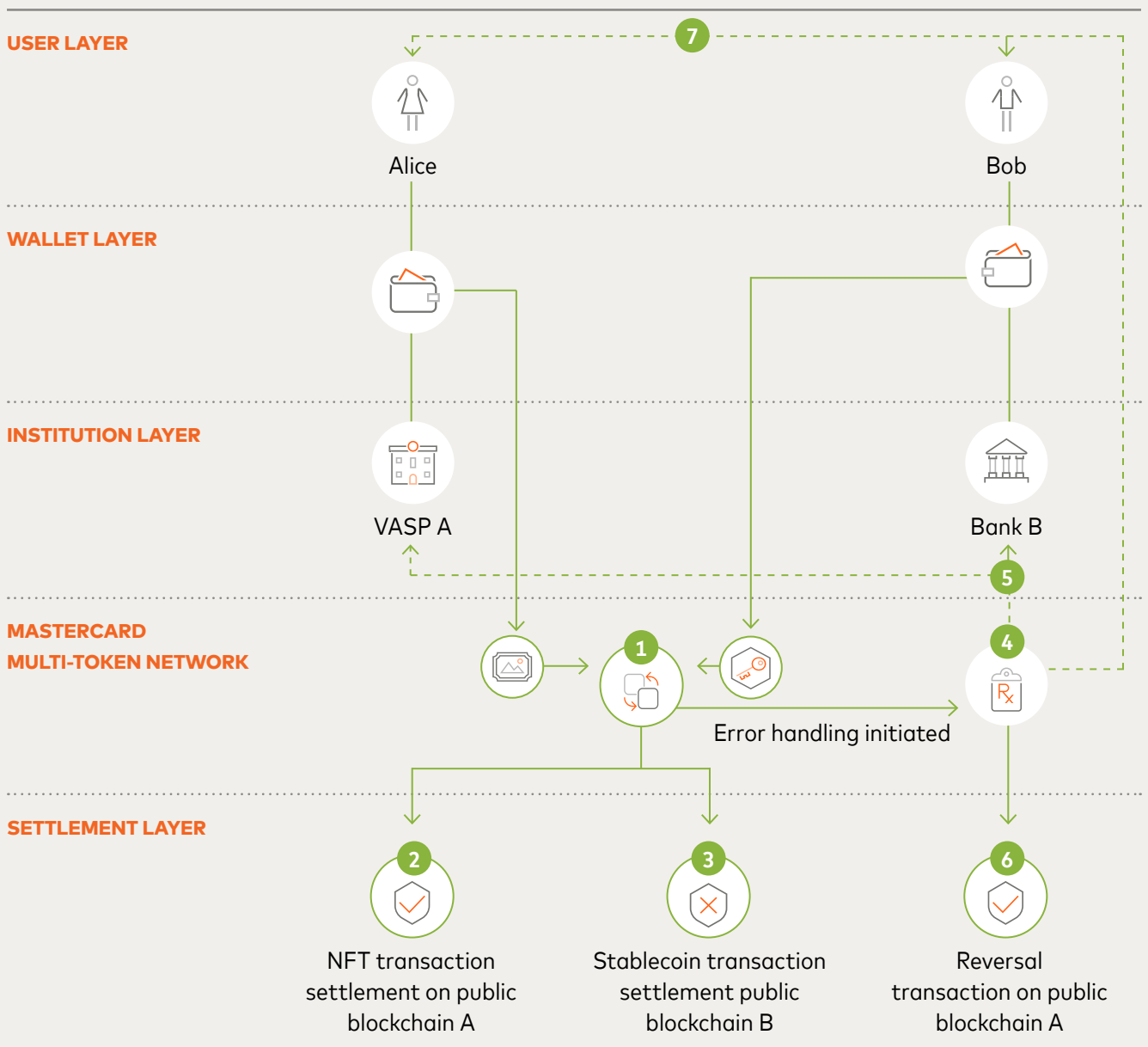
To better understand how the MTN governance framework could provide the confidence necessary to enable a wide range of digital commerce transactions, we will explore two examples of purchases that do not go as planned. The first will revolve around an unexpected technical error on a public blockchain during an MTN-enabled cross-chain transaction, while the second will consider a situation where a business is unable to deliver on a set of services promised to a consumer. As in all the narratives outlined in this document, these user stories and diagrams are intended to be illustrative and provide an initial hypothesis for the types of activities and services the MTN could facilitate. Significant further effort would be required to specify both the detailed governance framework of the MTN and the underlying technical processes to support that framework.

For our first example, let's imagine Bob wants to purchase an NFT from Alice. Alice's NFT is on public blockchain A and Bob is holding stablecoins on a public blockchain B. Rather than utilizing the "wrapping" approach to interoperability described in pillar 3, let's explore how the MTN could support cross-chain interoperability by coordinating settlement across multiple chains, and how it could guarantee the atomicity of those transactions — even when things go wrong — through the application of its governance rules.

In this example, Bob agrees to purchase Alice's NFT for \$100 and instructs Bank B to fund the transaction using stablecoin holdings on public chain B. The MTN supports the coordinated execution of two individual transactions, one updating public blockchain A to move the NFT from an address controlled by Alice's wallet to Bob, and one updating public blockchain B to move the stablecoin from an address controlled by Bob's wallet to Alice. Everything goes as planned in the first leg of the transaction; Alice's NFT on public blockchain A is transferred to an address controlled by Bob's wallet. However, for some reason the update to the public blockchain B fails to record the transfer of ownership from an address controlled by Bob's wallet to an address controlled by Alice's wallet. This creates a problem that if unresolved would mean Bob holds Alice's NFT and remains in control of his stablecoins, while Alice would've gotten nothing out of the deal.

We can imagine a system where the MTN instantly recognizes that this transaction has not gone according to plan and launches a set of error-handling protocols. Under this system the MTN might instruct Bob's bank and Alice's VASP to prevent transactions involving Alice's NFT until the error is addressed, while simultaneously initiating a countermanding transaction on public blockchain A that transfers Alice's NFT back to her control. This action would effectively unwind the transaction, placing both Alice and Bob in the same position where they started. They could then be notified of the failed transaction by their respective financial service providers and decide whether they would like to attempt the transaction again. While the specifics of how these and other situations would be handled by the MTN remain to be determined, this narrative provides a picture of how the network's governance framework could foster confidence between stakeholders that their transactions will happen as intended.

Error handling and governance flow for a technical fault



1. Alice and Bob decide to conduct a cross-chain exchange of Alice's NFT on public blockchain A for \$100 in stablecoin on public blockchain B.
2. During the settlement stage of the process, the update to the public blockchain A is executed successfully, transferring Alice's NFT to an address controlled by Bob's MTN wallet.
3. Unfortunately, the update to the public blockchain B fails, and the update in ownership to Bob's stablecoin is not recorded. As a result, the \$100 in Bob's stablecoin remains at an address controlled by his MTN wallet.
4. The MTN recognizes that the cross-chain transaction has not been conducted successfully and automatically initiates an error resolution process.
5. The MTN notifies Alice's VASP and instructs Bob's bank not to allow transactions involving Alice's NFT while the error is addressed.
6. An updated transaction is initiated on the public blockchain A, effectively reversing the transfer of Alice's NFT to Bob. This unwinds Alice and Bob's positions to be the same as at step 1, with Alice in control of her NFT and Bob in control of his \$100 in stablecoin.
7. Alice and Bob are notified that their transaction has not been successful and offered an opportunity to try again.

SECTION 3: MULTI-TOKEN NETWORK

For our second example, let's imagine that Alice has previously purchased an NFT via a transaction on the MTN from her favorite sports team. This NFT is effectively a ticket that gives Alice the right to attend her team's upcoming game. However, inclement weather leads to the game's cancellation. Fortunately for Alice, the MTN governance framework provides a clear set of rules for how such situations should be handled and NFT holders are automatically reimbursed via their MTN wallets in much the same way that an individual who purchased tickets with their credit card might be.

Error handling and governance flow for non-delivery of services

USER LAYER



Alice



Sports team

WALLET LAYER



INSTITUTION LAYER



VASP A



Bank B

MASTERCARD MULTI-TOKEN NETWORK



Automated reimbursement process initiated

SETTLEMENT LAYER



Settled on public blockchain A

1. Alice's favorite sports team notifies its bank that due to adverse weather conditions they have been forced to cancel a game.
2. As per the terms of the MTN governance framework (N.B. this framework is hypothetical, with the details of the scheme TBD) the team's bank initiates a reimbursement of NFT ticket holders via the MTN.
3. The MTN manages the transfer of assets to NFT holders across the network, enabling each to be reimbursed in their original medium of payment.
4. Alice, who purchase her NFT using a stablecoin on the public blockchain A receives the same in reimbursement.
5. Settlement of the reimbursement is executed on the public blockchain A.

How the Mastercard Multi-Token Network powers digital asset commerce

Taking a step back, we see that the combined pillars of the MTN have the potential to drive significant changes in how banks, VASPs, consumers and businesses collectively interact with the world of digital assets, enabling a virtuous cycle of improved user experience, increased consumer adoption and accelerated innovation of digital asset use cases. Once fully realized, the MTN could provide banks, VASPs, consumers and businesses with a new way of developing payments and commerce applications by:

Supporting banks' enablement of digital asset use cases

By establishing a trusted compliance framework, ensuring a high bar for the stability of payment tokens and enabling the tokenization of commercial bank deposits, the MTN would facilitate banks' ability to continue their core business of lending, while simultaneously allowing consumers to use their bank deposits for new digital commerce applications.

Providing consumers a simpler and safer way to access digital assets

The MTN would be a meaningful step toward the goal of enabling consumers to use digital asset products and services with confidence, irrespective of their level of technical sophistication. Consumers would have confidence in the stability of their payment tokens and be secure in the knowledge that they enjoy a clear set of protections against fraud and theft. Moreover, they would be able to conduct traditional and digital asset financial transactions from the same accounts.

Simplifying businesses' deployment of digital asset products and services

As consumers become more comfortable with seamlessly moving between traditional and "on-chain" products and services, we expect a growing number of businesses would explore the potential for blockchain-based offerings to meet their clients' needs. This could include a multitude of use cases, ranging from the retail sale of concert tickets in the form of NFTs to the simplification of business supply chain management and financing.

Accelerating the development of novel blockchain applications

The increased safety and security enabled by the MTN would foster increased interest in digital asset use cases. The MTN would provide businesses with turnkey standards for developing secure, compliant and interoperable blockchain-based applications that provide consumers with robust data, privacy and consumer protections.

Together, these forces would create a flywheel for innovation and adoption. Looking to the future, we can imagine a world where broader adoption of the MTN might support a range of use cases for digital assets, enabling simple transfers of payment tokens, delivery for payment swaps, and even the sophisticated layering of programmable logic within a composable framework to be delivered with improved safety, security and compliance for all parties. These are a handful of potential use cases the MTN could enable:

Use case 1: Simple transfers of digital payment tokens

MTN would provide a safe and simple way to enable transfers of payment tokens and provide a framework for banks to interact with public and private blockchains and provide the associated functionalities for their customers. This can support cross-border remittance use cases or where payment token transfers can complement existing off-chain applications including scheduled payments or disbursements.

Use case 2: Automated swap of digital payment assets and other tokenized assets (Delivery versus Payment)

Multiple non-payment assets can be tokenized, and these can be natively digital (e.g., NFT art, gaming assets) or a representation of a real-world asset (e.g., invoice, real estate). These can be referred to as "delivery assets." Tokenization of "delivery assets" brings significant benefits including the ability to fractionalize as well as track the movement of ownership easily. Where these "delivery assets" exist on-chain, the MTN, through the use of smart contracts, would allow the automated and synchronized swap of these assets with payment tokens, improving efficiency and reducing risks in these transactions.

Use case 3: Conditional or automated payments

Smart contracts can be leveraged to automate transfers of digital assets based on the completion of events. This could, for example, deliver escrow functionality or the ability to split payments between different parties based on pre-set criteria codified into smart contracts. The uses can range from automating payouts in supply chains to helping split marketplace payments among different parties in a transaction.

04

Mastercard Multi-Token Network proofs of concept

To test the fundamental viability of the MTN concept, Mastercard is working with partners from across the financial sector — including both traditional and crypto-native institutions — to develop and integrate the four pillars of the MTN via a series of proofs of concept (PoCs) and pilots. In fact, many of our recently announced efforts in the digital asset space directly support the long-term vision of the MTN. In this section, we will briefly explore how the recently announced Mastercard Crypto Credential™ PoC takes a first step in the development of pillar 1 (trusted identities and compliance), while our experimentation with tokenized deposits helps to advance the goal of pillar 2 (expand the availability of stable and regulated payment tokens). Finally, our recent work with a major central bank provides a tangible view of how the MTN can support interoperability between disparate networks.

MTN pillar 1: Crypto Credential PoC

Pillar 1 focuses on ensuring that all institutional participants in the MTN meet stringent onboarding standards for their users. As a first step towards this objective, we announced Mastercard Crypto Credential in April 2023. This service aims to establish a governance framework that defines identity verification standards and obligations. Customers of a VASP (and potentially in the future banks) that participate in this service can create a user-friendly credential (e.g., alias, username) allowing them to use this credential rather than the long and complex blockchain address. This credential would also act as a confirmation that the customer's VASP meets the identity verification standards set by the MTN. Additionally, Crypto Credential would allow VASPs that completed the KYC process to provide attestations (on-chain and off-chain) that participants meet the verification requirements. Crypto Credential also facilitates the seamless exchange of transactional metadata between counterparties to enable their compliance with regulatory requirements. This would have a range of benefits including avoiding the need to create a central repository of sensitive data.

Initial user experience tests of Crypto Credential have demonstrated the value of the service. They show how users across multiple VASPs will be able to interact using simple credentials rather than complex blockchain addresses, limiting errors in the transfer of funds. At the same time, participants gain confidence that their counterparties have been held to high compliance standards, minimizing the frictions are compliant with relevant regulatory obligations, and facilitating counterparties' compliance with the Travel Rule.

MTN pillar 2: Tokenized deposit PoC

Pillar 2 of the MTN focuses on the use of regulated, stable and scalable payment tokens. In line with this goal, our second PoC focused on exploring the use of tokenized deposits by enabling banks to mint tokens representing deposit liabilities and transfer these between other participating banks. The resulting inter-bank obligations from these transfers, whilst only simulated funds, were then shown they could be settled using Mastercard's existing card settlement network.

This PoC demonstrated that it is possible for banks to issue fully programmable tokens representing their customers' deposits via the MTN, and that these tokens could be moved between banks in real-time. While settlement within the PoC was conducted using Mastercard's existing system, consideration is being given to the role that next-generation token-based settlement systems, such as a wholesale CBDCs, could play in supporting the use of tokenized deposits. Critically, the PoC also demonstrated that it was possible to restrict the transfer of tokenized deposits to banks within the MTN, which will likely be critical to managing the risk and compliance obligations associated with these assets.

MTN pillar 3: Interoperable CBDCs for Web3 commerce

Pillar 3 focuses on enabling secure interoperability between assets on multiple public and private blockchains using a variety of different techniques. In this PoC, Mastercard explored how a CBDC on a private blockchain might be employed to facilitate the purchase of an NFT on a public blockchain. To do this, a partner financial institution acted on behalf of a customer to lock a portion of the funds in the customer's CBDC wallet then, using underlying Mastercard technology, issued wrapped CBDC tokens on a public blockchain. Smart contracts native to that public block chain were then used to execute an exchange of the wrapped CBDC tokens for an NFT, after which the wrapped tokens were then redeemed by the seller to their CBDC wallet via their financial services provider, again using underlying Mastercard technology. Throughout this entire process, Crypto Credential was utilized to ensure that only permissioned wallets could transact across the system.

This PoC demonstrated that it is possible to use a CBDC to make safe and compliant purchases from Web3 ecosystems native to public blockchains. Moreover, it demonstrates how controls can be placed on the movement of tokens even when those tokens are used beyond their native issuance infrastructure. Future PoCs could explore how this approach could be customized to meet more detailed obligations, such as rules prohibiting non-residents from holding CBDCs.

MTN path forward

Work on the MTN is just getting started – and beginning in the UK, we are launching a beta version of the MTN, that will serve as a home for further testing and exploration of new use cases. The goal of this work is to power the evolution and adoption of accessible and consumer friendly blockchain-based payment systems with embedded security, trust and compliance. We are excited to welcome traditional players, digital-asset native innovators and regulators into this environment as we pursue the MTN vision of unlocking the opportunities of digital assets by delivering a safer and more secure ecosystem for all parties.

05

The role of the public sector in unlocking the potential of digital assets

The rapid innovation in permissionless crypto ecosystems has posed a significant challenge for financial regulators around the world. Many are excited by the potential for blockchain technology to drive innovation and competition within financial markets. Yet they remain highly concerned about the many risks native to these ecosystems, including the presence of fraud, market manipulation, AML/CFT violations and – increasingly – a limited degree of systemic risk. The challenge facing regulators demands nuance. They are tasked with walking the fine line between reining in the many risks of emerging digital asset ecosystems without quashing the potential for innovation. It's clear that implementing and enforcing thoughtful digital asset regulation would help to counter bad actors and encourage responsible innovation, but the enormous breadth of use cases being pursued by crypto-entrepreneurs, and the complex networks of intermediaries that enable them, make it very a challenging endeavor to achieve in practice.

We believe that affirmative regulatory guidance – whether through clarification of how existing rules apply to digital assets or the issuance of entirely new guidelines for digital assets – would open the door to building solutions like the MTN that can help initiate a cascade of positive developments in the crypto universe, enabling the broader adoption of blockchain technology as an engine for digital commerce.

We urge regulators to take the following four steps to help unlock this opportunity:

Clarify and enforce consistent compliance expectations across payment technologies

We firmly believe that digital asset ecosystems – and indeed any financial ecosystem – should succeed or fail based on their own inherent merits (e.g., speed, efficiency, capacity for innovation), not based on regulatory arbitrage or an unlevel playing field. As such, the regulatory obligations in each jurisdiction for digital assets – particularly relating to payments – should set compliance requirements, enforcement measures and regulatory outcomes that are in line with those of other payment technologies.

What does this have to do with the MTN? Where regulatory and compliance requirements are not uniformly deployed across different payment rails, strong incentives would exist for innovators to engage in regulatory arbitrage. A lack of enforcement for new entrants could also disincentivize firms from investing in regulatory compliance. In other words, if a significant percentage of payments migrate to digital asset ecosystems because customers and businesses expect looser regulatory obligations or weaker enforcement of those obligations, then the payment ecosystem as a whole would suffer. Digital asset communities would see few incentives to participate in efforts like the MTN that strive to establish a fundamentally higher baseline of compliance, thus creating higher levels of risk for users.

SECTION 5: THE ROLE OF THE PUBLIC SECTOR

While many national, state and local regulators and international standards setters such as the Financial Action Task Force (FATF) deserve praise for their work deploying clear and consistent compliance frameworks for digital asset payment flows, the rapidly evolving nature of this space would demand continuous engagement from regulators and policymakers, as well as constant vigilance by enforcement authorities. For example, while the U.S. Department of the Treasury has issued clear guidance that the Travel Rule must be implemented by VASPs, enforcement of this requirement has been limited, providing some stakeholders with insufficient incentives to invest in solutions that would improve their compliance and that of their counterparties.

We strongly believe that solutions like the MTN can improve overall compliance across the digital asset community, supporting high-quality AML/CFT due diligence and sanctions screening, establishing clear terms and risk-sharing models among counterparties, enforcing adherence to data protection and privacy obligations, and minimizing any unfair, deceptive or abusive practices. However, it can do so only if the rules for all players are uniformly applied, and if a critical mass of stakeholders invests in building networks where participants are committed to holding each other to the highest standards.

Establish robust regulatory frameworks for stable payment tokens

Clear and consistent regulatory regimes can do little to ensure the safety and stability of payments if the medium of exchange used cannot be trusted. That's why establishing clear guidelines and authorization requirements for "stable payment tokens" is a central requirement of the MTN. These requirements would ensure the parity and fungibility of money (and money-like assets) across the network, providing stakeholders with confidence that any stablecoin, tokenized deposit or CBDC being used for payment on the network met the highest standards of safety, security and compliance.

While some aspects of these standards could be determined among MTN participants, regulation and corresponding guidance would facilitate alignment, certainty, enforceability and broad-based trust in these assets. We encourage governments to prioritize the development of robust regulatory frameworks for payment instruments within digital asset ecosystems, including stablecoins, tokenized deposits and in some instances CBDCs. The distinct characteristics of each of these asset types demand that they be considered independently of one another:

Stablecoins

As a new type of asset with distinct risks depending on its structure and scale, stablecoins may require the development of a novel regulatory framework or updating existing regulations to adequately bring them within the regulatory perimeter. Clear regulatory standards are required to ensure the safety and stability of stablecoin arrangements, particularly regarding liquidity, quality and custody of reserves. Additionally, there is a need for clearer guidance around users' redemption rights, consumer protections, transparency and disclosure requirements and risk management standards – especially involving operational resilience, settlement finality and cybersecurity. It will also be important to consider resolution arrangements in the event of the failure of a stablecoin.

All issuers of stablecoins, whether insured depository banks, non-depository banks or non-banks, should be subject to appropriate and equivalent authorization, oversight, supervision and reporting requirements. Careful consideration should be given to the application of deposit insurance for these assets, which could increase the appeal of regulated stablecoins.

Tokenized deposits

It is Mastercard's view that tokenized deposits should present a much less significant undertaking for regulators than stablecoins. Whereas stablecoins are a new asset, consumer deposits are a well-understood and highly regulated financial instrument with many years of legal and regulatory precedent. It is our view that a deposit liability of a commercial bank represents the same set of rights and claims irrespective of whether it is recorded in the account management system of a bank mainframe or represented by a token within a private blockchain-based interbank network. As such, we believe that the regulatory treatment of deposits should, in most cases, be consistent across tokenized and account-based deposits, with consumers receiving the benefit of the same deposit insurance, disclosures and unauthorized use protections. While special consideration would likely be needed for the distinct operational and settlement risks raised by the tokenized form of deposit transactions, existing risk-based guidance should provide significant direction on these issues.

SECTION 5: THE ROLE OF THE PUBLIC SECTOR

Central bank digital currencies

Similar to tokenized deposits, CBDCs should require few new regulations, since they represent a digitized version of a centuries-old asset class. However, as we consider the future role that CBDCs might play in payment ecosystems, it is important to recall that the scope and objectives of most retail CBDC projects differ significantly from the far-reaching ambitions of the broader digital assets space. While a CBDC could theoretically act as a medium of payment in digital asset ecosystems – and would be particularly well-suited to via an overlay network such as the MTN – few retail CBDC designs currently under discussion envision providing native interoperability with permissionless digital asset networks. Instead, retail CBDC projects tend to be aimed at the narrower goal of establishing a domestic retail digital payment scheme that enables payment via a central bank liability (rather than a commercial bank liability). As a result, it is not always clear how, or even if, a CBDC would interact with digital asset ecosystems.

Looking forward, we would encourage central banks considering the development of a CBDC to carefully assess the future relationship between the CBDCs' role as a medium of payments and the much more far-reaching ambitions of digital asset ecosystems discussed in section 1 of this paper. Mastercard would welcome opportunities for active dialogues with central banks on how an offering like the MTN could support the secure and compliant interoperation of a CBDC with public and private digital asset ecosystems via a set of regulated intermediaries.

Resolving key uncertainties around the regulation of digital assets

By establishing clear, consistent and enforceable regulations for digital asset payments, and ensuring that money-like assets are held to high standards of safety and stability, regulators can lay a strong foundation for payments in digital asset ecosystems. But on their own, these steps provide only two of the three components needed to unlock the potential of these ecosystems.

For most transactions, the payment is only part of the story. More interesting and varied is the product or service being purchased with that payment. In digital asset ecosystems today, most payments fund the purchase of speculative investment assets by buyers willing to take significant risks in the hope of big gains. While the MTN would strive to reduce the risks inherent in these speculative transactions, the central goal of the network would be to expand the range of transactions conducted within digital asset ecosystems by enabling seamless, safe and secure purchases of digital goods and services that are consumed rather than invested in.

From today's vantage point, it's difficult to tell what use cases might take root, but we can imagine a world where consumers use the protections offered by the MTN to confidently purchase an NFT hat from their favorite sports team to be worn by an avatar in a virtual world, that itself is operated as part of a decentralized and creator-run social network. But for these kinds of use cases to thrive, both buyers and sellers would need clarity around the regulatory treatment of the goods and services being purchased. For example, the sports team minting NFTs (and the marketplaces that sell them) would need to know the legal status of these assets, the creators of the digital world would need to know the kinds of disclosures they must provide to their subscribers, and consumers would need to know the potential tax implications of these purchases. Without clarity on these questions, buyers would not have a clear view of their risks and sellers wouldn't know if they are fulfilling their regulatory obligations. Such uncertainty may be tolerable where stakeholders have the hope of enormous speculative gains, but for more day-to-day digital commerce, regulatory clarity is a necessity.

SECTION 5: THE ROLE OF THE PUBLIC SECTOR

Mastercard is committed to supporting regulatory authorities in their ongoing efforts to deliver clarity around digital asset regulation and recognizes that this enormously complex task will not be accomplished overnight. Given that, we urge regulators to focus their attention on the following questions as a foundational starting point in this effort:

- What activities involving digital assets are permissible for banks to engage in?
- How will securities and commodities regulation apply to each type of digital asset and what would be the corresponding authorization and compliance requirements?
- What authorization regimes will apply to digital asset activities other than securities and commodities – for example, money transmission, e-money or payment institution regulations?
- What standards will apply to address operational risks and ensure the resiliency and reliability of blockchain transactions, such as management of cyber risk?
- How will data protection and privacy regulations apply to the novel technology, activities and business structures underlying digital assets?
- What disclosures and/or standards of transparency should be provided to end users looking to consume digital asset products?

Collaborating with the private sector on digital asset innovation

Establishing effective regulation and governance of emerging digital asset ecosystems demands the combined insights and capabilities of the public and private sectors. Mastercard is a firm proponent of public-private collaboration on this issue, with both working to find an appropriate balance between the risks and opportunities of innovative technologies and novel business models. Regulators can play an important role in encouraging responsible private sector innovation through regulatory sandboxes, safe harbors and risk management frameworks, as well as through direct public-private collaborations.

Mastercard is actively seeking opportunities to collaborate with leading central banks on testing key aspects of the MTN, with a particular focus on leveraging wholesale CBDCs (those designed to facilitate large-value interbank transfers) between participants in the network and unlocking the value of the MTN to consumers by supporting retail CBDCs.

06

Next steps

Mastercard is excited to work with a diverse and growing set of partners to accelerate the development of the Mastercard Multi-Token Network, along with the growth of digital asset ecosystems. To facilitate that collaboration, we will be releasing a beta version of MTN in select markets.

MTN beta will be the home for much of the on-going development features and industry collaboration across the four pillars and aims to bring the security of the Mastercard network to applications which have a need for blockchain-based payments.

MTN beta will enable:

- Banks and other token issuers to explore and interact with MTN capabilities being built
- Fintechs and application developers to work with our primitives and combine application logic to test new use cases that can be exposed to banks and other token issuers
- Both non-live proofs of concept and, at a future time, live pilots in close collaboration with local regulators

Our goal is to make promising use cases available broadly over time in collaboration with banks, governments and fintech partners.



For more information on Mastercard's digital asset products and services, visit our **website** and featured topic on the **Newsroom**.



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