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Project DAMA

Simplifying digital fund management and investment servicing

A report by

Deutsche Bank

MEMENTO BLOCKCHAIN

Project DAMA

The emergence of digital funds is an exciting prospect for the industry, but challenges – both in terms of launching a fund and accessing it by suitable investors – remain. Project DAMA – a MAS Financial Sector Technology Innovation Proof of Concept collaboration between Deutsche Bank and Memento Blockchain – is addressing the associated challenges.

By providing a one-stop digital fund investment servicing platform, asset managers and their existing transfer agents, fund administrators, and custodians can plug-in-and-play to significantly reduce the effort required to launch and administer digital funds. At the same time, Project DAMA aims to be an open architecture platform that can facilitate investors' access to different funds from different asset managers, as well as cater to different custodian participants and custody models.

Project DAMA proof of concept (POC) co-leads

Boon-Hiong Chan, Global Head, Fund Services, APAC Head, Securities Market Development & Technology Avocacy, Deutsche Bank Securities Services

Federico Cristina, Director and Co-Founder, Memento Blockchain

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Foreword

Project DAMA (Digital Assets Management Access) is a proof of concept (POC) developed by Memento Blockchain Pte Ltd and Deutsche Bank AG Singapore to demonstrate how a permissioned – or governed – investment servicing platform can facilitate the management of digital funds that are investing in digital assets (i.e., tokenised securities). Memento provided the technical and implementation expertise, Deutsche Bank shared functional requirements, and both parties collaborated together on the platform's design.

Digital investment funds (digital funds) are made up of digital assets and digital money – and enable qualified investors to manage their investments in a cheap, easy, and responsive way. This emerging asset management product is an exciting prospect – and is distinguished from traditional book entry funds by the new possibilities it brings, including distribution models, investor suitability tests, mass customisation features, transparency and investor record integrity. Tokenisation technologies, such as cryptographic private-public keys, can be combined with account-based book entries to optimise manufacturing and provide cost-effective last-mile delivery, with the user experience unaffected by the need to manage complex cryptographic keys.

In Singapore, interest in this area is rising, with SGX's MarketNode/ FundNode currently working on a permissioned fund network infrastructure for digitally native funds, and the Monetary Authority of Singapore (MAS) having worked on a POC for an tokenised Variable Capital Company (e-VCC). Hedge funds, wealth management and index funds are likely to be the first segments to adopt, which chimes with Singapore's leading position as a fund management hub.

As such, the POC Project DAMA aims to test and demonstrate the technical and commercial feasibility of some of these key innovative features, which can, in turn, lower the barrier of entry for asset managers looking to launch a digital fund. The infrastructure is designed to be a one-stop investment servicing platform that combines and adapts the core components of transfer agency, fund administration, custody and payments for the digital fund environment, while also allowing for a decentralised, open architecture that enables self-custody of assets.

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Launching and accessing digital funds

Today, asset managers looking to launch digital asset-type investment products will need to collaborate with multiple intermediaries and service providers, including transfer agents, fund administrators, and payments providers, before they can design and launch the fund – raising the barrier of entry.

The process for an investor looking to move from fiat currency to digital assets will similarly be intermediated by many different parties, which further raises the barrier for their participation.

With multiple parties involved in the chain, asset managers and institutional investors will need to think about the amount of due diligence, discussions and contracting needed, which also raises the operational complexity and barriers to launching and accessing digital funds.

At the same time, these intermediaries may not be ready – lacking the capabilities to intermediate flows into digital funds or service these funds and the tokenised assets they contain.

All told, this makes the process of launching or accessing these funds not only time-consuming, but costly and risky, which, outside of the most well-resourced players, would discourage the majority of asset managers and institutional investors from entering the market.

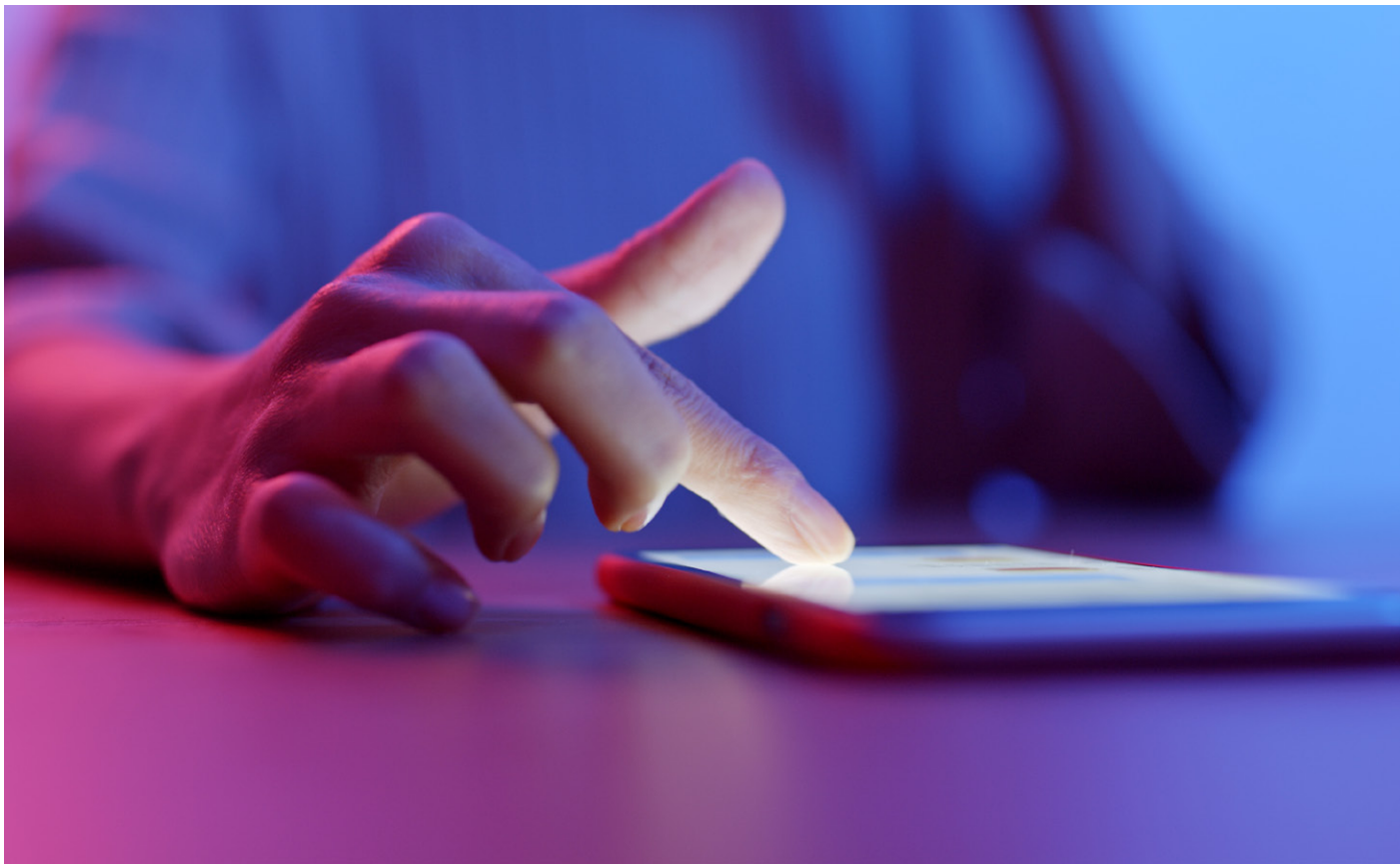
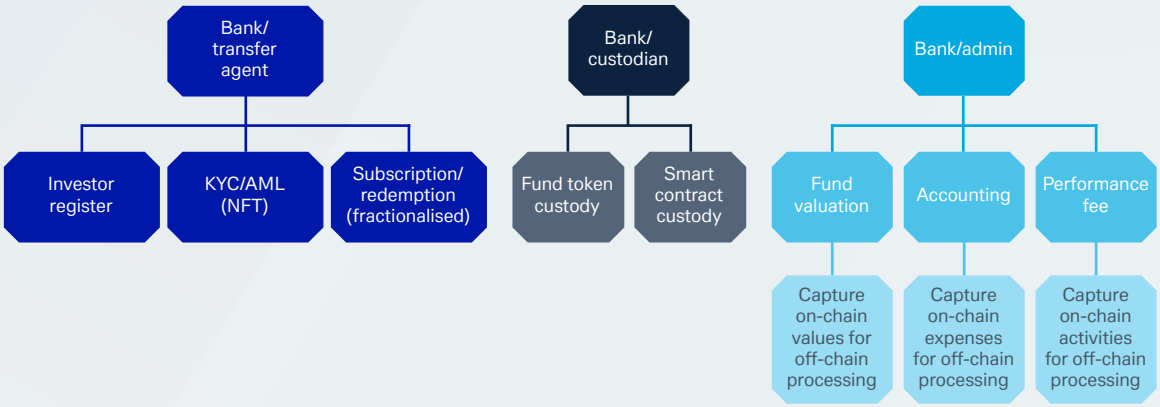


Figure 1: Multiple intermediaries to set up or facilitate access to a digital fund

Figure 1a: The need for multiple digital-ready intermediary activities to support a digital fund can deter adoption. For example:

Participant	Intermediary	Key activities provided
Investor	Fiat to digital cash intermediary	To change from fiat to digital cash To change from digital cash to digital assets (subscription in kind)
	Digital asset custodian	To safekeep and administer digital assets
Asset Manager	To tokenise fund (fund tokeniser)	To tokenise fund or issue digital native fund Smart contracts
	To distribute fund (distributor and transfer agent)	Manage digital fund distribution Manage investor onboarding and KYC Manage investor record keeping
	To administer fund	To value and account for fund; capture on-chain expense Performance fees calculations
	Reporting	Consolidate digital assets and traditional assets activities for client and regulatory reporting

Figure 1b: If key investment servicing areas can be combined on a single platform to extend the capabilities of traditional technologies to service digital funds, the barriers to adoption for asset managers and intermediaries can be reduced. The POC focused on the below areas:



Source: Deutsche Bank

Important questions remain

The transition from today's digital-based practices and towards tokenised funds and digital asset management represents a significant growth opportunity – but it is not without its risks. Several unknowns remain and each will need to be considered for the transition to be a success.

For example, some of the outstanding questions include:

—How can tokenised funds and the prospect of new distribution models engender cost-effective growth? – Can the viability of investor records on distributed ledger technology (DLT) reduce costs?
—Will there be significant new costs involved? For example, will investors (accredited or institutional) be exposed to the complexities of managing cryptographic-operated tokens?
—How will governance topics, such as know-your-customer (KYC), sanctions filtering, digital assets valuation and accounting, be managed?

2

Opportunities and addressable market

Digital assets can offer unique investment opportunities not available in traditional asset classes. This includes the ability to develop a wide range of digital asset funds, including:

— Funds that give regulated exposures to crypto assets/DeFi
— Tokenised securities, including assets from the growing private markets
— Structured digital asset products that include hedges, derivatives and environmentally-friendly components

The underlying DLT can be an efficient distribution platform, while smart contracts can offer new features to differentiate funds on a cost-effective basis. The digital asset market is also rapidly evolving and growing, with new technologies and innovations emerging all the time. This is creating opportunities for asset managers to stay ahead of the curve and offer clients access to cutting-edge investment products and strategies.

Project DAMA is looking to meet these opportunities head on by providing an infrastructure for professional digital-asset management services (in particular active portfolio management) to fund houses, wealth management banks and other types of asset managers.

2.1 Singapore: the perfect backdrop

Singapore as a fund management market bodes well for the POC's future commercial possibilities. Singapore is a globally leading asset management and domiciliation hub, with over SGD5.4trn of assets under management and over 1,100 registered and licensed fund managers.*1

Singapore's regulations are also constantly evolving to meet future financial innovations. For example, the Monetary Authority of Singapore's Financial Services Industry Transformation Map 2025 includes a focus on private markets, the fund industry and the exploration of the potential of a tokenised real economy – making Singapore the perfect environment in which to develop Project DAMA.

These facts form the outline of a huge total addressable market. While no formal survey is available to indicate the available or obtainable serviceable market size, we believe there will be a segment of early movers and digital evangelists who will be the POC's starting points towards commercialisation.

2.2 Wider appeal

As a potential asset class for digital funds, there is a total capitalisation of roughly US$850bn of crypto assets (as of December 2022). Most of these assets are held by first-mover crypto investors who want full control on their portfolios and assets – and who enjoy the process of managing, buying and dealing with blockchains. A main interest in the asset class would be from family offices and institutional investors. Other candidate asset classes are private assets/private market, digital fixed income instruments and tokenised/fractionalised public equities where regulations allow.

Based on Memento's market research and industry discussions, there is a growing group of institutional investors who want exposure to cryptographic assets in their portfolios, but they are held back by the complexity – with some reluctant to undergo and understand self-custody due to a lack of choice in licensed secure third-party digital assets custodians.

That is, however, not to say there is not strong interest in crypto assets as an asset class. In fact, there are emerging interests in the potentials of tokenised financial instruments and tokenised funds globally.*2

*1. Asset Management, MAS, https://www.mas.gov.sg/development/asset-management
*2. For example, Abrdn in further step to investment fund tokenization – Scottish Financial Review, Oct 2022

3

The focus of the POC

The POC tests the viability of the technology in providing key investment servicing activities on a single platform, which will be operated by a bank or transfer agent and utilised by asset managers – with investors and investors' banks as participants.

The key aims of Project DAMA included:
— Setup digital asset-based tokenised funds in an agile and cost-effective manner.
— Distribute digital assets funds with different investment strategies to accredited investors.
— Provide the data needed for regulatory reporting or risk management activities.
— Provide a digital fund investment servicing platform that serves as investor records.
— Facilitate efficient KYC, AML and sanctions filtering that can be based on digital identity.
— Test smart-contract based, modularised fund valuation, accounting and third-party custodian capabilities.
— Facilitate financial inclusion by distributing cost-effective tokenised funds over a wide geographic area.

4

Project DAMA: what we have accomplished

Project DAMA integrates with traditional investment servicing systems to enable digital asset and digital fund servicing using existing capabilities. The POC showcases the potential for a permissioned investment intermediation process for digital funds that provides institutional or accredited investors with access to this new emerging asset class.

The following features have been developed as part of the project:

4.1 Digital identity

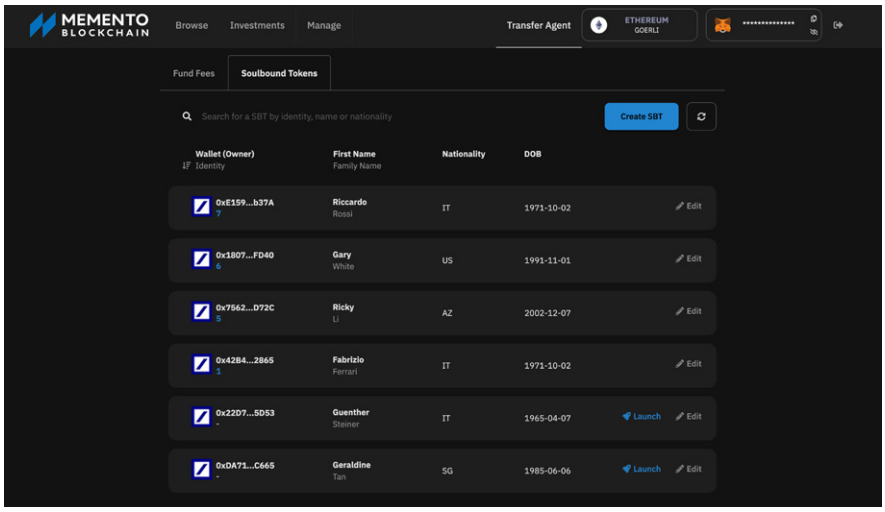
To enable digital identity on a decentralised finance (DeFi) investment platform that is built on Ethereum, we created a unique and non-transferable token that would represent the digital identity of a wallet owner (see Figure 2 and 3). This token is known as a Soulbound Token (SBT), which means that it is tied to a specific object – in this case a person represented by a wallet. Using the SBT, we can then verify the identity of the wallet owner and grant them access to different DeFi investment opportunities – without requiring them to provide personal information each time.

We implemented the SBT via an Ethereum Request for Comments (ERC) 721, a commonly accepted standard in the Ethereum ecosystem used for the creation of non-fungible tokens. By using this standard, each minted token is unique and non-interchangeable (not fungible). We then made further changes in the code to make our ERC-721 token non-transferable.

A trust anchor keeps the KYC checks and all accompanying documentation on an off-chain basis, which means that they are not stored on the blockchain itself. This allows us to maintain the privacy of the user's personal information, while still being able to verify their identity.

Additionally, the SBT can be used to restrict access to certain services or provide benefits to token holders. For example, it could be used to ensure that only token holders with a certain level of risk can trade the tokenised funds within their tolerance limit.

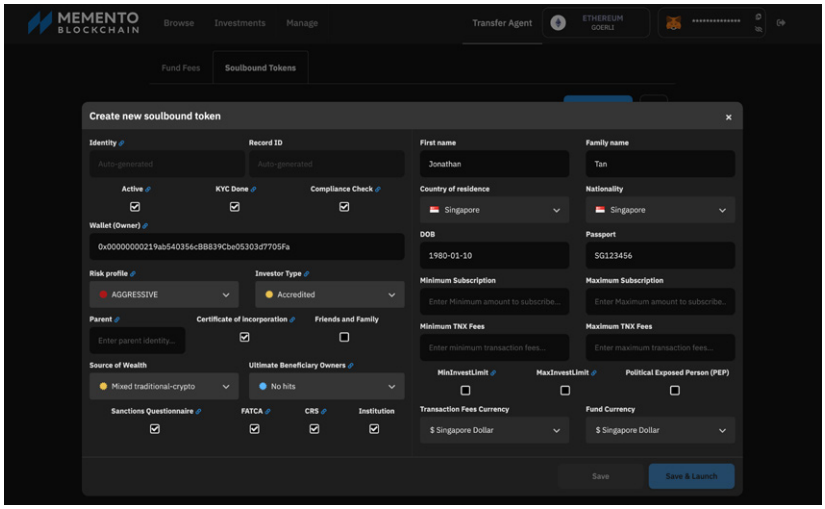
Figure 2: Soulbound token overview



See appendix for larger image

Source: Memento Blockchain

Figure 3: Soulbound token creation



See appendix for larger image

Source: Memento Blockchain

The role of the transfer agent

The transfer agent – in this case a bank – is responsible for managing the SBT and performing KYC checks on investors. This means that the bank will be responsible for minting and sending the SBT to the investor's wallet and maintaining the SBT's lifecycle. The bank will perform KYC checks on investors to ensure regulatory compliance, determine their investment risk profile and gather other relevant information. This token can only be recalled or modified by the transfer agent.

To mimic the distribution channels that a transfer agent would typically support, the POC has built a marketplace as a distribution point, which will generate relevant data captured by Project DAMA to facilitate offline transfer agency processing (e.g., rebate computation and distributor commission). The POC should also be able to facilitate typical transfer agency investor communication – with added possibilities to distribute programmable incentives to investors.

Once an investor holds an SBT from this transfer agent, they will be able to access funds from different asset managers based on a single KYC check. This means that the investor can use their SBT to access multiple investment opportunities without having to go through the KYC process again – making the process secure, compliant, and convenient for investors.

The new digital identity workflow

The traditional transfer agency model is a linear flow of value based on the fund, the fund's transfer agent, distributors and to the ultimate investors. An investor that subscribes to two asset managers serviced by the same transfer agent need to carry out the KYC process twice. With a digital identity token, there is potential to change this linear value:

A) A digital identity token that is operated by the transfer agent means that the KYC check of an investor, which has already performed for "fund manager A", can be reused for funds managed by "fund manager B" – provided they are serviced by the same transfer agent (as the transfer agent is the trust anchor of the Digital Identity token, since they perform the investor KYC).

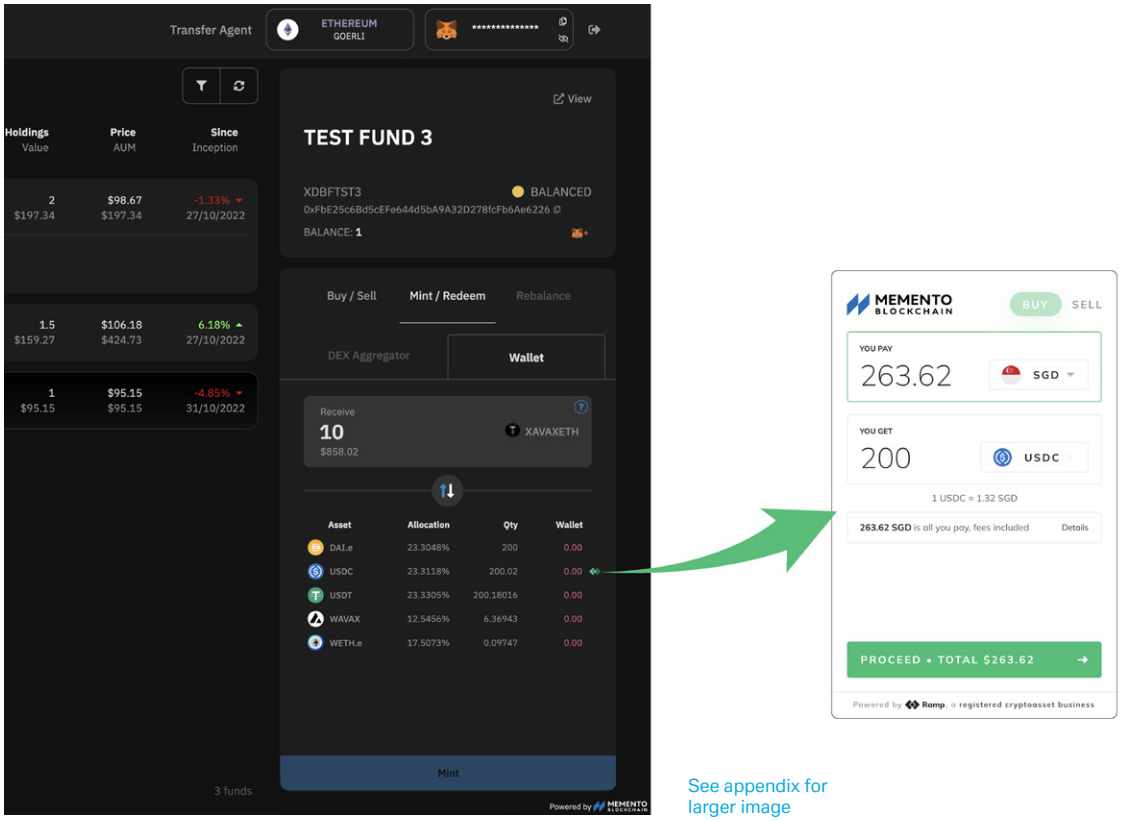
B) This means that at the minimum, this investor can seamlessly access funds by different fund managers serviced by the same transfer agent.

C) This characteristic creates a "multi-sided" platform business model that a transfer agent can offer to asset managers, with the managers on one side of the platform, investors on the other, and the platform as a distributor for various custodians to plug into. This can facilitate a network aggregation effect to facilitate the adoption of digital funds.

4.2 The on-ramp solution

We have partnered with a third-party payment provider to enable the conversion of fiat money to digital currency. This feature would allow the user to use a bank transfer to convert fiat into digital currency (see Figure 4).

Figure 4: On ramp solution converting fiat to digital



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Source: Memento Blockchain

4.3 Interaction with the decentralised application (Dapp)

To keep digital assets safe, Project DAMA used Metamask – the cryptocurrency wallet – to connect both centralised and decentralised digital asset custody wallets to the decentralised application (Dapp).*[3] Metamask is plugged into the platform as the custody component to accept and send digital assets, fund tokens and digital cash – with the blockchain on which these assets sit acting as the investors' record of ownership.*[4] During the connection, the Dapp will check if the wallet contains the SBT and if the KYC status is "passed." If both checks return positive, the wallet will be able to interact with the digital asset management infrastructure.

Project DAMA also demonstrates the possibilities to integrate with multiple custody wallets in order to effectively function as an open architecture for custody.

*3. While the POC took the option of highlighting investors' management of private-public key via self-hosted wallets, this is not necessary as long as the investors' intermediaries (custodians) would have the capabilities to (i) safekeep the funds token and assets, and (b) operate the related cryptographic keys on their behalf.

*4. An internal legal review by a Memento legal advisor opined that there is legal precedence in Singapore for public blockchains to be recognised as evidencable investor records.

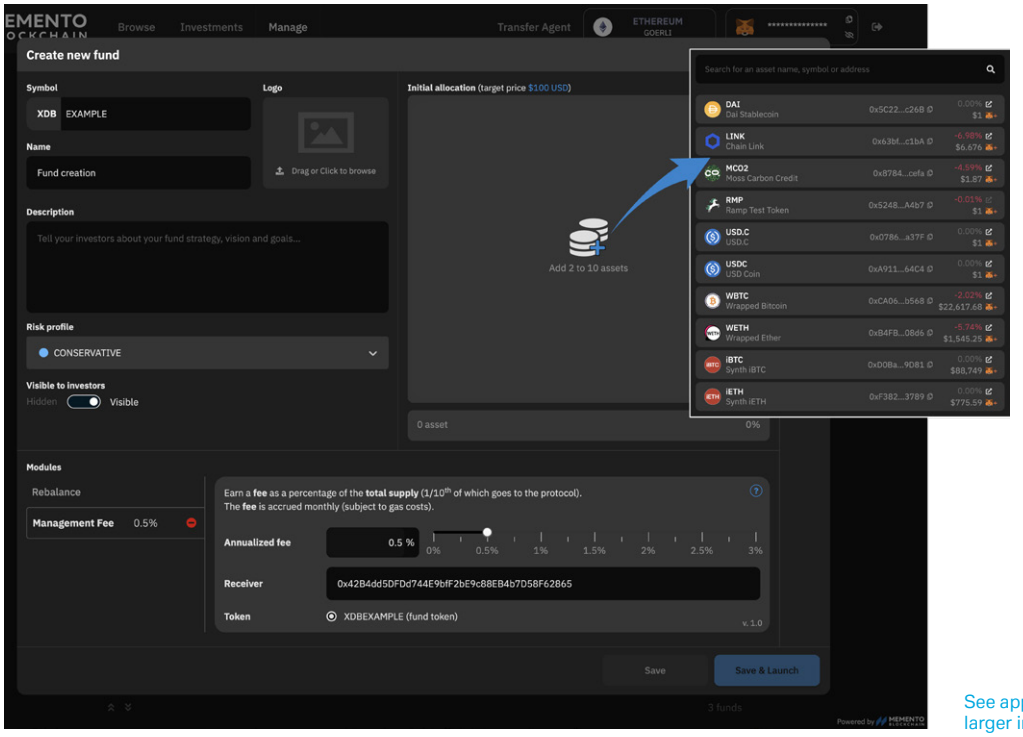
Key definitions

—A digital wallet is a software program or service that allows an individual to store, send, and receive digital assets such as cryptocurrencies or tokenised assets. The digital wallet where the SBT is deposited can be either decentralised or centralised.
—A decentralised digital wallet, also known as a hot or cold wallet, is one that is not controlled by a central authority. Instead, it is owned and controlled directly by the user. Hot wallets are online wallets that are connected to the internet and are therefore more vulnerable to hacking attacks. Cold wallets, on the other hand, are offline wallets that are not connected to the internet and are therefore considered more secure.
—A centralised digital wallet is owned and controlled by a third party, such as a financial institution or a cryptocurrency exchange. These types of wallets are often more secure because they have multiple layers of protection in place, such as insurance and security protocols. However, they also come with the risk of being hacked or the provider going out of business, leading to the loss of the user's digital assets.

4.4 The fund creation

Before an investor can access the list of investment strategies represented by the tokenised funds, the fund manager must create and launch a fund (see Figure 5). This can be done through a one-window wizard, where the fund manager can:
— Define the fund investment strategy
— Select the underlying assets and weighting
— Define the risk rating
— Define if the fund active/passive (rebalancing enabled/disabled)
— Define the fund management fees

Figure 5: Creation of a digital fund (portfolio manager view)



See appendix for larger image

Source: Memento Blockchain

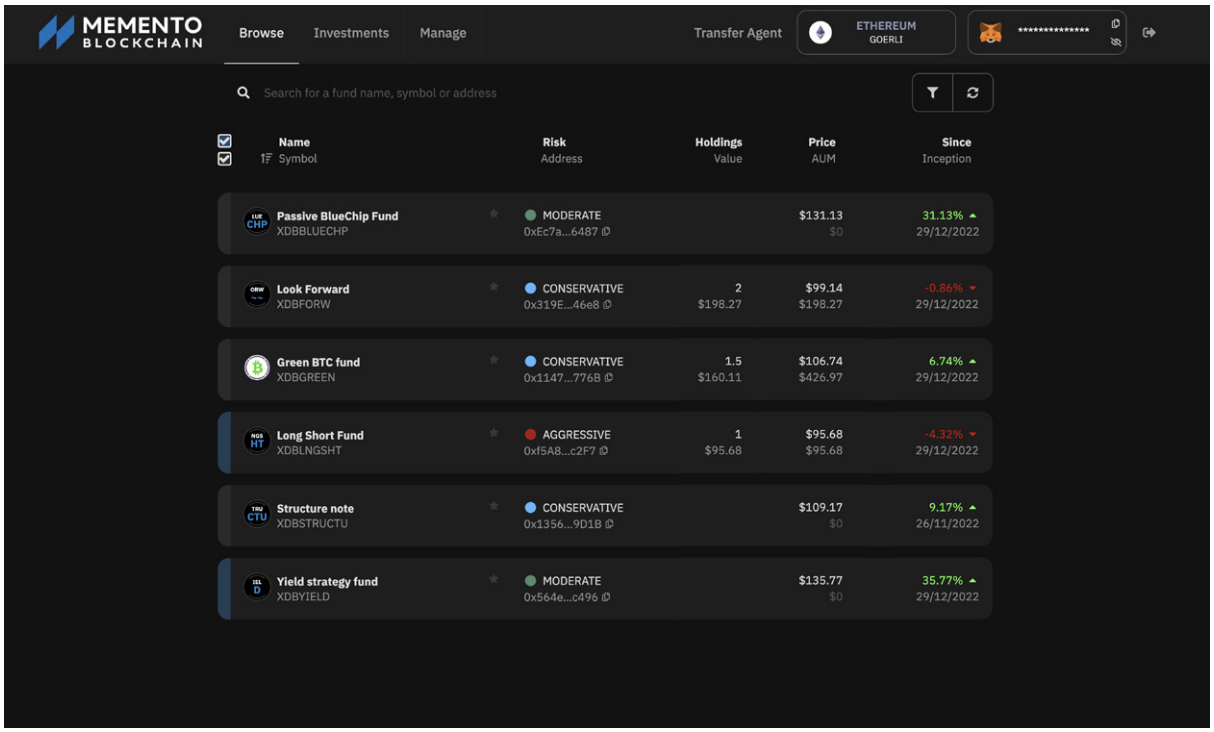
4.5 Fund strategies

Fund tokens are a bearer instrument with monetary value and represent claims on the underlying assets. Instead of redeeming a fund unit with the asset manager, a fund token can be traded in the secondary market and be transferred on a peer-to-peer (P2P) basis to another suitably qualified investor on the same platform.

The POC has used crypto assets as a proxy for tokenised assets, as well as its own asset class. Based on crypto assets, the team have also created digital funds on the Ethereum testnet with five different investment strategies:

- Passive weighted cap blue chip index-type fund. This strategy involves creating a fund that is passively managed and weighted based on the market capitalisation of the underlying assets, which in this case would be blue chip cryptocurrencies. The fund could also generate additional yield for investors by "lending" the underlying cryptocurrencies.
- Portfolio of long-short crypto. This strategy involves constructing a portfolio of both long and short positions in cryptocurrencies, with the goal of generating returns through both positive and negative price movements.
- "Green" Bitcoin fund. This strategy involves creating a fund that invests in Bitcoin and focuses on environmentally responsible practices, such as investing in renewable energy or offsetting carbon emissions.
- Yield portfolio. This strategy involves constructing a portfolio of assets that generate regular income, such as through staking or borrowing in the DeFi space. The goal of this portfolio would be to provide investors with a steady stream of income combined with capital growth.
- Structured note with crypto derivatives. This strategy involves creating a structured financial product, such as a note or bond, that is backed by cryptocurrency derivatives. The goal of this product would be to provide investors with some degree of capital protection while also generating return through the use of derivatives.

Figure 6: Landing page



Source: Memento Blockchain

See appendix for larger image

Future potential

While the funds provide a holistic context to the POC, the key purpose of these five fund strategies are to further identify the lifecycle activities and fund accounting/valuation requirements that are outside the scope of the POC.

As the POC is technology focused, it does not make explicit differences between a digitally native fund and a tokenised fund that is based on an existing traditional fund. Digital asset investment strategies, digital assets, digital asset valuation, accounting and/or custody-asset safety topics are also outside of the scope of the POC.

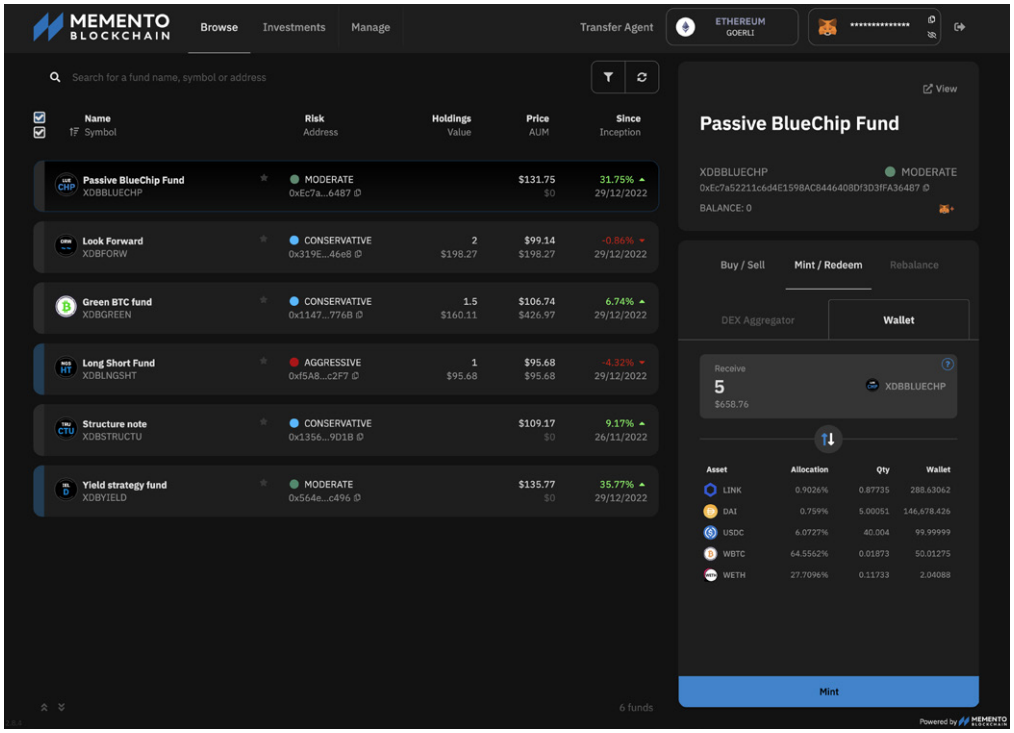
4.6 Fund subscription

There are four different ways to subscribe to a fund through Project DAMA:

Subscription through direct minting

This subscription method involves the user providing the required collaterals in the form of tokens to mint the tokenised fund (see Figure 7). Minting is a way to create new tokens, which can then be traded or used as a form of investment. This process incurs a minting fee, which the asset manager or fund manager charges to cover the cost of minting the tokens.

Figure 7: Subscription through direct minting



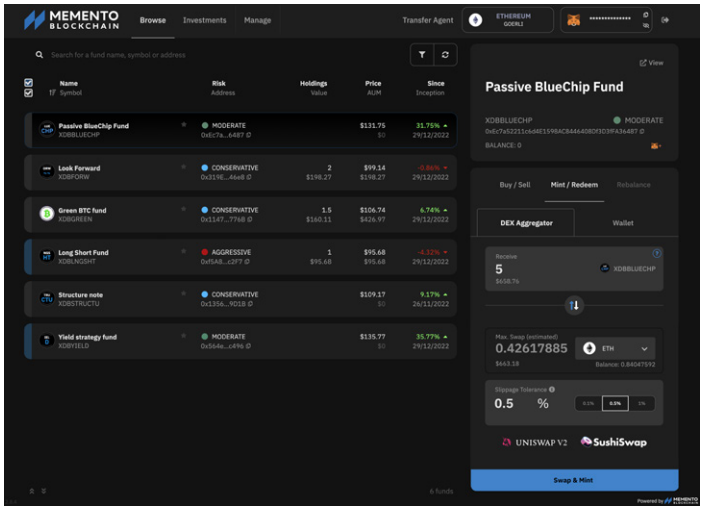
See appendix for larger image

Source: Memento Blockchain

Subscription through CombSwap

This subscription method has been built for the POC and enables the investor to use a digital asset of choice to swap for all the underlying assets in a single transaction at the best prevailing market rates (see Figure 8).

Figure 8: Subscription through decentralised exchange (DEX) aggregator



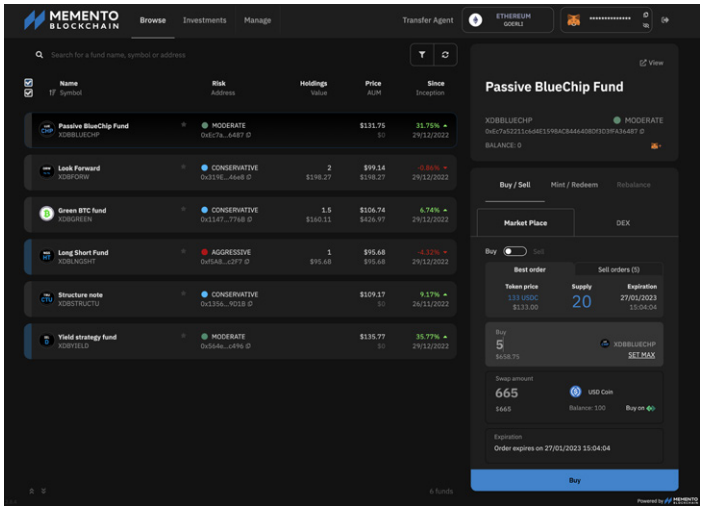
See appendix for larger image

Source: Memento Blockchain

Subscription through the marketplace

This subscription method has been built for the POC and involves using an in-built exchange to atomically swap the tokenised fund for a stablecoin or another digital asset. This means that the user can exchange their stablecoin or other digital asset for the tokenised fund without the need for a third party to hold the assets or facilitate the exchange. This can be a convenient and efficient way to subscribe to the fund.

Figure 9: Subscription through the marketplace



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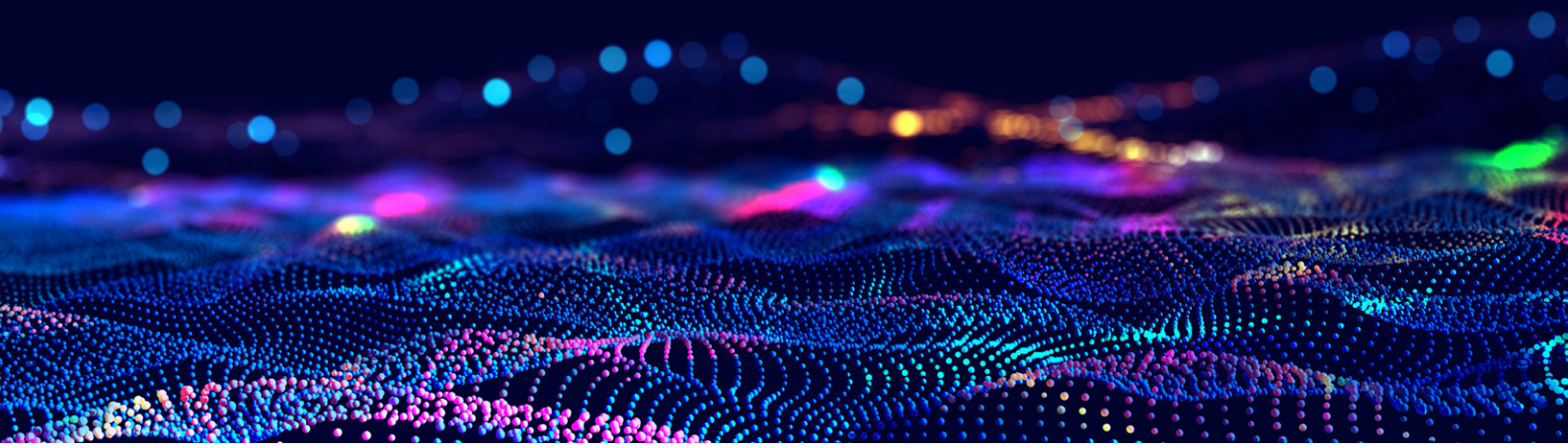
Source: Memento Blockchain



Subscription through a decentralised exchange

This subscription method involves purchasing the tokenised fund from a decentralised exchange (DEX). For this to be possible, someone must first create a liquidity pool with the tokenised fund on the DEX. This involves depositing a certain amount of the tokenised fund into the DEX, which can then be traded by other users. This subscription method allows users to access the tokenised fund through a decentralised platform, without the need for a centralised exchange or intermediary.

4.6.1 Subscription fees

The fees for subscribing to the tokenised fund can be charged to the user in different ways depending on the subscription method. The specific fee charging method will depend on the terms and conditions of the tokenised fund and the preferences of the asset manager or fund manager.

For subscriptions through the marketplace, the fees may be incorporated into the price of the tokenised fund. These fees may include the minting fee and any other fees involved, such as transfer agent fee.

For subscriptions by direct minting, the fees can be charged directly to the user as a separate fee during the subscription.

While on-chain fees are calculated on the spot once the transaction is submitted to the blockchain, for the purpose of this POC, the remaining fees are calculated off-chain once daily.

4.7 Mass customisation

Mass customisation is a concept that allows investors to tailor their investment portfolios to their specific needs and preferences. This can be achieved through a process that involves the fund manager preparing a rebalancing proposal, signing a transaction to create a rebalanced version of the fund, and allowing investors to opt out of the rebalancing process if they choose to do so.

With mass customisation, investors can maintain their original investment strategy when opting out of rebalancing their portfolio. This allows investors to retain control over the allocation of their assets and the weightings of individual investments within their portfolio.

Rebalancing is the process of adjusting the allocation of assets in a portfolio to maintain the desired level of risk and return. For example, if an investor's portfolio includes stocks, bonds, and cash, and the value of the stocks in the portfolio increases relative to the bonds and cash, the investor may want to rebalance their portfolio by selling some of the stocks and buying more bonds and cash. This helps to maintain the desired level of diversification and minimises the risks associated with having too much of one type of asset.

If an investor opts out of the rebalancing process, there will be a redemption from the original fund and minting of the new fund with the original allocation. This means that the investor will be able to maintain their original investment strategy, rather than being forced to accept the rebalanced version of the fund. The investor will be responsible for paying the associated fees for the redemption and minting transactions.

The ability to customise their investment portfolios can be particularly useful for investors who want to adjust the weightings of their portfolio without changing the overall allocation. For example, an investor who is satisfied with the overall allocation of their portfolio, but wants to increase their exposure to a particular asset class, can do so through mass customisation.

In addition to providing investors with greater flexibility and control over their investment portfolios, mass customisation can also help asset managers to attract and retain customers. By offering a more personalised and tailored investment experience, asset managers can differentiate themselves from their competitors and offer a unique value proposition to their clients. Use cases include:
— Segment the investor base according to its characteristics for targeted marketing.
— Offer cost-effective, tagged-on features to a base investment product. For example, different features to a common underlying tokenised product to fit different investors' preferences.

Portfolio asset rebalancing workflow

A) The asset manager proposes a portfolio asset rebalancing.

B) Investors can either chose to retain the original portfolio allocation or to vote for their portfolio to be rebalanced.

C) Investors who voted for the new allocation strategy will transition to the new portfolio – with the associated costs – while investors who voted to remain with the original allocation will not be charged with the rebalancing expenses.

D) The respective fund token held by the investors will reflect the different valuation

4.8 Fees analysis

Project DAMA aims to build the process and understand the future roles and the revenue of a bank operating in the digital fund management industry.

The POC focused on two functionalities, which would be customised for each fund that is distributed:
— Capturing relevant digital fund's expenses like the Gas Fee – a transaction fee specific to the Ethereum blockchain network.
— Managing fees as inputs for the fund's accounting and valuation.

As such, the POC includes a programme to calculate the on-chain and off-chain fees charged in the life cycle of the digital fund.

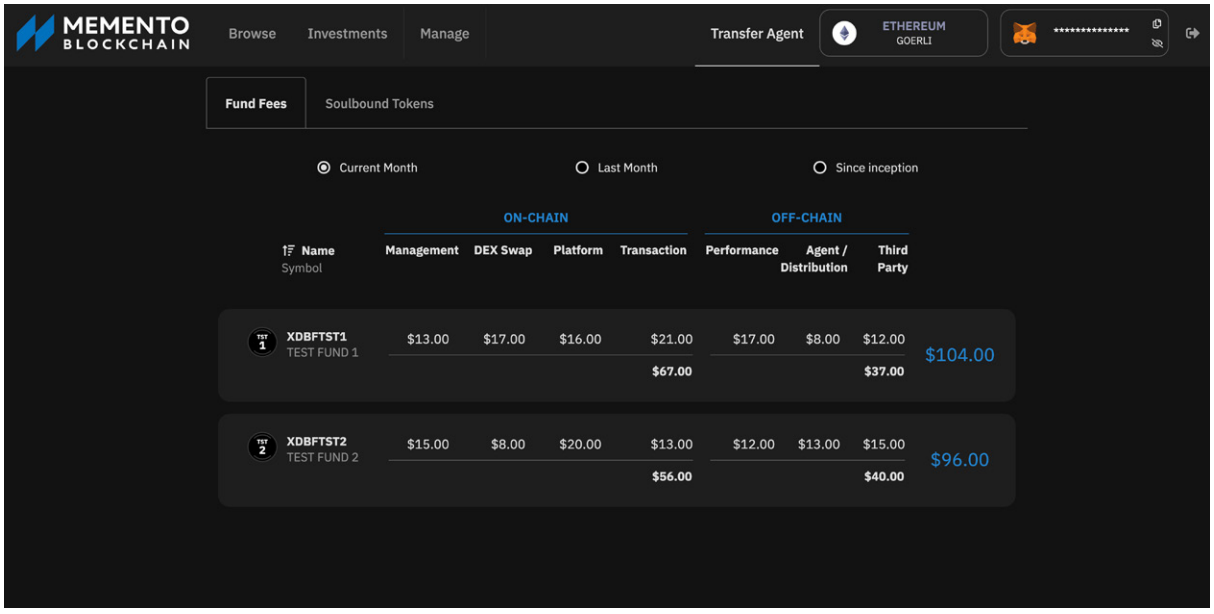
4.8.1 On-chain

— Management fees. This fee is levied by the asset manager or fund manager for providing investment management services. In the case of tokenised funds, these fees are charged on-chain, which means that they are recorded on the blockchain and paid in a form of cryptocurrency.
— CombSwap Fees. This fee is levied by the Domani Protocol that provide this service.
— Platform fees. These fees are related to the usage of the platform and are applied on all value transactions. Those are mint, redemption, rebalancing and buy and sell tokenised funds through the marketplace.
— Transaction gas fees. Transaction gas fees are levied by the blockchain network for processing transactions. In the case of tokenised funds, these fees may be incurred when launching, rebalancing, or otherwise managing the fund. These fees are typically paid in the form of a cryptocurrency that is supported by the blockchain network, such as Ether for the Ethereum network.

4.8.2 Off-chain

— Performance fees. These fees are levied by the asset manager or fund manager based on the fund's performance. These fees are typically charged as a percentage of the fund's net returns and are designed to incentivise the manager to deliver a strong performance. In the case of tokenised funds, performance fees may be charged off-chain, which means that they are not recorded on the blockchain but are instead paid in fiat currency or another form of cryptocurrency.
— Transfer agent fees and distribution fees. Transfer agent fees and distribution fees are levied by intermediaries who provide services related to the distribution and management of tokenised funds. These fees may be charged for tasks such as maintaining the register of fund holders, processing subscriptions and redemptions, and distributing income and other payments to investors. In the case of tokenised funds, these fees may be charged off-chain and paid in fiat currency or another form of cryptocurrency.
— Third-party fees. Third-party fees are charges levied by other service providers involved in the management or distribution of tokenised funds. This may include fees for services such as fiat/digital on-ramps, which allow investors to convert between fiat currencies and cryptocurrencies. In the case of tokenised funds, these fees may be charged off-chain and paid in fiat currency or another form of cryptocurrency.

Figure 10. Fees analysis overview



Source: Memento Blockchain

4.9 One-stop investment servicing capabilities

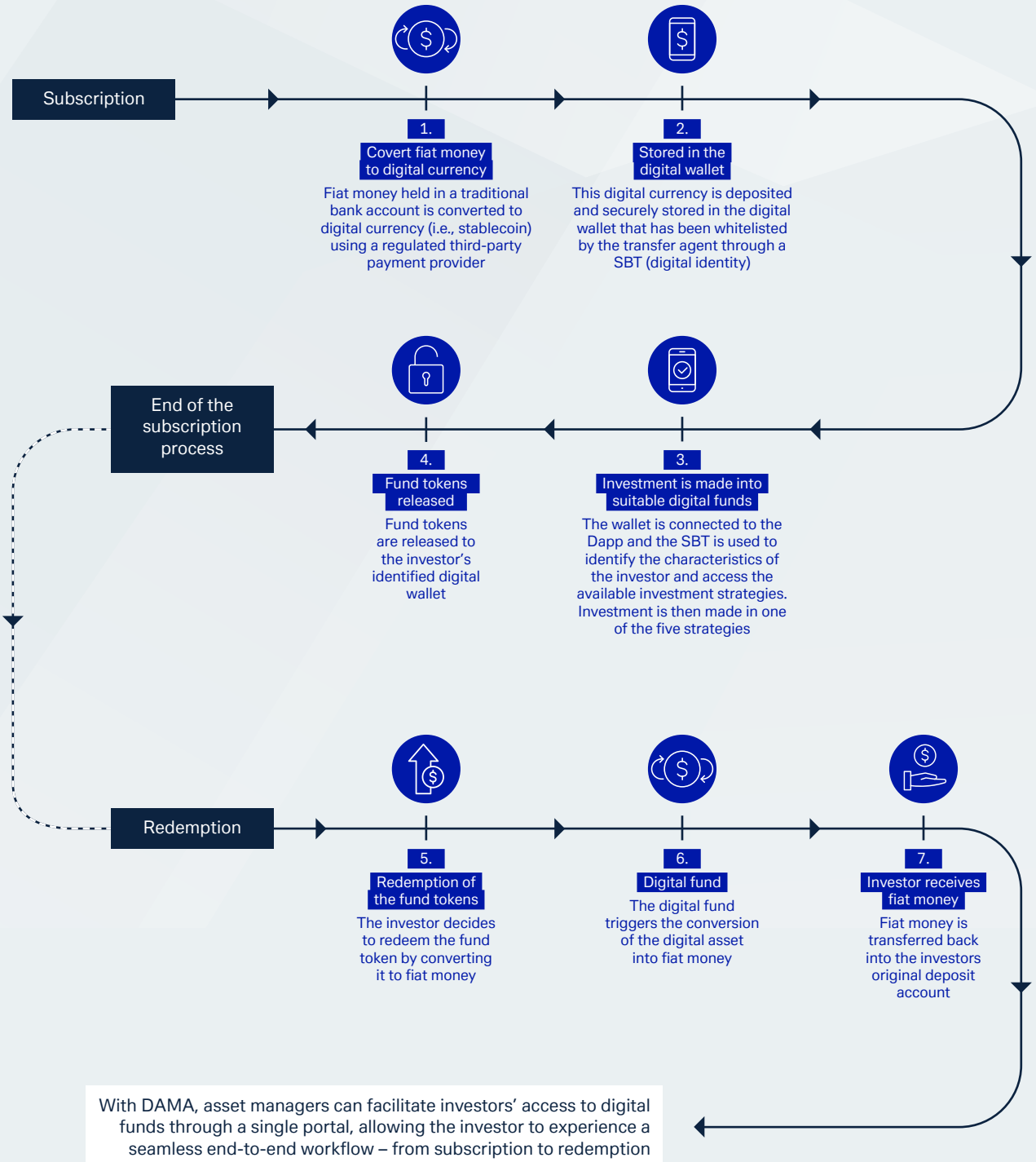
Asset managers are the envisaged buyers of DAMA services to help create new product developments and improve their time-to-market. If asset managers have outsourced their transfer agency and fund administration to third parties, then the envisaged users would change to become these third parties.

In addition to the investment servicing capabilities, the POC has included a marketplace, with Memento's digital fund formation and creation capability. Asset managers will buy the marketplace and the fund formation/creation capability. A transfer agent could operate the marketplace, while the digital cash representation used in the marketplace to facilitate subscription/redemption/trading of funds token could be operated by a main custodian appointed to the marketplace.

5

Project DAMA: the workflow

The workflow we have designed is a streamlined and secure process for converting fiat money to a digital currency – such as a stablecoin – and investing in one of several predetermined strategies through the use of a decentralised application (Dapp):



With DAMA, asset managers can facilitate investors' access to digital funds through a single portal, allowing the investor to experience a seamless end-to-end workflow – from subscription to redemption

6

Regulatory considerations

Digital funds

The POC leveraged the Project e-VCC report – part of the MAS Financial Sector Technology and Innovation (FSTI) POC scheme – that examined the legal and practical feasibility of tokenising a Singapore Variable Capital Company (VCC) structure using blockchain. The e-VCC project concluded that there is nothing explicit in Singapore's existing laws that prohibit the issuance of blockchain-native securities, although stamp duty was identified as a hurdle to secondary market activities of e-VCC shares.

Fractionalised digital bonds

The POC uses the completion of fractionalised blockchain-based bonds between BondEvalue and Northern Trust, and BondEvalue and Citi Securities Services, as evidence that tokenisation and fractionalisation of digital bonds with traditional underlying issuance are permissible under Singapore laws and regulations. The POC also refers to another MAS FSTI POC – known as Project Benja – that investigated the feasibility of issuing an over the counter (OTC) digital native bond in Singapore.

Fractionalised digital private market assets

The POC refers to the ADDX.com website, which offers fractionalised access to private market assets, as evidence that fractions in digitalised private market assets is possible in Singapore.

Fractionalised digital listed equities

Fractionalised digital listed equities offer a new way for investors to access and invest in traditional listed equities such as stocks and bonds. By allowing investors to purchase fractions of these assets rather than requiring them to buy a whole unit, fractionalised digital listed equities can make it easier and more affordable for individual investors to diversify their portfolios and access a wider range of investment opportunities.

Crypto assets and stablecoin

Crypto assets such as Bitcoin, Ethereum and StraitsX (SGD stablecoin) are other possible assets of a digital fund. The activities and access to such assets and to stablecoins in Singapore are clearly regulated.

Blockchain as a source of investor ownership record

Blockchain technology can be used to track and record the ownership of fractionalised digital listed equities by individual investors, creating a secure and transparent record that is resistant to tampering. Using blockchain as a source of investor ownership record can reduce the risk of errors in the record-keeping process and increase the speed and efficiency of transactions. The use of blockchain can help to improve the transparency and integrity of the market for fractionalised digital listed equities and protect the interests of investors.

An internal legal memo from Memento's legal adviser stated (see Appendix 1):

"…It is hereby submitted that the proposed Proof of Concept ("POC") will create a "Fund Token" which will be tagged to a public address. The Fund Token will be operated using private-public key cryptography, and the ownership record of the Fund Token will be based on the blockchain. It is submitted that such a record is a viable legal evidence of ownership of the Fund Token. Therefore, it is submitted that the Fund Token, whose ownership is recorded on the public chain, can serve as evidence of ownership by an investor who has control over the public address of the Fund Token. Furthermore, the Fund Token will be likely capable of giving rise to proprietary rights and that such rights can be protected by remedies normally available to enforce proprietary rights. This will further establish the position of Singapore law that the tokens and their records on the blockchain will give rise to proprietary rights that can be enjoyed by the owners of those tokens."

7

Project DAMA: the key findings

The key findings of PROJECT DAMA include:

1. Single platform. Technologically, it is feasible to aggregate key investment servicing activities onto a single platform that can significantly reduce the due diligence effort by asset managers seeking to launch digital funds, and for traditional intermediaries to participate in digital funds. This can immediately bring down the barriers to entry and foster adoption.

2. Digital identity. One of the key learnings from the POC is the importance of digital identity technology in enabling a compliant and efficient investment process. By using digital identity solutions such as the SoulBound Token, asset managers and their transfer agents can perform KYC checks and sanctions filtering without the need for a proliferation of private or personal data. This technology can help asset managers to comply with relevant regulations and ensure that only suitability-tested investors or legal entities are able to invest in digital funds.

3. Blockchain as a source of investor record. With near-instant API between the blockchain records and "traditional" records maintained by a transfer agent, which are presently recognised by regulations and laws, the legality and integrity of investor records are maintained. This adds to investor protection and reduces the barrier to adoption by investors.

4. Fund tokens. Instead of just redemption, fund tokens can be traded peer-to-peer. Funds tokens represent a claim to the underlying digital assets. Fund tokens issued by the asset manager, recorded by the transfer agent based on blockchain records and can be safe kept by custodian.

5. Fund administration. On-chain data like expenses that will be accrued to a fund's expense ratio can be efficiently captured by smart contracts. This facilitates valuation and accounting functions are performed off-chain.

6. Fiat-digital cash leg on-ramp. The digital identity should facilitate access to the fiat-digital on-off ramp, reducing significant frictions in trading the fund tokens into more liquid tokens then fiat. Investing in fund tokens should be a seamless experience once the investor is in possession of the SBT, which is only obtained once they have passed all necessary KYC.

7. New innovations. "Mass customisation", decentralised self-hosted custody, open-architecture custody, open-market rebalancing, personalised experience through digital identity.

8. No disintermediation of traditional roles. Transfer agent as a trust anchor of digital identity tokens; Custodians to operate mass customisation activities akin to existing asset servicing activities; Custodian to operate the digital cash representation in a digital fund marketplace; DAMA platform offered by fund services provider to asset managers.

Appendix

LEGAL MEMORANDUM-2 – DECEMBER 2022

1. This is an internal legal memorandum (the "Memo") prepared by Memento Blockchain Pte. Ltd. (UEN: 201734451C; "the Company"). The Memo is strictly private and confidential to the Company and any entity with whom the Company may share the Memo. This Memo has been issued by the Legal Department of the Company and may not be copied, published, displayed, disclosed, reproduced or redistributed in any manner to any person whatsoever without the prior expressed consent in writing of the Company.

2. The Company is concerned on whether its investors' funds or any records of token 'ownership' (in layman terms) that are maintained on blockchain may be recognised as an official source of legal ownership. In legal terms, to establish ownership over an asset, that assets must conform to certain characteristics which grant proprietary rights to its holder.

3. The locus classicus on determining the characteristics of a property right is the case of National Provincial Bank Ltd v Ainsworth [1965] AC 1175 ("Ainsworth") at 1248, providing that a right, in order to be a proprietary right, *"must be definable, identifiable by third parties, capable in its nature of assumption by third parties, and have some degree of permanence or stability."*

4. This was followed by the UK Jurisdiction Taskforce ("UKJT") in its "Legal Statement on Cryptoassets and Smart Contracts" (November 2019), where it considered the question of whether English law would treat a particular 'cryptoasset' as property. The UKJT stated (at para 85) that 'cryptoassets' have all the characteristics of property, and that their novel or distinctive features do not disqualify them from being property. 'Cryptoassets' are not disqualified from being property simply because they may not be classifiable either as things in possession or as things in action. 'Cryptoassets' could be therefore treated in principle as property.

5. According to the most recent developments in the courts of Singapore as well, the answer to query of this Memo should be in the affirmative. In CLM v CLN and others [2022] SGHC 46 ("CLM"), the court awarded a proprietary injunction to the plaintiffs, a remedy that can be granted only if it is established that the party pleading for it has suffered a detriment to a proprietary interest. In CLM, where Bitcoin and Ethereum tokens were misappropriated from the plaintiff, the Singapore High Court had to grapple firstly with the issue of whether cryptocurrency is property.

6. Various prior cases already ventured with the proposition that cryptocurrency gives rise to proprietary interests. In B2C2 Ltd v Quoine Pte Ltd [2019] 4 SLR 17, the Singapore Court of Appeal, the apex tribunal in Singapore, reasoned that cryptocurrencies do meet the four requirements set out in Ainsworth and *"have the fundamental characteristic of intangible property as being an identifiable thing of value"* (at [142]). Further, as this decision found that it is possible for cryptocurrencies to be held on trust, cryptocurrencies seem to have elements akin to proprietary interests. However, the court in that case, while satisfied that cryptocurrencies could be created as property in a generic sense, did not pronounce itself on the question of what the precise nature of such property right was.

7. The approach is confirmed by academic commentators. In Kelvin F K Low and Ernie G S Teo, "Bitcoins and other cryptocurrencies as property?" (2017) 9(2) *Law, Innovation and Technology* 235, the authors posited on what is the nature of the proprietary right arising from holding cryptocurrencies. When investors hold funds in an exchange or other third-party wallet, for example, the nature of the relationship between such an exchange (or third-party wallet or facility) and its users is custodial in nature or it can be more akin to a bank account. The authors argued that such distinction can have dramatic consequences for end users. As a lawyer interviewed by the Financial Times explained in the aftermath of the popular exchange Bitfinex being hacked, *"[w]ith Bitfinex, user wallets were segregated. As a result, the relationship was seemingly more custodial in nature. In other words, the hack resulted in the theft of users' property". Conversely, "in the bank account situation, losses are necessarily socialised whereas socialising deposit box losses would be theft".*

A custodial relationship is more likely to involve a trust given that cryptocurrencies are incorporeal. If an exchange (or third-party wallet or facility) holds cryptocurrencies on trust, then any stolen cryptocurrencies would belong to the users whose wallets were hacked. The exchange (or third-party wallet or facility) would not ordinarily be liable to such users unless they were negligent but even if they were, they would not be able to use cryptocurrencies from other users' wallets to reimburse users whose wallets were hacked as this would entail a breach of trust to those other users whose wallets were not hacked. If, however, the relationship merely entails a personal obligation to transfer a specified amount of cryptocurrency on demand, akin to a bank account, then any cryptocurrencies stolen were stolen from the exchange and not its users. The exchange (or third-party wallet or facility) would remain liable to its users to the full extent of its obligations although if it were insolvent, then losses would be shared among users *pari passu*. In other words, the losses would be socialised. This discussion highlights that while the nature of the relationship between a third-party service holding cryptocurrencies on behalf of its users or investors is unclear, property rights over cryptocurrencies may represent a novel form of property altogether, where the legal right is inseparable from its registration, in this case on the blockchain.

8. In the Commonwealth, court decisions have implicitly accepted that cryptocurrency may be regarded as property, although no court has attempted to identify the precise nature of the property right before, if any. In *Elena Vorotyntseva v Money-4 Limited and others* [2018] EWHC 2596 (Ch), similar to CLM, the English High Court issued a proprietary injunction preventing the removal of specific ETH and BTC holdings. In coming to his decision, the judge there observed that there had been no suggestion that cryptocurrencies could not be a form of property.

9. *In Copytrack Pte Ltd v Wall* [2018] BCSC 1709, the Supreme Court of British Columbia in Canada ordered that about CAD 400,000 worth of Ethereum be traced, suggesting that Ethereum was recognised as a species of property susceptible to tracing.

10. Finally and most importantly, in *Ruscoe v Cryptopia Ltd (in liq.)* [2020] 2 NZLR 809 ("Ruscoe"), the High Court of New Zealand held at [120] that cryptocurrencies do meet the standard criteria / four requirements set out by Lord Wilberforce in Ainsworth to be considered a species of property. Cryptocurrencies are a type of intangible property as a result of the combination of three interdependent features. They obtain their definition as a result of the public key recording the unit of currency; the control and stability, necessary to ownership and for creating a market in the tokens, are provided by a private key attached to a corresponding public key, and the generation of a fresh private key upon a transfer of the relevant coin. In detail, the application of the characteristics of blockchain to the requirements in Ainsworth are as follows:-

a. The first requirement is that the right must be "definable". To this end, cryptocurrencies are computer-readable strings of characters which are recorded on networks of computers established for the purpose of recording those strings and are sufficiently distinct to be capable of then being allocated to an account holder on that particular network (see Ruscoe at [105]).

b. The second requirement is that the right must be "identifiable by third parties". The important indicator is whether the owner has the power to exclude others from using or benefiting from the asset (Ruscoe at [110]). Excludability is achieved in respect of cryptocurrencies by the computer software allocating the owner with a private key, which is required to record a transfer of the cryptocurrency from one account to another (see Ruscoe at [112]).

c. The third requirement is that the right must be "capable of assumption by third parties". As cryptocurrencies are the subject of active trading, this characteristic is definitely applicable to cryptocurrencies as well (see Ruscoe at [116]).

d. The fourth requirement is that the right and the asset must have "some degree of permanence or stability". In this respect, the blockchain technology provides stability to cryptocurrencies, and a particular cryptocurrency token stays fully recognised, in existence, and stable unless and until it is spent through the use of the private key, which may never happen (see Ruscoe at [118]).

11. As CLM fully adopted the positions set out in the cases referred to above, it is likely that subsequent court decisions will maintain this approach in determining whether cryptocurrencies are to be considered 'property' in Singapore for the time being. Further, as the cryptocurrency assets in CLM were capable of giving rise to proprietary rights which could be protected by remedies normally available to enforce proprietary rights, it is established that the position of Singapore law is that tokens and their records on a blockchain will give rise to proprietary rights which can be enjoyed by the owners of those tokens.

12. In the light of the discussion and materials referred to above, it is submitted that in Singapore as well as most jurisdictions of common law, the records on a blockchain demonstrating a connection between a given amount of tokens and a private or public key, will establish proof of an user having a proprietary right in those tokens, which can be exercised and enforced against third parties.

13. It is hereby submitted that the proposed Proof of Concept ("POC") will create a "Fund Token" which will be tagged to a public address. The Fund Token will be operated using private-public key cryptography, and the ownership record of the Fund Token will be based on the blockchain. It is submitted that such a record is a viable legal evidence of ownership of the Fund Token. Therefore, it is submitted that the Fund Token, whose ownership is recorded on the public chain, can serve as evidence of ownership by an investor who has control over the public address of the Fund Token. Furthermore, the Fund Token will be likely capable of giving rise to proprietary rights and that such rights can be protected by remedies normally available to enforce proprietary rights. This will further establish the position of Singapore law that the tokens and their records on the blockchain will give rise to proprietary rights that can be enjoyed by the owners of those tokens.

This document was last amended on 23 December 2022.

Memento Blockchain Pte Ltd

The Legal Department

Figure 2: Soulbound token overview

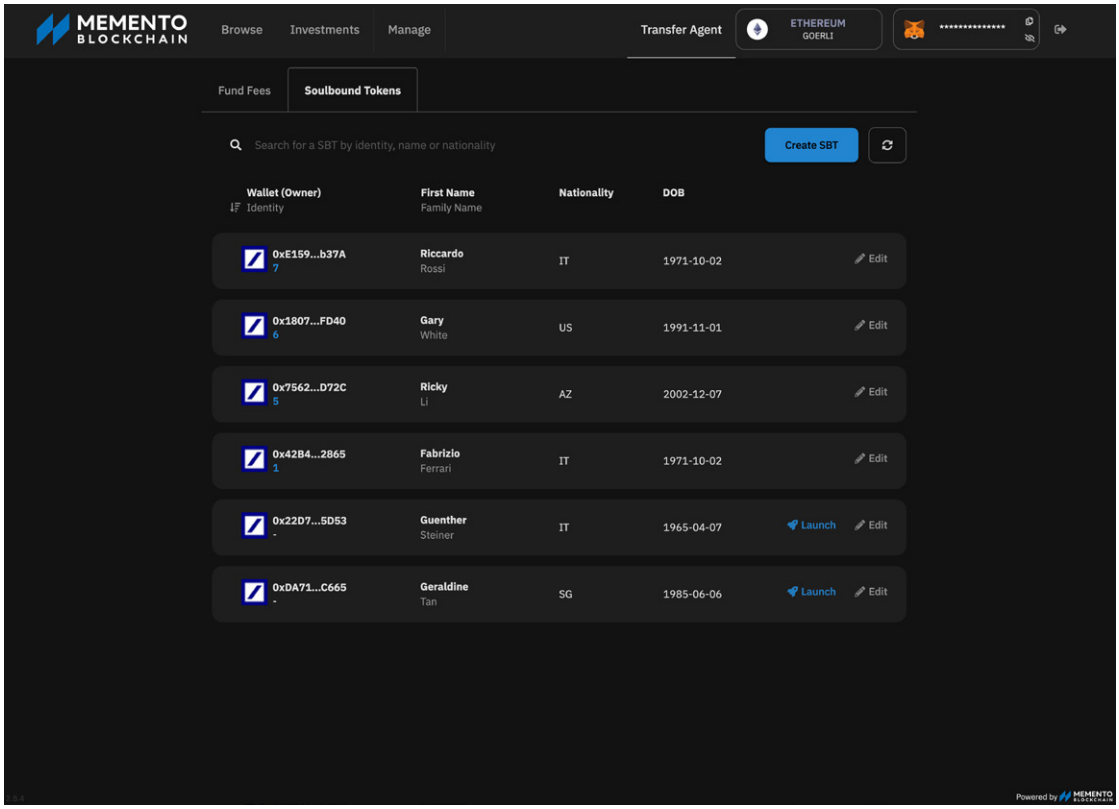


Figure 3: Soulbound token creation

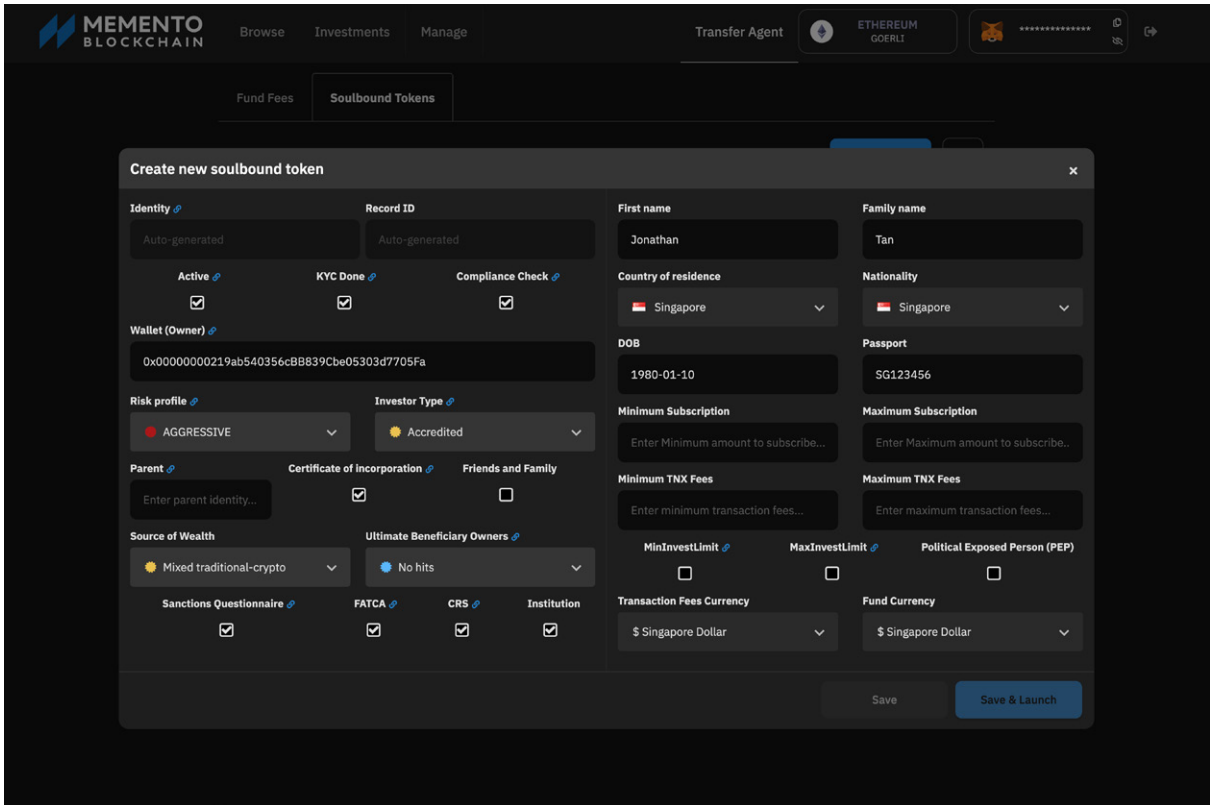


Figure 4: On ramp solution converting fiat to digital

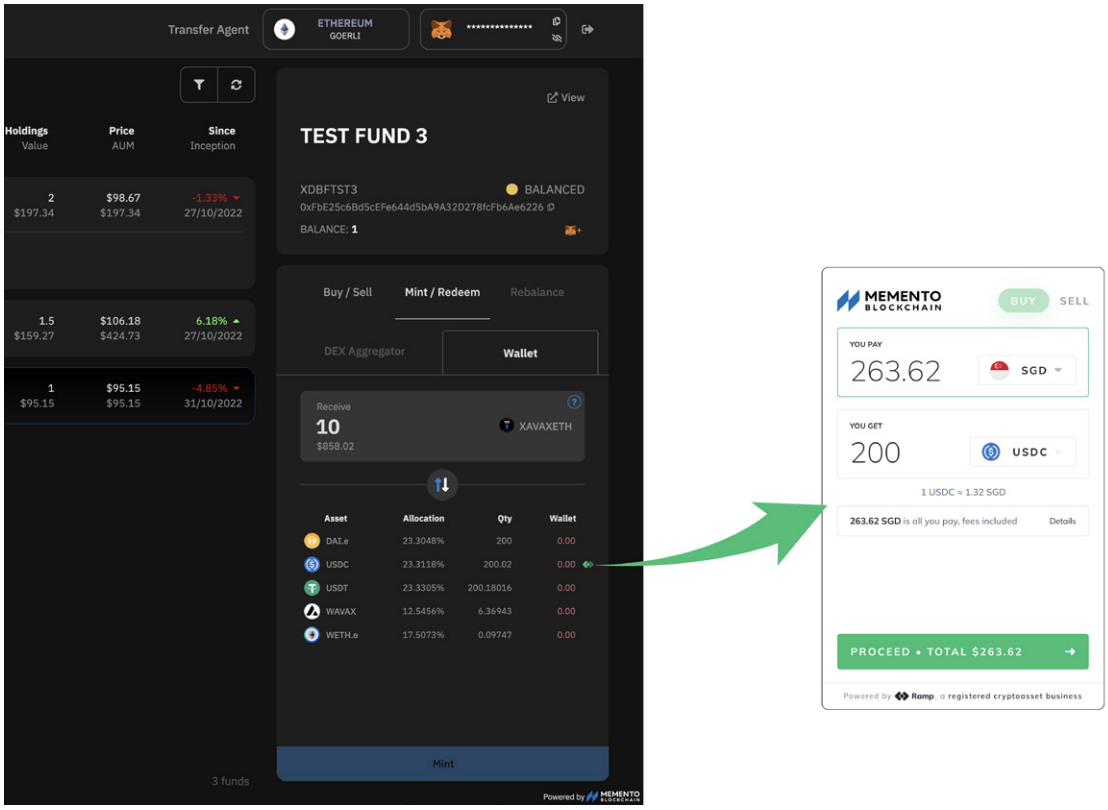


Figure 5: Creation of a digital fund (portfolio manager view)

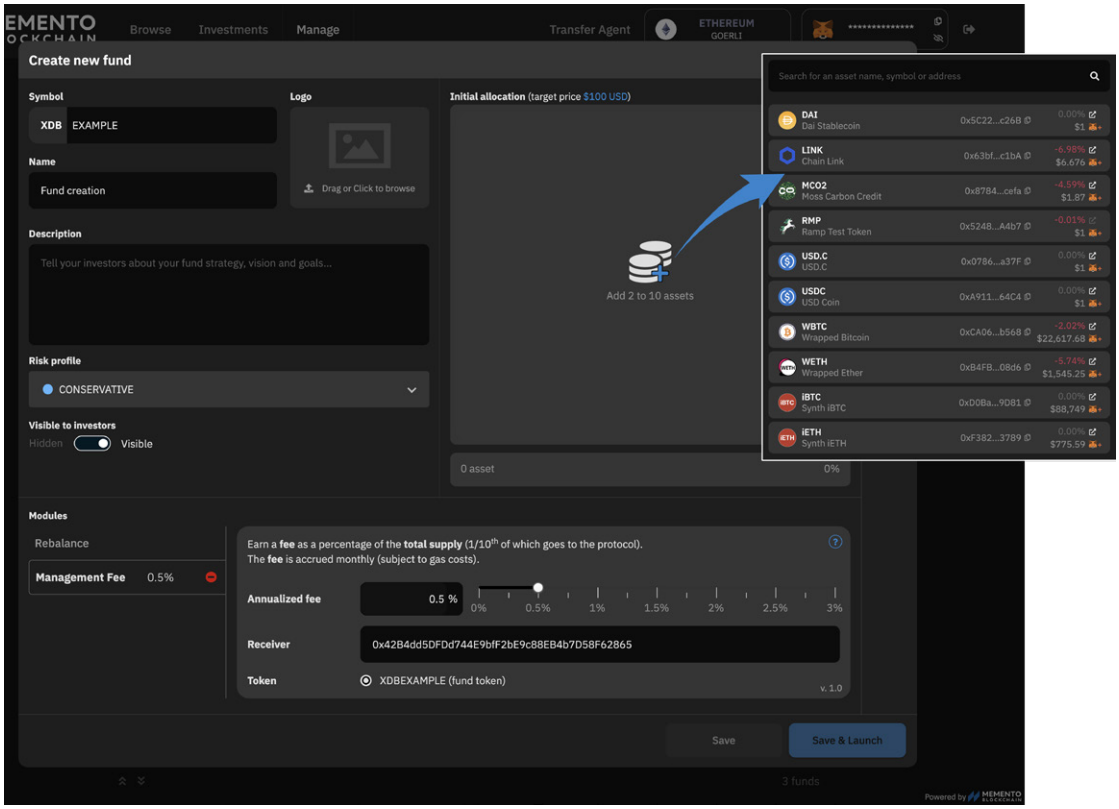


Figure 6: Landing page

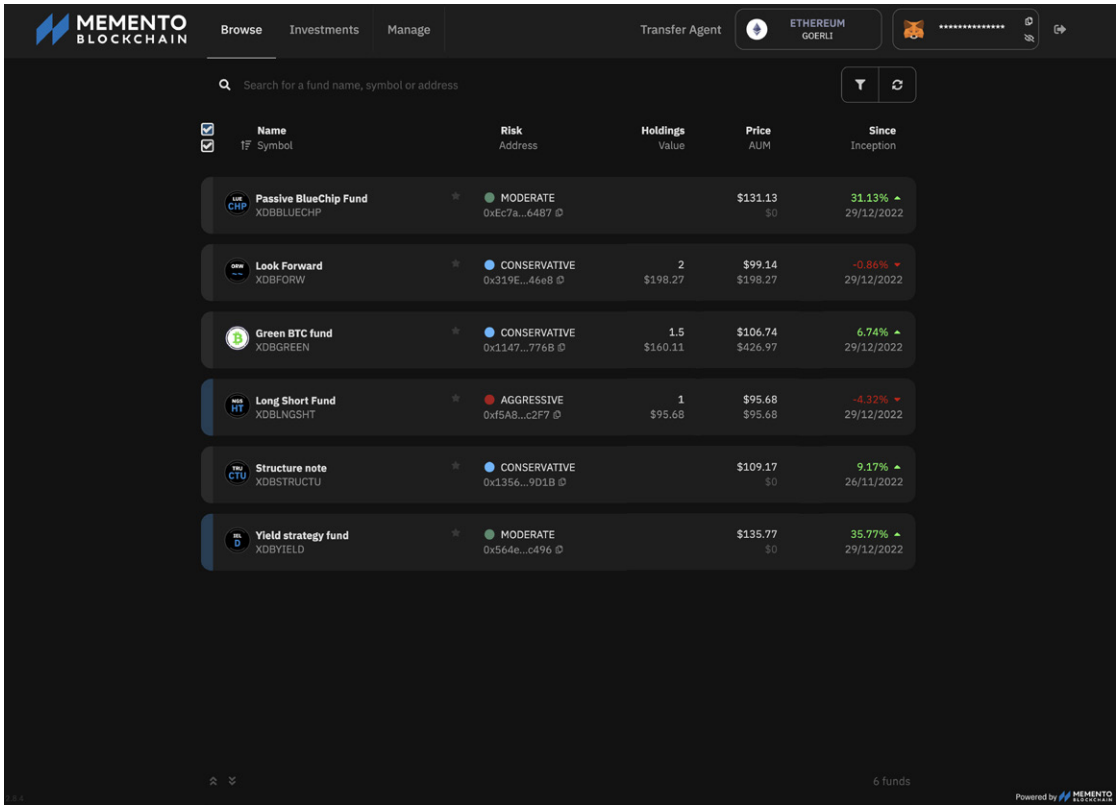


Figure 7: Subscription through direct minting

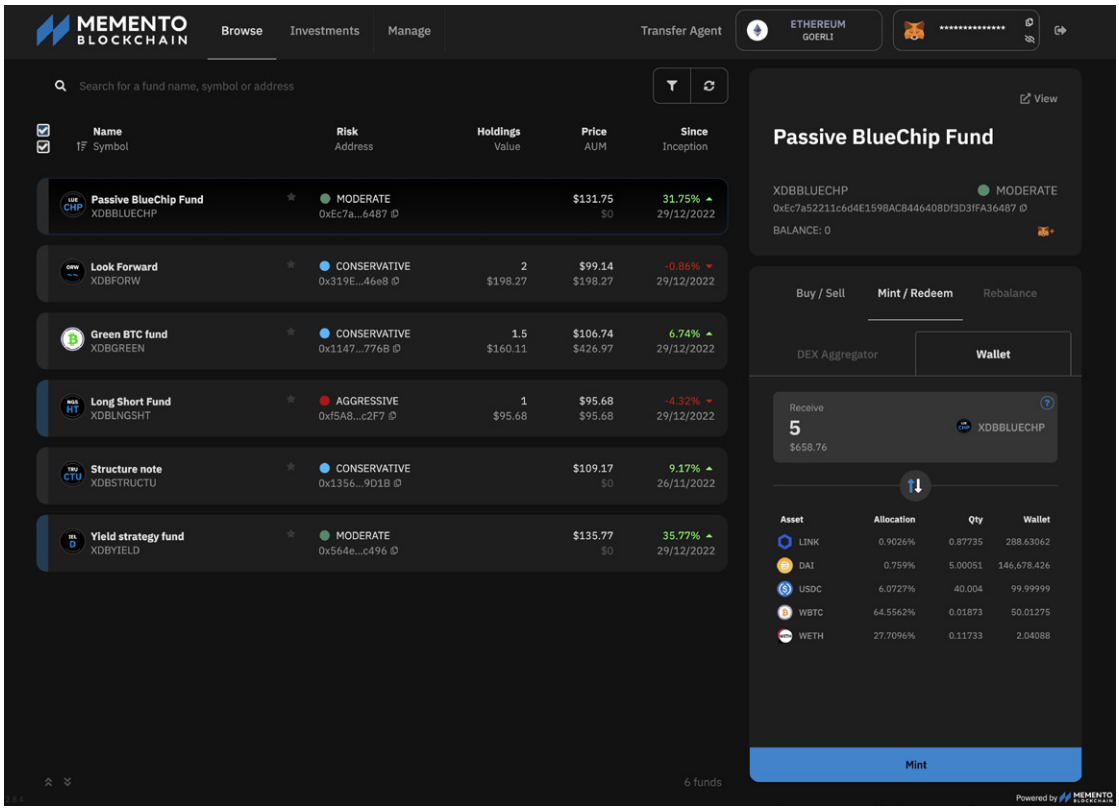


Figure 8: Subscription through decentralised exchange (DEX) aggregator

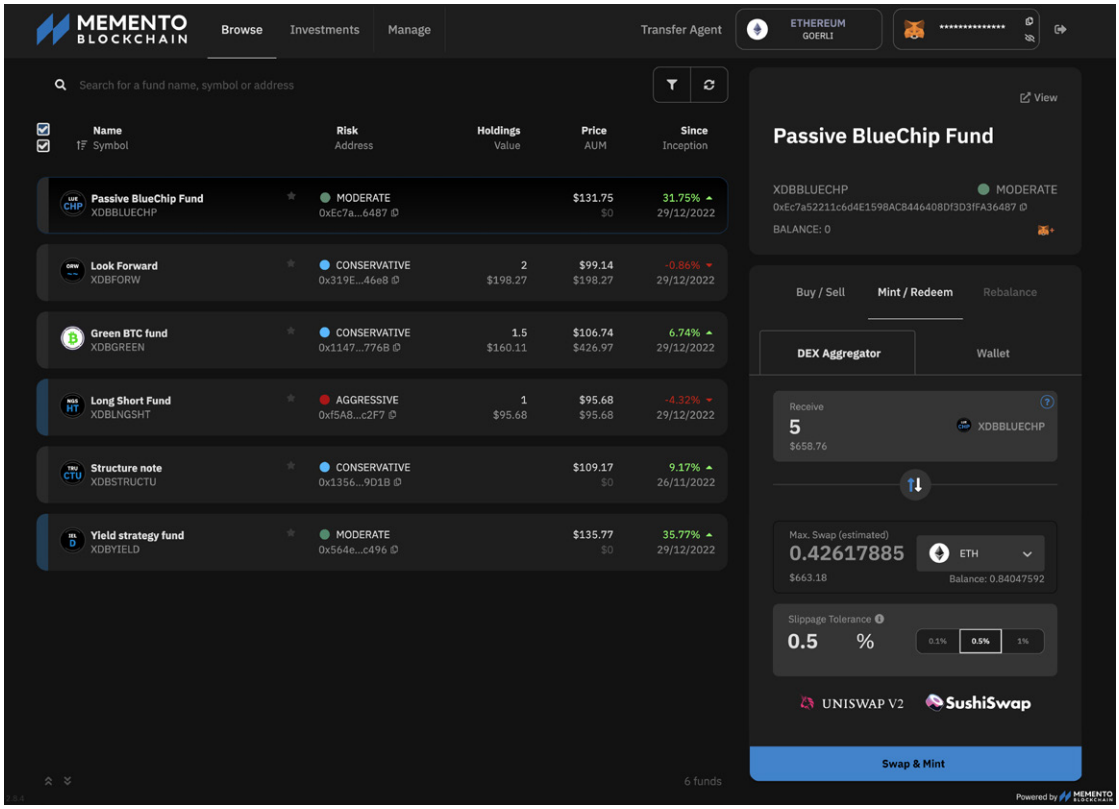
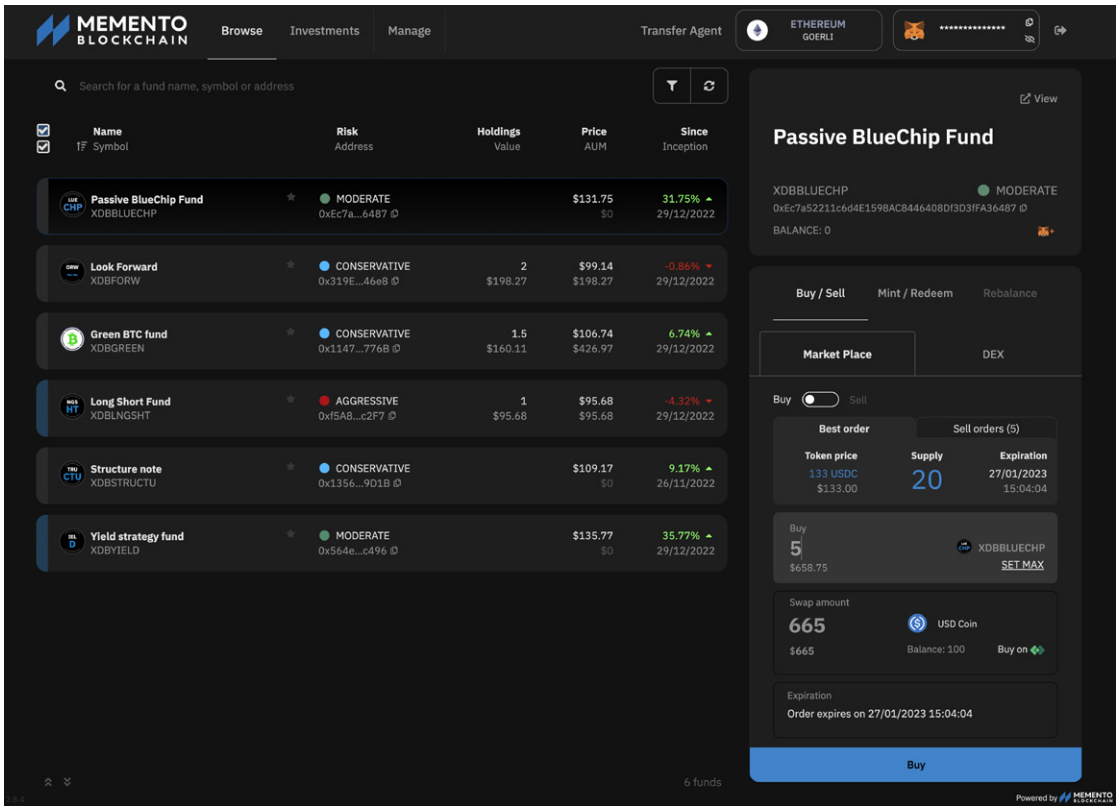


Figure 9: Subscription through the marketplace



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