PURPOSE BOUND MONEY:
A NEW PARADIGM IN VALUE TRANSFER

White Paper
June 2024

This report is commissioned and funded by Amazon.
The report was prepared with assistance from Grab, McKinsey & Company, the Monetary Authority of Singapore and StraitsX.

Contents

A NEW PARADIGM IN VALUE TRANSFER

- Utility of digital money is on the rise and can exist in multiple forms (CBDC, stablecoins, tokenized deposits and liabilities)

- Those issued on a blockchain offer the promise of programmability and greater functionality in value transfer for end-users

- Purpose Bound Money (PBM), a version of programmable money, may find product market fit in specific use cases such as discount couponing, instant credit and cross-border FX

- To scale the future vision for PBM, several coordinated activities such as standard setting and improving the user experience need to be pursued, likely in public/private partnerships focused on achieving "greater good" for end consumers.

INTRODUCTION

Cash, they say, is king. But as we prepare to enter the second quarter of the 21st century, that appears to be changing. For the first time in modern history, everyday consumers have the realistic option of abandoning paper money in favor of multi-functional digital money, reducing the cost and friction in payments, promoting financial inclusion and creating a superior user experience.

In this report we will evaluate the latest evolution of digital money, exploring the function of money beyond a simple medium of exchange to become a novel instrument to deliver real innovation in value transfer. We challenge the assumption that innovation must be wrapped around the use of money, rather focusing on composable innovation embedded in money itself. And we will explore the material benefits of applications of new, technology-enabled programmable money for value transfer, both for merchants and their end consumers.

Historical context

Historically, consumer payments have encountered three distinct challenges: (i) technologically, fragmentation of systems has led to high costs which do not scale with the payment, (ii) inconsistent compliance policies have resulted in high costs of risk mitigation, and (iii) a highly variable end-user experience in which simplicity may be forfeited for better economics. Furthermore, making cross-border payments has incurred additional challenges, with greater expense, complexity and slowness due to needing multiple intermediaries and correspondent banks to connect different banking systems and complete the currency exchange itself. Accordingly, any attempt at establishing a new payments paradigm should aim to: (i) simplify the process of value transfer, with fewer intermediaries, greater access and affordability, (ii) reinforce security and trust of payment networks, and (iii) enhance the experience of the end-user customer (for example, enabling merchants or their customers to get paid sooner and at lower cost).

There have been multiple attempts to address these challenges over recent years. In particular, migrating from the physical transfer of store of value to messaging systems which help to reconcile (central) bank ledgers has begun to reduce fragmentation; the introduction of blockchain-based systems so that payments can be tracked on a unified ledger (single source of truth) has improved payments speed and security; and the development of programmable money has taken aim at improving the end-user experience by enabling the automation of certain transactions.

But experimentation with programmable money in particular has provoked numerous debates: Since digital money is generally traceable, the ability to limit illegal activities (e.g., money laundering) has been matched with concerns about loss of user privacy. When issued by a Central Bank, the ability to directly manage monetary policy restricts the secondary utility of money in day-to-day usage and so-called decentralized finance applications. Although in theory it makes transactions cheaper and more accessible, attempts to improve financial inclusion have faced resistance based on the need to develop and adopt new technological infrastructure. And innovation with programable money often raises concerns about cyber security and even destabilization of sovereignty of monetary policy.

The true promise of experiments with programmable money has been to accelerate and improve the affordability of payments for consumers. Here, we will attempt to demystify the specific features of programmable money and synthesize learnings from these experiments. We will explore applications which create benefits and value for merchants and their customers. Finally, we will conclude with a roadmap for potential implementation, adoption and successful scaling of these applications.

Archetypes of ‘programmable money’

Today, tokenized value can be found in many forms, from money (e.g., stablecoins and Central Bank Digital Currencies, CBDCs), to debt instruments, to derivatives. But the dominant narrative is still that tokenization – the creation of digital financial instruments on a blockchain – is useful mostly in creating complex investment vehicles or niche business-to-business (B2B) payment rails. This characterization overlooks the largest class of tokenized assets, money, which today totals more than $160Bn of tokenized value.

Tokenized money can exist in multiple forms, either as CBDCs, stablecoins, or tokenized bank deposits:

CBDC is a digital representation of a sovereign currency issued by, and as a claim on a jurisdiction’s Central Bank. The majority of CBDC value in use today (e.g., Central Bank issued digital Swiss Francs) has found utility in wholesale payments, settling trades in capital markets. Concerns about privacy have thus far limited retail adoption given the common belief that all retail CBDCs (e.g., account balances and individual transactions) are traceable by their issuer. CBDCs have been launched in only 3 countries today but are being piloted in nearly 40.[1]

Stablecoins are privately issued cryptocurrencies, whose value is pegged to fiat money, physical goods, or tangible financial assets (e.g., Tether, USD Coin, Paxos Dollar). Stablecoins are issued on, and run on distributed ledger technology (blockchain) and can serve as a store of value, or as a medium of exchange with other digital assets also issued on a blockchain. Stablecoins have already been piloted as a vehicle for financial stability and exist on dozens of blockchains.[2]

Tokenized deposits are digital tokenized representations of traditional financial assets, such as money or securities, that can be stored and transferred on a blockchain network. These tokens represent ownership or claims on the underlying assets and can be traded or used as collateral in various (decentralized) finance (DeFi) applications.[3]

The goal of all these forms of tokenized money is to be freely exchangeable (i.e., fungible) and instantly convertible into fiat money without deviating from their 1:1 equivalent peg (i.e., liquid). However, to make this version of digital money truly more useful than the digital bank deposits commonly found online, various efforts have been undertaken to make such money programmable.

Stablecoins have proliferated and represent the majority of tokenized money[4] because of their token programmability, the ability to implement payment logic into the core settlement logic (for example, to enable automated, pre-authorized or recurring payments, or to create contingent escrow deposits). Programmability has the potential to supercharge digital commerce by

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1 https://www.atlanticcouncil.org/cbdctracker/
2 https://www.bis.org/cpmi/publ/d187.pdf
3 https://www.mckinsey.com/industries/financial-services/our-insights/tokenization-a-digital-asset-deja-vu
4 Daily volumes using JPM Coin passed $1Bn in Oct 2023, similar to monthly transaction volumes in the e-yuan CBDC. Meanwhile daily stablecoin transactions can top $100Bn

eliminating inefficiencies (e.g., creating buyer/seller direct exchange marketplaces), lowering processing costs and reducing settlement times, especially in more complex transactions such as cross-border payments.

In order to implement programmability, tokenized money typically must be issued on a blockchain that is compatible with ‘smart contracts’. These are digital contracts stored on a blockchain that become self-executing when predetermined logic conditions are met. Smart contracts can also endow tokens with specific properties, such as whitelisting of their recipients or limiting transaction sizes. In reality these conditions are coded into the tokens themselves and such composable, programmable stablecoins (for example, Circle’s USDC and Tether’s USDT) are almost exclusively issued on public, permissionless blockchains like Ethereum and Solana.

We can find digital money today being employed in various forms of programmable money, programmable payments and ‘Purpose Bound Money’:

Programmable Payments: The automatic execution of money transfer procedures once a pre-defined set of events or conditions are met (also known as conditional payments) – implementable using APIs interacting with traditional finance ledgers. Rules and logic typically expire with the execution of each payment. Examples today include standing orders and direct debits (i.e., recurring payments).

Programmable Money: Self-contained store of value and programming logic combined into the medium of exchange (or its data). Rules and logic transfer with the programmable money. Equivalent to a thin universal wrapper logic around tokenized money, examples include tokenized deposits and stablecoins.

Purpose Bound Money (PBM): Combines features of programmable money and programmable payments and enables money to be directed towards a specific purpose by imposing features and conditions (e.g., geographical, merchant or product) for its use, without requiring the underlying money itself to be programmed. These conditions, effectively created as a ‘wrapper’, are agnostic to the underlying type of tokenized asset, but generally assume regulated digital money. As described in the seminal technical whitepaper published by the Monetary Authority of Singapore (MAS), PBMs are bearer instruments, transferrable peer-to-peer (without intermediaries) containing digital money as a store of value.[5] Once the conditions of use are met, digital money is released and becomes unbounded. PBM imposes constraints on the payer (how the money can be used) and can drive outcomes, but there are no conditions or constraints imposed on the payee (once money is unbounded). Examples include digital vouchers and government disbursements.

Pros and Cons of Programmability

Making digital money truly programable introduces both benefits and limitations. In particular, integrating programmable conditions into digital money may limit its ability to function as a truly fungible, universal medium of exchange, and may imply potential re-programming of existing digital money.

[5] https://www.mas.gov.sg/-/media/mas-media-library/development/fintech/project-orchid/mas-project-orchid-report.pdf

Programmable payments can deliver a range of benefits, including a wide range of use cases such as automated treasury management (e.g., provided by JPM Onyx), conditional split payments (e.g., demonstrated in Project Rosalind) and minimizing settlement risk (with Delivery vs Payment feature). Experiments have also shown programmable payments to be open to a wide variety of developers for commercialization of use cases such as programmable release of escrow on delivery of goods and services, and the sweep of cash to a Certificate of Deposit (CD) account once an account balance exceeds a given threshold.

Programmable money can also deliver specific benefits, including embedding global standards for Anti-Money Laundering (Combating the Financing of Terrorism, CFT) into money itself, enabling traceability of money and payment, and white-listing of users and their wallets.

Purpose Bound Money. The true innovation of Purpose Bound Money is to combine many of these benefits, enabling 'compliance by design' and preventing spend of money beyond its intended use (e.g., in welfare or loyalty rewards) and requiring strict adherence to AML/KYC compliance requirements. The ability to attach specific rules to existing payment instruments can impose conditions such as limiting the geography, merchant stores and time in which the money can be spent before expiry, without requiring PBM creators to issue new money.

But with these benefits come challenges and risks also. Perhaps the most serious challenge for any form of novel digital payment is the technical complexity of integrating a new standard, protocol or platform into existing systems. In most instances, scaling a new solution involves either costly investment in onboarding new customers, or else incumbent providers maintaining parallel systems during migration. When cost, speed, security or experience benefits are marginal, the case for investment may be weak.

For programmable, digital money in particular, vulnerabilities in smart contracts and challenges securing private key access to the tokenized money have both been exploited in repeated, expensive hacks in recent years.[6] Because blockchain-based transactions are decentralized and immutable, theft or loss of funds is rarely reversible, and few regulatory or legal protections exist to provide adequate compensation. In jurisdictions where regulations are still unclear, several providers of digital asset services have been subjected to costly enforcement actions.[7]

Purpose Bound Money similarly has faced challenges related to privacy and consumer rights concerns, market distortion risk and issues with end-user experience. Restricting the use of funds to specific purposes or within constraints like use in a specific geography challenges the core principle that money is infinitely fungible and may even be viewed as infringing individual users' rights to spend money freely. Since the restrictions are typically imposed on the user, not the recipient, this additionally raises privacy concerns related to user identity. Restricting how PBM can be spent may lead to market distortions, especially in the case of the issuance of discount coupons which (intentionally) affect the demand for goods and services relative to their supply. And as seen in early experiments (e.g., see Project Orchid below), end-user experience has

[6] Arguably the first major exploit of a smart contract was in 2016 on The DAO, a smart contract on the Ethereum blockchain, which enabled the attacker to request and extract 3.6 million ETH, today worth over $10 Billion

[7] For example, multiple settlements have been reached with Virtual Asset Service Providers in recent years, such as $24 million with Bittrex and $29 million with Robinhood Markets Inc. in 2022 (SEC.gov)

not always matched the existing payment journey for merchants or customers and still has some way to go to be truly seamless. To effectively tackle such challenges, it will be essential that PBM is created with effective governance and oversight focused on public good, and with incentives for adoption which outweigh these potential downsides.

One of the challenges of any form of programmable money is the need for a common technology protocol that supports the programmed functionality. To scale successfully, it is critical that implementation does not lead to fragmentation in the payments ecosystem via creation of "walled gardens". Given the novelty of PBM, this will require the technology to be designed at the outset as interoperable across platforms, wallets and payment rails. Such interoperability will also encourage composability – the ability for various tokens and their smart contracts to communicate with each other – and accelerate additional innovation. Looking forward, the adoption of a common standard will ensure PBM tokens are compatible with different wallets, ledger platforms and therefore developers and stakeholders, without suffering from subsequent obsolescence.

Setting the bar for user adoption

Historically, blockchain has been described as a solution in search of a problem. But for its wider adoption in payments today, it is imperative that stakeholders see real-world use cases (i.e., for both businesses and their customers), with real-world benefits. In payment applications, the use of blockchain needs to address a consumer problem, benefitting either merchants or their customers. This benefit can be in the form of lower fees (for example, cheaper than credit card interchange), better user experience (e.g., easier recourse and reimbursement than manually requesting refunds), or the elimination of the link between physical cash, fraud and crime (e.g., guaranteeing finality). Only through delivering measurable benefits do we expect the creation of a flywheel for more widespread, organic adoption.

In many advanced economies today, payments are near instant, encounter very low friction and cost, and can be reversible via a central agency such as a bank (for example, Zelle in the US). As such, digital payments are widespread (91% of US population report using digital payments), both online and in-store.[8] In emerging economies this has not been the case, and in many areas of large population concentrations (e.g., in SE Asia, Egypt) cash is still the dominant mode of value exchange. However, advances in technology infrastructure in such countries is now enabling rapid electronification, such as 24x7 payments in Brazil (Pix), or the peer-to-peer and person-to-merchant payments enabled by the Unified Payments Interface (UPI) in India. As part of this dematerialization (digitization), programmable money may have the most impact in emerging economies, solving challenges with cash by putting digital money into the hands of end users.

Consumers have become accustomed to a seamless payments experience, with instant tap-and-pay and 1-3 seconds confirmation physically in store, and equally rapid confirmation of payment receipt online. Therefore, to deliver real benefits and spur widespread adoption, any new solution must replicate or improve upon this current low-friction experience, while providing added benefits for merchants and their customers. These benefits can include the creation of authentic credit history, enabling instant credit and elimination of fraud.

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[8] McKinsey Digital Payments Consumer Survey, 2023

Recording a history of transactions on a blockchain long-term can create a complete, auditable history of commerce for merchants and transactions by their customers. This history could enable better future credit decisioning, creating working capital for merchants and raise credit limits for (underbanked) consumers, thereby promoting greater financial inclusion. Similarly, merchants could tokenize payables invoices to achieve better payment terms for loans and improve short-term capital availability.

To compete with existing payments, programmable money, in particular PBM, must enable such services, such as new credit facility, while delivering an equally seamless (and invisible) payments process. Several design options have been considered (including blockchains, wallets, trigger mechanisms), and tested via real-world pilots. Even more significantly, these services must align with government priorities and are most likely to succeed in a healthy public-private investment partnership.

Lessons learned from early pilots

Many of these design options have been tested in recent real-world pilots. In particular, two pilot initiatives, Project Orchid and Project Rosalind, sought to test critical components of blockchain-based programmable payments in real-world physical transactions.

Project Orchid (ongoing) has comprised a series of live experiments with programmable money issued in digital wallets to gain insights into the practical implementation of core design and technical features. Between 2021 and 2024, the MAS administered multiple experiments with Purpose Bound Money in which transactions were conditioned by geography, merchant and time.

I. **Singapore fintech festival 2022:** PBM piloted with more than 5,000 attendees in sales of bubble tea and coffee at 20 food/beverage outlets. A fully-regulated Singapore Dollar-backed stablecoin, XSGD, was issued by StraitsX in $1, $2 and $5 denominations and wrapped as a Non-Fungible Token (NFT) with conditions (expiration date and acceptance by specific merchants) for its redemption. The PBM tokens were created on Polygon, a Layer 2 blockchain with historically low fees and transaction latency, and air-dropped into users' non-custody digital wallets. Fintech company Grab (with 180M users in SE Asia) provided acquirer services to merchants. However, the payment experience was slow, with longer on-chain settlement confirmation times than expected and additional friction at the Point of Sale (compared with credit card, or touch and pay) caused by reliance on QR codes. Notably, the user experience fell short of more typical Near Field Communication (NFC) payments.

II. **Singapore F1 grand prix 2023:** PBM deployed in voucher packs of various denominations aimed at visiting tourists ('Singapore Pitstop Pack'). Such voucher packs were sold in voucher marketplaces and made available in a range of Web3 wallets including the popular Grab wallet (more than 20k wallets activated). In this live experiment, the underlying XSGD (in voucher packs of $1, $2 and $5) were issued by StraitsX but backed by a bank (UOB), who minted DSGD behaving effectively as digital Singapore dollars. The wrapped dollars – effectively issued as a collectible NFT – carried with them time and merchant restrictions and could not be used as partial payments (since transaction amounts less than the voucher amount required a separate settlement process). Local payment gateways provided standard merchant acquiring services and merchants required only 3-4 weeks of technology integration (plus POS staff testing).

Notably, the transaction flow worked without friction as expected, though some latency of payment confirmation remained due to temporary congestion on the Polygon blockchain and the extent of the experiment was limited (around 200 merchants across Singapore).

III. **Singapore fintech festival 2023:** PBM deployed in the e-commerce checkout process via a variety of Web3 wallets (including Grab as well as other Web 3 wallets like *Metamask* enabled via the opensource WalletConnect protocol) geo-fenced in Singapore. This real-life pilot tested using PBM as programmable escrow which was subsequently (and then immediately) released on satisfactory receipt of goods (with visibility on both ends of the transaction). While XSGD, issued by StraitsX, was used as the pilot's digital currency, the underlying online commerce smart contract was designed to be compatible with any underlying digital currency. Notably the onboarding of merchants took considerable effort and time and was not necessarily scalable.

These experiments highlighted real potential, but also significant challenges. For **user experience**, the requirement of a QR code introduced unnecessary friction (especially in online checkout), while reliance on the Polygon public blockchain intermittently led to noticeable transaction delays. For **technology**, the use of a public blockchain led to high and variable transaction (gas) fees, at times growing to rival the value of the individual transaction. For **merchant experience**, onboarding of merchants was costly and time consuming and therefore likely not scalable, even though it was handled by the existing merchant acquirer.

Project Rosalind, in contrast, has involved the creation of a layer of prototype Application Programming Interfaces (APIs) between the central bank and service providers to enable interoperability of payment systems with a retail CBDC. Over the last 2 years, the Bank of England and the Bank for International Settlements Innovation Hub have conducted experiments with CBDCs involving functions such as account management, balance enquiries, deposits and withdrawals, simulating a central bank ledger for both tokens and accounts, and constructing API layers to orchestrate account requests from service providers. These experiments tested multiple front-end use cases to make users' lives easier, involving several CBDC solutions[9]:

I. Micropayments: Tested ability to provide cost-effective micropayments for digital content and services, including automated device-to-device IoT payments

II. Conditional payments: Tested the use of programmable money to create escrow and automatically trigger payments based on predefined events and conditions (e.g., payment on delivery)

III. Government payments: Tested the ability to distribute welfare payments directly to recipients

IV. Cross-border transactions: Tested the simplification of remittances by enabling direct transfer of CBDCs between different issuing jurisdictions

V. E-commerce: Tested the ability to provide instant settlement for e-commerce transactions, including multiple front-end use cases:

[9] https://www.bis.org/publ/othp69.pdf

i. QR-code push payments (customer scans merchant's QR Code to pay)

ii. Request to Pay (users input wallet alias and approve merchant request at online checkout)

iii. Authenticated request to pay (merchant scans QR code and initiates request to be paid)

iv. Creation of E-receipts, stored to avoid paper receipts.

While Project Rosalind did not involve PBM, it did demonstrate the power of two-tier public-private partnerships for implementation in which the private sector provides the user-facing services such as digital wallets in support of core infrastructure provided by the Central Bank. Such private sector providers include payment interface providers (PIPs) and ecosystem service interface providers (ESIPs) (e.g., banks and regulated non-financial institutions). Project Rosalind also confirmed that APIs could work with token- as well as account-based ledgers, opening the possibility of combining such a system with subsequent utility of tokens like PBM. Unfortunately, these experiments also demonstrated the challenges resolving the offline double spend problem, a residual problem for any payments system not able to maintain live access to a single source of truth (either a centralized or distributed ledger) and therefore unable to synchronize offline and online payments.

Both Projects Orchid and Rosalind have been able to demonstrate the material benefits from using digital currency. In particular: the cost of facilitating and settling payments (e.g., average on-chain Polygon gas fees of $0.01 regardless of transaction size) has generally been much lower than conventional payment networks (e.g., card interchange fee of at least 1% of transaction amount); cost reductions have been identified for merchants, network providers and the end users; achieving instant finality avoids counterparty settlement risk (with instant notification of value transfer and settlement); and compliance and regulatory benefits can be achieved through easier audit and demonstrating compliance with conditions (i.e., Know Your Customer layer).

In addition, the experiments created the potential for delivering significant consumer benefits from PBM, for example utilizing the conditions of PBM for budgeting, setting spending limits (for family members), offering loyalty rewards and hyper-personalized wallet-based marketing. Uniquely, PBM can offer the wrapping logic benefits with any underlying digital asset, subsequently unwrapping into fully fungible digital assets, including fiat money.

These experiments have highlighted the learnings for critical design features for future deployments of PBM, which include:

I. **User experience:** privacy remains a concern, with various experiments trialing distribution of digital currency for anonymous transactions without providing the central bank visibility or access to PII and payments data

II. **Technology choice:** Careful choice of (blockchain) infrastructure is needed to enable reliable, consistent, fast and cheap settlement. Choice of wallet determines the quality of end-user experience and needs to be well controlled

III. **Target markets:** Identification of high value target markets (i.e., not Singapore which is small and already a well-developed market), with a focus on large, emerging economies where PBM provides the greatest improvement today

IV. **Development model:** preferred delivery through public and private sector collaboration, with a two-tier model which could be suitable for scaling PBM

V. **Industry standards:** Agreement on common standards, especially for programmable protocols, will enable scaling, as well as expansion to many more currency denominations to improve utility.

Other international payments experiments have demonstrated the potential of programmable money to deliver additional benefits to end consumers but have also encountered many of the challenges listed above and demonstrate the need for ongoing experimentation and a robust roadmap to overcome fundamental design challenges.

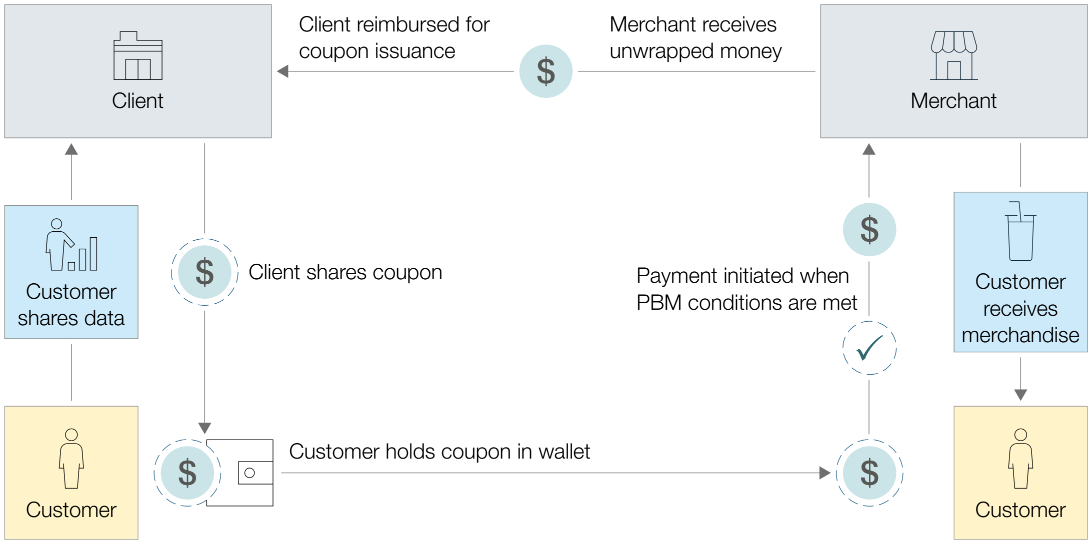
End state use cases

The majority of experiments historically have focused on the feasibility of digital money for central banks, infrastructure providers and payments processors. In practice, adoption will be driven both by widespread availability and by benefits delivered to end-users. In such instances, reductions in cost of facilitating payments and settlement are not necessarily felt directly by these customers. Unless savings are passed on, the end customer feels no benefit, and adoption will be slow. Use cases with direct consumer benefits are therefore essential to successful scaling.

From the experiments conducted to date, it is apparent that the innovations in Purpose Bound Money – easy delivery to user wallets, restricting redemption to specific purposes and merchant conditions, the addition of a KYC-condition to tackle money laundering, and the provision of efficient escrow services – likely offer advantages to users in specific situations. In particular, discount couponing, cross-border foreign-exchange (FX) swaps and the replication of some tougher traditional payment modes like cash-on-delivery with immediate recourse, create especially advantageous use cases that can benefit from the added functionality offered by PBM, even if there remain several technological and scaling challenges.

Discount couponing: discount couponing has existed in the pre-digital world for many years, offering preferential pricing to customers presenting with a coupon specifically for a particular product, merchant and often specific expiration window. But such coupons may be counterfeited and subject to bad-actor manipulation. In a digital-first economy, coupons can still be presented with payment, but PBM offers the potential to combine the coupon with the payment token itself. Blockchain enables the coupon to be verified for authenticity and redemption history, while the underlying financial asset (e.g., fungible digital cash) can be automatically released once the coupon has been redeemed. The discount value proposition can be appealing to consumers and delivered by merchants directly to their wallet as a personalized loyalty offer. The borderless nature of blockchain and digital wallets potentially expands such couponing to a global audience, allowing organizations, both public and private, to run campaigns and promotions without relying on bespoke promotion tooling mechanisms. (Exhibit 1).

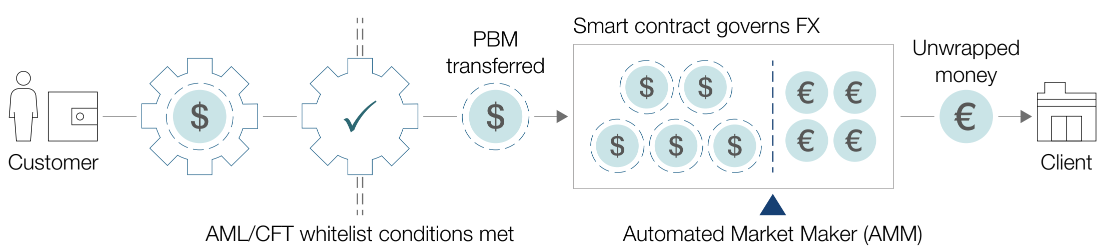
Exhibit 1 **Discount couponing**



Cross-border payments: Foreign exchange in cross-border payments has historically been expensive both because of the heavy compliance burden and instances of limited liquidity. Cross-border FX using PBM (e.g., for trade invoicing) can address both of these challenges through its 'compliance by design' and access to decentralized finance. PBM can support a regulatory wrapper with smart contracts which can harmonize AML/KYC cross-border needs (e.g., setting conditions for use that satisfy money movement rules such as the FATF travel rule) and enable automatic KYC and white-listing/sanction checks at the level of individual users and their wallets when satisfying the token's purpose. Automating such critical tasks makes low value transactions just as feasible as large ticket purchases.

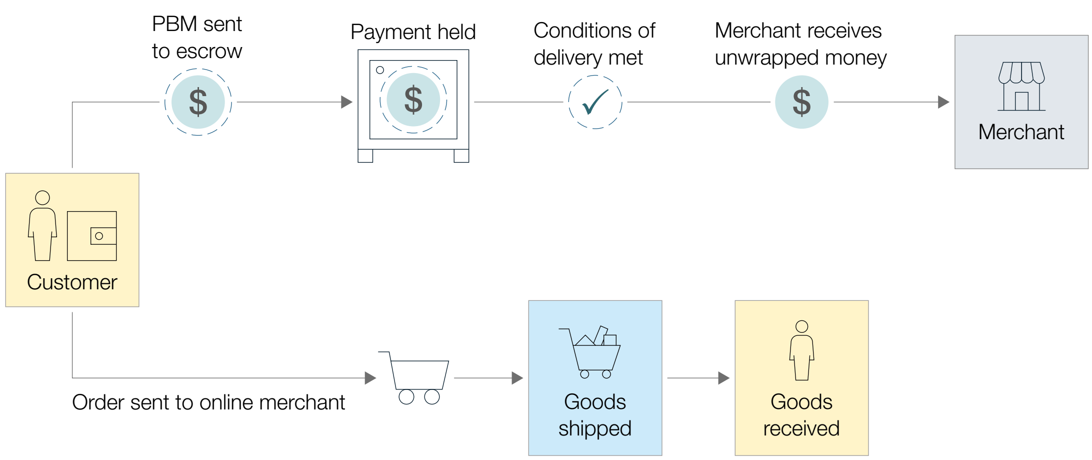
PBM could also enable payment in one currency and then unbound into a different (stablecoin) currency by engaging with smart contracts for currency swaps. This could be facilitated in a Web3 wallet using a DeFi solution like Uniswap or equivalent Automated Market Maker (AMM) application, in which the exchange rate is automatically and dynamically priced according to the relative abundance of specific currency pairs. While such a solution would require lots of currency pairs available on chain and plenty of liquidity pools, the proliferation of digital money is a credible enabler. In countries with currency control, PBM can also introduce spend limits (Exhibit 2).

Exhibit 2 **Cross-border payments**



Programmable escrow: Trade in many emerging economies still functions through 'cash on delivery', with the buyer retaining payment until satisfactory goods are received. In a digital economy, PBM enables payment to be supplied in its bound form, and then subsequently unbounded and released to the supplier only on receipt of goods. Such 'programmable escrow' ensures funds are not taken until a user is satisfied, and the merchant is paid immediately once the transaction is complete. Such funds in escrow are visible to both parties in a trade (as "good funds"), and their programmability largely eliminates fraud. Under such a scheme, tokenized escrow could even function as collateral (similar to factoring), achieving easier credit and better payment terms, and can therefore add utility to merchants as well as their customers (Exhibit 3).

Exhibit 3 **Escrow/Cash on Delivery**



In addition to the use cases above, it has been suggested that PBM might also find use in future-dated contractual agreements (e.g., such as a lease downpayment or real estate purchase) or purpose-specific philanthropic giving (to avoid corrupt diversion of funds).

The underlying technology supporting PBM can facilitate substantial improvements in credit provision for small and medium-sized enterprises (SMEs). A paucity of credit history or collateral to secure loans today often results in SMEs being charged high interest rates on loans due to perceived higher risks. Further, the complexity and expense of burdensome compliance requirements can outweigh the benefits of obtaining credit altogether, creating pain for SMEs to manage their cash flow and inventory effectively. In contrast, recording and then reporting SME transactions on a blockchain can create an immutable, complete and transparent record of creditworthiness, enabling both fintechs and even incumbent traditional financial institutions to have greater confidence to lend on preferable terms. Programmable money enables short-duration and smaller-ticket lending with minimal administrative burden, and PBM could even direct funds to specific activities in the life cycle of a SME.

Roadmap for implementation

For these applications to fulfil the mission of 'future payments', they must scale to create meaningful benefits to society. Experiments like Projects Orchid and Rosalind demonstrated technical competencies but cannot be considered commercial successes. Therefore, given the specific applications for which PBM offers particular benefits, and the limitations of recent experiments, the path to implementation now assumes even greater importance.

While pilots are still important in providing insights into implementation considerations, they can only go so far without a concrete roadmap for mainstreaming and promoting adoption, that includes a clear principles-based regulatory framework that provides clarity and certainty for industry players, and a policy vision for integrating programmable money into the core payments system of the country. Therefore, below we describe 10 principles for building successful applications, then lay out 6 key modules for building engagement and implementation, including key issues to be debated and resolved.

10 Principles for building successful applications in PBM

1. Establish a **governance framework**, with a clear mandate and rules for PBM for the public good to provide the clarity needed for regulation, compliance and risk-proportionate frameworks

2. Create broad **interoperable Infrastructure** to enable PBM – including consensus on which blockchain(s) to use, and seamless interoperability mechanisms to promote composability and further innovation

3. Further advance **the practical learnings** of using PBM, including making the underlying technology (blockchain, tokens, wallets) largely invisible

4. Build a clear understanding of the **commercial case**, with banks and other financial institutions showing leadership (in public/private partnership with governments and regulators)

5. Plan for scaling to **specific markets** with greatest potential benefit (e.g., emerging economies at different starting points)

6. Encourage experimentation with, and adoption of benefits, to achieve **higher PBM transaction volumes**

7. Expand range of digital **currency pair** denominations in smart contract swaps to facilitate more widespread use in cross-border FX

8. Multiply **venues on which tokenized assets are traded**, especially where digital money can be exchanged for other digital assets used as collateral

9. Achieve **alignment with existing regulations** in payments (stablecoin, domestic & cross-border money transfer) and/or highlight potential need to update existing regulation in tandem with new use cases

10. Create viral 'gamification adoption' moment or other **incentives to promote adoption** across major merchants and user wallets.

Roadmap to engagement and implementation

To enable and scale the retail use cases described earlier, industry-led pilots involving a diversity of experiences will need to progress further, with real money. Live trials will expand innovation and enable end users – both customers and merchants – to choose the best options. Accordingly, we propose 6 key building blocks with varying time horizons to completion, including:

1. PBM Standards

Design and agree a universal, composable standard set for PBM (including "compliance by design"). Establish a consistent framework for wrapping underlying value (e.g., ERC-1155 semi-fungible token), providing on chain settlement, checking attestation (or whitelisting) and enabling interoperability of smart contract rules and conditions to enable true fungibility. Such a standard will dramatically improve scaling of PBM, both domestically and more importantly internationally. For example, such a universally agreed standard will make possible settlement between international and local wallets, all on the same network, with as little capital investment as possible.

2. Regulation & Compliance

Focus on positioning PBM within existing banking and payments regulation for expediency. This includes satisfying existing KYC and CFT checks and minimizing credit/liquidity risks, providing prudential treatment of the underlying token value and effective reporting, and even solving real-world problems such as fraud. Since PBM utility will likely scale exponentially cross border, minimum compliance standards will need to be agreed to consistently satisfy differences in regulations in different jurisdictions (e.g., proceeds of crime / sanction screening). Previous proposals from Project Orchid suggest that relying on PBM to implement compliance checks via policy wrappers requires a trust relationship between parties and the issuing bank. Through this relationship, it has been proposed that banks can create a "smart contract" library from which the relevant smart contracts for compliance checks can be shared and implemented – per transaction – thanks to the composability of PBM design. In doing so, we expect this "compliance by design" to be welcomed by different regulators who are therefore less likely to inhibit wider adoption.

3. Fungibility of money

Continue experimentation with different forms of value as underlying backing for PBM. Although blockchain uniquely offers on-chain, instant atomic settlement, additional off-chain solutions for FX (including employing smart contracts in Automated Market Makers) will enable even greater Interoperability of PBM (and efficiency gains). As CBDCs become more widely available (especially wholesale CBDCs as reserves), true fungibility will be achievable with full end-to-end on-chain value transfer.

4. User experience

Improve end-user experience by abstracting away complexity as much as possible (achieving faster, cheaper, better payments). For customers this includes wider wallet choice and interoperability, making payment possible with any wallet, as well as advancement of technical solutions to enable partial balance payments. Besides invisibility, this can enable preferential payment terms for customers such as Buy Now Pay Later installment solutions like “pay in 4”. Similar benefits for sellers, such as instant disbursement, ability to accept hybrid payments and offering seamless rewards incentives will likely accelerate adoption.

5. Collaboration and adoption

Incentivize and accelerate wider adoption, especially among merchants, by facilitating broad collaboration between value chain players (e.g., integration of stablecoin issuer, wallet provider, merchant acquirer). Expand the conditions under which more stakeholders (e.g., merchants) can easily become PBM creators. Improve merchant education and acceptance by making the process as seamless as possible for merchants to accept and get paid, as fast as an instant payment transaction. Further improvements in adoption are anticipated with the ability of merchants to accept hybrid payments, including split payment partly by voucher, partly by fiat (without special education of merchant cashier). Offering digital rewards and discount vouchers to incentivize merchants and users (including digital collectibles) can further enhance the PBM value proposition.

6. “Greater Good”

Developing the technical specifications of PBM and CBDCs is typically outside the expertise of many public sector agencies. For that reason, any successful deployment likely depends on a healthy public/private partnership, in which the private sector players (e.g., banks or fintechs) conduct technical development, provide input on governance principles and oversight mechanisms, and public sector players like central banks and regulators establish consistent and transparent regulatory frameworks, and develop policies that serve to promote adoption as the new standard.

A significant number of financial institutions worldwide are already progressing their own proprietary solutions (e.g., JPM Onyx, SG Forge, etc). It is reasonable to assume that diverting resources to developing a competing alternative would be a challenge. In such instances, interoperability will be essential, enabling co-existence of solutions, not competition, and creating more value from the existing infrastructure. Indeed, it is fair to expect that the ultimate outcome of today’s experimentation should be guided by what is best for the end-consumer, rather than what is best for the public or private entity investing in its development.

Accordingly it is proposed that, if the optimal solution is guided by what is chosen by consumers (not decided by technology providers), then public agencies like central banks have an active role to play as sponsors of such optimal solutions. Regulators and other public agencies should collaborate actively to ensure that the roadmap to such an optimal solution creates a healthy environment for scaling, delivers greater efficiency for the economy as a whole, and supports economic growth and opportunity for the “greater good”.

Unsurprisingly, many of these building blocks are inter-dependent, though setting and agreeing standards while satisfying regulatory requirements will be the primary enablers to further experimentation in order to maximize user experience and widespread adoption.

In addition to these important actions, there remain unresolved challenges to be addressed which are peculiar to PBM. These include:

I. Account abstraction: separating the complexity of wallets and private keys from the more familiar user account activities

II. Name addressing: provision of a service linking a familiar user proxy (name, phone number) to digital wallet addresses

III. Offline payments: enabling the use of PBMs in offline transactions or in form factors other than connected devices like smartphones to maximize financial inclusion.

As various forms of tokenized money have emerged (CBDCs, stablecoins, tokenized deposits), each has evolved with a focus on a particular purpose (e.g., wholesale CBDCs for capital markets settlement, stablecoins for retail payments and crypto purchase settlement). They perform well in aggregate, but none have been designed from the bottom up for a specific use case. Here, we posit that Purpose Bound Money can elevate the utility of the underlying digital money in very specific use cases and we make the case for applications in e-commerce loyalty, cash on delivery and FX. Launching PBM issued on a blockchain creates secondary benefits for users (such as credit history, access to working capital), deemed essential for wider retail adoption. And the clarity and visibility for regulators likely makes them predisposed to offer their approval and support. If the current schedule of experimentation fulfils its objectives of simplifying value transfer, reinforcing security and enhancing the user experience, then we see a high likelihood that PBMs will make the leap to delivering a new paradigm in value transfer.