M10

Payments Modernization Through Deep Payments Innovation

Abstract

Today's payment infrastructure has failed to keep up with the evolving needs of a global, always on economy. Payments can be slow, insecure, vulnerable to money laundering and financing of illegal or illicit activities. The old infrastructure requires frequent manual intervention for payments to be completed. As a result, payments (particularly international) suffer from delays, high cost and inconvenience.

Domestically, commercial banks in a number of countries have begun to address these issues through the adoption of open banking and real-time payments. UPI is an example of a new payment mechanism introduced first through a consortium of the largest banks, then mandated by the Indian government, and in a short period of time becoming nearly universal in adoption across India.

Unfortunately, these domestic payment innovations from commercial banks have not been followed by similar innovations in international payments. Perhaps because there are fewer commercial banks which are truly international. Perhaps because banks from different countries have been unable to align on standards or a common platform.

In any event, as a result of the lack of commercial bank innovation in international payments, two trends have emerged in recent years. The first is the introduction of stablecoin cryptocurrencies by technology companies. The second is a number of central banks now investigating (but not yet adopting) central bank digital currencies (CBDC). Both stablecoins and CBDC have the potential to improve international payments, but they also introduce new problems and risks to the global payment ecosystem.

Design of a modern payments system must address not only today's payments requirements but also anticipate likely future requirements. We identify several important trends that should be considered when designing and building a new payments system. The trends are then translated into high-level requirements.

We then describe M10's approach to payments modernization through the use of shared digital ledgers for central bank money (M0) and commercial bank money (M1). Details including payment flow, system architecture, regulatory compliance, system economics and the issuer evaluation process are discussed.

Finally, we review a number of use cases enabled by the M10 network and how it can serve as an RTP system, connect disparate RTP systems and be an alternative to CBDC.

The need for payments modernization

While the global economy is becoming more "instant", always-on and with new business models emerging, payments capabilities haven't kept up. Today's payments infrastructure is hampered by

- Slow settlement that doesn't meet the 24x7, always-on business and personal lives
- Poor security that leads to fraud
- Poor tracking/tracing which allows money laundering and terrorism financing
- A hairball infrastructure that requires frequent manual intervention, which ultimately leads to high cost

Simply put, payment systems are not meeting the needs of society. This is not news to central bankers and regulators.

In fact, central bankers around the world are calling for payment modernization and are looking for commercial banks to bear the responsibility for creating faster, better and cheaper payments infrastructure.

"I'm not in favor of always immediately calling on the state. In a market economy, it's up to companies to develop products that meet customer demands."
- Mr. Jens Weidmann, Bundesbank, January 2, 2020

This is supported by the President of ECB's remark from around the same time.

"The prospect of central bank initiatives should neither discourage nor crowd out private market-led solutions for fast and efficient retail payments in the euro area."
- Mrs. Christine Lagarde, ECB, January 8, 2020

After all, commercial banks paved the way in the past with innovations such as payment cards and SWIFT.

Providing a payments infrastructure that enables instant payments to anywhere in the world in a safe, secure and easy way, at low cost is essential in order for the world economy to grow. In the following sections we will review recent improvements in the payments ecosystem and discuss how to accomplish further payments modernization.

Domestic payment innovations

Historically, payment innovations have started with commercial banks. In recent years, these innovations have also been spurred by government mandates requiring commercial bank compliance. Two of these innovations include closely related but distinct groups of initiatives:

Open Banking

The EU legislated open banking with the Second Payments Services Directive (PSD2). PSD2 requires banks in the European Economic Area (EEA) to provide approved third parties access to customer accounts for retrieving account information and initiate payments.

Banks are expected to provide this access via application programming interfaces (APIs). Other regions and countries have, or are following the European model.

Real-Time Payments (RTP)

Banks can cooperate to enable faster interbank payments. This is indeed happening in many parts of the world where Real-Time Payments (RTP) systems are being deployed[1]. By the end of 2020, 70 countries are expected to have RTP systems deployed. Banks in Europe have standardized on SCT Inst[2]. In the U.K. banks use the Faster Payments System and in Singapore there is FAST[3], etc.

Typically, RTP systems have been designed for interbank transfers and extending the RTP functionality out to the banks' customers has been each bank's prerogative. An example of this is the RTP system from The Clearing House in the U.S. where the banks own the customer interface through their own mobile apps, or through Zelle.

The Unified Payment Interface (UPI) in India has taken a different approach and allowed third parties to easily access the RTP system. This quickly expanded the ecosystem and is the basis for UPI's success. (See Box 1).

Box 1: Unified Payments Interface (UPI) in India

What is UPI?

Unified Payments Interface (UPI) is an instant real-time payment system developed by National Payments Corporation of India (NPCI) facilitating interbank transactions. The interface is regulated by the Reserve Bank of India and works by instantly transferring funds between two bank accounts on a mobile platform. As of December 2019 there are 143 banks live on UPI with a monthly volume of 1.3 billion transactions and a value of ₹2.0 trillion (US$28 billion)[4]. Nearly 50% of all consumer payments in India are made with UPI. It's particular stronghold is with low-value payments. Several factors contributed to the success of UPI including the government's decision for demonetization, low cost and the availability of a ubiquitous ID system (Aadhaar).

It is important to note that both standardized account access and RTP are primarily domestic solutions. They were not intended to improve the efficiency of payments across-borders. Due to the nature of cross-border payments, most commercial banks have been slow to innovate on the traditional correspondent banking nostro account framework. Perhaps this is because there are fewer commercial banks doing business around the globe. Perhaps this is because commercial banks in different countries have been unable to agree on common protocols or to build a common platform[5].

Cross-border payments are frequently delayed due to use of a correspondent banking network that introduces multiple hops for a payment to go through (it's hard to believe that more than 150 years later, international payments still rely on an antebellum system of nostro and vostro accounts)[6]. Also, settlement in foreign currencies can be limited to central bank opening hours, further delaying completion of a cross-border payment.

Cross-border payment innovations

As a result of the lack of cross-border innovation by commercial banks, technology companies with the DNA to innovate and disrupt have attempted to fill the gap. The first generation of solutions was blockchain-based cryptocurrencies such as Bitcoin and Ripple XRP. These cryptocurrencies tend to fluctuate in value significantly, making good for little more than investor speculation.

A second generation of blockchain based cryptocurrencies emerged — stablecoins (see Box 2). There is now a plethora of stablecoins in the market. Most of them are issued by private entities. Until now, stablecoins have primarily been used as a store of value and not as a medium of exchange (payments), but one company, Facebook, is resolved to change this. In June 2019, Facebook announced the formation of the Libra Association, a non-profit organization that would issue a stablecoin backed by a basket of fiat currencies — Libra. Because of Facebook's size and large customer base, the project attracted the attention of central banks and regulators worldwide.

Box 2: Stablecoin definition

What is a stablecoin?

Stablecoins are cryptocurrencies designed to minimize the volatility of the price of the coin by maintaining the same value as the asset they are pegged against. Stablecoins can be pegged against government issued fiat money, other cryptocurrencies, commodities, or be algorithmic by manipulating supply and demand of the coin. Stablecoins are based on blockchain (also known as "distributed ledger technology (DLT)") and are designed for either retail or wholesale use cases. There are dozens of stablecoin projects in the market, or in development. The most popular retail stablecoin is Tether with a market cap of approximately USD 4.0 billion. Retail stablecoins are traded on crypto exchanges, while wholesale stablecoins are meant for settlement within, or between banks. For example, in February 2019 JPMorgan Chase launched "JPM Coin" to serve as a payment tool between its clients.

General purpose blockchain/DLTs have shown to add little benefit to account-to-account based payment systems offered by banks. Instead, these technologies struggle with transaction throughput, latency, scalability and poor resource utilization.

The announcement of Libra and other stablecoins has raised concerns among central bankers related to monetary control. Partly in response to these private solutions and partly in recognition that commercial banks were not, on their own, able to innovate new and more efficient cross-border payment systems, central banks began considering solutions in which the central bank would issue digital currency.

Central Bank Digital Currency, or CBDC for short became a hot topic during 2019. Many central banks are investigating CBDC.[9] The pros and cons of CBDC (see Box 3 - on next page) has been discussed by central bankers, regulators and academics for a few years, but with Libra this became more acute. For example, People's Bank of China (PBOC) is expected to accelerate its launch of a CBDC version of the renminbi in 2020.[10] This then puts more fuel into the CBDC fire as such an effort by the PBOC could potentially undermine the USD, EUR and JPY as global currencies. As a result, CBDC has caught the attention of the Federal Reserve and European Central Bank.[11] Japan, which previously was cool to the idea of CBDC, has begun re-examining the idea in response to the threat of digital RMB destabilizing the JPY.[12] However, no other countries appear ready to go beyond a proof of concept (POC) at this time.

It is also worth noting that all of the CBDC POCs that we have reviewed to date rely on the use of general purpose DLT technology. This will raise the same cost, inefficiency and latency issues briefly described in Box 2.

Given the disintermediating effects on commercial banks, the risk of destabilizing banks and the operational challenges to central banks, we believe CBDC may only be adopted by most central banks as a last resort.[13]

Box 3: CBDC definition, pros and cons.

What is a CBDC and why is it being considered?

Various blockchain-based solutions have been proposed to allow central banks to issue digital currency. There are two types of CBDCs - general purpose and wholesale. The former is aimed at households and the latter for use between financial institutions. Both types would serve as legal tender. According to BIS[14], about 70% of central banks are exploring CBDC. To date, only the Central Bank of Bahamas has launched a CBDC.[15]

According to the IMF[16], the pros and cons of CBDC can be summarized as:

Pros	Cons
• Reduce cost of cash	• Banking-sector disintermediation[17]
• Stabilize payment system	• "Run risk"
• Counter new digital currencies	• Central bank balance sheet and credit allocation
• Enhance monetary policy	• Costs and risks to the central bank

In the next sections we will look at the likely trends in payments and as a result requirements for a modern payments system that can last and what the properties of such a system should entail.

Modern payment system considerations

Looking into the crystal ball for what will drive the needs for payment technologies in the near and distant future will help in understanding the key payment systems requirements. Changes in national economies, international relations, introduction of new technologies and regulations will drive the requirements for payments. A few trends will emerge that result in some key considerations for payment systems.

Increase in payment transaction volume

Global payments volume has been on a steady upwards trend and will continue to grow.[18] In addition, spikes in transaction volumes will occur more frequently with online shopping events. For example, November 11 is "Singles' Day" in China and it has become the world's largest online shopping event. On this day in 2019, AliPay processed at its peak, 544,000 orders per second.[19]

In a first phase, growth will be fueled by emerging markets - primarily the APAC region. In a second phase additional emerging markets (Latin America, Africa) will further accelerate growth. And in a third phase, machine-to-machine (M2M) payments will add further growth. This third phase could cause exponential growth of low-value transactions, or microtransaction.

Consideration: High transaction throughput will be critical for global payments systems. They must be able to handle millions of transactions per second with low latency at peak times. For payment service providers, infrastructure elasticity is required to handle peaks with minimal increase in cost.

Payments with multiple asset types

Today, payments are performed with cash and cash equivalents such as central bank money (M0) and commercial bank money (M1). In the future, additional asset classes may be used for payments such as fractional ownership of equities, real estate, or commodities. Add to that future forms of stablecoins and cryptocurrencies.

Consideration: Future payment systems must be able to transfer and settle any type of digital asset for the purpose of payments.

Fraud attempts become more sophisticated

Through social engineering[20] and other techniques, fraud becomes more sophisticated. However, as technology improves and the world becomes free from insecure authentication methods using passwords, payments fraud will eventually decline the same way email spam did. Payments fraud will not end, but become more targeted, just as "spear phishing"[21] has become the most harmful type of email spam.

Consideration: Payments system must be designed to prevent targeted fraudulent attacks. Due to improved security methods, most such attempts will rely on social engineering.

Refined customer experiences

For consumer payments, payment cards replaced cash. Smartphones are replacing the need for carrying plastic (or metal) payment cards and wearables are replacing smartphones. Next, smartphones and wearables will be replaced by biometrics. There will be no need to carry cards or phone, or wearable. Instead, use your voice, show your face[22] or scan your finger to authorize a payment directly from your bank account. Great consumer experiences have a tendency to spill over to the business world. Expect similar low friction payment methods to appear in B2B payments. However, before these types of "invisible" payments can be realized, customers must trust the security of payment systems and that they're sufficiently protected against fraud.

Consideration: Authentication and authorization must be performed using digital signatures generated by biometrics. This requires public-key cryptography instead of passwords. Payment systems must provide, or integrate with digital identity directories to provide a better and safer customer experience. Furter, establishing customer trust is critical.

Open banking/data regulations

Regulatory requirements for open banking and in some cases open data is spreading throughout the world. In parallel and sometimes seemingly contradictory to open banking/data, data privacy regulations such as GDPR[23] will become common. Personally Identifiable Information (PII) and other sensitive data must be protected while easy, secure access to systems must be available for authorized parties.

Consideration: Requires a payments system with field-level secure access through APIs. Data access rights must be configurable as policies and auditable by accredited third parties.

The always-on & off world

Whether domestic, or international e-commerce transactions completed by consumers, currency volatility hedging by a corporate treasurer, or a machine-to-machine payment like a car paying for recharging its batteries, bank-to-bank payments will be done 24x7. That said, payments must also work in remote areas without Internet connectivity and in disaster mode situations where electricity is unavailable for longer periods of time.

Consideration: Payments must settle 24x7 across multiple currencies. Both online and offline 24x7 scenarios must be supported.

International trade and commerce is growing inexorably

International trade is growing and accounts for an increasing percentage of aggregate GDP.[24] Factors contributing to this increased trade and commerce include:

- The rise of e-commerce, both as a means of distributing products sourced from abroad (e.g., Amazon) and as a means of reaching international audiences (e.g., Flipkart).
- Improved transportation and logistics systems which allow for faster and cheaper sourcing and delivery of goods.
- The emergence of digital services, where workers can create and produce digital goods thousands of miles apart (and collaborate and coordinate their efforts remotely).
- The continuing growth of international trade, whether for raw materials and inputs or finished goods arbitraging labor and skills advantages.

Consideration: Making cross-border payments more efficient is becoming critical as trade and commerce becomes increasing international.

International payments should leverage RTP systems

Whether businesses or consumers, payers are increasingly able to use RTP systems introduced in their respective countries. These payers want to use the same payments systems and interfaces for international payments.

Consideration: Local RTP systems should easily connect to other RTP systems. Beneficiary addressing schemes must be extensible and settlement across multiple currencies must be instant.

Key properties of a better payments system

The properties of a payment system that meets the requirements of today's payers and payees while considering the trends above, will be as follows.

Table 1. Payment system properties.

Property	Description
24x7	System is always available. Payments can be completed and settled at any time of day and any day of the year. System upgrades can be performed without downtime.
Instant settlement	Payments settle within a second. Includes interbank settlement in central bank money and settlement of cross-border payments.
High throughput	Handles peaks of tens of millions of payment transactions per second with millisecond latency.
Linear [infinite] scalability	System scales linearly as payment transaction volume increases.
Any asset for payment	System can use fiat money or any type of digital assets as payment.
P2P settlement	Settlement is performed between two banks directly instead of using a correspondent banking model.
Open APIs	Programmatic access to all of the payment system's relevant functions. Used by payment instruments such as web services, mobile and wearable apps, etc.
Digital identity	Payers, beneficiaries and third parties accessing the payment system must identify themselves electronically. Built-in or accessed through APIs to external digital identity systems.
Fraud prevention	Payment pre-processing using info associated with payer, beneficiary, source of funds, etc. Payment instruments rely on biometric authentication and authorization.
Sanctions screening	Capture all relevant payment data to facilitate synchronous screening of cross-border transactions. Built-in or accessed through APIs to external digital identity systems.

Property	Description
AML/CFT	Capture all relevant payment data to facilitate asynchronous screening. Built-in or accessed through APIs to external digital identity systems.
Biometric authentication and authorization	The payer can authenticate against the payment system and authorize payments using biometrics such as face recognition, fingerprint, or voice.
End-to-end security	All interactions with the payment system are digitally signed. Digital signatures are generated by each party's private key, only available in a secure element.
Real-time payment status	Payer and beneficiary can retrieve payment status at any time during, or after the transaction. Available through API.
Real-time reporting/alerts	Real-time reports accessible for predefined events and alerts sent for time-critical events. Available through API.
Interoperability	Add connectivity to other domestic and cross-border payment systems with minimum IT effort and alteration to customer experience.
Credit transfer	A payment pushed by the payer to the account of the beneficiary.
Debit transfer	A payment pulled by the beneficiary from the account of the payer.
Request-to-pay	A message from the beneficiary that requests the payer to push a payment from the payer's account to that of the beneficiary.
Confirmation of payee	Validate the beneficiary's ability to receive funds before the transfer is performed.
Confirmation of funds	Validate that the payer has sufficient funds in their account to complete the payment.
Offline payments	A payment pulled by the beneficiary from the account of the payer.
M2M payments	Allow machines to pay other machines without human interaction.
End-to-end fee transparency	Prior to payment execution, payer and beneficiary have access to information about any fees levied.
Message format agnostic	Support ISO20022, but can accommodate any alternative future message format.
Extensible design	A software architecture that easily allows new features to be added.

Digital money rail is deep payments innovation

M10 Networks (M10)[25] has developed a digital money rail that allows central banks and commercial banks to address payments modernization in a cost effective way. It's an account-based digital money system that can also allow anonymous and offline transactions to support use cases often thought to be best served with a value-based system. At the core of M10 is a shared, centralized and hierarchical ledger. The proprietary M10 ledger is built for high throughput and scalability. There is one ledger per currency. Each ledger tracks digital central bank money (M0) and commercial bank money (M1). All participating banks and their customers are on the same centralized ledger, but each bank can only see and manage their customers' accounts. This can be compared to today's model where each bank operates their own core banking system. The M10 ledger does not replace the bank's core banking system, but runs in parallel with it.

Banks on the M10 network effectively have two books:

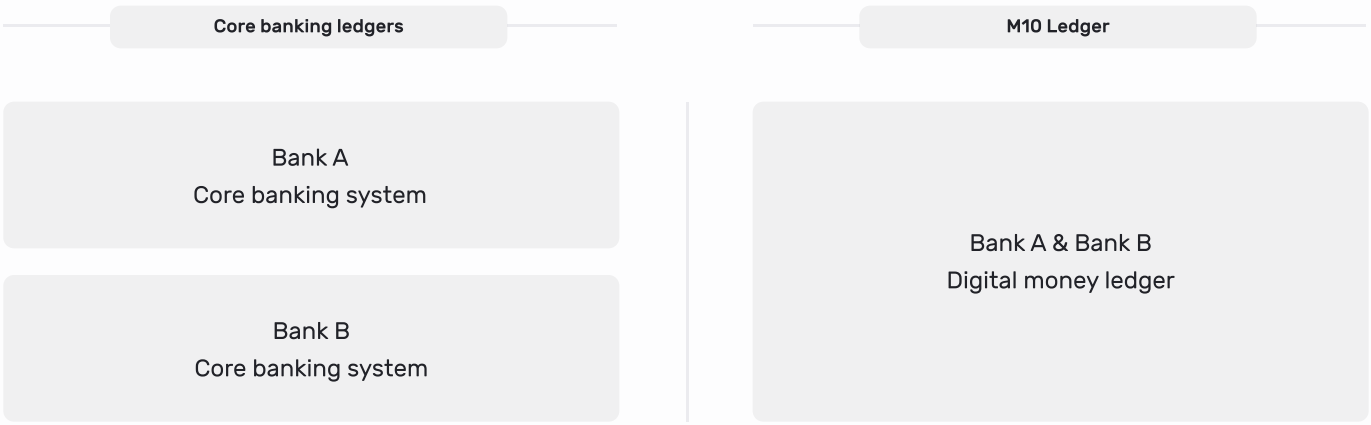


Figure 1. Parallel, independent systems.

The *shared* aspect of the digital money rail has multiple benefits. First, inter-bank settlement is instant. Second, it brings benefits in a similar way cloud computing vs. on-premise hosting of computing resources does — economy of scale and higher service level. The initial investment of joining the M10 network is low and is quickly recouped through lower operational cost, lower cost of liquidity and higher margin on payments revenue.

System roles

There are several participants in the M10 ecosystem, each with a defined role. A participant may fulfill one or multiple roles:

Role	Description
Operator	Runs the M1/M0 ledger + shared infrastructure.
Lead Sponsor	Holds Issuer funds in central bank account (CBA). Ideally the central bank, but can be a commercial bank appointed to be Lead Sponsor.
Sponsor	KYCs issuers.
Issuer	Bank or FI that provide their customers with digital money.
FX Sponsor	Bank who onboards issuers as FX clients. Sponsors do the FX for their clients.
FX Client	Bank who has onboarded to use the FX service.

Table 2. M10 system roles

Issuance

The ledgers in M10 represent both central bank money (M0) and commercial bank money (M1). Central banks can set the Liquidity Coverage Ratio (LCR) for its currency for all banks and/or for individual banks. The issuance of digital money is backed by a deposit. A deposit made by an issuer into the Lead Sponsor's central bank account results in the issuance of digital M0 money. See example in Figure 2.

1. Issuer A's central bank account is debited USD 100
2. The Sponsor's central bank account is credited USD 100
3. The Sponsor's M10 M0 ledger account is debited USD 100
4. Issuer A's M10 M0 ledger account is credited USD100

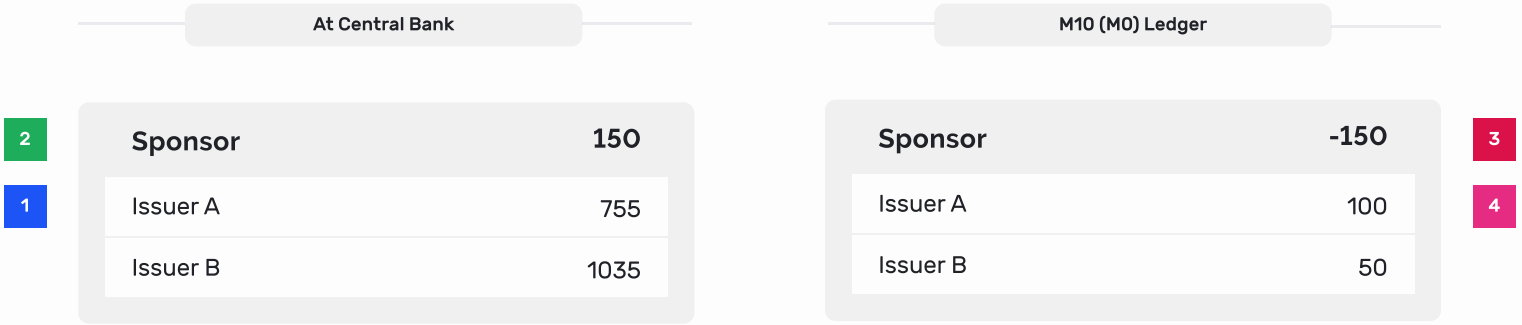


Figure 2. Issuance of digital central bank money. (Balances shown are before DB/CR).

The balance in the Sponsor's account at the central bank always equals the Sponsor's total liability on the M0 ledger.

There is no parent-child relationship between Sponsor and Issuers. Issuers are not account holders at the M0 Sponsor, but are peers in an M0 trust[26]. The trust is holding the participating Issuers combined assets in its name. The Sponsor is providing an account service to the trust and the ledger is the accounting service for the trust.

The ledgers can digitize other asset types (e.g. Treasury bonds) and express obligations enforced by the ledger system such as Delivery vs. Payment (DvP). This enables the system to support FX swaps and repos.

Moving funds between core banking and M10 ledgers

Like the issuance of digital central bank money, a customer may request that some part of her commercial bank account balance be converted to digital money on the M10 ledger. This does not affect the balance sheet of the bank as it moves part of the M1 liability of the bank from the bank's core banking ledger to the shared M10 ledger. For example, for a customer (Alice) who banks with Issuer A to move funds (e.g. USD 5) from her core banking account to her M10 USD ledger account requires four operations - the same process as when issuing M0 money:

1. Alice's core banking account is debited USD 5
2. Issuer A's core banking account is credited USD 5
3. Issuer A's M10 USD ledger liability is debited USD 5
4. Alice's M10 USD ledger account is credited USD 5

Going from digital money to core banking takes the reverse path.

Issuer A - Core Banking

Issuer A	**-225**
Alice	75
Bob	100
Charlie	50

M10 (M1) Ledger

Issuer A	**-80**
Alice	5
Bob	35
Charlie	40
Issuer B	**-65**
Denise	20
Eric	30
Fred	15

Figure 3. Loading a digital money account. (Balances shown are before DB/CR).

Note that the Issuer's liability to its customers is always equal to the sum of the customer account balances. E.g. see Issuer A in Figure 3 above: (-80) = 5 + 35 + 40.

Domestic payment instructions

Today, payments between two parties at the same Issuer settle on a bank's core banking system. It works the same way in M10. Payments between two parties that are customers of the same Issuer settle in the M1 money of that Issuer. However, to settle payments between customers of different Issuers, settlement must occur in central bank money. In the below example, Alice, a customer of Issuer A transfers USD 5 to Charlie, a customer of Issuer B. Both Issuers, Alice and Charlie have accounts on the M10 ledger.

1. Alice's USD M1 ledger account is debited USD 5
2. Issuer A's USD M1 ledger account is credited USD 5
3. Issuer A's USD M0 account is debited USD 5
4. Issuer B's USD M0 account is credited USD 5
5. Issuer B's USD M1 account is debited USD 5
6. Charlie's USD M1 account is credited USD 5

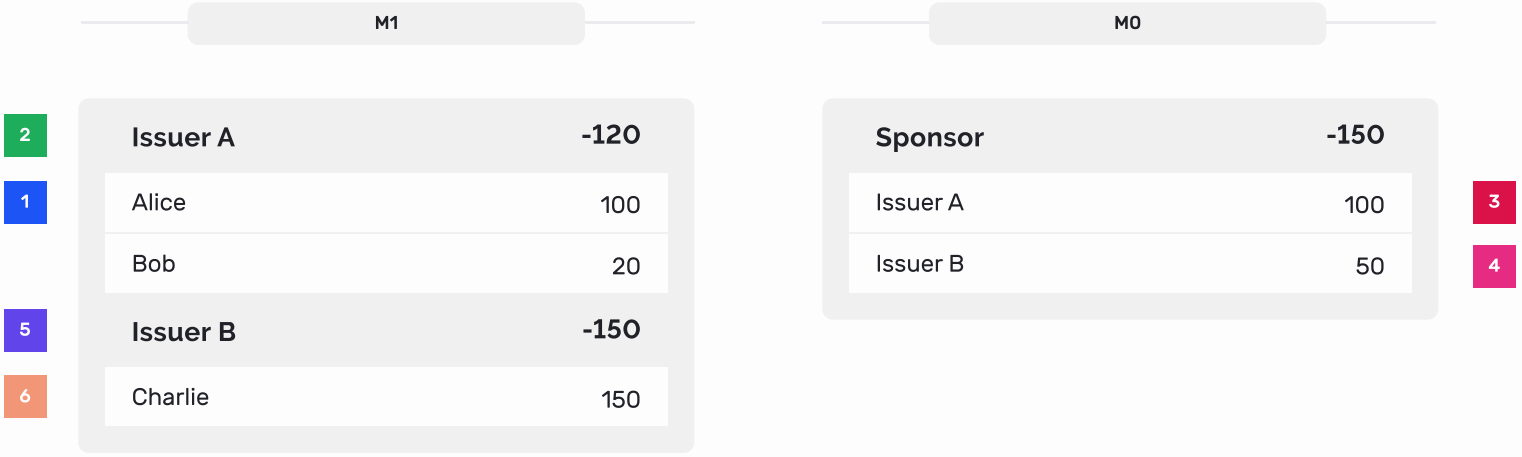


Figure 4. Interbank payment. (Balances shown are before the DB/CR).

Cross-border payment instructions

Moving funds between different banks and currencies can be done in multiple way.

Figure 5 shows the most common method.

Presume Alice wants to send EUR 10 to Jacques, a client of the French bank, Bank C. (For this example we assume a EUR/USD exchange rate of 1.10).

If desired, a bank can be the exclusive FX provider for its clients.

1. Alice's USD M1 ledger account is debited USD 11
2. Issuer A's USD M1 ledger account is credited USD 11
3. Issuer A's USD M0 ledger account is debited USD 11
4. FX Sponsor's USD M0 ledger account is credited USD 11
5. FX Sponsor's EUR M0 ledger account is debited EUR 10
6. Issuer A's EUR M0 ledger account is credited EUR 10
7. Issuer A's EUR M0 ledger account is debited EUR 10
8. Issuer C's EUR M0 ledger account is credited EUR 10
9. Issuer C's EUR M1 ledger account is debited EUR 10
10. Jacques' EUR M1 ledger account is credited EUR 10

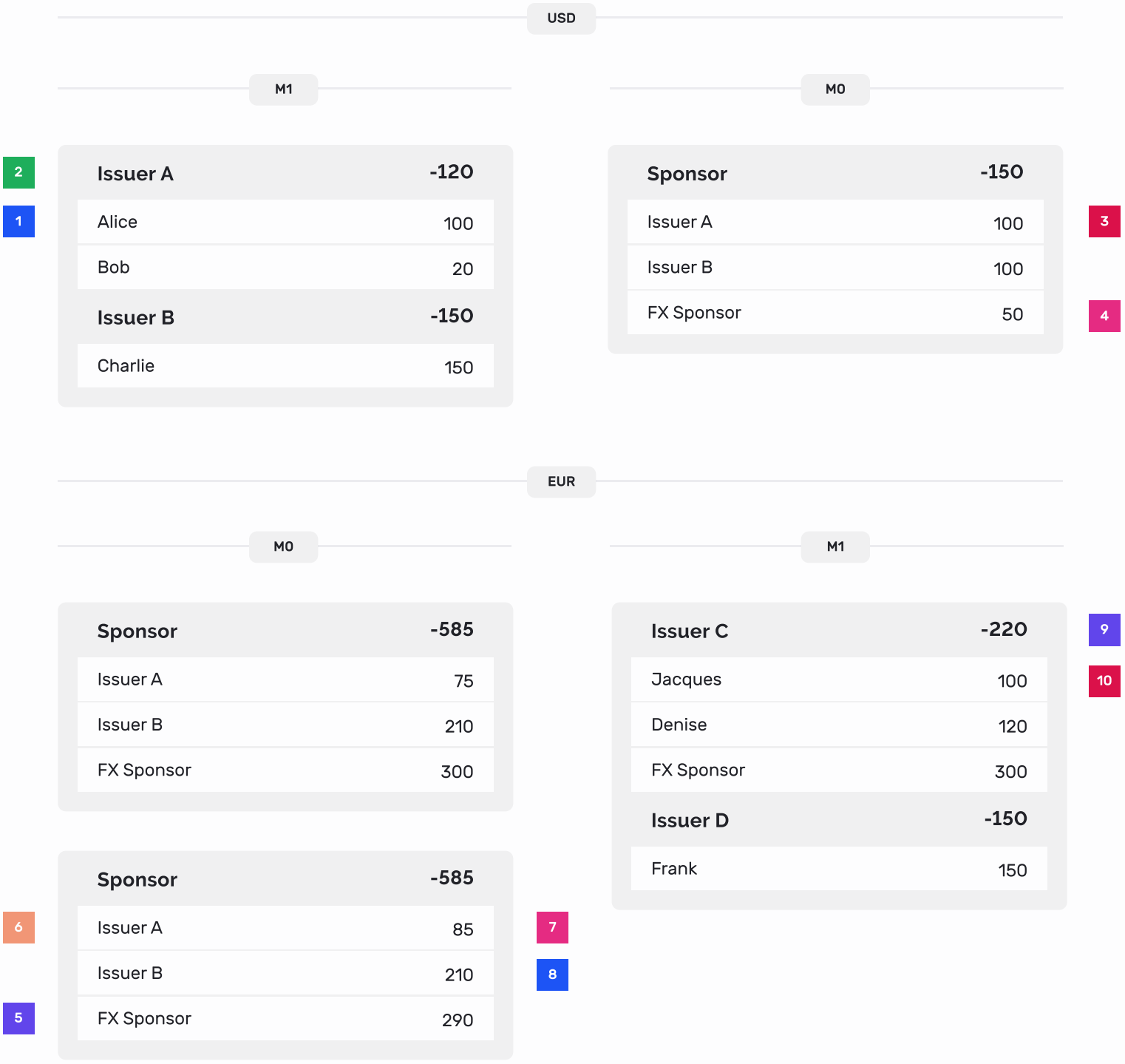


Figure 5. Interbank payment with FX. (Balances shown are before the DB/CR).

As can be seen in Figure 5, there are no nostro accounts. Each Issuer effectively has an account on multiple digital M0 money ledgers. If an Issuer is short of funds on one M0 money ledger, it can "top up" the account by doing a central bank transfer to the Sponsor, or performing an FX operation. E.g. If the Issuer is short EUR it can exchange M0 USD for M0 EUR.

Avoiding settlement risk

Settlement between commercial banks is performed in central bank money. Therefore, settlement risk is a function of how the M0 money backing the M0 funds on the M10 ledger are secured. There are 3 options:

1. The M0 ledger is 100% prepaid funds. In this scenario, an Issuer receives an M0 balance by funding the Sponsor's CBA ("trust account").

2. The M0 ledger uses Deferred Net Settlement (DNS). In this case, the M0 ledger starts at zero and the ledger tracks the net position of each Issuer. At the close, the Issuers must fund their liabilities or face a penalty.

3. A combination of 1 and 2 where Issuers pre-fund their account, but are also allowed an intraday credit line by the central bank commensurate with the amount of collateral the Issuer has on deposit with the central bank that is in excess of that used by the Issuer's traditional central bank account.

Option 1 is the default. There are 3 methods to mitigate settlement risk in option 1:

A. The central bank acts as the Sponsor.

B. A special purpose bank (narrow bank) whose only purpose is to hold funds for the Issuers is created.

C. A trust account is created with the participating Issuers being the trustors and beneficiaries, and a neutral trustee is selected who is bound to obey the determination of the ledger for fund allocation (or a super-majority of the beneficiaries).

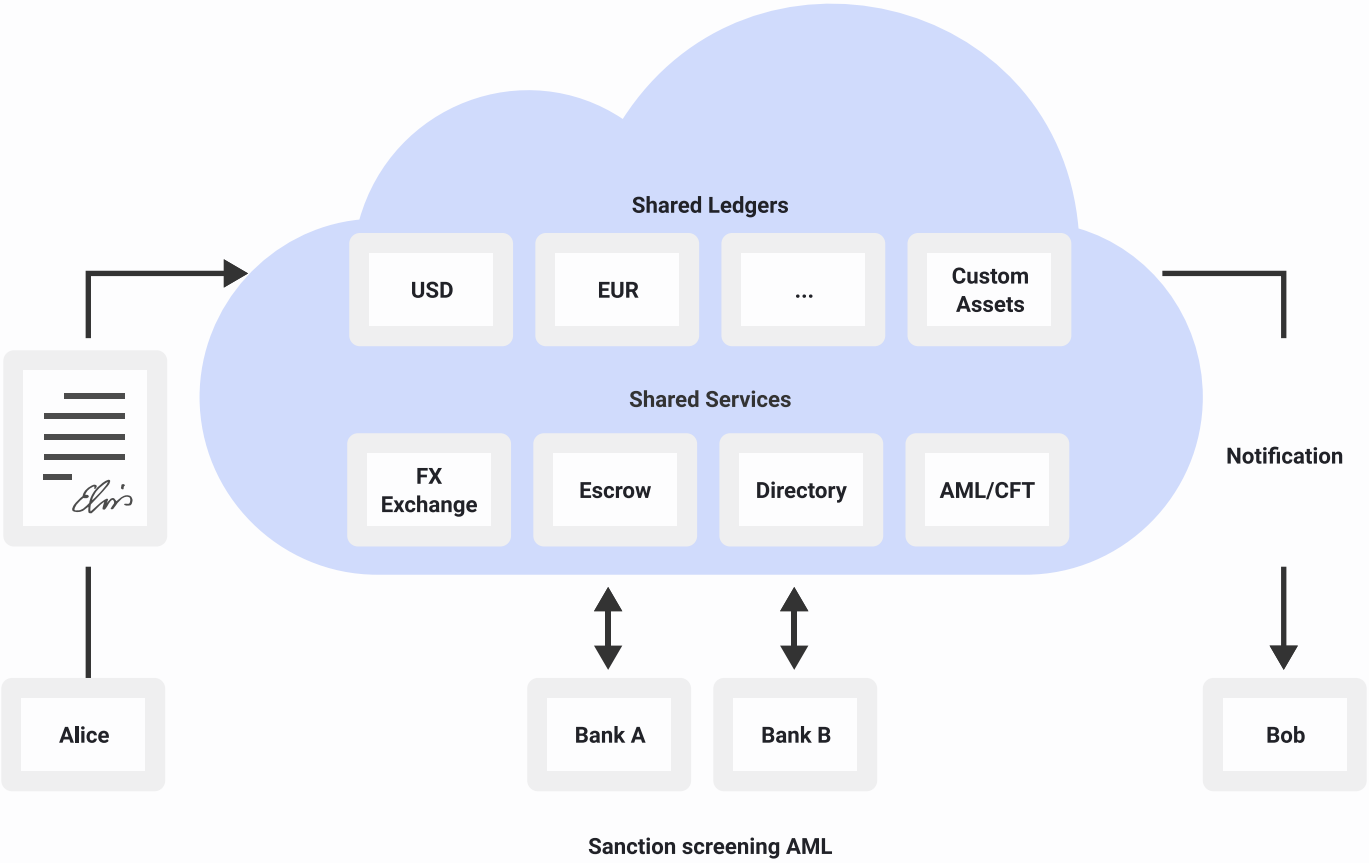
Multiple techniques can be applied to limit risk in a DNS scenario including credit limits per Issuer, multiple settlements each day, posting collateral, creation of a "default fund" etc., some of which can be enforced by the ledger.

System architecture

The M10 service is a hybrid cloud and on-premise solution. A bank service (software provided by M10) runs on premise at each Issuer and connects to the Issuer's core banking system. The M10 network scales linearly to process millions of ledger transactions per second. The ledgers are available 24x7 allowing payments to be settled instantly in the same currency, or across currencies.

Each ledger is hosted by a trusted party in multiple independent data centers where each data center validates its peers. Onshoring requirements are supported through hosting in the country associated with the currency. For more details about the infrastructure including failover, security, etc., please contact M10.

In addition to the ledgers, other shared services include Directory, FX Exchange, AML/CFT screening and more.



Regulatory compliance

M10 is a network that banks join as Issuers. The liability for regulatory compliance resides with the Issuers. Individuals and businesses participating in the M10 ecosystem have been on-boarded by their Issuer who is responsible for KYC. The ledger does include modules for AML/CFT and sanctions screening that can be used on behalf of participating Issuers as a further check on their own screening. Issuers can configure their own set of rules and define blacklists and whitelists. Issuers receive a stream of the transactions including all metadata in order to do the screening using existing tools and processes. During the payment flow, calls are made to Issuers' screening tools before payments are processed by the ledger.

Economics

Issuers pay license fees and per transaction fees to participate in the M10 network. Issuers set the transaction prices for their customers (payers and payees). M10 and M10 network service providers share the transaction revenue.

Minimal capital expenditure is incurred by Issuers. The cost of integrating M10 with an Issuer varies depending on the availability of core banking APIs. Maintenance is low as most functions reside in the cloud, or in the on-premise M10 server.

Evaluation process

Issuers can evaluate the M10 network with minimal IT effort. Suggested evaluation process:

Role	Description
Connect a core banking sandbox to the M10 test network	Validate functionality and integration steps.
Connect live core banking to the M10 network with limited accounts and transfer amounts.	Re-validate functionality in the live environment. Attain customer feedback.

Table 3. Evaluation process.

Digital money rail enables modern payments

The correspondent banking model is hierarchical. To send funds between banks at the bottom of the hierarchy you need to traverse up the hierarchy and then down the hierarchy to reach the destination. A digital money rail avoids the correspondent banking model and allows banks to transact directly with each other across currencies and where payments are settled instantly. See Figure 7.

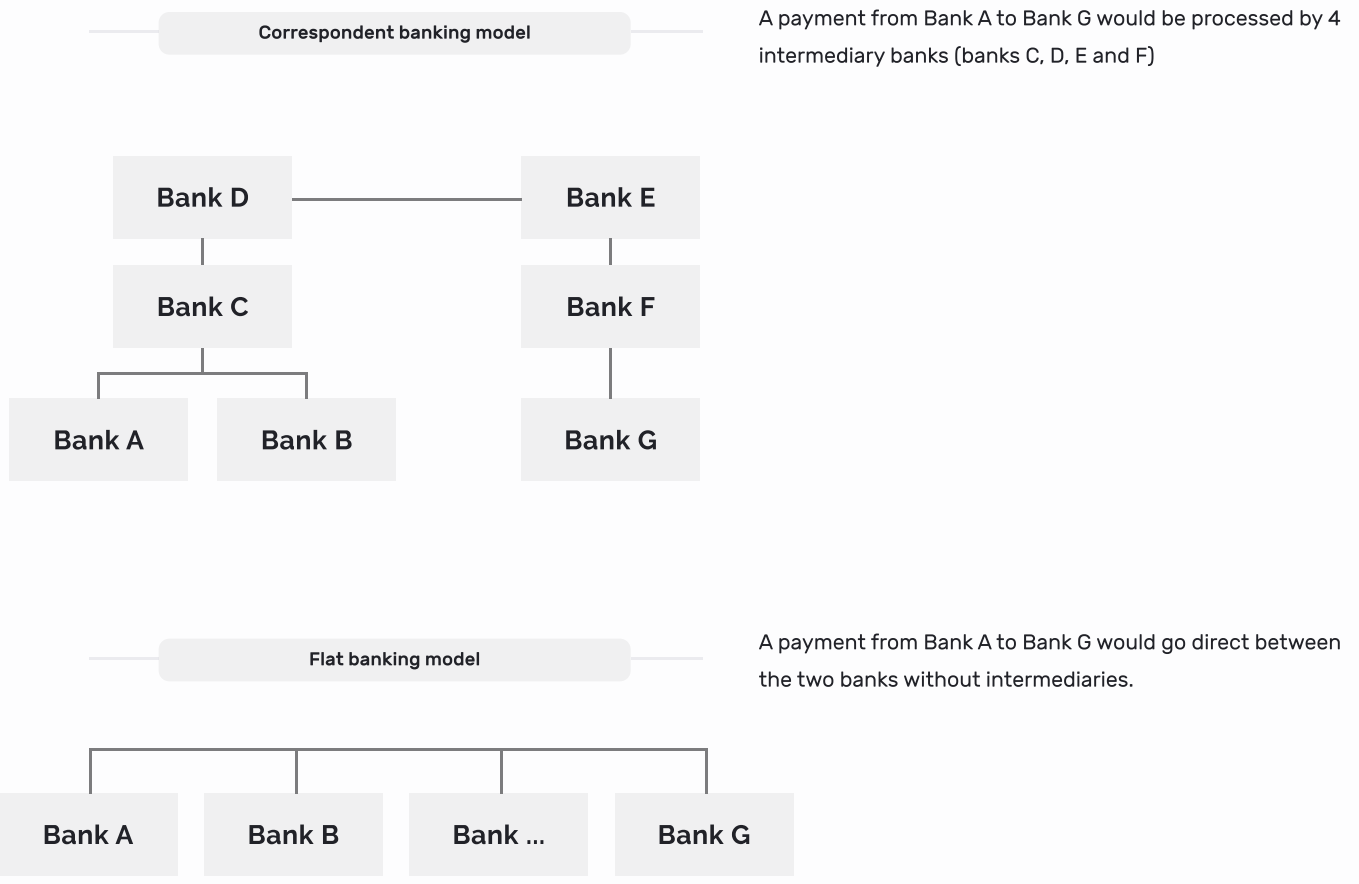


Figure 7. Replacing correspondent banking with flat structure.

Depending on the use case, the M10 network delivers significant benefits to users, issuers and countries:

Use case	Customer/ Biz User	Issuing Bank	Country
Intra-bank transfers (treasury management)	Bank's internal treasury department	Greater efficiency in managing cash balances in each country	Facilitates foreign banks doing business in emerging markets
Cross-border trade 2019 global flows: $133T[27] 2019 global revenues: $149B[27]	Faster payments at lower cost Lower risk Improved transparency and compliance	Retain corporate customers and attract new customers as they expand internationally	Increase international trade and increase GDP
Cross-border e-commerce 2019 global flows: $1.5T[27] 2019 global revenues: $37B[27]	Seller can more easily sell outside the country Consumers can more easily shop outside the country	Facilitates Cross-border merchant acquiring This sector is growing 23% YoY27	Increases volume of international e-commerce for merchants and consumers in the country
Cross-border disbursements 2019 global flows: $1.2T[27] 2019 global revenues: $18B[27]	Cheaper, faster and safer remittances for remote workers and payment recipients	Compete against private disbursement services; attract retail deposits	Increase GDP from remote workers Easier to regulate and tax
Cross-border remittance 2019 global flows: $0.5T[27] 2019 global revenues: $26B[27]	Cheaper, faster and safer remittances for overseas workers	Compete against private money transfer services; attract retail deposits	Increase GDP from overseas remittances Easier to regulate and tax

Table 3. Evaluation process.

Digital money rail as an RTP system

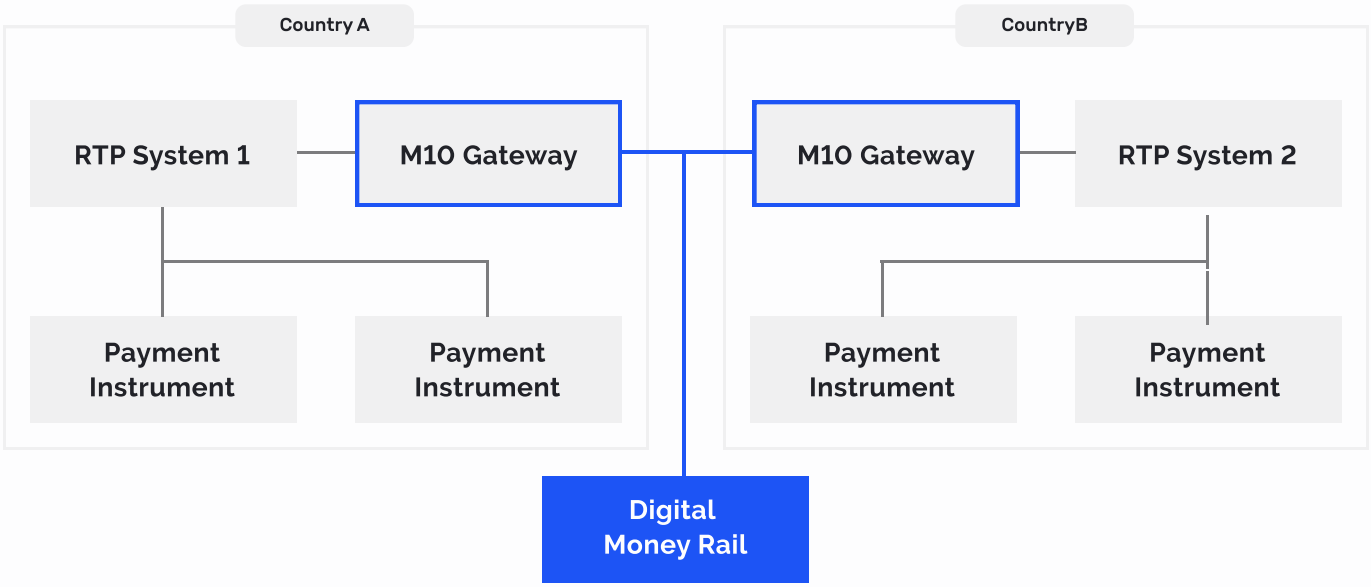
A digital money rail provides the critical functions required by an RTP system and adds valuable functions such as instant cross-border payments and open APIs. A digital money rail would coexist harmoniously with existing payment rails such as an ACH.

Countries which do not currently have an RTP can transition to RTP through the adoption of the M10 network protocols with low effort.

Digital money rail to bridge RTP systems

For countries with existing domestic RTP systems there is an opportunity to connect to other countries' RTP systems. This allows existing RTP payment instruments (e.g. mobile apps) to be used, thus requiring only minimal change to the customer experience. E.g. a user of PayNow in Singapore could send funds instantly to a Swish user in Sweden by simply entering the Swedish beneficiary's mobile phone number and the amount in SGD or SEK. The payment would settle instantly.

Figure 8. Digital money rail connecting two RTP systems.



Digital money rail as an alternative to CBDC

There are generally two types of CBDC: 1) “general purpose” CBDC; 2) “wholesale” CBDC. A general purpose CBDC means that the CBDC is offered to households directly by the central bank. A wholesale CBDC is used for payments between financial institutions only. A paper issued by ECB[28] listed the potential benefits of a CBDC and proposes a solution to two prominent arguments against CBDC, namely (i) risk of structural disintermediation of banks and centralization of the credit allocation process within the central bank and (ii) risk of facilitation systemic runs on banks in crisis situations.

The paper acknowledges that a general purpose CBDC might be a catalyst for the further shrinkage of bank balance sheets. The paper did not cover the operational impact for a central bank to serve households directly. This may in itself make a general purpose CBDC infeasible.

The main driver for central banks to investigate CBDC stems from the desire to provide more efficient retail payments. A digital money rail serves as a highly efficient retail payments system without the disadvantages of CBDC such as the operational challenges for central banks to serve household accounts and the risk of structural disintermediation.

Conclusion

Great advances have been made and are continuously being made to modernize payments infrastructure to meet demands. However, cross-border payments are still suffering from slow settlement times, lack of transparency and high cost. Banks must address these shortcomings, or watch themselves being disintermediated by new market entrants. Banks are challenged by new market entrants from the high-tech industry, by complex regulations and narrowing profit margins, so any attempt to modernize payments infrastructure must be done with as little disruption as possible to existing systems. Banks should address cross-border payments by adopting a digital money rail that interacts seamlessly with existing systems. It is the fastest and most cost effective way for banks to meet customer demands of today and tomorrow.

M10 proposes that banks meet these critical demands with a parallel ledger system available 24x7 that allows issuance of fungible digital money where settlement is performed in central bank money. This allows transfer of funds globally in any currency with instant settlement. This is possible because there is no longer a reliance on correspondent banking and nostro accounts.

About M10 Networks

M10 Networks is solving the problems associated with transferring money globally, so people worldwide can do business without friction.

M10's bank-grade digital money rail enables banks to increase their financial agility and evolve a new suite of transfer services for their corporate and retail customers. It allows banks to use digital money instead of conventional payment systems to perform transfers, settlements and remittances instantly and at a low cost.

M10 was founded by serial Silicon Valley entrepreneur, Steve Kirsch, who has invented several groundbreaking internet technologies and has had a number of highly successful exits.

M10 is located in San Mateo, California.

For further information, please visit www.M10.io.

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from local to regional, national or international, banks struggled to settle with one another. With the emergence of national banks in New York and London, regional banks increasingly moved to opening nostro accounts in these money center banks. This facilitated settlement between two regional banks, using their respective nostro accounts. John A. James and David F. Weiman, From Drafts to Checks: The Evolution of Correspondent Banking Networks and the Formation of the Modern U.S. Payments System, 1850-1914 (June 2006)

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