Business applicability report

Contents

Executive summary[1]

As the regulated financial services industry continues to assess how to best serve the evolving needs of a global, always-on economy, reliance on traditional, legacy infrastructures has made it challenging to realize the true benefits that new forms of technology could provide to the industry. While legacy infrastructures have proven to be resilient and time tested, the industry continues to explore how alternative operating models can offer new functionality, lower costs, and enable a range of new capital markets products, services, and functions. In particular, the industry sees the potential of developing an always-on, multi-asset, and interoperable settlement infrastructure that may allow for further modernization, innovation, and resiliency within the regulated financial services industry.

The Regulated Settlement Network (RSN) proof of concept (PoC) is an industry initiative built upon the foundation established within the Regulated Liability Network (RLN) US PoC[2] conducted in 2023 by a subset of US financial institutions. The purpose of the RSN PoC was to explore how tokenized securities and tokenized central bank and commercial bank deposits could be deployed within a financial market infrastructure (FMI) leveraging shared ledger technology to advance settlement capabilities in comparison to existing infrastructures. The subsequent RSN PoC set out to:

- **Support a multi-asset network.** The RSN included various asset types, including tokenized central bank deposits, commercial bank deposits, tokenized securities, bonds, and other regulated securities within a single shared ledger.

- **Facilitate enhanced interoperability.** The RSN aimed to promote interoperability across different tokenized financial networks with the goal of enabling seamless and efficient processing and settlement capabilities. Interoperability was a key element of the PoC, enabling the RSN to connect with other regulated third-party networks, ensuring that cross-network transactions can achieve legal finality of settlement. This capability may enhance the efficiency of cross-network transactions and also support the settlement of securities, bonds, and other regulated assets across diverse networks in tokenized central bank deposits.

- **Ensure 24/7 operation.** Leveraging the benefits of shared ledger technology, the RSN could be a candidate to support the global economy, which requires continuous availability, allowing economic actors to contract and settle obligations precisely and at any time.

1 The New York Innovation Center (NYIC) at the Federal Reserve Bank of New York was a technical observer in this PoC, and its role in this project was narrowly focused on observing the participants' research and experimentation. The content of this report, including any potential regulatory or supervisory frameworks for the RSN, and the Federal Reserve's legal authority to participate in RSN or any similar arrangement, does not necessarily reflect the views of the Federal Reserve Bank of New York or any other parts of the Federal Reserve System.

2 Regulated Liability Network US Proof of Concept Findings.

The RSN hypothesis

The RSN PoC explored the application of shared ledger technology to regulated assets and deposits to deliver programmable, simultaneous, and coordinated legal settlement finality on a 24/7 basis. The PoC assumed the existence of a two-tier financial system of central bank and commercial bank deposits, incorporating tokenized central bank deposits and commercial bank deposit tokens. Additionally, the RSN included delivery versus payment (DvP) and the settlement of securities, bonds, and other financial assets, all within a shared ledger operated by a new, hypothetical FMI. The RSN aimed to provide seamless integration with other networks, potentially providing a comprehensive and efficient settlement solution for the global financial ecosystem.

The RSN PoC looked to demonstrate the benefits of shared ledger technology when delivered within the existing traditional monetary system and how such characteristics could modernize the regulated financial services industry.

Preserved attributes of regulated financial services

- Operators licensed by official governmental agencies.

- Two-tier monetary system consisting of central bank and commercial bank deposits, preserving the singleness of money.

- Sanctions, know your customer (KYC), anti-money laundering (AML), combating the financing of terrorism (CFT), and other regulations and standards.

- Governance and risk management functions provided by intermediaries such as central security depositories (CSDs) and central counterparties (CCPs).

- Insured deposit accounts.

- Clear legal framework governing both cash and securities.

Distinct benefits provided by shared ledger technology:

- Common source of truth: Provides enhanced data consistency and transparency, reduces the need for manual reconciliation processes, and maintains a consistent and auditable data trail for RSN member banks.

- Simultaneous settlement capabilities: Reduces settlement and counterparty risk by ensuring transactions are settled in real time, improving liquidity management, and overall settlement efficiency.

- Programmable settlement capabilities: Enables automation of various steps within the settlement process, reducing manual intervention and potential fat finger errors throughout the settlement life cycle.

- Immutability: Ensures the integrity, reliability, and auditability of data.

- Enhanced reliability: Allows for continuous market operations.

The hypothesis of the RSN is that combining the beneficial capabilities of shared ledger technology with the positive attributes of the existing regulated financial services industry could lead to the creation of a common industry settlement solution that serves the evolving demands of the financial services industry. Should the above be feasible, the RSN could provide an always-on, interoperable, and programmable industrywide settlement infrastructure that could alleviate a number of the existing risks and challenges faced today.

The RSN proof of concept (PoC)

To test the hypothesis of the RSN, a subset of market participants from the public and private sectors convened within the RSN PoC to explore whether tokenized US dollar central bank and commercial bank deposits, and tokenized securities within a shared ledger FMI, might provide benefits beyond what can be achieved by traditional settlement systems.

Participants in the RSN PoC

Working group participants include:

- Citi
- J.P. Morgan
- Mastercard
- Swift
- TD Bank N.A.

- U.S. Bank
- USDF
- Visa
- Wells Fargo
- Zions Bancorp

Project contributors

- BNY Mellon
- Broadridge
- DTCC
- The International Swaps and Derivatives Association (ISDA)
- The MITRE Corporation
- Tassat Group

Technical observer
The New York Innovation Center (NYIC) at the Federal Reserve Bank of New York

Program manager
Securities Industry and Financial Markets Association (SIFMA)

Advisor
Deloitte & Touche LLP provided advisory services to SIFMA

Technology provider
Digital Asset

Law firm
Sullivan & Cromwell LLP

How the POC was conducted

Category	In Scope	Out of Scope
Currency	• USD only	• Non-USD
Legal Instruments	• Tokenized commercial bank deposits, tokenized central bank deposits, US Treasury securities, and investment-grade (IG) bonds	• CBDCs, cryptocurrencies, stablecoins, e-money tokens, and other digital assets
PoC participants	• US-based, regulated financial institutions	• Non-US-based regulated institutions • Non-regulated institutions
Use cases	• Client-to-client IG bond DvP settlement • Centrally cleared dealer-to-dealer treasury DvP settlement • Cross-network DvP settlement • Cross-network correspondent bank settlement • Cross-network intraday repurchase (repo) agreement settlement	• Retail use cases • Decentralized finance • Participation of end users (e.g., corporate clients)
Types of blockchain	• Private, permissioned networks	• Public, permissionless networks
Technology environment	• Sandbox only • GUI access only • Interoperability with other third-party networks	• Connection to bank systems

Use cases

The RSN working group tested two scenarios to explore potential settlement improvements in comparison to existing processes. The two scenarios explored were:

1. Multi-asset delivery versus payment (DvP) settlement

2. Cross-network settlement

Between the two scenarios, five individual use cases were analyzed:

3. Multi-asset DvP settlement

   • Client-to-client investment grade (IG) bond DvP settlement: Simultaneous settlement for IG bond DvP settlement within the RSN FMI. This use case explored whether the RSN could serve as a simultaneous settlement infrastructure in which transfers in ownership of IG bonds were settled through theoretical tokenized central bank deposits.

   • Centrally cleared dealer-to-dealer treasury DvP settlement: Deferred settlement for centrally cleared treasury DvP settlements within the RSN FMI. This use case explored whether the RSN could provide precise, dynamic settlement capabilities and preserve the positive benefits provided through transaction netting while also complying with the upcoming SEC Treasury Clearing mandate.

4. Cross-network settlement

   • Cross-network DvP settlement: Multi-asset settlement initiated off the RSN through an interoperability solution with an external network. The RSN aimed to provide coordinated settlement finality in tokenized central bank deposits and to coordinate off-RSN multi-asset settlement.

   • Cross-network correspondent bank settlement: Interbank settlement for transactions initiated off RSN member banks leveraging RSN settlement agent banks to achieve coordinated settlement in tokenized central bank deposits for commercial bank transactions initiated off the RSN.

   • Cross-network intraday repurchase (repo) agreement settlement: Intraday repo DvP transaction initiated off the RSN with both legs of the repo transaction being settled simultaneously on the RSN.

POC findings

Business applicability findings

Multi-asset and cross-network settlements could be enhanced through a shared ledger FMI that consists of tokenized securities and tokenized central bank and commercial bank deposits where each institution operates its own partition.

The working group concluded that the creation of an FMI that encompasses the above characteristics could alleviate a number of existing challenges today, such as infrastructure fragmentation, lack of visibility into settlement status, and the need for manual intervention at various points throughout the settlement life cycle.

The result may provide the financial services industry a common settlement infrastructure that is always on, programmable, and offers precise settlement capabilities to allow financial institutions to realize enhanced collateral and liquidity optimization.

Technical feasibility findings

The PoC achieved simultaneous DvP settlement of securities and regulated assets within the RSN system. The shared ledger technology enabled synchronized balance sheets across participants, eliminating traditional delays associated with proprietary databases and batch processing. The RSN design supports various asset classes on a single ledger, demonstrating the scalability and versatility required for modern financial transactions. The system successfully prototyped tokenized central bank deposits, tokenized commercial bank deposits, tokenized securities, and bonds within a unified framework.

The PoC showcased integration of multiple networks, enabling synchronized settlement across diverse platforms. By leveraging interoperability solutions, such as the Swift interlinking prototype and direct API integrations, the RSN demonstrated its capability to connect with other DLT solutions and construct complex use cases involving the RSN as a settlement venue.

Legal viability findings

It is likely that an operational RSN could be designed under existing legal frameworks. The legal analysis did not identify any issues that would prevent the creation of the RSN as contemplated within the PoC, although further analysis and engagement with regulators would be required before any final conclusions can be reached. In particular, there may be complexities under existing legal frameworks in regulating a system that includes holding and transfers of both deposits and securities, and these complexities would need to be addressed further in a later phase. In this regard, due to the securities nexus, additional discussions and likely registration or exemption with the SEC will need to be addressed.

The use of shared ledger technology to record and update ownership of central bank and commercial bank deposits and securities entitlements should not alter the legal treatment of the assets or transfers of them, and the tokens used by each respective RSN member will not have independent legal significance that would be subject to new regulatory requirements beyond those otherwise applicable to deposits and securities. For each of the use cases explored in the PoC, the RSN should be able to provide settlement finality at a specified point, including at a point synchronized with a third-party regulated network.

Opportunities for further research after RSN

The working group determined that the RSN is a candidate design for such a network but recommends a fuller exploration of the design space through a dedicated feasibility study encompassing—but not limited to—non-functional requirements, financial and business requirements, operational and functional requirements, and legal and regulatory requirements. This study would further engage the wider financial services industry, encompassing front- and back-office personnel and should be performed as a public-private collaboration, bringing together appropriate stakeholders and gathering inputs from end users.

Based on the findings of the PoC, the working group will continue to drive discussions with the public sector on industry advocacy around specific regulatory gaps within the United States. Additionally, the RSN program manager, SIFMA, intends to continue the dialogue around the concept of a shared ledger FMI through its industry forums to identify opportunities to operationalize the RSN concept.

The working group was encouraged to learn that a shared ledger FMI that consists of tokenized securities, central bank deposits, and commercial bank deposits could provide a common industry settlement infrastructure that supports simultaneous and precise settlement capabilities to the financial services industry. The working group also identified meaningful use cases where existing market infrastructures might be transformed through the potential application of a shared ledger FMI.

Introduction

Building upon the findings of the Regulated Liability Network (RLN) proof of concept (PoC), a subset of members from the US financial services industry reconvened to test the hypothesis of the Regulated Settlement Network, a 24/7 settlement network for multi-asset and cross-network transactions.

Considering the RLN US PoC focused on a shared ledger financial market infrastructure (FMI) consisting solely of tokenized central bank and commercial bank deposits, the working group set out to evaluate the value of a single, shared ledger system that brings both cash and securities into a single settlement system paradigm. As the network now included more than just tokenized cash, the working group named this effort the Regulated Settlement Network (RSN), a common settlement infrastructure for multi-asset and cross-network transactions that has the potential to modernize the regulated financial services industry and establish the next generation of market infrastructure. The PoC looked to cover three aspects of the RSN:

• Business applicability

• Legal viability

• Technical feasibility

This report presents the findings of the RSN's business applicability, in which the potential business benefits of such a network were explored.

The RSN PoC examined the application of shared ledger technology to execute multi-asset transactions for tokenized regulated securities, central bank deposits, and commercial bank deposits to deliver programmable, flexible settlement capabilities within the existing US regulatory framework.

Within the scope of the PoC, the working group recognized the practical challenges of introducing a single multi-asset infrastructure, and hence, two separate scenarios were explored:

• Multi-asset delivery versus payment (DvP) settlement

• Cross-network settlement

For the multi-asset DvP scenario, two use cases were tested to evaluate the benefits and considerations of tokenized central bank and commercial bank deposits and tokenized securities residing on the same multi-asset ledger. The Working Group sought to validate whether simultaneous settlement capabilities on the RSN could be achieved and that the technology could scale to different types of cash and securities:

• Client-to-client investment grade (IG) bond DvP settlement

• Centrally cleared dealer-to-dealer treasury DvP settlement

The cross-network settlement scenario tested three use cases to examine whether the RSN could serve as a settlement venue for interbank asset exchange between both RSN member banks and non-RSN member banks leveraging an interoperability solution. By testing these use cases, the working group was able to consider the viability of an interoperable model that would provide opportunities to demonstrate coordinated settlement capabilities and scalability with other regulated third-party networks:

• Cross-network DvP settlement

• Cross-network correspondent bank settlement

• Cross-network intraday repurchase (repo) agreement settlement

For each use case, current financial system processes served as a baseline. The use cases were then simulated in a technical sandbox and compared to their respective baselines. The remainder of this report will detail the key findings, benefits, and recommendations across each use case and for the broader RSN FMI concept.

Problem statement

In the current state of the financial services industry, the settlement of securities transactions remains a complex and time-sensitive process, which can lead to inherent inefficiencies and risks to market participants.

The legacy security settlement process involves the transfer of ownership of securities, which typically occurs the day following the execution of a trade (T+1 in the United States). Existing market infrastructures are composed of clearing systems (central counterparties), settlement systems (securities settlement systems, central securities depositories, large-value payment systems), and trade repositories, among others. As each institution operates its own siloed, proprietary ledger representing its assets and liabilities, fragmentation remains between legacy systems. While legacy settlement infrastructures have

been able to successfully adapt to reduced settlement times in recent years, opportunities to modernize the settlement process and allow the industry to achieve efficient, precise settlement capabilities still remain. Persistent risks in security settlement include, but are not limited to, the prevalence of siloed databases and incompatible, difficult-to-update legacy systems.

To move toward a more efficient and resilient settlement ecosystem, the industry should consider prioritizing the modernization of its infrastructure, embracing new technologies and streamlined processes that can help mitigate existing risks and enhance overall market stability.

The RSN hypothesis

Various industry initiatives across the globe have been undertaken or are underway to test how shared ledger technology may resolve existing risks and challenges faced by the financial services industry. Initiatives such as Project Agorá,[3] the United Kingdom Regulated Liability Network (UK RLN),[4] and Global Layer One (GL1)[5] are exploring the concept of a unified, shared ledger infrastructure as articulated by the Bank for International Settlements (BIS) unified ledger[6] and Finternet papers.[7]

The RSN PoC also tested the concept of a shared ledger infrastructure; however, the RSN working group set out to specifically test how multi-asset and cross-network settlements could be enhanced through the use of shared ledger technology by improving the synchronicity and transparency among participating firms and enabling parallel, pre-settlement processing while preserving existing privacy standards. At the beginning of the PoC, the working group identified a set of hypotheses that served as a baseline across each of the in-scope use cases:

- Could shared ledger technology improve the coordination and orchestration of financial settlements due to each institution within the RSN maintaining their respective institutions' books and records, reducing settlement delays and the reconciliation process?

- Are transactions that are unique to each party able to preserve existing privacy standards and be stored as an immutable record on a partitioned, shared ledger infrastructure rather than in siloed, proprietary ledgers?

- Can a shared ledger FMI reduce settlement risk while providing real-time liquidity management and visibility capabilities?

- Is settlement finality for multi-asset and cross-network transactions able to be achieved in real time or when specific transaction parameters are met on a 24/7 basis?

- Is the FMI able to support programmability through the implementation of smart contracts consisting of business and contractual logic, leading to automation of manual steps within the trade life cycle?

- Can non-RSN market participants operating on third-party networks still benefit from the RSN's 24/7 settlement capabilities through the use of a correspondent banking model?

With the above questions in mind, the RSN working group wanted to understand if an FMI leveraging shared ledger technology can improve current settlement infrastructures while also preserving the positive attributes of the regulated financial system. By bringing multiple regulated institutions on the same shared system of record while maintaining privacy requirements through the use of institutional-specific partitions, regulated financial institutions may realize increased transparency into liquidity and collateral positions, and improved operational efficiency—and may provide new functionality that meets the demand of an always-on, 24/7 global economy.

To test the applicability of shared ledger technology to the regulated financial services industry, the working group prototyped a theoretical FMI. This prototype simulated tokenized central bank and commercial bank deposits, and select US regulated securities to understand what enhancements such a network could provide in comparison to legacy systems.

Key characteristics of the regulated financial system that the RSN working group looked to preserve within the shared ledger FMI were:

- Time-tested rules and regulations (e.g., AML, KYC considerations).

- Market participant roles and responsibilities (e.g., Federal Reserve, custodian banks, commercial banks, central counterparties).

- A stable, sovereign currency providing a two-tier system of central and commercial bank deposits.

- A current commercial law framework that continues to apply for both tokenized payments and securities.

Should these characteristics be maintained, the result might provide a public-private, sovereign-currency banking infrastructure for multi-asset and cross-network transactions that reinforces central bank money as the preferred settlement asset for interbank transactions.

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3 Bank for International Settlements (BIS), "Private sector partners join Project Agorá," September 16, 2024.

4 UK Finance, "Regulated Liability Network," September 2024.

5 Monetary Authority of Singapore, *Global Layer One: Foundation layer for financial networks*, June 2024.

6 BIS, "Blueprint for the future monetary system: Improving the old, enabling the new," in *BIS Annual Economic Report 2023*, June 20, 2023, pp. 85–118.

7 Agustín Carstens and Nandan Nilekani, Finternet: *The financial system for the future*, BIS Working Papers No. 1178, April 15, 2024.

 "The project is a valuable opportunity to explore the potential of distributed ledger technology (DLT) to support responsible innovation. It brings public and private sector participants together to explore how this technology can be applied to develop innovative solutions for regulated products capital markets. The project highlights the many opportunities for DLT to drive greater efficiency, flexibility, and resiliency in the capital markets."

Charles de Simone,
Managing Director and Deputy Head of Technology, Operations, and Business Continuity, SIFMA

Potential benefits of RSN

Adoption of the RSN may represent a real-time, asset-agnostic, and scalable settlement network that creates a unified ecosystem for market participants aided by real-time visibility and flexible settlement capabilities. Potential benefits that were identified due to the design considerations of the RSN include:

- **Availability*:** 24/7 operation.

- **Settlement finality*:** Capable of end-to-end legal finality of settlement.

- **Efficiency*:** Upfront identification of exceptions and errors, reducing reconciliations, and manual intervention.

- **Interoperability:** Achieve broader reach to non-RSN institutions and tokenized third-party networks.

- **Resilience and security*:** Shared ledger architecture could strengthen FMI resilience, while maintaining robust data protection capabilities offered by the financial system today, and reduce a potential single-point-of-failure risk.

- **Programmability*:** Automation through on-ledger business logic.

- **Extensibility to other regulated financial institutions:** Inclusion of regulated non-RSN member banks through the use of a correspondent banking model and interoperability solution.

- **Multi-asset:** Capable of representing and settling different financial instruments on the same network.

- **Precise settlement capabilities:** Provides firms the ability to settle simultaneously, in real time or at a later agreed-upon time by financial institutions, to allow for precise settlement capabilities, reducing settlement risks and delays in achieving settlement finality.

- **Collateral optimization:** Inclusive of multiple CSDs, custodian banks, regulatory agencies, and commercial banks to allow for the seamless movement of tokenized collateral across various institutions on an as-needed basis.

- **Reduction in infrastructure fragmentation*:** Brings various financial institutions into a single, shared ledger FMI.

- **Better liquidity management:** Real-time visibility into a firm's collateral and cash position while not relying on batch cycles can allow firms to better manage their liquidity and optimize collateral.

- **Unlocking new use cases and novel financial products:** Real-time and dynamic settlement capabilities can offer firms the ability to provide new products and services to their client base, such as intraday repos to provide intraday funding.

*Extended benefit from RLN to RSN.

The RSN proof of concept

Building upon the RLN PoC, the RSN PoC looked to introduce various types of tokenized securities to the network to test how tokenized multi-asset and cross-network settlements may be achieved through the use of shared ledger technology and an interoperability solution. Throughout the PoC, subject matter experts across the financial services industry collaborated across a variety of use cases to test the hypothesis that shared ledger technology may enhance how tokenized multi-asset and cross-network transactions are settled.

Among participating US regulated financial services institutions, the PoC simulated multi-asset DvP settlement and cross-network settlement finality use cases that are settled in a common infrastructure using theoretical tokenized central bank deposits.

RSN PoC participants

The RSN PoC brought together market participants from the public and private sectors to gain further consensus on the use of shared ledger technology in the US financial system.

The Securities Industry and Financial Markets Association (SIFMA) served as program manager for the RSN PoC. RSN working group participants in the PoC included Citi, J.P. Morgan, Mastercard, Swift, TD Bank N.A., U.S. Bank, the USDF Consortium, Visa, Wells Fargo, and Zions Bancorp. Project contributors were engaged to provide expertise of specific roles that each institution plays in the market today. Contributors for the PoC included BNY Mellon, Broadridge, DTCC, International Swaps and Derivatives Association (ISDA), MITRE Corporation, and Tassat Group.

The working group was supported by the law firm Sullivan & Cromwell LLP, technology provider Digital Asset, and Deloitte & Touche LLP, who provided advisory services to SIFMA.

The New York Innovation Center (NYIC) at the Federal Reserve Bank of New York was a technical observer in this PoC, and its role in this project was narrowly focused on observing the participants' research and experimentation. The content of this report, including any potential regulatory or supervisory frameworks for the RSN, and the Federal Reserve's legal authority to participate in RSN or any similar arrangement, does not necessarily reflect the views of the Federal Reserve Bank of New York or any other parts of the Federal Reserve System

"RSN has built upon the previous RLN work to explore the potential of a multi-asset settlement platform. Traditional finance relies on dedicated settlement infrastructures for each type of asset. However, shared ledger technology may offer an opportunity to break away from isolated systems, creating a platform where all regulated financial instruments could potentially be settled around the clock with legal finality of settlement. In the RSN project, we have charted a possible course to a more general-purpose venue for the settlement of regulated digital assets"

Nick Dent, Global Head of Flow Financing, Citi

"The RSN initiative proved that distributed ledger technology can provide significant efficiencies for a variety of use cases across multiple networks, operated by different entities, through tokenization of existing regulated money/assets. These complex transactions currently require a patchwork of supporting platforms, but RSN proved that doesn't need to persist."

Jon Prendergast,
Head US Payments Strategy,
TD Enterprise Payments

PoC scope

Category	In scope	Out of scope
Currency	• USD only	• Multicurrency
Legal instruments	• Tokenized central bank deposits, tokenized commercial bank deposit, tokenized US Treasury securities, and other tokenized assets	• Retail CBDC, cryptocurrencies, stablecoins, e-money tokens
PoC participants	• US-based, regulated participants	• Non-US-based regulated institutions • Non-regulated institutions
Use cases	• Investment-grade (IG) bond DvP • Centrally cleared treasury DvP • Interoperable interbank DvP • Interoperable interbank PvP • Interoperable intraday repo	• Retail use cases • Decentralized finance use cases
Technology environment	• Sandbox only • GUI access • Functional and select non-functional requirements	• Connection to bank legacy systems
Legal analysis	• Existing legal and regulatory framework analysis	• Formal legal opinion • Future considerations of potential policy recommendations
Governance	• Preliminary discussions of potential RSN Rulebook rule book and future-state market infrastructure	• Full consideration of potential RSN compliance with the Principles for Financial Market Infrastructures (PFMIs), and the development of an RSN Rulebook rule book.
Access to central bank money	• Existing access criteria to central bank money	• Expanded access to central bank money
Access to US securities	• Existing access criteria to US securities	• Expanded access to US securities
Security Ownership Structure	• Intermediated holding system	• Direct holding system
Wallet structure	• Hosted wallets	• Self-hosted wallets
Customer data	• Simulated, dummy data	• Live, real-value transactions
Settlement mechanism	• Real-time gross settlement • Dynamic settlement • Net settlement	• Liquidity savings mechanisms
Types of blockchains	• Private, permissioned networks	• Public, permissionless networks

Role of tokenized central bank and commercial bank deposits in the RSN PoC

Central bank money plays a crucial role in the global financial system as a safe settlement asset and store of value. In the United States, central bank money takes two forms: (1) physical currency (e.g., cash) issued by the Federal Reserve and widely circulating, and (2) deposits held by eligible institutions (e.g., depository institutions) at the Federal Reserve.

Commercial bank deposits also play a vital role in the financial system as a widely used medium of exchange and store of value and facilitate the availability of credit via the fractional banking system. In the United States, commercial bank deposits typically exist in digital form within deposit accounts held by clients of commercial banks. These deposits are denominated in the same units as central bank money, such as US dollars. Interbank payments occur in central bank money—the monetary anchor that enables the liabilities of regulated institutions to be exchanged at par value, also known as the "singleness" of money.

The RSN PoC tests how tokenized US central bank deposits and commercial bank deposits can be maintained on the RSN and assesses several purported benefits, all while maintaining the existing two-tiered financial system. Theoretically, both tokenized central bank deposits and tokenized commercial bank deposits resemble existing central bank reserves and commercial bank liabilities, but in tokenized form. Tokenized central bank deposits are digital representations of central bank liabilities that are made available by the central bank and can be used by eligible account holders to facilitate and effect interbank settlements.

The PoC defined a set of theoretical assumptions for tokenized central bank deposits as a settlement asset to complete its research purpose, which are outlined below:

- Tokenized central bank deposits are a digital record of central bank deposit liabilities, denominated in US dollars.

- An account with a Federal Reserve Bank is a requisite to maintain and settle payments in tokenized central bank deposits using the Fed Cash partition within the RSN.

- Tokenized central bank deposits are recorded and maintained within the Federal Reserve's (FR) partition on the RSN.

- Tokenized central bank deposits are used as a settlement asset for the interbank payment leg of certain use cases, which results in a corresponding credit and debit of tokenized central bank deposits within the transacting RSN member banks' accounts on the FR partition.

8 The assumptions defined below does not necessarily reflect the views of the Federal Reserve Bank of New York or any other parts of the Federal Reserve System, including with respect to the Federal Reserve's legal authority to participate in RSN or any similar arrangement.

- Consistent with existing operations, an RSN member bank has visibility into its tokenized central bank deposits balance and other account information.

The PoC also defined a set of theoretical assumptions for tokenized commercial bank deposits and their role within the RSN FMI, which are outlined below:[8]

- Deposits at commercial banks (including those that do not have a reserve account with the FRB) are represented as commercial bank deposit tokens on their respective partitions.

- Tokenized commercial bank deposits in the system are only visible to eligible parties with access to the respective commercial bank partition.

- Tokenized commercial bank deposits are non-transferrable digital representations of commercial bank deposits that facilitate the settlement of financial obligations between counterparties participating on the RSN.

- While transactions between financial institutions are settled in tokenized central bank deposits, RSN tokenized commercial bank deposits allow RSN member banks to track the liabilities to their respective clients.

- Clients of RSN member banks can instruct their bank to move its tokenized deposit balance to and from its traditional fiat account as needed.

With these assumptions in mind, and by having both forms of tokenized money on the same network, the RSN may provide RSN member banks the ability to:

- Settle transactions simultaneously with 24/7 availability in the safest settlement asset, tokenized central bank deposit.

- Improve liquidity and efficiency of transactions by enabling instant, secure, and 24/7 transfers of value between participating banks and financial institutions.

- Enhance transparency and traceability for transactions that RSN member banks are party to, providing a clear audit trail of transaction history.

The structure of representing tokenized central bank and commercial bank deposits together on a single platform could enable programmable functionality that supports settlement risk-reducing capabilities for payment-versus-payment (PvP) settlement and DvP settlement; whereas in the traditional paradigm, balances are maintained on separate, siloed proprietary infrastructures and systems.

Role of tokenized securities in the RSN PoC

In addition to the tokenization of different forms of money, the RSN PoC also experimented with the tokenization of securities. Tokenized securities within the RSN FMI are assumed to have the same ownership rights as they do today. Theoretically, tokenized securities can potentially provide enhanced operational efficiency and automate more complex transaction logic via smart contracts. In the RSN PoC, the working group tested DvP use cases that included various securities (e.g., IG bonds and US treasuries). The working group hypothesized that should tokenized securities be maintained on a shared ledger, programmable platform with tokenized forms of money, this could streamline the settlement process, reduce settlement risk and counterparty risk, improve coordination among transacting parties, and potentially improve liquidity. For the purpose of the PoC, the RSN working group spent a significant amount of time considering the design of how the entitlements to tokenized US securities could be represented on the shared ledger in order to avoid fragmented liquidity between the RSN and legacy infrastructures.

The PoC defined a set of theoretical assumptions for tokenized securities to complete its research purpose, which are outlined below:[9]

- Consistent with its role in operating a central securities depository, the Federal Reserve could represent tokenized treasuries on a "Fed Securities partition" within the RSN, held within tokenized securities accounts.

- An account with a Federal Reserve Bank is a requisite to maintain RSN tokenized treasuries on the Fed Securities partition and to settle inter-bank tokenized treasury transactions through RSN at the Fed Securities partition.

- An account with a Federal Reserve Bank is a requisite to maintain RSN tokenized central bank deposits on the Fed Cash partition and to settle inter-bank tokenized security use-cases that rely on the Fed Cash partition for the funds leg.

- Transfers of tokenized US treasuries (i.e., the debit and credit of the seller's and buyer's respective securities accounts to extinguish and create securities entitlements) are recorded and maintained within the Fed Securities partition.

- Transfers of tokenized IG bonds (i.e., the debit and credit of the seller's and buyer's respective securities accounts to extinguish and create securities entitlements) are recorded and maintained within the CSD partition.

- The RSN would be interoperable with legacy infrastructure systems, with the RSN serving as the common source of settlement data for transactions that are settled on the RSN.

- The existing US legal framework for indirectly holding securities through an intermediated holding system would extend to the RSN.

9 These assumptions do not necessarily reflect the views of the Federal Reserve Bank of New York or any other parts of the Federal Reserve System, including with respect to the Federal Reserve's legal authority to participate in RSN or any similar arrangement.

Use case introduction

Building off the RLN US PoC, where the RLN working group demonstrated that both domestic and cross-border payments denominated in US dollars (USD) could theoretically achieve simultaneous 24/7 settlement, the RSN working group decided to test how simultaneous and coordinated, 24/7 settlement capabilities could be extended to multi-asset and cross-network transactions. The RSN working group selected five use cases to depict the flexibility and scalability of the RSN as a settlement ecosystem, which could potentially serve the next generation for multi-asset and cross-network settlements.

- Client-to-client investment grade (IG) bond DvP settlement
- Centrally cleared dealer-to-dealer treasury DvP settlement
- Cross-network DvP settlement
- Cross-network correspondent bank settlement
- Intraday repurchase (repo) agreement settlement

Figure 1: Domestic interbank payments design

Multi-asset DvP settlement	Use case description
Client-to-client IG bond DvP settlement	Client-to-client transaction consisting of tokenized IG bonds settled in real time in tokenized central bank deposits and tokenized commercial bank deposits. By introducing a CSD partition to the RSN FMI, in which the CSD warehouses the entitlements to various securities on behalf of banking institutions, the working group aimed to test how simultaneous, 24/7 DvP settlement capabilities could be achieved on the RSN FMI.
Centrally cleared dealer-to-dealer treasury DvP settlement	Considering the upcoming SEC Treasury Clearing Mandate, which requires a large portion of US Treasury trades to be cleared through a CCP, the group analyzed how the RSN could comply with the mandate by establishing a CCP partition within RSN. This allowed financial institutions to achieve precise settlement capabilities, allowing the institutions to fund their executed transactions and not require pre-funding for all transaction types. This crucial design choice between the two use cases sought to show that RSN could provide dynamic, precise settlement capabilities, conceptually providing both real-time gross settlement and net settlement.
Cross-network settlement	**Use case description**
Cross-network DvP settlement	The use case demonstrated how a corporate client could use MTN to securely purchase a tokenized real-world asset (e.g., a carbon credit) from a third-party platform that had integrated MTN as a payment solution using tokenized commercial bank deposits. The working group set out to understand if RSN could serve as an interoperable, 24/7 interbank settlement venue for the payment leg of transactions carried out on other tokenized asset platforms.
Cross-network correspondent bank settlement	This use case analyzed how two Tassat banks that are non-RSN member banks could initiate payments off RSN by leveraging RSN member banks as settlement agents through a correspondent banking model to access the RSN FMI and achieve cross-network interbank settlement finality in tokenized central bank deposits. This use case intended to show that RSN could serve as an industry wide settlement infrastructure through both direct participation and a correspondent banking model.
Intraday repurchase (repo) agreement settlement	The use case engaged with Broadridge and its Distributed Ledger Repo (Broadridge DLR) platform to test how two RSN members that are also Broadridge DLR members use DLR to initiate a 3-hour intraday repo to better optimize its tokenized collateral on RSN and be able to provide intraday funding to settle same-day trade obligations. This use case intended to show how RSN's common settlement infrastructure, which contains various forms of tokenized collateral could allow firms to seamlessly access and deploy its collateral and provide real-time liquidity through an intraday repo transaction initiated on Broadridge DLR.

Throughout the remainder of this report, a detailed overview of each of the in-scope use cases will be provided, considering use case assumptions, high-level process flow design, and potential benefits and shortcomings of a shared ledger FMI.

Client-to-client IG bond DvP settlement

Introduction

Given the recent industry move to settle securities transactions on a T+1 (Trade date plus one day) basis, the RSN working group analyzed how an FMI that leverages shared ledger technology and maintains tokenized securities, tokenized central bank deposits, and tokenized commercial bank deposits within the RSN FMI could further enhance multi-asset settlement capabilities. This use case specifically looked at how a tokenized IG bond trade between two clients could be settled simultaneously on the RSN FMI.

Today, the US IG bond market operates within a well-defined structure involving primary issuance and secondary trading, with a central securities depository (CSD) playing a pivotal role. While the market has been able to transition to T+1 settlement on its existing technology infrastructure, opportunities still remain to allow firms to better manage their collateral and liquidity, while also reducing settlement and counterparty risk. Within legacy systems, various challenges are inherent to market participants. Select examples include:

- **Reliance on batch processing:** Existing market infrastructures and banks heavily rely on batch processing, which lacks real-time processing and reduces visibility into settlement status.

- **Existing operating hours:** If trades are not entered with the CSD by a specific cutoff specific time, next-day settlement will not be achieved.

- **Trapped collateral and liquidity:** Once the CSD and other settlement infrastructures close for the day, the assets and cash due to settle are "trapped" and cannot be leveraged elsewhere.

- **Manual processes of trade life cycle events:** Various steps within the trade life cycle require human intervention, ultimately leading to potential data errors and delays in settlement finality.

- **Lack of settlement predictability:** Status of transaction settlement remains challenging across various steps of the settlement life cycle given incompatible, fragmented settlement systems, forcing firms to overcollateralize their positions while awaiting settlement confirmation.

Use case overview

The IG bond DvP use case was intended to prove that the RSN could work as a settlement infrastructure for simultaneous multi-asset settlements. The use case aimed to show that by having a shared ledger infrastructure that contains tokenized securities, tokenized central bank deposits, and tokenized commercial bank deposits could achieve 24/7 simultaneous settlement capabilities, enhancing settlement transparency and reducing counterparty risk.

Figure 1: Client-to-client IG bond DvP settlement high-level design
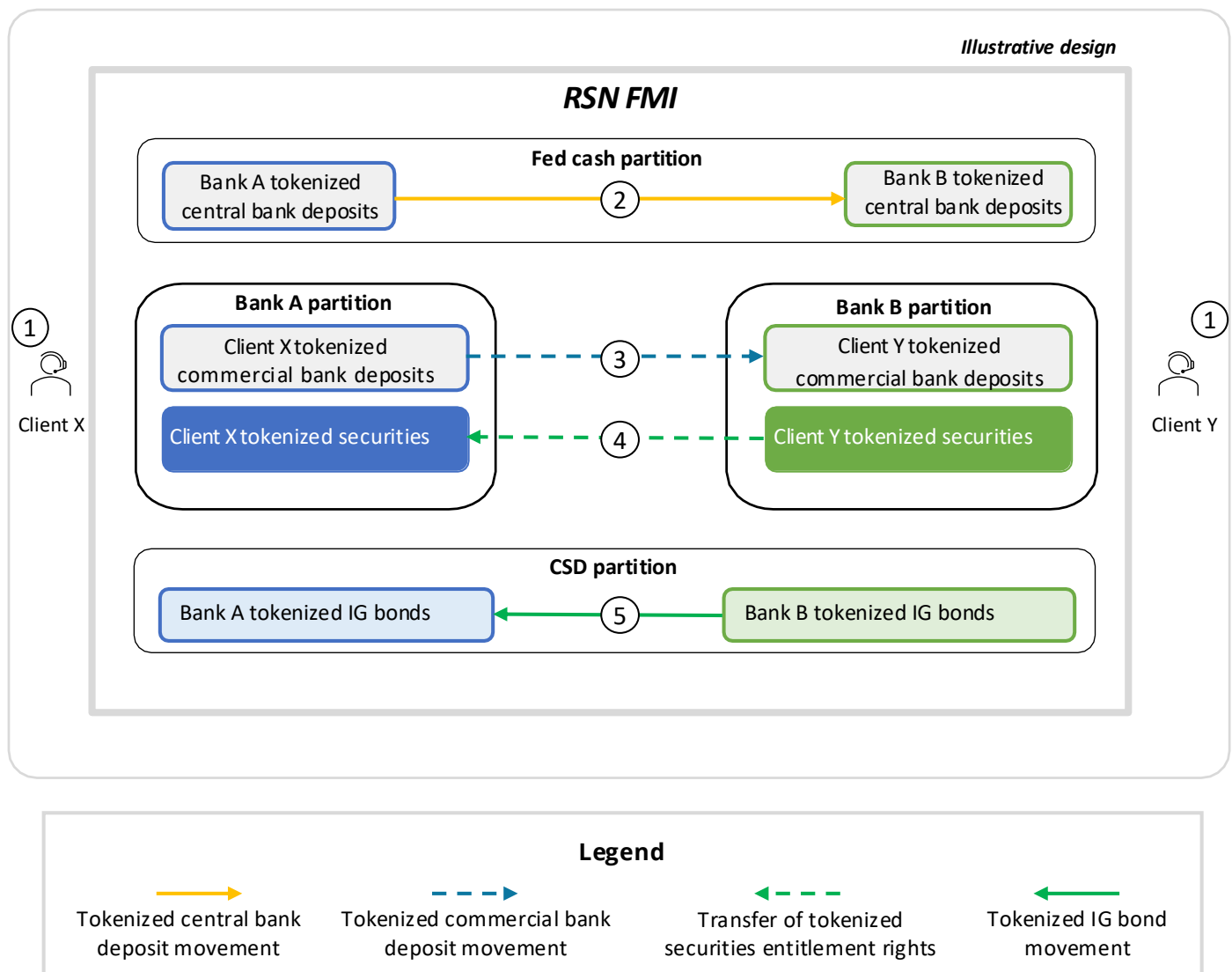
The IG bond DvP use case was built on a few key assumptions:

- Client deposits at commercial banks are represented as commercial bank deposit tokens on each institution's respective partitions and are only visible to eligible parties with access to the respective commercial bank partition.

- Central bank reserves held at a Federal Reserve Bank are represented as tokenized central bank deposits on the Fed partition and are only visible to the central bank and the commercial bank holding the tokenized central bank deposits (e.g., the owners of the tokenized central bank deposits are only able to see their own balances).

- The FR controls issuance, debits, and credits of tokenized central bank deposits upon request of RSN member banks.

- Multi-asset proposals in the system are only visible to the institutions involved in the transaction (i.e., the owners of the partitions that need to be updated by a multi-asset proposal).

- The IG bond entitlement rights to a bank are maintained within the CSD partition and the CSD controls the debits and credits of entitlements of tokenized IG bonds within the CSD partition upon request of RSN member banks.

- Trade terms, such as security CUSIP, trade amount, and price, are agreed upon prior to being submitted to the RSN FMI[10] for on-chain matching and distribution of settlement approval requests.

- All payment data is transferred in ISO 20022 format, including data necessary for compliance checks by each of the parties.

- It is assumed that Bank A and Bank B would continue to perform applicable sanctions checks as well as KYC, AML, and CFT checks in the same way, but was out of scope for the PoC.

- Prior to a final transaction signature, any party of the transaction can reject the transaction proposal, even if previously accepted.

The process flow for a DvP transaction on the RSN can be broken down into five key steps:

1. Clients of Bank A and Bank B execute a DvP transaction for an IG bond. Once each transacting party has performed the necessary compliance checks and approves the transaction settlement request, the following settlement process takes place simultaneously.

2. The Fed Cash partition debits Bank A's tokenized central bank deposit balance and credits Bank B's tokenized central bank deposit balance in its account maintained on the Fed Cash partition.

3. Bank A debits Client X's commercial bank deposit token account maintained on Bank A's partition and Bank B credits Client Y's commercial bank deposit token account maintained on Bank B's partition.

4. The visibility of the IG bond security entitlement transfer that is taking place at the CSD is mirrored within the Bank A and Bank B partitions to show the transfer of ownership from Client Y to Client X.

5. The CSD transfers the IG bond entitlement rights from Bank B's tokenized security account to Bank A's tokenized security account on the CSD partition.

- As a result of the updated tokenized central bank deposit balances between Bank A and Bank B, Client X's commercial bank deposit tokens at Bank A are debited, and Bank B's commercial bank deposit tokens are credited and issued to Client Y's account, in result increasing the liabilities recorded on Bank B's partition while decreasing the liabilities recorded on Bank A's partition. The above steps occur concurrently.

- Client Y has the opportunity to redeem the commercial bank deposit tokens received into its USD bank deposit account, which would reduce Bank B's liabilities represented on the RSN.

10 RSN FMI is extendable to include partitions to broker-dealer legal entities of RSN banks.

Key findings and expected benefits

The base use case findings showed that the RSN design could operate successfully as a multi-asset settlement infrastructure on a shared ledger infrastructure. Key findings include:

- **Ability for precise, simultaneous settlement:** The RSN was able to settle tokenized IG bond DvP transactions at the moment that all approval messages are received from the transacting parties and time conditions are met.

- **Unlocking of trapped collateral and liquidity:** As the RSN is 24/7 in nature and not restricted to existing settlement windows, financial institutions and their clients can continue to leverage their cash and securities for other obligations.

- **Enhanced liquidity and collateral visibility:** Given trades are settled in real time and there is no reliance on existing settlement windows, financial institutions will have real-time visibility into their cash and collateral positions by not having to rely on overnight batch settlement processes. This also will allow firms to identify trade fails earlier in the process and not have to wait until the end of existing settlement cycles to realize if the trade settled or failed.

- **Straight-through processing and automation:** Through the use of smart contracts, once trades were executed and submitted to the RSN, based on the predetermined characteristics of the transaction (i.e., transaction counterparty, trade amount) allowed for firms to auto-approve or auto-reject transactions, reducing the need for manual intervention.

- **Liquidity and collateral optimization:** Through simultaneous settlement, firms can minimize the need to over-collateralize positions as trade failures are able to be identified prior to kicking off the settlement process, which will provide enhanced predictability of their cash and asset flow.

- **Cross-partition asset movement:** As the RSN FMI consists of a CSD and multiple custodian banks on a single, shared ledger, which provided RSN member banks the ability to move collateral in real-time across the network, allowing for real-time optimization of collateral and liquidity in comparison to standard settlement cycles.

- **Scalability to other types of regulated assets:** While the RSN working group concluded that not all assets and transactions should move to a real-time settlement model, the network could scale to achieve real-time settlement for other asset types and subsets of transactions should funding and securities be available.

Use case conclusion

The first use case of the RSN was able to depict that the RSN concept could provide the necessary operations for a real-time multi-asset settlement system. The RSN working group does not believe that the entire US securities market should move to real-time settlement, but there are specific asset types where real-time settlement could be more feasible than others.

"RSN continues to build on industry-wide efforts to better leverage the application of distributed technology in the financial markets. We believe that there is real value to be achieved through liquidity and collateral optimization by adding programmability to financial infrastructure.

An FMI that is thoughtfully built to support a variety of monies and a spectrum of assets, and integrated into existing financial architecture, is worth continued research and investment to bring more efficiency and transparency to the market."

—John Schwartz,
Managing Director, Head of North America Fixed Income Financing,
J.P. Morgan

Centrally cleared dealer–to–dealer treasury DvP settlement

Introduction

As the US financial services industry prepares for the upcoming SEC Treasury Clearing mandate, the second use case the RSN working group explored was how the RSN could serve as an industry settlement venue for centrally cleared treasury DvP transactions. This use case expanded on the client-to-client IG bond DvP settlement use case by introducing a CCP partition and custodian bank partition to the RSN FMI, while also introducing multiple settlement windows within a trading day to allow firms to still achieve T+0 settlement and also realize the existing efficiencies provided by netting.

The current market for US Treasuries operates with the crucial involvement of CCPs, which act as intermediaries between buyers and sellers to mitigate counterparty risk. CCPs provide clearing and settlement services for various financial instruments, including US Treasuries. For Treasury transactions that are centrally cleared, trades are first matched by the CCP, which verifies the consistency of buy and sell orders. Once matched, the CCP novates the trade, becoming the buyer to every seller and the seller to every buyer, thereby transferring the risk from the original counterparties to itself. To manage this risk, CCP risk management practices contain elements that cover default funds, initial margin, and variation margin to cover potential losses in the event of a default. As of 2022, only approximately 20% of all repos and 30% of reverse repos are centrally cleared, whereas in 2017, only 13% of Treasury cash transactions were fully centrally cleared.[11] This percentage is expected to grow with the SEC Central Clearing mandate, making efficiency and lower clearing costs important to the market.

The structured processes facilitated by CCPs hold opportunities for both simplification and modernization. It is also expected that additional firms may enter the Treasury CCP market in the upcoming months, which will drive competition within the clearing space but also lead to further market fragmentation for financial institutions to manage their positions and collateral across multiple CCPs. Additional challenges that frequent the market today include:

- **Reliance on batch processing:** Existing market infrastructures and banks heavily rely on batch processing, which lacks real-time processing and reduces visibility into settlement status.

- **Existing operating hours:** If trades are not entered with the CSD by a specific cutoff specific time, next-day settlement will not be achieved.

- **Trapped collateral and liquidity:** Once the CSD and other settlement infrastructures close for the day, the assets and cash due to settle are "trapped" and cannot be leveraged elsewhere.

- **Manual processes of trade life cycle events:** Various steps within the trade life cycle require human intervention, ultimately leading to potential data errors and delays in settlement finality.

- **Lack of settlement predictability:** Status of transaction settlement remains challenging across various steps of the settlement life cycle given incompatible, fragmented settlement systems, forcing firms to overcollateralize their positions while awaiting settlement confirmation.

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11 "Statement on final rules regarding Treasury clearing," US Securities and Exchange Commission (SEC), December 13, 2023.

The RSN working group set out to test how the RSN could allow RSN member banks to comply with the SEC Treasury Clearing mandate for eligible transactions, while reducing the challenges expected to be faced by the industry. This use case specifically explores how once executed transactions are submitted to the CCP for matching, clearing, and novation, the CCP then submits the netted transaction to the RSN to allow RSN member banks the ability to realize their net balance within a specific asset which is ultimately settled at a later point in the day.

Figure 2: Centrally cleared dealer-to-dealer DvP settlement high-level design
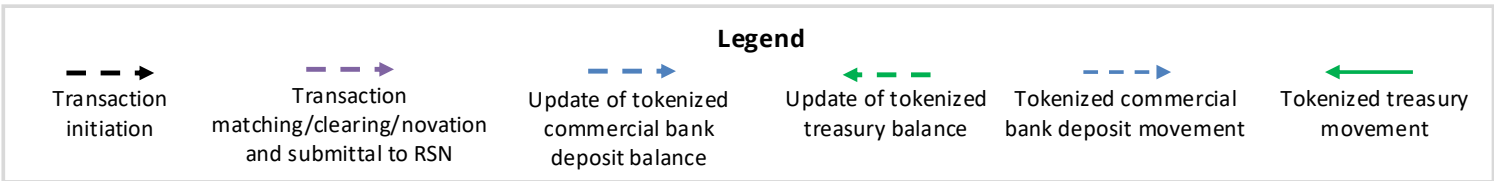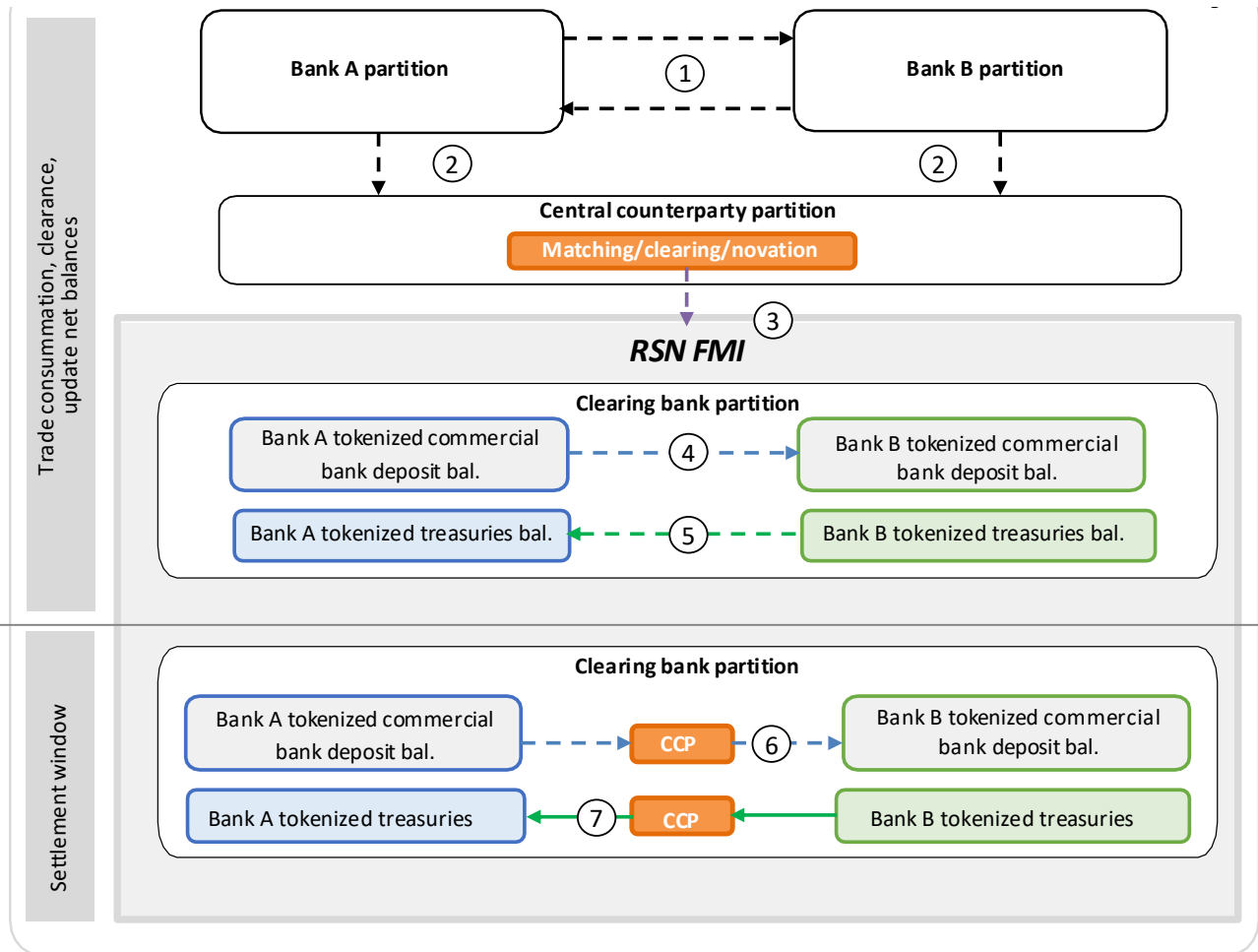
The CCP use case was built on several key assumptions:

- The use case involves facilitating a DvP of US Treasury transactions between two RSN participant banking counterparties, Bank A and Bank B, who are members of a CCP.

- Trade terms, such as security CUSIP, trade amount, and price, are agreed upon prior to reaching the CCP and RSN FMI.

- The RSN is utilized to facilitate the settlement of these transactions, with the clearing bank partition exclusively maintaining the entitlements to the tokenized assets and tokenized commercial bank deposits.

- The trade is executed, matched, cleared, and novated prior to reaching the RSN for settlement, and the CCP submits the updated net balances to the RSN in real time, which is ultimately settled later in the trading day. Considering that the cash settlement is occurring across the books of the custodian bank, the Fed Cash partition was not included in this use case.

The process flow for a DvP transaction on the RSN can be broken down into seven key steps:

1. Initially, Bank A and Bank B, or a matching engine, initiate a transaction to the CCP by creating a transaction instruction order. Bank A sends a receive versus payment (RvP) (MT541) message to the RSN, while Bank B sends a delivery versus payment (DvP) (MT543) message.

2. The CCP performs trade matching, clearing, and novation, verifying the trade details and creating novation for the involved banks.

3. The CCP then submits the updated net balances to the RSN FMI.

4. Bank A and Bank B are able to view their cash positions in real time and earmark the net position due to settle.

5. Bank A and Bank B are able to view their net security positions in real time and earmark the net position due to settle.

6. At the conclusion of a settlement window, the RSN automatically triggers settlement, achieving settlement between the banks and the CCP.

7. The settlement of securities between the bank and the CCP occur simultaneously to cash settlement.

Key findings and expected benefits

The findings of the centrally cleared dealer-to-dealer DvP settlement use case showed that the RSN could operate successfully as a multi-asset settlement infrastructure for centrally cleared treasury transactions, allowing market participants to realize the efficiencies of netting while still achieving same-day settlement. Key findings include:

- **Enhanced liquidity capabilities:** By not requiring transactions to be pre-funded as in the previous use case, firms are able to better manage their liquidity by allocating cash and collateral to other obligations with an earlier settlement time.

- **Netting efficiencies:** As the RSN will settle the net obligations for firms across specific CUSIPs, multiple transactions are able to be aggregated, resulting in a single net obligation for each RSN member bank against the CCP. This aggregation reduces the number of transactions that need to be settled and only deploys the liquidity due to settle, further allowing firms to better optimize their cash and collateral.

- **Intraday settlement capabilities:** Precise, scheduled intraday settlement capabilities allow firms to have real-time visibility into its inflows and outflows of cash and collateral due to settle, enabling greater liquidity and collateral optimization while enhancing risk management capabilities.

- **Collateral optimization:** As RSN member banks will be able to view and earmark their net balances due to settle at a later point in the trading day, firms can allocate collateral and cash elsewhere instead of waiting for batch-cycle processes to be completed, allowing institutions to be as prescriptive and precise for transaction settlement as required.

- **Increased operational resiliency:** Through the inclusion of multiple CCPs, custodian banks, and other financial institutions, operating their own partitions on a shared ledger FMI alleviates the risk of a single point of failure. For example, in the instance that a firm's partition is unavailable, other market activity could continue to progress across the network.

- **Standardized integration:** Given that firms are expected to integrate to multiple CCPs for eligible transactions, by having a shared ledger FMI where various CCPs could reside, it could standardize the integration process and reduce fragmentation of inventory. This structure could allow for firms to quickly move collateral across various institutions on a real-time, as-needed basis.

Use case conclusion

Overall, the introduction of netting and intraday settlement capabilities to the RSN FMI framework represents a significant enhancement that allows RSN member banks the ability to settle both gross and netted transactions enabling precise settlement capabilities. Additionally, this framework could be extended to include numerous CCPs and custodian banks to allow for firms to manage their cash and collateral on a common settlement infrastructure, in which collateral can seamlessly be moved across the network instead of relying on existing settlement windows and fragmented industry systems. Furthermore, this ultimately would allow RSN member banks the ability to have a real-time visibility into transaction activity, optimize collateral efficiently across the network, and reduce market fragmentation through the use of a shared ledger FMI.

"The RSN PoC proved that bridging siloed systems and processes with a general shared ledger capable of cleanly coupling assets through tokenization may positively impact settlement times, liquidity, availability, and reconciliations in multi-asset transactions. It's exciting to consider the possibilities of a shared multi-asset settlement network and the beneficial upstream effect to client and customer experiences. While the PoC results are very promising, the industry collaboration to innovate responsibly through astute technical exploration and candid discourse is just as impressive. It is this style of consortium approach that enables progress and purpose."

—Mike Villano, SVP,
Head of Digital Assets & Blockchain Practice,
U.S. Bank

DLT interoperability for multi-asset transactions in regulated financial institutions

At the conclusion of the centrally cleared treasury DvP use case, the RSN working group shifted its focus to analyzing how a shared ledger FMI could connect with other tokenized networks to offer coordinated settlement capabilities for transactions initiated off the RSN. The goal of the RSN working group was to understand the potential benefits and challenges of integrating multiple external networks to the RSN FMI to provide a common settlement infrastructure for the industry that achieves cross-network settlement finality for both payments and multi-asset transactions.

Shared ledger vs. interoperable venues

Having multiple assets on a common shared ledger may offer distinct advantages over enabling interoperability across different venues. A shared ledger environment can streamline processes by enabling simultaneous settlement and reducing the need for complex reconciliation. This setup can enhance transparency and reduce operational risks associated with managing multiple ledgers. However, the trade-offs include increased computational demands and the need for robust security measures to protect the integrity of the shared ledger. Having multiple asset classes residing on a single ledger may also introduce undesired levels of systemic or concentration risk, which would need to be carefully evaluated.

Conversely, interoperability across different networks allows for greater flexibility and scalability, as each venue can operate independently while still being part of a broader network. This approach can be beneficial for institutions that need to comply with varying regulatory requirements across jurisdictions. However, it may introduce complexities if different standards and protocols are used across different platforms, requiring corresponding intermediation between them. Additionally, interlinking multiple networks limits the ability to guarantee simultaneous settlement across both networks as there is reliance on multiple settlement operators. Instead, settlement is orchestrated across networks, requiring communication and coordination between the participant networks. In any case, there is growing consensus within the financial services industry that there will not be one single universal ledger, and therefore cross-network interoperability will remain a critical requirement across the financial ecosystem.

Establishing interoperability standards is crucial for the success of a multi-asset shared ledger settlement system. These standards should address the technical interoperability, operational processes, and regulatory requirements that need to be met. Although such requirements were not in scope for this project, a core question that was analyzed throughout the PoC is whether the benefits of interoperability can be realized within existing legal and operational frameworks (refer to the RSN's Legal Viability Report).

Introduction to interoperability in the RSN

Enabling interoperability with third-party networks can expand the reach of benefits that could be enabled by the RSN FMI. By extending the capabilities of the RSN FMI to integrate with third-party platforms, institutions can unlock access to additional services that increase adoption, scalability, and efficiency while reducing costs and mitigating risks through a common settlement infrastructure. An interoperability solution allows for seamless communication and coordination between different systems and platforms, facilitating smoother and faster settlement cycles and reducing the risk of fragmented liquidity across "digital islands."

A critical consideration is whether the envisioned settlement system would cater to specific use cases or serve as a single settlement system for the US market across multiple types of cash and securities. The RSN PoC aimed to demonstrate that the network can support different use cases and network integrations. For example, connecting existing securities networks to the RSN could standardize DvP settlements and potentially provide settlement in central bank money on a 24/7 operating basis.

For the interoperability use cases explored through the PoC, the RSN leveraged third-party network providers to test coordinated DvP, interbank, and repo settlement capabilities. Moreover, this approach fosters innovation and competition among service providers, driving continuous improvement and adaptation to evolving market needs. By embracing interoperability, financial institutions may achieve greater operational resilience and can offer more comprehensive services to their clients, positioning themselves at the forefront of the financial industry's digital transformation. The working group decided to test the interoperability use cases through two methods. The first leveraged Swift's network interlinking prototype and a simulated version of its enhanced Transaction Management platform. Additionally, Mastercard enabled a direct connection between its Multi-Token Network (MTN) and the RSN, demonstrating this as part of the cross-network DvP settlement use case.

Introduction to the Swift interlinking prototype

Following Swift's own industry experiments[12] that demonstrated its ability to interlink different types of DLT-based networks and traditional systems, Swift's experimental interlinking prototype has been used to support the orchestration of transactions between the RSN and various third-party platforms.

The design of the Swift interlinking prototype centers on two key components: an interface that is deployed on each network through a node managed by the respective network operator, and a central Swift orchestration component to orchestrate and route transactions between the networks.

One of the major benefits of this approach demonstrated that different blockchain networks could be interlinked for cross-network transactions through a single gateway, and that Swift's transaction management capabilities could orchestrate all inter-network communication with the security of the Swift network. Leveraging a hub-and-spoke-type model could provide a more standardized and scalable model than through an increasing number of point-to-point connections.

"Interoperability has to be a central consideration for the future of the financial ecosystem. These latest results demonstrate the potential of shared ledgers, and Swift is pleased to be working with the participants to ensure that effective cross-network communication and coordinated settlement are an integral part of that design. To ensure the global ecosystem can benefit from the latest shared ledger technology, we have to achieve interoperability at scale, and collaboration across initiatives such as the RSN will be vital to achieving that vision."

—Nick Kerigan, Managing Director,
Head of Innovation,
Swift

12 "Connecting digital islands," Swift CBDC sandbox project results report, March 2023

Cross-network DvP settlement

One of the significant challenges faced today by tokenized asset and cash networks is the coordination of settlement with other networks outside of traditional operating hours. This forces networks to operate in a siloed capacity, reducing liquidity across networks, restraining from scaling, and limiting access to other forms of liquidity and assets on a 24/7 basis. The primary objective of this use case was to assess the RSN's potential as an interoperable 24/7 industry settlement venue, with an external network serving as a service provider to facilitate the movement of commercial bank deposits and other tokenized assets, while the RSN would support the interbank synchronized settlement through the movement of tokenized central bank deposits. This setup could enable the use of tokenized central bank deposits to programmatically settle obligations on behalf of RSN member banks arising on third-party networks that support trusted digital asset transactions and other activities.

Use case description

This use case evaluated the exchange of an asset and payment between two banking counterparties for the benefit of their customers.

To this end, the PoC leveraged Mastercard's Multi-Token Network (MTN), a set of foundational capabilities designed to make transactions within digital asset and blockchain ecosystems secure, scalable, and interoperable, ultimately enabling more efficient payment and commerce applications. The goal of this use case was to achieve cross-network coordinated settlement finality in tokenized central bank deposits on the RSN for transactions initiated on MTN

on a 24/7 basis. The use case demonstrated how a corporate client could use MTN to securely purchase a tokenized real-world asset from a third-party platform that had integrated MTN as a payment solution using tokenized commercial bank deposits. MTN intended to safely and securely coordinate the settlement of the obligations that arose between the two financial institutions from the transaction using tokenized central bank deposits within the RSN.

Figure 3: Cross-network DvP settlement high-level design
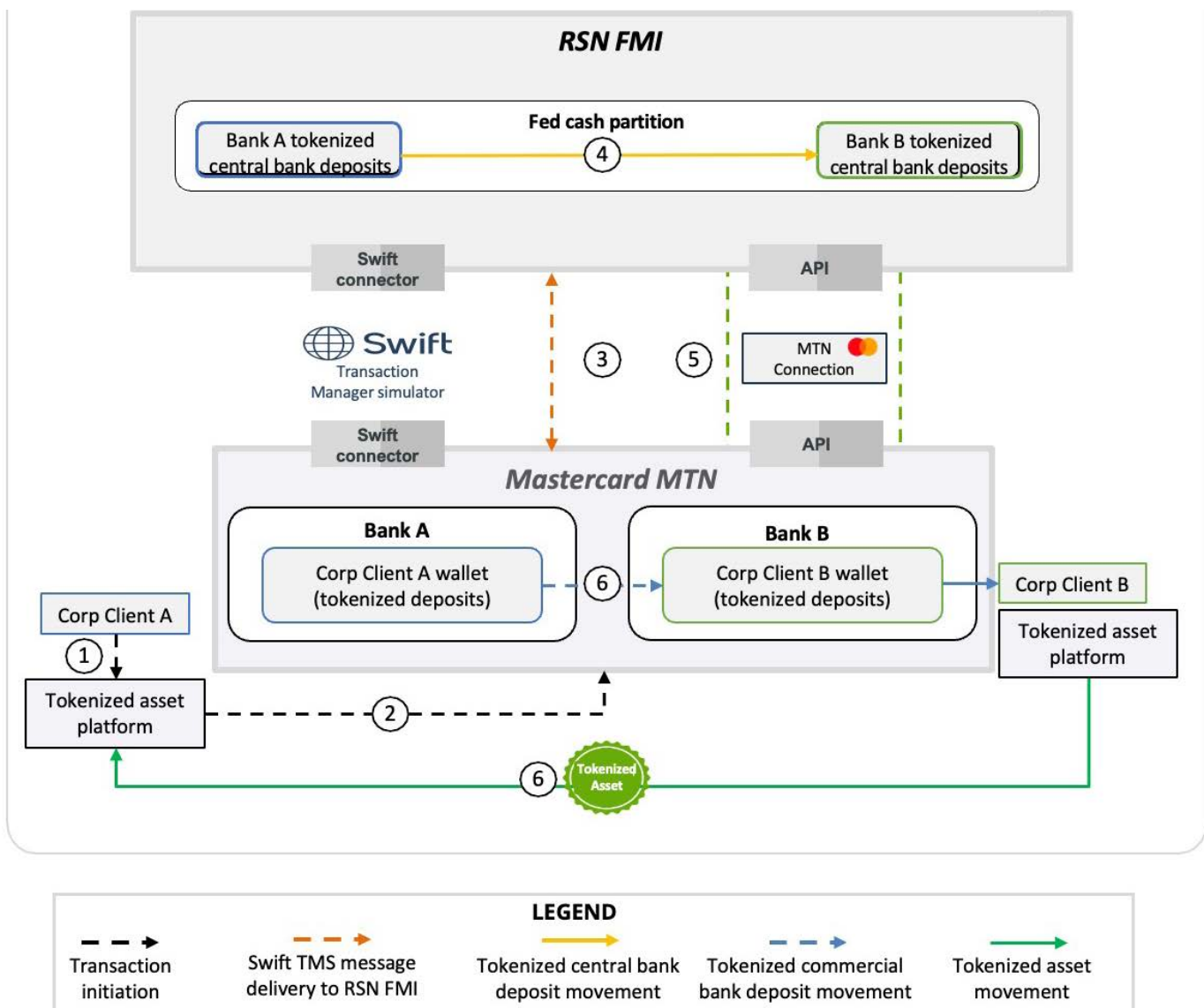
The cross-network DvP settlement use case was built on several key assumptions:

- MTN member banks are also RSN member banks.

- MTN has legal authority to submit transactions on behalf of their banks to the RSN.

- AML/KYC checks are performed prior to reaching the RSN.

- Transaction details (e.g., transaction counterparty information) are contained in the message sent from MTN directly to the RSN using API connectivity or via Swift's prototype.

- Technical mechanisms are implemented on both the RSN and MTN to earmark funds while awaiting transaction settlement.

The process flow for a transaction initiated on MTN, which is ultimately settled in tokenized central bank deposits on the RSN, can be reduced to six key steps:

1. Bank A's client initiates a purchase of a tokenized real-world asset via a tokenized asset platform that has integrated with MTN.

2. The tokenized asset platform allocates digital assets to be purchased and sends a message to MTN. MTN then performs necessary transaction checks with Bank A, notifies the platform, and proceeds with settlement steps.

3. MTN, on behalf of Bank A, submits a transaction request message to the RSN via either the direct integration or Swift's prototype.

4. Following receipt of transaction request and approval by transacting parties, Bank A's tokenized central bank deposit balance is debited and Bank B's tokenized central bank deposit balance is credited on Fed Cash partition.

5. Concurrent with step 3, the RSN sends a settlement notification message either directly using the MTN integration or via Swift's prototype.

6. On MTN, Client A's tokenized commercial bank deposit account is debited while Client B's commercial bank deposit account is credited. The exchange of the digital asset is moved from Client B's account to Client A's account.

Key findings and expected benefits

The findings of the cross-network interbank DvP settlement use case showed that the RSN could serve as an industry settlement infrastructure for other third-party networks. Specific key findings include:

- **Extending the RSN's capabilities to third-party networks:** The RSN and MTN were able to be connected through either Swift's prototype or direct API integration to coordinate settlement on the RSN for transactions initiated outside of the RSN, proving that the RSN could scale to provide a common settlement infrastructure for other third-party networks and platforms.

- **24/7 settlement availability in tokenized central bank deposits:** The RSN's 24/7 operational network would allow MTN and other third-party network transactions to be processed and settled at any time and without operating window limitations. This continuous availability is particularly advantageous in a globalized economy where financial activities span multiple time zones. The use of tokenized central bank deposits ensures that these settlements are secure, reliable, and backed by the central authority, providing a robust framework for uninterrupted financial operations. This round-the-clock accessibility enhances liquidity management and operational efficiency for financial institutions.

- **Enhanced liquidity management:** Third-party networks such as MTN can leverage the same source of liquidity between the RSN and MTN rather than having to segregate funding across a variety of networks, reducing the possibility that firms would need to fragment their liquidity positions.

- **Expansion of asset availability:** Leveraging the RSN as a settlement platform allows for the development of a diverse ecosystem of tokenized asset networks. This could be achieved by connecting to other platforms that are tokenizing various types of assets. This approach to extensibility provides the financial ecosystem with greater flexibility and opportunities for diversification in a manner that does not require additional change, and therefore risk, each time a new asset type is supported.

- **Network standardization:** Enabling a secure settlement system to support external third-party platforms that contain various asset types and tokenized central bank money will allow third-party platforms to seamlessly interact with the RSN without the underlying settlement system having to reconfigure each time a new platform is connected. This approach of extending overall capability via distinct layers provides a mechanism to support future innovation in the ecosystem by enabling a range of third-party platforms to provide competitive services to the market upon a robust and resilient settlement substrate.

- **Reduction in settlement risk:** Settlement risk—the risk that one party will fail to deliver the terms of a contract with another party at the time of settlement—is reduced through the RSN's coordinated settlement capabilities between networks. By enabling immediate finality of settlement for interbank obligations in tokenized central bank deposits on RSN, this reduces the likelihood of settlement failures. This real-time processing ensures that both parties fulfill their obligations simultaneously, enhancing trust and reliability in financial transactions.

Use case conclusion

The cross-network DvP settlement use case served as a foundational use case for the RSN PoC and was able to prove that a shared ledger FMI could interoperate with other third-party platforms and be a venue to provide cross-network settlement finality in tokenized central bank deposits on RSN for off-network transactions, allowing RSN to connect to other approved networks and to not be restricted to intra-network initiated transactions.

"To support the evolving needs of the global financial ecosystem, we need to build technologies that deliver security, interoperability, and scale. Mastercard is excited to deepen its work on the RSN project and demonstrate how secure digital asset payment solutions like the Mastercard Multi-Token Network can enable the expansion of RSN's value to a broader set of use cases."

—Raj Dhamodharan, Executive Vice President, Blockchain & Digital Assets, Mastercard

Cross-network correspondent bank settlement

Introduction

The next use case that the PoC tested was how the RSN may be used as a common settlement infrastructure for transactions initiated between corporate clients of two separate non-RSN member banks.

The goal was to achieve settlement finality in tokenized central bank deposits through a correspondent banking model that consisted of RSN member banks acting as settlement agents. This use case intended to show how non-RSN member banks transacting on behalf of their underlying clients could extend the benefits of the RSN to approved third-party networks and non-RSN member banks.

Use case description

The PoC explored connectivity to Tassat's private permissioned blockchain-based infrastructure, which provides a platform for the facilitation of real-time, tokenized commercial bank transactions between financial institutions. By connecting to the RSN via Swift's network interlinking prototype and leveraging RSN settlement agents, Tassat aimed to enable non-RSN banks on the Tassat Interbank Network the ability to transact with an expanded network of banks on the RSN.

Figure 4: Cross-network correspondent bank settlement high-level design
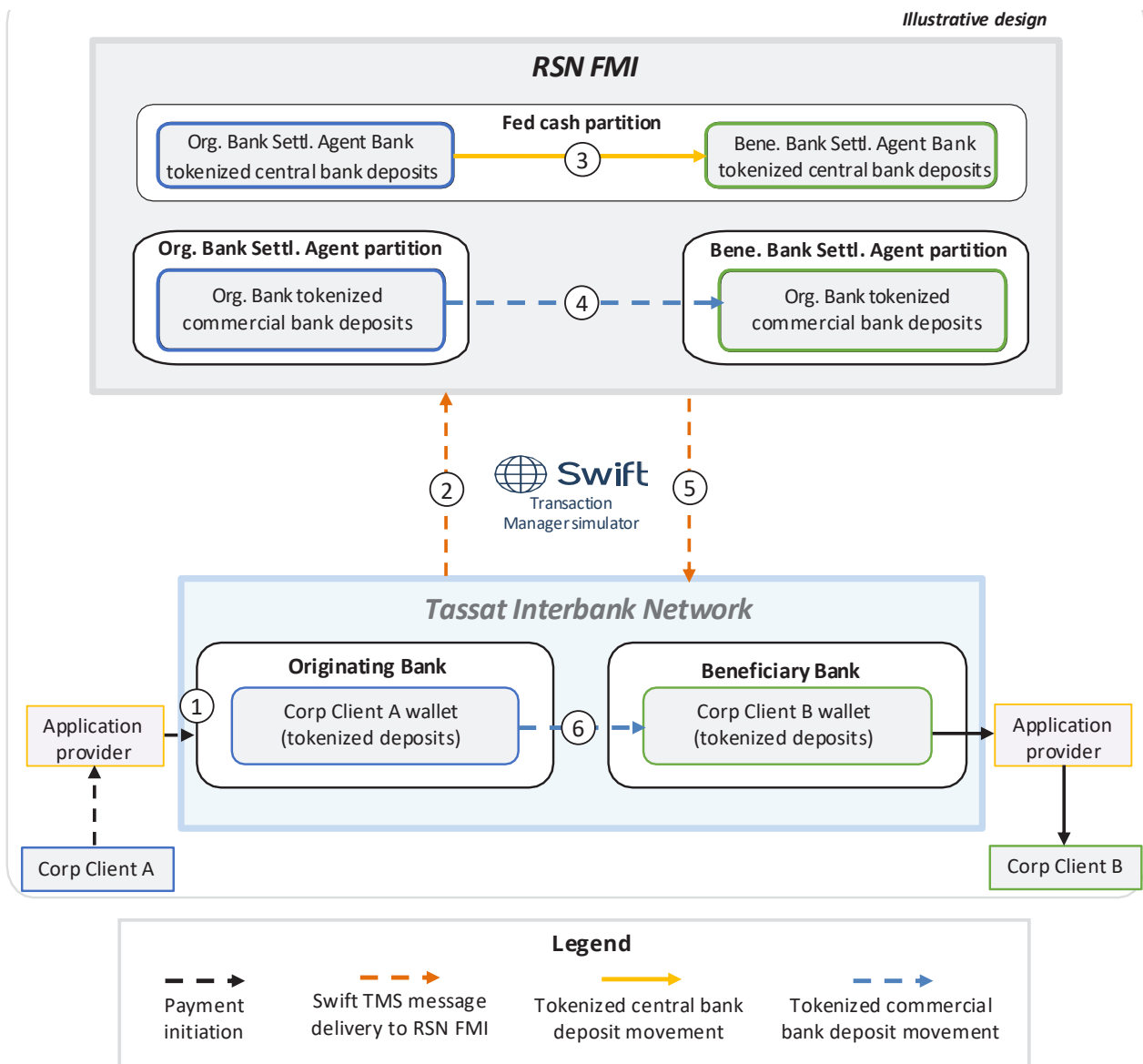
Use case description

The cross-network correspondent bank settlement use case was built on several assumptions:

- Tassat member banks are not RSN member banks.

- Tassat member banks would have a preexisting relationship with an RSN member bank to serve as a settlement agent.

- The Tassat Interbank Network platform will have the legal authority to submit a transaction initiated on its network to the RSN.

- Swift's prototype is deployed on the Tassat Interbank Network platform and the RSN to allow for cross-network communication, and transaction details are submitted to the RSN and settled in tokenized central bank deposits via RSN settlement agents.

- When the transaction message is received on the RSN FMI, the FMI constructs the settlement path to the appropriate settlement agents based on the information contained in the message submitted to the RSN.

- Tassat member-bank commercial bank deposit tokens are debited on the originating bank ledger and credited on the beneficiary bank ledger leveraging the Tassat Interbank Network.

- Necessary AML, KYC, and compliance checks take place by both Tassat banks prior to reaching the RSN for settlement.

- The settlement agents also perform AML, KYC, and compliance checks once the transaction is received within the RSN ahead of settlement.

The process flow for a transaction initiated between two Tassat member banks that is ultimately settled in tokenized central bank deposits on the RSN through the use of RSN settlement agents can be reduced to six key steps:

1. Corporate Client A that banks with the originating bank initiates a payment to Corporate Client B that banks with the beneficiary bank.

2. Once AML and KYC checks are performed, the tokenized deposits within Corporate Client A's wallet are earmarked and the Tassat infrastructure submits a transaction request containing the necessary transaction information to the RSN through Swift's prototype.

3. Once the originating and beneficiary settlement agents perform their AML/KYC checks, and both settlement agents and the Fed Cash partition approve the transaction request, the originating settlement agent's tokenized central bank deposit account is debited and the beneficiary settlement agent's tokenized central bank deposit account is credited.

4. The originating settlement agent debits the tokenized commercial bank deposit account of the originating bank and the beneficiary settlement agent credits the beneficiary bank's tokenized commercial bank deposit account.

5. The RSN sends a Pacs.002 ACSC message to Swift's prototype, which is routed to the Tassat Interbank Network platform, confirming that settlement on the RSN has been achieved.

6. Once this message has been received, the originating bank releases the earmarked funds, which are debited from Corporate Client A's wallet within the originating bank and credited to Corporate Client B's wallet within the beneficiary bank.

Key findings and expected benefits

The findings of this use case indicated that the RSN could successfully operate as a common industry settlement venue for non-RSN member banks operating on third-party networks (e.g., the Tassat Interbank Network platform) through the use of settlement agents. The RSN working group was keen to explore the benefits of how the existing correspondent banking model could operate within a shared ledger FMI. This use case proved that regulated financial institutions that are not RSN member banks operating on separate third-party platforms could still achieve the benefits provided by the RSN through an interoperability solution. Key benefits for this use case include:

- **Extension to non-RSN banks through RSN settlement agents:** Ensures that financial institutions can conduct transactions at any time, and not be reliant on existing settlement windows. This continuous access enhances liquidity management, reduces settlement delays, and enables institutions to capitalize on market opportunities around the clock, thereby fostering a more dynamic and responsive financial ecosystem for banks not participating in the RSN through the use of settlement agents and an interoperability solution.

- **Interoperable network for digital transactions:** Facilitates seamless transactions between different financial institutions and systems, ensuring compatibility and smooth integration across various platforms. This interconnectedness enhances the efficiency and speed of interbank payments, reduces friction in the financial ecosystem, and promotes greater financial inclusion by enabling more participants to engage in a common settlement infrastructure through the use of settlement agents.

- **Reduction of credit and settlement risk:** Enables finality of cross-network transactions for RSN member banks and non-RSN member banks that engage with a settlement agent, which minimizes the time during which counterparties are exposed to potential default.

Use case conclusion

While many of the business benefits are similar between the interoperability use cases, this specific use case set out to explore a model where non-RSN member banks could access the RSN through a correspondent banking model with RSN member banks acting as settlement agents to extend the benefits of the RSN. This use case depicted the ability for non-RSN member banks to leverage the RSN as a common industry settlement venue for off-network transactions.

"The successful implementation of the Cross-Network Correspondent Bank Settlement use case demonstrates the transformative potential of RSN as a common settlement infrastructure, enabling seamless transactions and fostering a more dynamic financial ecosystem."

—Harris Simmons, Chairman and CEO,
Zions Bancorp

Cross-network intraday repurchase (repo) agreement settlement

Introduction

The final use case that the RSN working group explored was the ability to connect to a third-party platform to initiate intraday repurchase agreements in which both legs of the transaction are settled on the RSN. Expanding on the non-centrally cleared investment-grade bond and centrally cleared DvP use cases, the intraday repo use case was performed in collaboration with Broadridge's Distributed Ledger Repo (DLR) product. The use case intended to demonstrate that the RSN could facilitate intraday repo transactions across two separate networks with enhanced transparency, real-time visibility, and automated synchronized settlement of both cash and securities for both legs of a repo transaction that are maintained on the RSN, ultimately providing an intraday funding solution to allow RSN member banks to better optimize their cash and collateral on an intraday basis.

This use case highlights how integrating the RSN with other platforms, such as the Broadridge DLR, through an interoperability solution such as Swift's interlinking prototype, could synchronize transaction execution and settlement, expanding transaction optionality and enhancing market liquidity for Broadridge DLR member banks that are also RSN member banks. Furthermore, the interoperability of the Broadridge DLR use case is a key feature, allowing seamless cross-network transactions and continuous access to funding and liquidity management on a 24/7 basis. While not limited solely to Broadridge DLR, by enabling interoperability with other tokenized platforms, the RSN ensured that financial institutions can operate within a versatile and interconnected ecosystem, providing access to liquidity to allow banks to better optimize their collateral and be able to settle obligations on an as-needed basis.

Today, there is a small amount of activity in intraday markets given the limited industry options for this type of activity. This is mainly due to the following challenges:

- **Technical limitations:** Existing legacy technology infrastructures do not have the ability to book and settle intraday repo transactions outside of the existing acceptable settlement times.

- **Limited network interoperability:** While some solutions exist, transaction activity is solely for members of existing solutions, forcing such networks to operate in a siloed capacity and not be industrywide.

- **Increased operational complexity:** Deployment of additional solutions can be operationally complex when transitioning between legacy infrastructures to new technologies.

- **Limited intraday participation:** Given the aforementioned challenges, activity in the intraday market has not realized broad industry participation, limiting the activity and liquidity within the industry.

The RSN working group set out to depict how the RSN, serving as a common settlement infrastructure where tokenized assets, tokenized central bank deposits, and tokenized commercial bank deposits reside, could alleviate the previously stated challenges.

Figure 5: Cross-network intraday repurchase (repo) agreement settlement high-level design
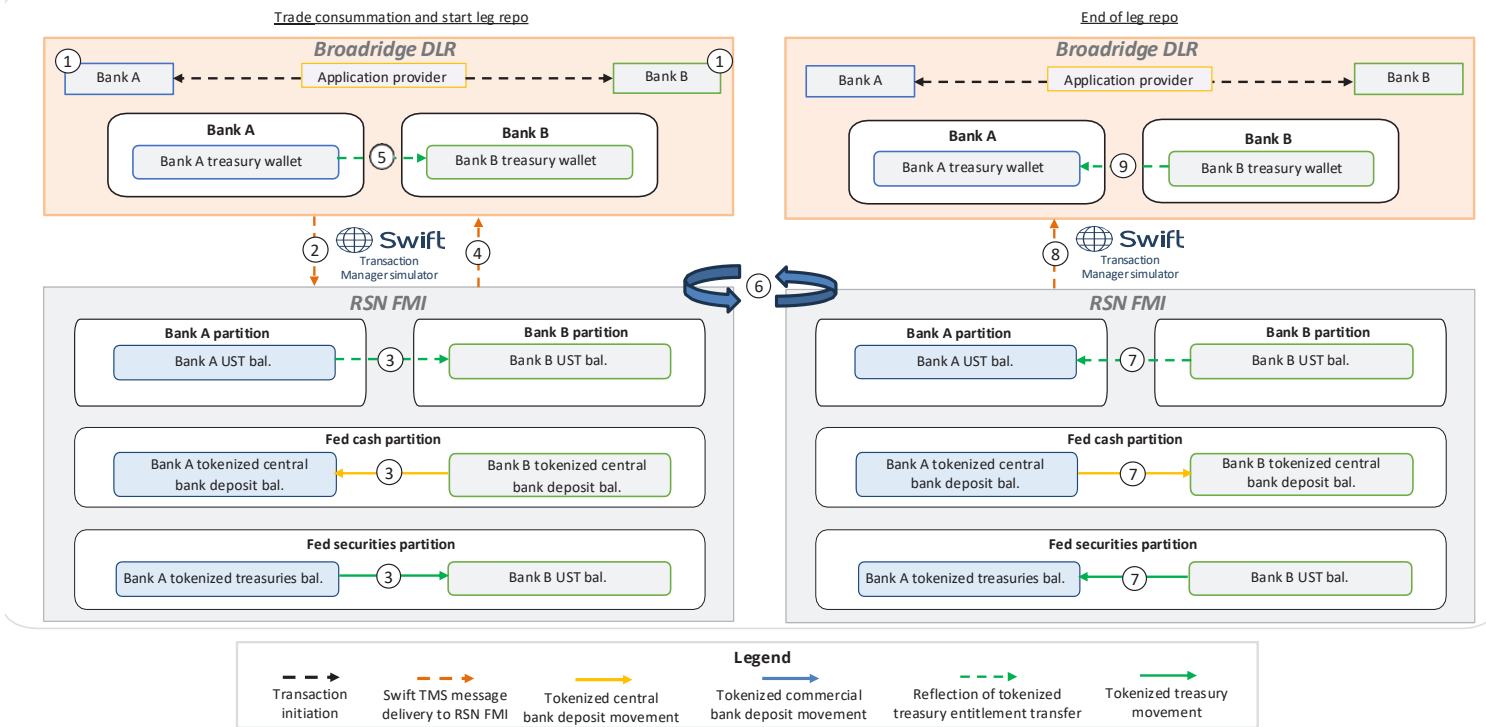
The cross-network intraday repurchase (repo) agreement settlement – Broadridge DLR intraday repo use case was built on several assumptions:

- Broadridge DLR banks are also RSN member banks.

- Broadridge DLR has the legal authority to submit a transaction to RSN on behalf of its member banks.

- The start leg of the repo occurred at 10:00 a.m. ET, and the end leg took place at 12:00 p.m. ET, providing a 2-hour term for this transaction.

- Tokenized treasuries maintained within the Fed Securities partition preexist in RSN member accounts within the Fed Securities partition.

The process flow for a repo transaction initiated between two Broadridge DLR banks where both legs of the transaction are settled on the RSN can be reduced to six key steps:

1. Bank A and Bank B enter into a repo transaction on DLR.

2. Once the trade is executed and the necessary AML and KYC checks take place, Broadridge DLR submits the transaction details to the Swift interlinking prototype, which is then routed to the RSN for settlement.

3. Once Bank A, Bank B, Fed Cash, and Fed Securities partitions each approve the transaction, Bank A's tokenized security account is debited and Bank B's tokenized security account is credited on the Fed Securities partition. Bank A's tokenized central bank deposit account is credited and Bank B's tokenized

central bank deposit account is debited on the Fed Cash partition. The reflection of cash and security ownership is mirrored on the bank partitions for real time visibility by the banks.

4. Once settlement occurs, the Swift interlinking prototype routes the successful transaction message back to Broadridge DLR.

5. Once this message is received, the accounts on Broadridge DLR's platform are updated reflecting the transaction that took place on RSN.

6. At 12:00 p.m. ET on the same trade date, the end leg of the repo automatically unwinds, leading to the following steps:

   a. Bank A's tokenized security account is credited and Bank B's tokenized security account is debited on the Fed Securities partition. Bank A's tokenized central bank deposit account is debited and Bank B's tokenized central bank deposit account is credited plus the agreed-upon interest rate. The reflection of cash and security ownership is mirrored on the bank partitions.

   b. Once settlement occurs, the Swift interlinking prototype routes the successful transaction message back to Broadridge DLR.

   c. Once this message is received, the accounts on Broadridge DLR's platform are able to be updated reflecting the transaction that took place on the RSN.

Key findings and expected benefits

The RSN was able to successfully connect with Broadridge DLR through the use of Swift's interlinking prototype to settle both legs of repo transactions initiated through Broadridge DLR. Considering the IG bond DvP use case was settled simultaneously, and the centrally cleared treasury DvP use case was settled various times throughout the trading day, financial institutions would need access to intraday funding solutions to be able to offset trade obligations on the same day, instead of financing transactions overnight and on trade date in the current T+1 settlement market. This use case proved critical to allowing firms to better optimize cash and collateral to settle same-day trade obligations. Specific key findings for this use case include:

- **Enhanced liquidity management:** As the RSN provides 24/7 access to liquidity and simultaneous settlement capabilities for tokenized cash and assets on the RSN, financial institutions can manage their liquidity needs more effectively throughout the trading day to settle obligations on behalf of the institution and clients. The ability to perform intraday repo transactions provided an as-needed funding option, helping institutions meet short-term obligations and better optimize liquidity and collateral inventory.

- **Reduced sizing of liquidity buffer:** The ability to reduce liquidity buffers (driven by the Basel III LCR requirement), which are a function of intraday liquidity spikes and cash flows, is an intraday repo solution that allows institutions to manage their liquidity needs and intraday spikes more effectively.

- **Reduced nature of manual operations:** Since the specific end time of the repo was included in the initial transaction message, the end leg of the repo is able to automatically take place, reducing the need for manual intervention for unwinding the end leg of a repo transaction.

- **Increased transaction optionality:** By connecting the RSN and Broadridge DLR, the system provides additional transaction options to RSN members, enabling them to engage in a wider range of executable transactions. The ability to set dynamic start and end times for repo transactions throughout the trading day offers greater flexibility and customization for market participants. This flexibility can help institutions better manage their funding and investment strategies.

- **Collateral optimization:** As the RSN will reflect the securities and cash held in custody within the underlying partitions as part of the repo transaction, increased transparency and real-time visibility into the status of securities on the network was achieved.

- **Extensibility to other third-party platforms:** By having a common settlement infrastructure where the RSN contains various forms of securities and cash with multiple types of applications linking with the RSN allows RSN member banks to seamlessly interact with other applications. This reduces fragmented liquidity and security inventory while providing greater network interoperability capabilities.

Use case conclusion

The completion of the cross-network intraday repurchase (repo) agreement settlement use case proved to be significant for the RSN PoC and how the future of how cross-network multi-asset and intraday repo transactions can be achieved. Offering intraday funding solutions in a shared ledger environment consisting of tokenized securities, tokenized central bank deposits, and tokenized commercial bank deposits could reduce existing market fragmentation and allow for financial institutions to offset trading obligations sooner, permitting greater optimization of cash and collateral while reducing settlement and counterparty risk. It is important to note that while this use case was performed in collaboration with Broadridge DLR, the wider array of benefits could be extended to other tokenized third-party platforms, allowing for seamless cross-network settlement capabilities across the industry.

"Precise funding using intraday repo on a network like RSN holds the potential to improve liquidity management and reduce funding costs across the industry."

—Arushi Sood Joshi, Head of Distributed Ledger Technology and Digital Assets Center of Excellence, Wells Fargo

Potential benefits of RSN

The RSN PoC built upon the foundational benefits demonstrated by the US RLN PoC and introduces several additional advantages that further enhance the efficiency, reliability, and security for multi-asset and cross-network settlement. Below, we delve deeper into the specific benefits that the RSN concept could provide to the financial services industry.

Inherited benefits from RLN

The RSN inherited several key benefits from the RLN US PoC, including improved liquidity management, streamlined and consistent communication standards, enhanced data transparency, and 24/7 settlement availability. RLN demonstrated the potential for simultaneous settlement finality for PvP transactions, reducing counterparty risk and establishing a common global framework for end-to-end data transparency and interoperability. These foundational benefits provided a robust baseline upon which the RSN builds further enhancements.

Benefits of the RSN FMI system

The RSN PoC introduced several advanced benefits for multi-asset and cross-network settlement capabilities. By offering precise, dynamic settlement capabilities; supporting a multi-asset FMI on a shared ledger; enabling programmable transactions; and facilitating interoperability with other FMIs, the RSN significantly enhances the efficiency, reliability, and security of single asset as well as multi-asset and cross-network transactions. These benefits position the RSN as a transformative solution that can address the evolving needs of the global financial system and drive future growth and innovation. By addressing inefficiencies in the current financial infrastructure, the RSN could catalyze wide-ranging changes in how financial markets operate, leading to a more efficient, transparent, and stable financial system.

Precise settlement

One of the most significant enhancements offered by the RSN is the ability to facilitate precise settlement capabilities, either in real time or at predetermined intervals. This capability offered several key benefits:

- **Precision of settlement timing:** The system allows for transactions to happen in real time or when funding is available. For more complex transactions, it provides optionality in settlement timing to allow for institutions to fund transactions throughout a trading day. It allows for seamless settlement of transactions regardless of time of day, improving market efficiency, reducing delays in settlement finality, and allowing for better optimization of cash and collateral.

- **Enhanced intraday liquidity capabilities:** Enabling real-time settlement for both legs of repo transactions can allow institutions to manage short-term liquidity needs more effectively, reducing the cost and risk of short-term borrowing. An intraday funding solution can allow financial institutions to meet their immediate liquidity requirements; as a result, it enhances overall financial stability, operational efficiency, and better optimizes its collateral.

- **Integrated operations:** Integrating various asset types, including tokenized central bank deposits, tokenized commercial bank deposits, tokenized securities, bonds, and other regulated assets within a single ledger streamlines the settlement process by reducing the frictions between multiple infrastructures and systems. This integration simplifies the management of different asset classes, enhances operational efficiency, and allows for the seamless movement of cash and collateral across the network in real time and at any time.

Network interoperability

- **Cross-network settlement finality:** The ability to provide coordinated settlement capabilities for transactions initiated on third-party networks can enhance the efficiency, speed, and reliance of cross-network transactions by having a common settlement infrastructure. This capability allowed for the RSN to serve as a common industry settlement platform that can support the settlement process for various types of third-party platforms.

- **Standardization and integration:** Standardization of processes and protocols within the RSN can help facilitate consistent cross-network interoperability capabilities, facilitating smoother integration between different third-party networks. This standardization can reduce operational complexities, streamline the onboarding process to the RSN for third-party networks, and improve overall market efficiency.

- **Scalability to third-party networks:** While the RSN working group has a general belief that there will not be one single network in a future state, having a common settlement platform that is connected to various third-party applications and platforms could provide greater flexibility and scalability of cross-network solutions that may enhance liquidity, collateral, and risk management capabilities.

- **Collaborative ecosystem:** Connecting the RSN to multiple third-party networks demonstrates the potential for a collaborative ecosystem in which different financial institutions and market participants can interact and transact more effectively. This collaboration can drive innovation and enhance overall functionality of financial markets.

Programmability

- **Programmable market infrastructures:** The RSN FMI was able to facilitate programmable transactions that reduced the need for human intervention and enabled both real-time and precise settlement capabilities once predetermined transaction parameters were met. This integration was able to enhance the overall functionality and performance in comparison to legacy systems.

- **Automation of complex processes:** Through the deployment of smart contracts, straight-through processing of specific processes were achieved. RSN member banks were able to automatically fund tokenized central bank deposit accounts in the instance of insufficient balances, while also being able to auto-approve certain transactions based on predetermined transaction parameters.

- **Automated and standardized compliance checks:** While still under consideration, if the RSN incorporates standardized compliance checks, it could lead to the development of automated compliance solutions, which could allow for a more seamless settlement process following client onboarding.

Enhanced risk and compliance capabilities

- **Transparency:** Real-time record of proprietary positions and in-flight transactions greatly increases transparency, allowing for increased visibility of settlement status and the opportunity to reduce associated operational overheads. In the instance of regulatory inquiries or reporting capabilities, firms could be able to provide a standardized view of transaction history across the RSN.

- **Resiliency:** Shared ledger technology removes the singe-point-of-failure risk inherent in legacy infrastructure, enabling access to records independent of the availability of third parties. Additional opportunity to consider distribution of operation of the infrastructure across market participants significantly enhances operational resiliency.

- **Better tools for market oversight:** The increased transparency and real-time nature of the RSN could provide participants and regulators with better tools for market and systemic risk monitoring. This could lead to more effective regulation and potentially reduce the likelihood of financial crises.

The RSN working group was able to identify a number of benefits that shared ledger technology can provide to the regulated financial services industry. While the use case benefits identified were specific to each use case, further industrywide benefits could be achieved by having a common settlement infrastructure that is interoperable with third-party solutions, ultimately providing regulated financial institutions with greater transparency, visibility, and settlement capabilities to meet the evolving demands of its clients and a global digital economy.

"The team at Visa is excited by the results of the RSN project. It proved what it set out to—that a shared ledger FMI could provide a common industry settlement infrastructure to the financial services industry. We look forward to continued collaboration on future feasibility studies."

—Tim Moncrieff, VP and Global Head of Strategic Initiatives, Visa

Conclusion

The RSN PoC was an industry initiative building off the findings from the US RLN PoC, in which the RSN working group explored the intersection of shared ledger technology and the regulated financial system, with a focus on real-time, dynamic, and cross-network settlement finality for securities and other regulated assets. The group came together to address a shared question: How might shared ledger technology be employed to transform payments, securities, and cross-network settlements while leveraging existing regulatory frameworks?

During the PoC, subject matter experts from the working group participants explored the business, technical, and legal feasibility of a novel settlement system and provided the following key findings:

- **Business applicability**
  - Multi-asset and cross-network settlements could be enhanced through the use of a shared ledger FMI that consists of tokenized securities and tokenized central bank and commercial bank deposits where each institution operates its own partition.

  - The working group concluded that the creation of an FMI that encompasses the above characteristics could alleviate a number of the existing challenges today, such as infrastructure fragmentation, lack of visibility into settlement status, and the need for manual intervention at various points throughout the settlement life cycle.

  - The result may provide the financial services industry a common settlement infrastructure that is always on, programmable, and offers precise settlement capabilities to allow financial institutions to realize enhanced collateral and liquidity optimization.

- **Technical feasibility**
  - The PoC achieved simultaneous DvP settlement of securities and regulated assets within the RSN system. The shared ledger technology enabled synchronized balance sheets across participants, eliminating traditional delays associated with proprietary databases and batch processing.

  - The RSN design supports various asset classes on a single ledger, demonstrating the scalability and versatility required for modern financial transactions. The system successfully handled tokenized central bank deposits, tokenized commercial bank deposits, tokenized securities, and bonds within a unified framework.

  - The PoC showcased integration of multiple networks, enabling synchronized settlement across diverse platforms. By leveraging interoperability solutions such as the Swift interlinking prototype and direct API integrations, the RSN demonstrated its capability to connect with other DLT solutions and construct complex use cases involving the RSN settlement venue.

- **Legal viability**
  - It is likely that an operational RSN could be designed under existing legal frameworks. The legal analysis did not identify any issues that would prevent the creation of the RSN as contemplated within the PoC, although further analysis and engagement with regulators would be required before any final conclusions can be reached. In particular, there may be complexities under existing legal frameworks in regulating a system that includes holding and transfers of both deposits and securities, and these complexities would need to be addressed further in a later phase. In this regard, due to the securities nexus, additional discussions and likely registration or exemption with the SEC will need to be addressed.

  - The use of shared ledger technology to record and update ownership of central bank and commercial bank deposits and securities entitlements should not alter the legal treatment of the assets or transfers of them, and the tokens used by each respective RSN member should not have independent legal significance that should be subject to new regulatory requirements beyond those otherwise applicable to deposits and securities. For each of the use cases explored in the PoC, the RSN was able to provide settlement finality at a specified point, including at a point synchronized with a third-party regulated network.

As the capital markets industry continues to look to develop and modernize products and infrastructure to increase efficiency, reduce risk, and unlock new services, the RSN working group stressed that the approach taken in the RSN PoC is one potential solution. Ahead of adoption of such a network, such as the RSN, there will need to be broader industry consensus and alignment between both public and private sectors across a variety of areas, including:

- Non-functional requirements
  - Performance and scale
  - Network resiliency
  - Security and privacy
  - User experience

- Financial and business requirements
  - Financial cost of developing and operationalizing a system
  - Market structure considerations
  - Network adoption
  - Use case development

- Operational and function requirements
  - 24/7 network capabilities
  - Connectivity and compatibility with traditional systems

- Legal and regulatory requirements
  - Governance of the FMI
  - Supervision by regulatory agencies

Recommended next steps

The working group has determined that the RSN has the potential to be implemented by the industry as a new operating model offering benefits to participants while building on the foundations of regulated capital markets products and processes. Following the initial exploration of the RSN model through the PoC, the working group recommends a fuller exploration of how the RSN would operate and key design and business considerations through a dedicated feasibility study, which would encompass, but is not limited to, the above topics. This study would further engage the wider financial services industry, including front- and back-office personnel, and should be performed as a public-private collaboration, bringing together appropriate stakeholders and gathering inputs from end users.

Based on the findings of the PoC, the working group will continue to drive discussions with the public sector on industry advocacy around specific regulatory gaps within the United States. The RSN program manager, SIFMA, intends to continue the dialogue around the concept of a shared ledger FMI through its industry forums to understand the RSN concept more fully and to identify opportunities to operationalize it. In parallel, the regulatory context analyzed in the RSN legal report will provide a foundation for further advocacy and dialogue on areas of potential regulatory modernization needed to accommodate post-trade ledger-based innovation within the securities and banking regulatory frameworks.

The PoC provides a detailed perspective on how a shared ledger FMI that consists of tokenized securities, tokenized central bank deposits, and tokenized commercial bank deposits could operate, and working group members see it as highlighting the benefits that would be offered by a common industry settlement infrastructure that supports simultaneous and precise settlement capabilities. The use cases explored during the PoC demonstrate the potential to transform industry post-trade processes through the potential application of a shared ledger FMI.

Appendix

Application of Common Domain Model (CDM) in the RSN

The Common Domain Model (CDM) is a standardized, machine-readable, and machine-executable framework that represents financial products, trades in those products, and the life cycle events of those trades. It is designed to be composable, allowing financial products to be represented as combinations of payouts and features. The primary product classes covered by the model to date include derivatives, repos, and securities loans. CDM is built according to a set of design principles that ensure its robustness and flexibility. These principles include normalization through the abstraction of common components, composability where objects are composed and qualified from the bottom up, mapping to existing industry messaging formats, embedded logic to represent industry processes, and modularization into logical layers. This composability, along with the inclusion of legal documentation, such as ISDA's Credit Support Annexes (CSAs) and International Securities Lending Association's (ISLA) Global Master Securities Lending Agreement (GMSLA), and collateral representation for ISDA, ISLA, and ICMA products, makes CDM particularly well-suited for providing the basis for smart contracts associated with real-world legal agreements.

CDM is an open-source product development solution hosted by Fintech Open Source Foundation (FINOS) and based on cross-industry collaboration between ICMA, ISDA, ISLA, financial institutions, trading platforms, and industry service providers. Implementation involves integrating CDM into existing systems and workflows, updating and/or mapping to data models, reconfiguring processes, and ensuring compliance with standardized definitions and structures. Distributed ledger technology and smart contracts have been leveraged to fully realize CDM's benefits, enabling real-time data exchange, enhanced transparency, and automated processes. Pilot projects and industrywide initiatives allow stakeholders to test and refine CDM applications before broader adoption, making CDM a cornerstone of modern financial infrastructure and driving greater efficiency and consistency across the industry. The

CDM's ability to map to existing industry messaging formats and its embedded logic for representing industry processes further enhance its utility, making it a comprehensive solution for modernizing financial market operations. Because of this, CDM was well-positioned for consideration as to how it could apply to the RSN and its various use cases, enhancing the efficiency and transparency of these financial transactions. The following common assumptions across the use cases illustrate how CDM's capabilities align with the needs of the RSN pilot: Trade terms (e.g., security CUSIP, trade amount, price, settlement time) will be agreed upon prior to reaching the RSN, and CDM provides a standardized framework for representing and agreeing upon these terms.

- Based on the banks' predefined auto-approval or auto-rejection ruleset, the trade counterparties may proceed directly from the trade submission without manual approval. CDM supports workflows, including an approval workflow that captures multiple approvals, which can be triggered manually or automatically.

- Specific transaction data (e.g., trade counterparties) can be updated to allow for transaction matching, and CDM includes functions for controlling amendments to trade terms, ensuring that transaction data can be accurately and efficiently updated as needed.

By leveraging CDM's standardized, machine-readable, machine-executable model, the RSN pilot can achieve greater consistency, transparency, and efficiency in financial transactions, ultimately contributing to a more robust and streamlined financial ecosystem. Some resources that set out how CDM can be utilized as the basis for smart contracts can be found here:

- [Building-Smart-Contracts.pdf (isda.org)](#)

- [The Future of the Securities Lending Market | On the Cusp of Transformation - ISLA (islaemea.org)](#)

Applicability to the RSN use cases

For specific use cases, CDM's capabilities are particularly beneficial. In the IG bond DvP use case, CDM would create instructions through its payouts representing the asset payout, generating "transfers" that describe the movement of securities/cash and between which parties. These transfers assume that an external system updates the settlement status from pending to settled, a process represented by the rest of the flow. Additionally, CDM has workflow steps that can support a workflow requiring multiple approvals, ensuring that all necessary parties have validated the transaction before it proceeds. Similarly, in the centrally cleared treasury DvP use case, CDM would create instructions through its payouts representing the forward payout, generating "transfers" that describe the movement of securities/cash and between which parties. These transfers also assume that an external system updates the settlement status from pending to settled, a process represented by the rest of the flow. CDM contains functions describing the matching and clearing of transactions, ensuring that all trades are accurately reconciled. While functions producing confirmations are not currently natively supported, confirms can be generated from CDM representations, allowing firms to use either the full representation or filter per the terms of their individual agreements. Additionally, CDM has workflow steps that can support a workflow requiring multiple approvals, ensuring that all necessary parties have validated the transaction before it proceeds.

In the cross-network correspondent bank settlement use case with Tassat, CDM would create instructions through its payouts representing the forward payout, generating "transfers" that describe the movement of securities/cash and between which parties. These transfers assume that an external system updates the settlement status from pending to settled, a process represented by the rest of the flow. CDM also has workflow steps that can support a workflow requiring multiple approvals, ensuring that all necessary parties have validated the transaction before it proceeds. For the Broadridge intraday repo and interoperability use case, CDM would create instructions through its payouts representing the spot and forward legs of the repo,

generating "transfers" that describe the movement of securities/cash and between which parties. These transfers assume that an external system updates the settlement status from pending to settled, a process represented by the rest of the flow. CDM has workflow steps that can support a workflow requiring multiple approvals, ensuring that all necessary parties have validated the transaction before it proceeds. See this page for full details on the Repo product within CDM: [Repurchase Transaction Representation in the CDM | Common Domain Model (finos.org)](). By leveraging CDM's capabilities across these use cases, and any future cases, an RSN FMI can achieve greater consistency, transparency, and efficiency in financial transactions, ultimately contributing to a more robust and streamlined financial ecosystem.

In the multiple use cases that incorporate collateral movements (client-to-client IG bond DvP settlement, centrally cleared dealer-to-dealer treasury DvP settlement, and intraday repurchase agreement settlement), the use of the CDM's collateral representation open-source code would be beneficial, which has been developed with collaborative efforts by ISDA, ISLA, and ISDA members; and it could be expanded, if needed, for cleared products' collateral.

Parties involved in the use case workflows could use the CDM's collateral representation natively, or they could map their data model to the CDM in an effort to reduce data friction. The Object Builder could be used to develop bilateral eligible collateral schedules in digital form, improving operational risks that are inherent with manual onboarding processes and unique document structures.

The collateral ecosystem is supported by tri-parties, administrators, custodians, end users, technology providers, prime brokers, clearing members, and CCPs, and the ecosystem would be much more efficient if as many parties as possible are using the same data model for collateral.

Glossary of terms

Term	Definition
CCP	Central Counterparty
Correspondent banking model	Process where one bank (the correspondent or settlement agent) provides services on behalf of another bank (the respondent) typically to facilitate transactions in which the respondent bank does not have direct access to a specific type of asset
Cross-Network Settlement	Process of completing and finalizing transactions between different blockchain networks to enable the transfer of assets and data across various third-party platforms or networks
CSD	Central Securities Depository
DvP	Delivery versus payment settlement mechanism where the transfer of securities occurs only if the corresponding payment is made simultaneously
FMI	Financial Market Infrastructure
Immutability	Characteristic that once data has been written to the blockchain it cannot be altered or deleted
Interoperability	Ability of different blockchain networks to communicate, share data, and interact with one another seamlessly to enable the transfer of assets and information across various blockchain platforms without the need for intermediaries
ISO20022 Messaging Standard	Standard for financial messages that enables interoperability between financial institutions, market infrastructures, and the banks' customers
MT541 Message	Message sent from an account owner to an account servicer to instruct the receipt of financial instruments against payment
MT543 Message	Message that instructs an account servicer to deliver financial instruments against payment
MT548 Message	Status update message sent by an account servicer to an account owner or designated agent to provide information about a settlement instruction
Net Settlement	Process of consolidating multiple transactions between parties within a defined settlement window into a single net amount
Pacs.002 Message	Message sent by an instructed agent to a party in the payment chain to report on the status of a payment instruction
Partition	Smaller, independent segment of a blockchain network that processes its transactions and smart contracts
Precise Settlement	Ability of financial systems and institutions to accurately and efficiently settle transactions, ensuring that all parties involved receive their due payments or securities in a timely and error-free manner.
Private, Permissioned Blockchain	Type of blockchain network in which access is restricted to a specific group of participants who have been granted permission
Resiliency	Ability of a blockchain network to continue operating and maintaining its integrity despite failures, attacks, or other adverse conditions
Shared Ledger Technology	Digital system for recording the transaction of assets in which the transactions and their details are recorded in multiple places at the same time
Simultaneous settlement	Process in which multiple transactions are completed and settled at the same time across different third-party networks or platforms
Synchronized Settlement	Coordinated completion of transactions across different third-party networks or platforms at the same time
Tokenization	Process of converting rights to an asset into a digital token on a blockchain by which each token represents ownership or a share of the underlying asset
Tokenized Central Bank Deposits	Traditional central bank deposits that have been converted into digital tokens on a blockchain or distributed ledger and represent the same value as the original deposits
Tokenized collateral	Assets that have been converted into digital tokens on a blockchain or distributed ledger that can be used as collateral in financial transactions
Tokenized Commercial Bank Deposits	Traditional commercial bank deposits that have been converted into digital tokens on a blockchain or distributed ledger and represent the same value as the original deposits
Tokenized Securities	Traditional financial securities (e.g., IG Bonds, US Treasuries, etc.) that been converted into digital tokens on a blockchain or distributed ledger and represent the same value as the original securities
Transparency	Characteristic of blockchain technology that allows all participants to view and verify transactions on the network