AN INDUSTRY CASE STUDY

Cross-Chain Settlement of Tokenized Assets Using Chainlink CCIP

A case study showcasing how financial institutions can leverage Chainlink CCIP to provide their clients with the ability to trade and settle tokenized assets across public and private blockchains.

Chainlink Labs

In Collaboration With Australia and New Zealand Banking Group (ANZ)

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Executive Summary

Financial institutions are increasingly exploring use cases that involve tokenized assets, with 93% of institutional investors believing in the long-term value of blockchain technology and/or digital assets. However, this new system of "onchain finance" is highly fragmented, as tokenized assets and related services are siloed across different blockchains that are not natively interoperable. This cross-chain communication problem has limited the adoption of tokenized assets by making them inaccessible and illiquid while making the integration process for financial institutions complex.

Blockchain interoperability is a widely recognized industry challenge, highlighted by the fact that Swift, Chainlink, and more than a dozen financial institutions—including Australia and New Zealand Banking Group Limited (ANZ), BNP Paribas, BNY Mellon, Citi, Clearstream, Euroclear, Lloyds Banking Group, SIX Digital Exchange (SDX), and Depository Trust & Clearing Corporation (DTCC)—collaborated to demonstrate how existing Swift infrastructure and Chainlink Cross-Chain Interoperability Protocol (CCIP)[2] could be used together to efficiently instruct the transfer of tokenized value between a range of blockchain networks.

This work inspired a bilateral engagement between ANZ and Chainlink Labs to take blockchain interoperability a step further—cross-chain settlement involving both tokenized assets and stablecoins. The following report shows how integrating a Digital Asset Services technology stack with Chainlink CCIP could help enable financial institutions to securely provide their clients with seamless access to tokenized assets across public and private blockchains via an internal or third-party web app.

The Tokenized Asset Opportunity Is Significant

Digital assets can be generally grouped into two categories: Native Digital Assets that don't have a real-world representation and tokenized real-world assets (RWAs) that have a real-world representation. Within these two categories, the digital assets can either be managed by a central party (e.g., USDC stablecoin) or be managed in a decentralized manner (e.g., DAI stablecoin).

The World Economic Forum estimates that $867T worth of value could be tokenized. A tokenized asset is data in the form of a digital token that represents or evidences ownership or rights in relation to something of value. Tokenized assets are stored and used via a digital distributed ledger, most commonly a public or private blockchain. The blockchain acts as a shared source of truth about ownership and the current state of assets. Blockchains' use of decentralized consensus to process state updates seeks to ensure the ledger remains accurate, immutable, persistent, and secure.

The Tokenized Asset Opportunity

Source: World Economic Forum

Tokenized assets are a multi-hundred-trillion dollar market opportunity that represents the next evolution in digital assets.

Financial institutions can play a critical role in the adoption of tokenized RWAs by serving as asset issuers, custodians, and gateways for their customers to seamlessly access and trade these digital assets. Tokenized RWAs can also introduce a variety of efficiency, usability, and transparency upgrades for how financial institutions interact with one another.

Some of the notable benefits of transitioning traditional financial assets into tokenized RWAs include:

- **Composability:** Anything can be tokenized on blockchains, from real estate, art, and credentials to cash, deposits, and bonds. Thus, blockchains enable all these assets to be standardized upon shared infrastructure rails, allowing the delivery of assets and payment for them to occur as an atomic transaction without a trusted intermediary. These composability benefits reduce transaction overhead, automate processes, and enhance the programmability of assets.

- **Fast Settlement:** Tokenized asset transactions can often be atomically settled instantaneously via smart contracts, particularly when the medium of exchange and asset are both on-chain. This improves the customer experience (e.g., cross-border payments) and reduces counterparty risk of late or unmade payments.

- **Accessibility and Liquidity:** Shared digital ledgers modernize asset infrastructure by enabling the fractionalization of asset ownership, potentially broadening access to a wider customer base, especially for assets that are difficult to source liquidity for.

- **Transparency:** A tamper-resistant record of asset ownership makes it easier to track the lifecycle and verify the provenance of assets, improving reconciliation processes.

> "The tokenization of illiquid assets is expected to grow to $16T by 2030—equivalent to around 10% of global GDP."
>
> BCG (2022)

The Tokenized Asset Landscape Is Fragmented

Tokenized assets and related services exist across multiple different public and private blockchains. Similar to the early Internet, where there were many separate intranets that did not interoperate, the various tokenized asset platforms of today also don't inherently communicate with one another due to the unique security model of blockchains. This blockchain interoperability problem has created a series of roadblocks that must be overcome for mass adoption of tokenized assets to be achieved.

- **Liquidity Fragmentation:** Tokenized assets may experience lower liquidity because the assets themselves and the users that may want to interact with them are scattered across different platforms. Tokenized asset liquidity across platforms must be unified if they are to reach their potential as a preferred asset class.

- **Integration Overhead and Complexity:** Full integration between each individual tokenized asset platform can be costly and time-consuming, limiting the speed of innovation between counterparties and introducing technological risk associated with having to interact with many different types of blockchain technologies. Users need a single gateway to all blockchains that is future-proof to the inevitable changes that will occur in the ever-changing digital asset landscape.

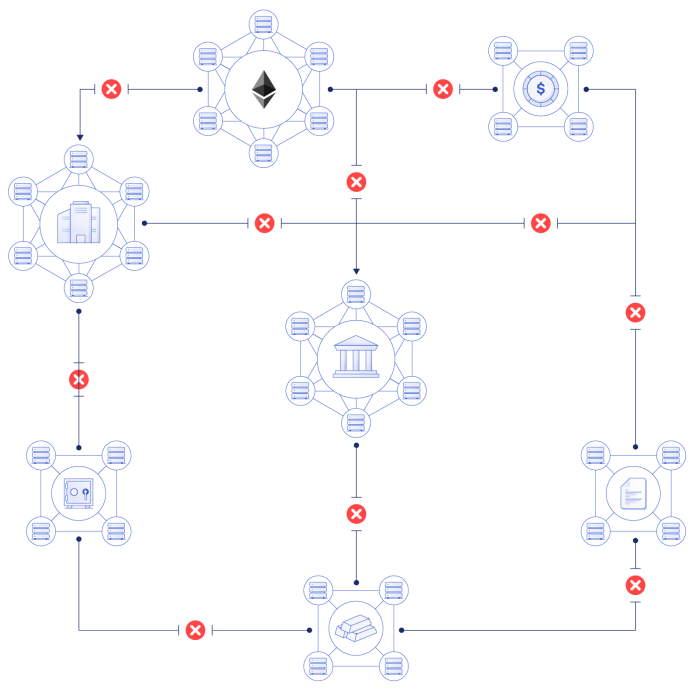
- **Suboptimal Consumer Experience:** The accessibility of tokenized assets, particularly across blockchains, comes with a steeper learning curve for new users, such as learning how to set up a wallet and interact with various distinct blockchains—all with the understanding that one mistake could put their tokenized assets at risk. Users should be able to interact with tokenized assets in a simple and secure manner with just a few clicks.

> "An increasingly fragmented DLT-based landscape was described by Global Financial Markets Association (GMFA) members, with specific concerns around the lack of interoperable initiatives forming 'islands of liquidity.'"
>
> GFMA, 2023

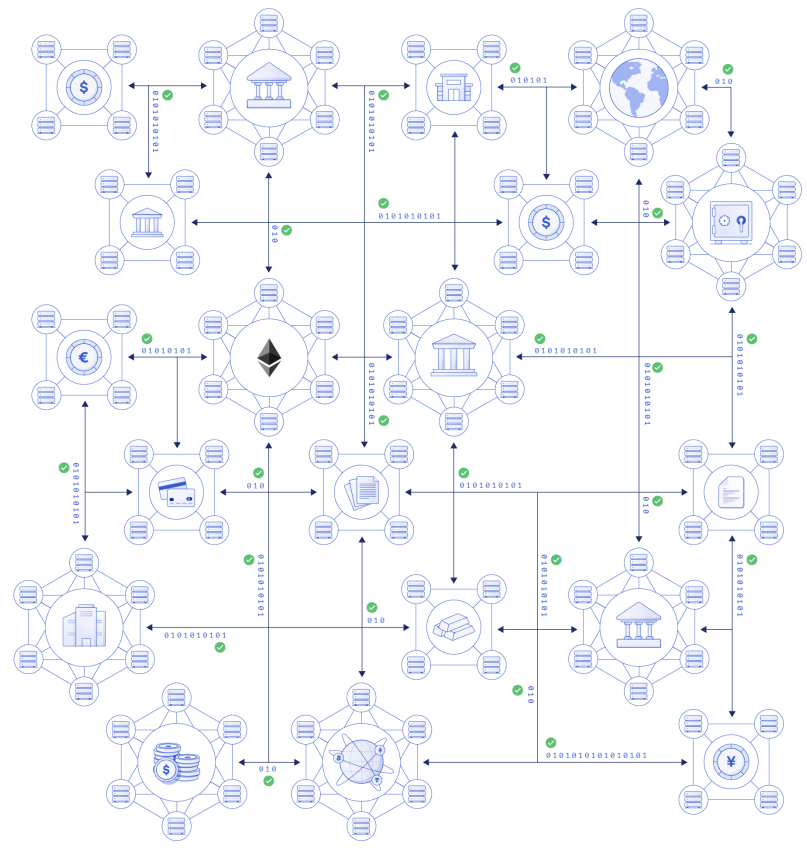
The fragmentation of the tokenized asset landscape requires an interoperability solution that allows for secure communication to and across public and private blockchains via a single interface. However, the solution needs to improve upon past attempts at blockchain interoperability if traditional markets are to adopt it as an industry standard.

Solving the Blockchain Interoperability Problem

Fragmented Tokenized Asset Landscape



Cross-Chain Interoperability via CCIP



Chainlink CCIP solves the blockchain interoperability problem by enabling secure cross-chain communication between any public or private blockchain.

Existing solutions for blockchain interoperability have often involved point-to-point blockchain-specific integrations, where each bridge or messaging framework between a specific set of chains is distinct. Integration with such solutions is often costly, time-consuming, and presents additional risk and inefficiencies. Moreover, each cross-chain implementation has its own security assumptions, settlement speeds, infrastructure setups, and development workflows that must be maintained and supported.

Past interoperability solutions have also often been limited due to their inability to provide broad support for both public and private blockchains, EVM and non-EVM blockchains, or arbitrary messaging and token transfer capabilities. Furthermore, some interoperability solutions were centralized, negating the security and reliability benefits of blockchains and presenting potential asymmetrical benefits to the owner or administrator of the solution.

CCIP: The Blockchain Interoperability Standard

Interoperability requires standards. This is evident in the existing financial system, where Swift drives the development and adoption of interoperability standards that allow banks to communicate with one another efficiently—a key driver of economic growth over the last few decades. The foundational prerequisite for any standard to gain adoption and have a chance to succeed is that it is secure and reliable.

> "Given the growing list of blockchain networks, which each host their own unique tokenized assets and digital asset services, it's imperative for the industry to align around a blockchain interoperability standard. Doing so will help enable seamless tokenized cross-chain DvP transactions between counterparties."
>
> Nigel Dobson, Banking Services Lead, ANZ

Chainlink CCIP

Chainlink—the industry-standard decentralized computing platform—has introduced an open blockchain interoperability standard called the Cross-Chain Interoperability Protocol (CCIP). CCIP is an abstraction layer and cross-chain messaging protocol that enables existing infrastructure to both connect to blockchains and instruct smart contracts (i.e., computer programs that are hosted and executed on blockchains) to send arbitrary data and enable token transfers across public and private blockchains.

Some of the notable advantages of CCIP include:

- **Liquidity Aggregation:** CCIP provides interoperability between any public or private blockchain, enabling buyers, sellers, and market makers to seamlessly transact assets and access broader liquidity across the multi-chain ecosystem.

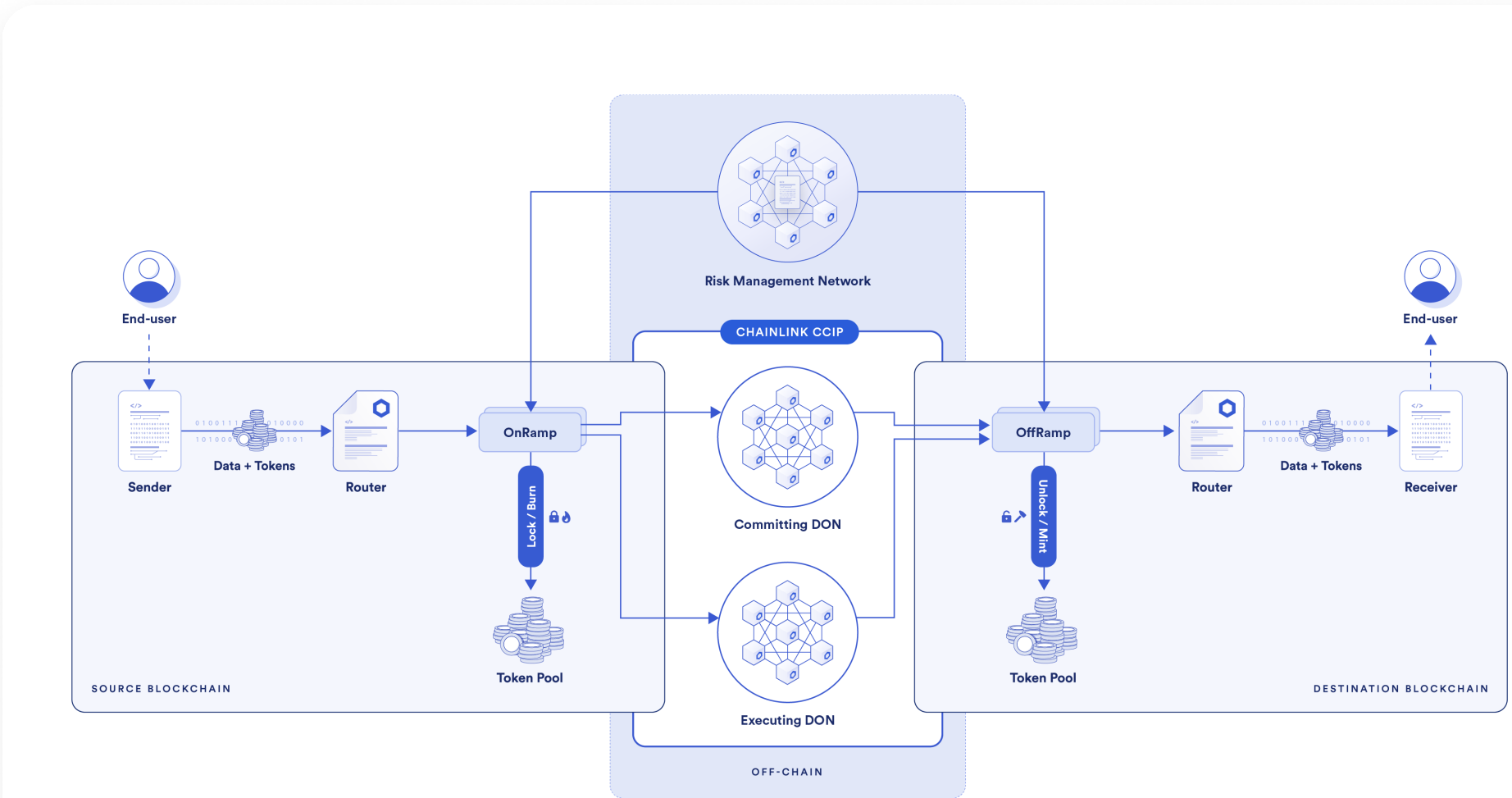
- **Speed of Integration:** CCIP eliminates the need to write custom code for chain-specific integrations. Developers only need to integrate the CCIP Router onchain to start building secure cross-chain applications, enabling their users to interact with any blockchain via a single interface.

- **Time-Tested Security and Reliability:** CCIP's consensus and messaging layer is powered by Chainlink decentralized oracle networks (DONs), which have already helped secure tens of billions of dollars for smart contract applications and enabled over $8.5 trillion in onchain transaction value. CCIP also supports customizable rate limits on transaction flows and and is secured by a Risk Management Network—an independent network that continually monitors and verifies cross-chain operations.

- **Reliable Transaction Execution:** A transaction price is quoted on the source chain via a gas-locked fee payment mechanism that confirms execution regardless of destination chain gas spikes and network congestion.

- **Future-Proof Technology:** CCIP is built to support future updates, such as the integration of new blockchains, the introduction of advanced functionalities, and the addition of other defense-in-depth approaches to security. Thus, integrating with CCIP eliminates future switching costs should new cross-chain functionalities be needed.

- **Developed by Industry Experts:** CCIP was developed and advised on by world-renowned cryptographers and computer scientists from the Chainlink Labs Research Team, which includes Ari Juels, Lorenz Briedenbach, and Dan Boneh.



Chainlink CCIP uses multiple layers of decentralization and enhanced risk management to provide enterprise-grade security and reliability for capital markets use cases.

Chainlink and ANZ Innovate in Cross-Chain Tokenized Asset Settlement

Chainlink Labs and ANZ teamed up to test cross-chain tokenized asset settlement given ANZ's work as a regulated financial institution in the digital assets space.[6]

ANZ provides banking products and services to over 8.5 million retail and business customers and operates across more than 29 markets. ANZ is consistently rated as the leading institutional bank within Australia.

ANZ is actively exploring the use of digital assets via a test-and-learn approach, engaging in a wide range of projects:[7]

- ANZ issued the first commercial bank-issued[8] AUD-referenced stablecoin on a public permissionless blockchain, referred to as A$DC.

- ANZ issued and traded tokenized Australian Carbon Credit Units (ACCUs) on a public blockchain mainnet with Grollo Carbon Ventures (GCV).

In a continuation of the test-and-learn approach, ANZ and Chainlink set out to demonstrate cross-chain tokenized asset settlement workflows across different use cases. The below use case demonstrates how ANZ enabled clients to engage in cross-chain interactions in a testnet environment, using an external web application.

Case Study: Cross-Chain Stablecoin Transfer for Tokenized Nature-Based Asset Purchase Enabled by ANZ Bank App via CCIP

OBJECTIVE

Test Delivery vs. Payment (DvP) across two blockchains using CCIP. This involved a client using ANZ's web app to buy tokenized nature-based assets denominated in a specific stablecoin on one blockchain with a different stablecoin issued on another blockchain. Case study transactions were conducted in a testnet environment with simulated forms of the relevant tokenized assets and stablecoins.

BUSINESS CONTEXT

DvP is a common form of settlement for securities that requires payment to be made either before or at the same time as the delivery of the securities. It's an important risk-management process to protect against securities being delivered without payment or payment happening without delivery of securities. Traditionally, DvP employs a trusted intermediary to facilitate the exchange since asset ledgers and payment rails are often distinct sets of infrastructure.

Blockchains provide an opportunity to modernize DvP because assets and payments can be tokenized on the same infrastructure, alongside custom logic (i.e., smart contracts) on how tokenized assets should be interacted with. This can enable atomic, non-intermediated DvP settlement when the medium of exchange and assets are both tokenized. However, tokenized assets often exist across different public and private blockchains, introducing friction when conducting cross-chain transactions.

Furthermore, regulated financial institutions have preferred, to date, to work with private permissioned blockchains, where network participants (i.e., validators) are known and approved (i.e., permissioned) and where access is managed (i.e., private). This makes the tokenized asset challenges of liquidity fragmentation and point-to-point integrations in the increasingly multi-chain landscape even more pronounced for participants in these networks.

SOLUTION

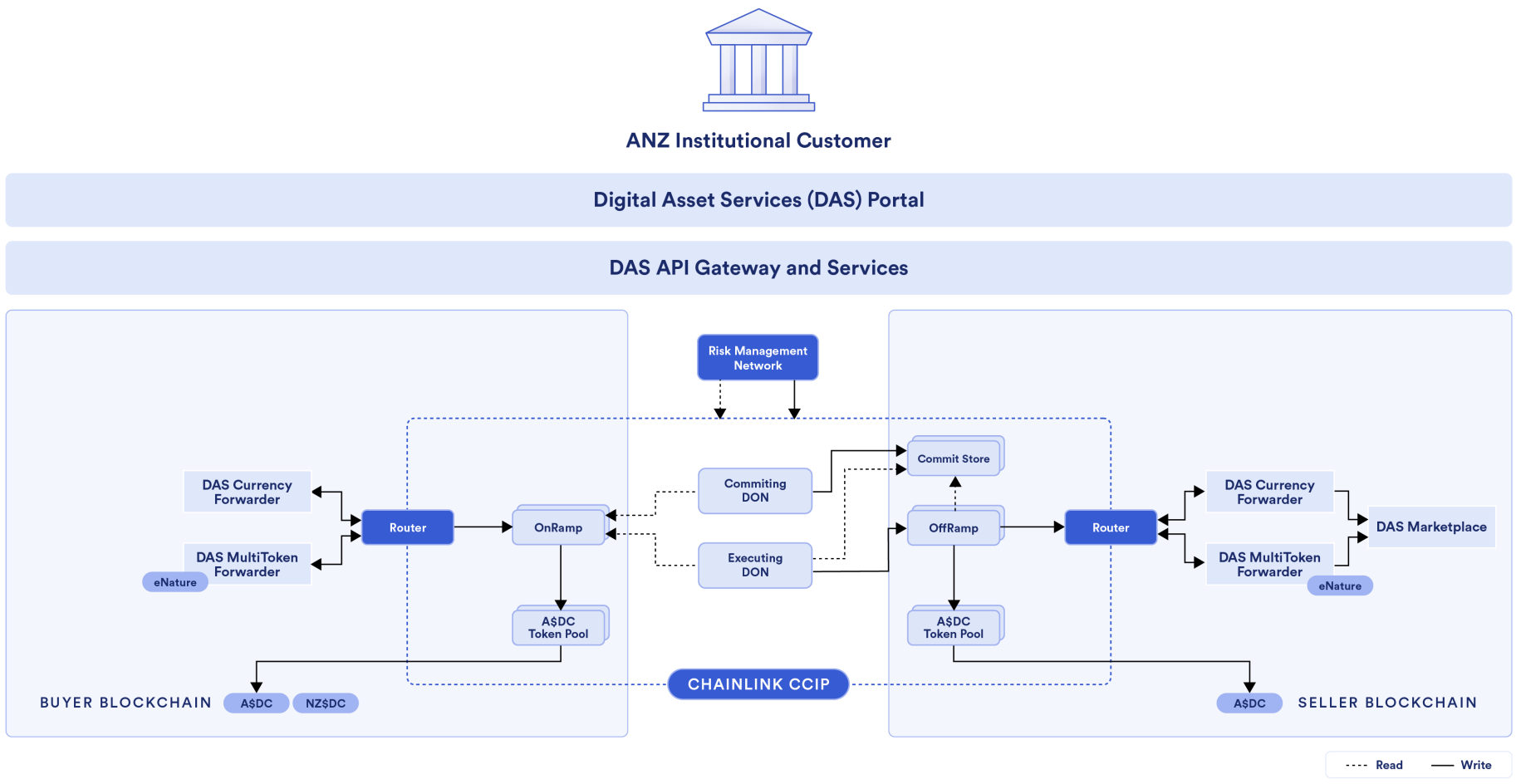
CCIP was utilized as backend infrastructure to allow ANZ to send data and transfer tokens between blockchains. ANZ then connected its services to CCIP to abstract away the complex backend systems and make the frontend user experience of interacting with tokenized assets a seamless experience for its clients. Some of the initial client services built by ANZ include:

- **Digital Asset Services (DAS) Portal:** A platform for clients to buy, sell, transfer, and redeem digital assets. The DAS Portal leverages services by Fireblocks, and its backend is enriched with DAS microservices and APIs.

- **DAS Tokenization Engine:** A digital asset tokenization application that allows clients to tokenize assets using the ERC-1155 multi-token standard.

- **DAS Services and APIs:** Horizontal backend services that provide key information under the bank's control. They are exposed to internal and external sources, such as allowing third-party applications to call and retrieve information as required. These services, along with the endpoints, make sure that the data is governed, vetted, available in real-time, and only transferred on a need-to-know basis.

- **DAS API Gateway:** A method for orchestrating digital assets under the bank's control, such as stablecoins. The gateway is also a way for external apps to connect to the ANZ services. Some of the features and information comprising the gateway include load balancing, routing, transaction volume, throughput management, and protocol translation.



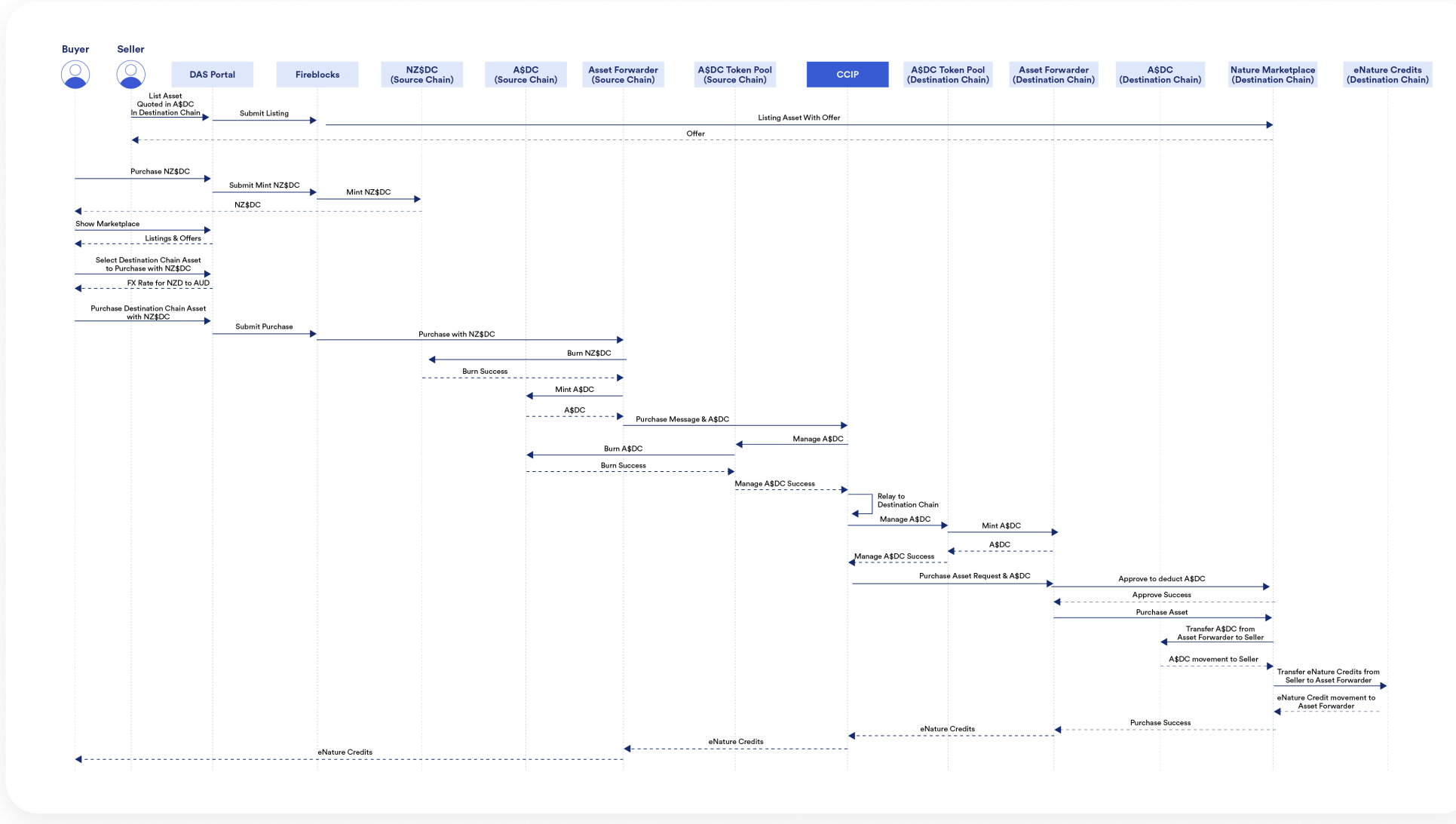
ANZ's Digital Asset Services Portal integrated with CCIP to showcase how clients could transact tokenized assets across any blockchain through an existing web app.

WORKFLOW

- An ANZ customer uses the DAS Portal to purchase NZ$DC on the source blockchain. NZ$DC is an ANZ-issued New Zealand dollar stablecoin.
- The customer uses the DAS Portal to purchase tokenized Australian nature-based assets issued as NFTs on the destination blockchain. The tokenized nature-based assets are priced by the seller in A$DC, an ANZ-issued Australian dollar stablecoin.

This purchase action initiates the following sequence of steps:

- The customer's NZ$DC is burned on the source chain, and an equivalent value of A$DC is minted into their wallet on the source chain. ANZ provides FX rates for this currency conversion transaction.
- Chainlink CCIP transfers the customer's A$DC from the source chain to the destination chain (via burn and mint), along with passing instructions for the A$DC to be used to buy a specified amount of nature-based assets.
- On the destination chain, the seller of nature-based assets receives A$DC tokens and, within the same blockchain transaction, the nature-based asset tokens are atomically sent to the buyer (via a CCIP transaction). As part of this process, the nature-based tokens are transferred (via CCIP messaging) into the buyer's digital wallet on the source chain.
- The result: The buyer receives nature-based asset tokens in exchange for NZ$DC, and the seller receives A$DC as payment for the sale of their nature-based asset tokens.



The technical workflow of how buyers and sellers transacted tokenized assets using ANZ's Digital Assets Services Portal and CCIP.

The DvP process was executed on the destination chain as one atomic transaction. The implementation is currently on testnet, where the following reference transactions can be viewed.

Buyer's Network	Buyer's Currency	Unit Price in A$DC_SEPOLIA	Quantity	Total Purchase Amount in Buyer's Currency	Tx Guide
FUJI	NZ$DC	1.23	2	7.6668173 (2.668173 Purchase Amount +5 Transaction Fee)	9a227c00-a267-4a73-bdef-61d027a0adab

CCIP Message ID	Approval Tx Hash (Source Network Fuji)	Source Network (Fuji) For purchase request doing CCIP send Transaction Hash	Destination Network (Sepolia)	Source Network (Fuji) Receiving nature-based asset	Transaction Fee Details
0x603e9424f15c8-ca73d7bc7edd11f06d fd50c5b851-fadc19212e41bc3dc7 61cfb	https://test-net.snowtrace.io/tx-/0x6cbc8bd21c18d64-fa58de2686b9c0d079 32a244a78e5e1542dc1 299729d52023	https://test-net.snowtrace.io/tx-/0xbd9f67aacf050cd4 e557508f88e56f51adb ec31b0595174eb965fc 5934aae4ec	https://sepolia.ether-scan.io/tx-/0xb6b3642722998769 1d1e00ccea44044c8a6 0393709234295e3ff213 8212a6193	https://test-net.snowtrace.io/tx-/0xadae-bac5a08ef65231ea14c 38708ba1ec4d7899c53 7c111e9a32cfc9dfb0c6 e4	0.001098184672 AVAX ($0.03) - 1st Step 0.014368495544 AVAX ($0.33) - 2nd & 3rd Step 0.0000963389513849 4 ETH - 4th Step 0.006548175 AVAX ($0.15) - 5th Step

Case study transaction details of the cross-chain settlement of ANZ-issued tokenized assets using CCIP.

RESULTS

- **Served Client Demand for Digital Assets:** Demonstrated ability to provide clients with access to a range of tokenized assets across multiple blockchains via CCIP.

- **Improved Customer Experience:** Demonstrated a technically complex cross-border, cross-chain, and cross-currency tokenized asset purchase using CCIP while providing a seamless customer experience involving a single currency on a single platform (i.e., the user only needs to interact with ANZ's DAS Portal and their digital currency of choice).

- **Facilitated a Cross-Chain interaction via a Single Interface:** Used CCIP as a single interoperability solution to transfer data and tokenized assets across blockchains in a decentralized, secure, and reliable manner.

> "We're excited to drive financial innovation at ANZ by providing our clients with seamless access to tokenized assets through an easy-to-use platform. Chainlink CCIP played a key role in abstracting away the blockchain complexity of moving tokenized assets across different chains and ensuring atomic cross-chain DvP."
>
> Lee Ross, Technology Domain Lead, ANZ

NEXT STEPS

Deploying the solution on blockchain mainnets and then expanding the workflow to include communication between different blockchain networks for different use cases.

Conclusion: Expanding the Frontier of Tokenization

The case study presented in this paper demonstrates that financial institutions can provide clients with secure access to a wide range of tokenized assets and digital asset services, even across different public and private blockchains. This can vastly simplify the user experience of interacting with digital assets while providing financial institutions with a way to serve client demand without substantial modifications to their existing infrastructure.

Utilizing CCIP as a blockchain interoperability standard facilitates this transition to onchain finance by empowering financial institutions to standardize their own internal interactions with each blockchain and how the industry as a whole transacts with external counterparties across blockchains. Instead of the current central ledger system, which oftentimes necessitates overlapping functionality across systems and requires expensive reconciliation tools or third-party vendors to ensure agreement, a modernized ledger infrastructure can emerge where liquidity is unified across platforms, DvP settlement can happen atomically without intermediaries, and all parties operate on a shared source of truth that is managed by an independent, credibly neutral network.

Similar to how interoperability standards transformed the Internet and global banking, a cross-chain interoperability standard could accelerate the adoption of tokenized assets amongst financial institutions.

Acknowledgments

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