KNOVA

White Paper

August 2025

Unified Transaction Management Platform

KNOVA

Executive Summary

Knova's infrastructure software aims to simplify financial asset management by treating all assets in a manner that allows them to be stored, secured, and transacted uniformly and efficiently.

Today, businesses must manage various asset types across disparate financial rails and systems. Introducing new asset types and systems often requires changes to existing flows and adds complexity. To streamline this process, Knova was designed to help businesses manage their complex financial networks today while preparing for the future of digital assets.

Knova targets problems with a unified way of managing/transacting across various assets and systems. Knova augments the programmability, interoperability, scalability, and real-time monitoring between backend systems, allowing for:

Unified Asset View
Gain a real-time, harmonized view of all assets and currencies, ensuring a single source of truth for all accounts.

Scalable Streamlined Management
Manage assets, wallets, and accounts through one ledger, adding asset types at scale without core system changes.

System Interoperability
Integrate seamlessly with both traditional finance and digital asset systems, simplifying interactions with various custody and omnibus accounts and networks.

Programmable Actions
Execute complex, multi-process transactions in a single step through powerful and configurable APIs.

Efficient Operations
Scale operations through wallet rebalancing, automated investment decisions, netted settlements, sweeping, and staking, etc.

Knova was built to bridge the gap between managing traditional financial and digital assets.

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Glossary

The Knova solution introduces some specific terminology that is referred to in this White Paper.

Term	Definition
Atomic Transaction	A specific type of transaction in which either all legs of the transaction succeed or fail (i.e., it is impossible for only a portion of the transaction to succeed while the rest fail).
Contract-Based Transactions in the Transaction Engine	Transactions are built on top of the underlying asset layer of Digital Twins via Contracts. Contracts help to create configurable transactions that cover a wide range of use cases, including atomic multi-party settlements (PvP, DvP), cross-border payments, escrow, etc., using industry-recognized techniques such as Hashed Timelock Contracts (HTLCs).
Custodial Wallet Service	Transacts and holds Digital Twins and owner information. Each wallet can hold a variety of asset types. Certain wallets can also be granted the ability as an 'Authority' to create Digital Twins into existence by registering the wallet and an asset (via an asset code) with the Transaction Validator. With permission granted by the Transaction Validator, the wallet can then begin issuing assets (at limits prescribed by the wallet) via signing from the Transaction Validator. Assets issued and transacted can be subsequently redeemed against this wallet via the Transaction Validator.
Decentralized Identifier (DID)	W3C standard for identifying wallets via Public Key Infrastructure (PKI) in a privacy-preserving cryptographic manner. No sensitive user data is stored. https://www.w3.org/TR/did-core/
Digital Twins	**Digital Twins**, also known as File-Based Digital Assets are fixed-value denominated files that include a non-malleable cryptographic proof of historical ownership. Digital Twins are brought into circulation via Authorized Intermediaries. Can represent various asset classes, including but not limited to digital deposits, treasuries, cryptocurrencies, and other asset classes.
Encumbrance and Unencumberance	**Encumbrance** - The process of locking an asset on an external system while on the Knova platform to ensure it cannot be double spent. **Unencumberance** - The process of unlocking an asset on an external system while offboarding on the Knova platform.
Hashed Timelock Contract (HTLC)	Transaction methodology that reduces counterparty risk via hash locks and timelocks to force acknowledgment of payment and or forfeit or payment, thereby allowing for atomicity in multi-step transactions/swaps.
Identity Bridge - Credential Adapter Service	Transforms existing KYC/KYB information into Verifiable Credentials (VCs) issued to the DID of a wallet that cryptographically attests to having a required credential (e.g., having an Account with the institution, being an accredited investor, etc.). The service integrates with the institution's existing KYC/KYB system using a standardized webhook interface, but is designed to plug in custom integrations as required.
Identity Bridge - User Management Service	Enables frictionless integration of end-user wallets with financial institutions' existing identity systems using SAML/OIDC. Provides APIs for user discovery using aliases, e.g., Phone number to Wallet Address lookup.

Identity Bridge - Registry Management	This service is a W3C-defined Verifiable Data Registry, which manages W3C DIDs and DID Documents associated with each wallet, as well as a revocation list of VCs. Attributes of the financial institutions' DIDs themselves can be searched to identify discovery services within financial institutions, as well as trusted issuers of credentials. Optional if other pre-existing Verifiable Data Registries are desired.
Know Your Customer/ Business (KYC/KYB)	The process by which financial institutions undergo due diligence on customers and businesses for compliance purposes while also assessing the risk of doing business with them.
Payment vs Payment (PvP) and Delivery vs Payment (DvP)	A transaction that involves two parties atomically exchanging assets. Atomic transactions are those that either fully happen or do not happen at all (i.e., party A can only send over assets to party B if and only if party B sends over assets to party A). Examples include: **Payment-vs-Payment** - currency A exchanged atomically for currency B. **Delivery-vs-Payment** - currency A exchanged atomically for security B.
Supplementary Services	Services that are not core to the Knova base technology but can be added on top of the system. One example includes the **Integration Service** for interacting with external systems.
Tokenization	The process of managing and trading rights and obligations on a ledger by digitally representing assets in a cryptographically protected and verifiable manner.
Transaction Validator Service	The Transaction Validator Service processes transactions via (1) reasoning about the status of the transaction and (2) carrying out the transfer and signing of Digital Twins.
Modified Unspent Transaction Output (UTXO)	A method that adopts Unspent Transaction Output (UTXO) principles to Knova's transaction process. Used during transactions to optimize denomination and numbers of Digital Twins in circulation.
Verifiable Credential (VC)	W3C standard for digital credentials, representing information from physical credentials such as a bank card or government identification. Digitally signed, tamper-resistant, and instantaneously verifiable. https://www.w3.org/TR/vc-data-model/

Introduction

Knova's infrastructure software aims to simplify traditional and digital financial asset management. Today, businesses are forced to manage too many disparate and complex financial rails.

Knova has created a system to streamline this process, helping businesses manage their complex financial networks today and prepare for the future of digital assets.

This White Paper will walk through the Knova system, first focusing on the technical components of the system, followed by what the Knova system enables with these building blocks.

Technology Overview

Knova was created to be modular to fit a variety of different business and operational use cases, but all use cases focus on integrating different data sources to provide financial institutions with a universal source of truth.

Knova is powered by 3 components: **Digital Twins**, **Interoperability Connectors**, and the **Transaction Engine**. Knova also features an optional **Identity Bridge** component.

These components work together to create the technical backbone of Knova through the **Knova System Architecture**.

Taken together, these technologies are able to solve a variety of different business problems, which are highlighted under **What Knova Enables**. Following this, a sample unified ledger diagram is shown to showcase the power of the technology.

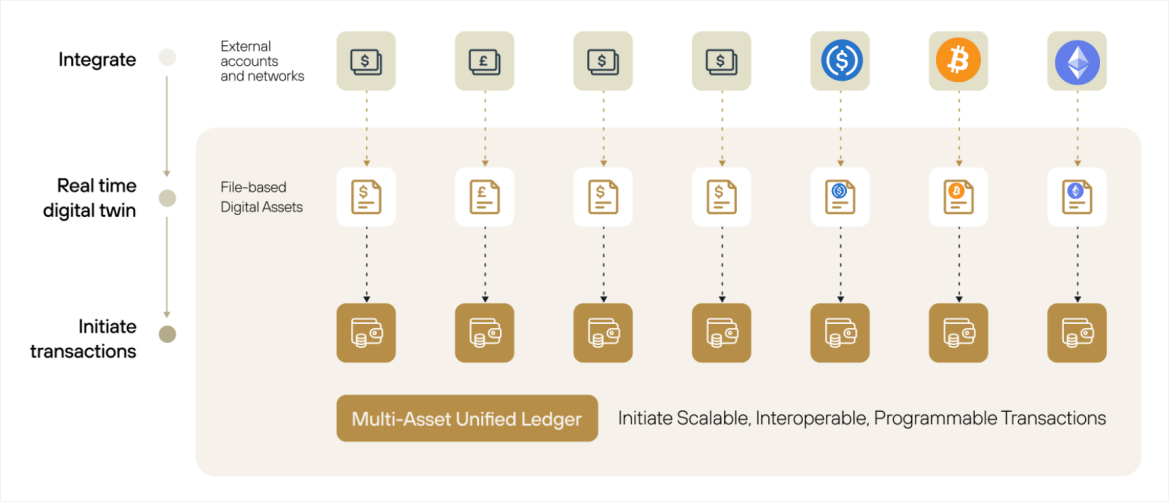
This paper is not intended to be overly technical. Instead, it will refer to the **Developer Portal** for more information on how different technical components work together.

Digital Twins

The building block of the Knova system is the Digital Twin (known technologically as a File-Based Digital Asset, or FBDA), which is moved throughout the system and between stakeholders via the Multi-Asset Transaction Platform. Digital Twins are not actually files but are instead just a conceptual shorthand to simplify their meaning and instead are a common data structure (i.e., Flatbuffer) stored as binary data in a traditional database or any other data stores.

Digital Twins serve as a common building block on the platform, representing all forms of different assets - whether it be cash, deposits, crypto, securities, or any financial asset. Knova can represent these assets as Digital Twins through different processes, depending on the use case. This process is used for mirroring assets that exist on an external system.

This enables a standard digital format so businesses can store, transact, audit, secure, and manage all asset types in a unified manner. Asset provenance when interacting with external systems is guaranteed under **Asset Encumbrance**.



Bringing Digital Twin Assets onto the Knova Platform

Digital Twin Structure

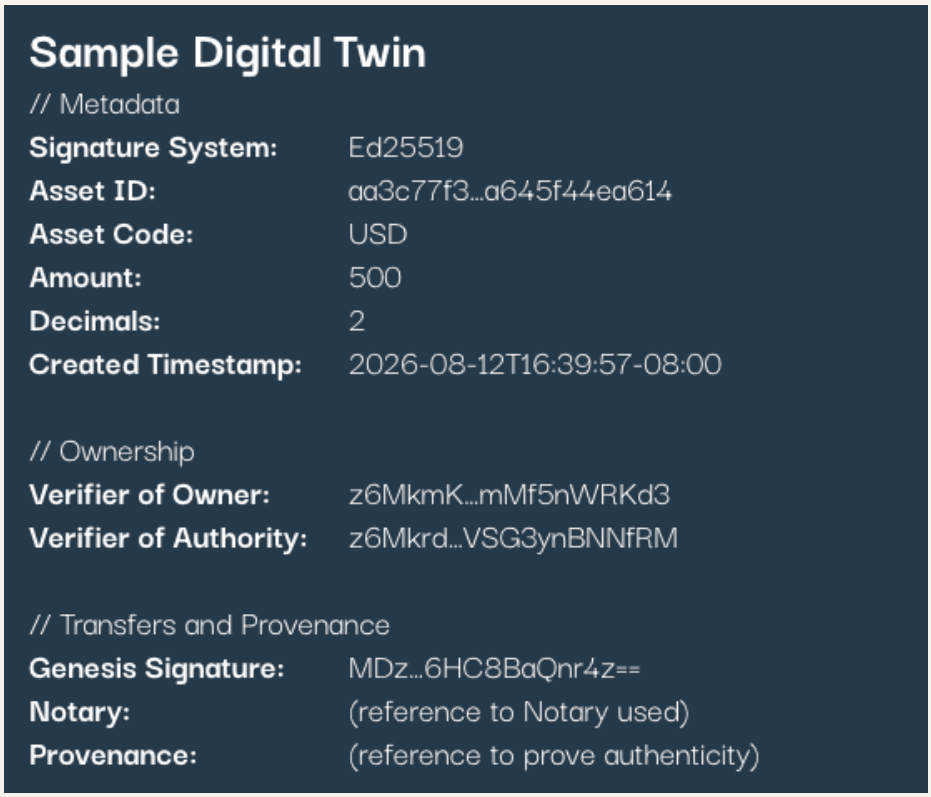


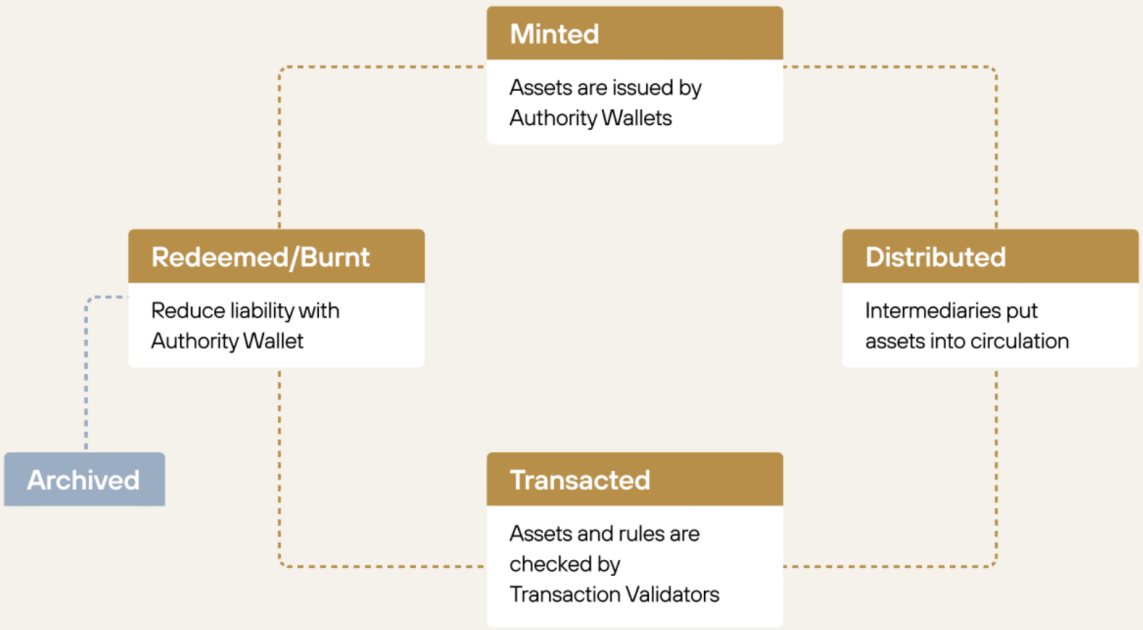
Diagram of Digital Twin Representing $5.00 USD (Simplified)

File-Based Digital Assets are designed to be flexible for different assets.

- The **Asset ID** serves as a method of uniquely identifying the Digital Twin in the system.
- The **Signature System** field is for identifying the cryptographic signature system in use.
- **Asset ID**, **Asset Code, Amount**, and **Decimals** are for specifying the value and type of asset being twinned (e.g., $100 USD),
- The Created Timestamp is to signify when the Digital Twin was first created.

For ownership, the **Owner Key** field and the **Authority Key** fields are used to determine the current holder and the original issuer of the asset, respectively. In summary, Digital Twins provide Knova with a lingua franca for interacting with different assets on the platform. Details on additional keys, signatures, hashes, etc., can be found in the **Developer Portal**.

Digital Twin Lifecycle



Sample Digital Twin Lifecycle

Wallets serve as governors of assets in the Knova system. Certain wallets can be configured to serve as an 'Authority' for a given asset code by the Transaction Validator. This wallet will then set its policies for limits, minting, and redemption for the asset. This limit of assets serves as the upper bound of asset supply.

Following the creation of this ruleset, Digital Twins can be created and distributed via interacting with the Transaction Validator Service. These Digital Twins are now "in circulation," and can be used in various transactions. Now, at any time (barring specific rulesets from the Authority), Digital Twins can be redeemed against the Authority wallet and taken out of circulation, resetting the value against the specified minting limits of the asset itself.

After redemption, "retired" Digital Twins can now optionally be Archived and moved into long-term storage.

Transaction Processing with UTXO

Digital Twins are given a fixed value at the time of issuance (say $5.00 USD) but may be asked to fulfill situations where this is not possible (e.g., trying to pay $4). Knova utilizes a Modified UTXO approach to file denominations, allowing for changing files into different denominations as required.

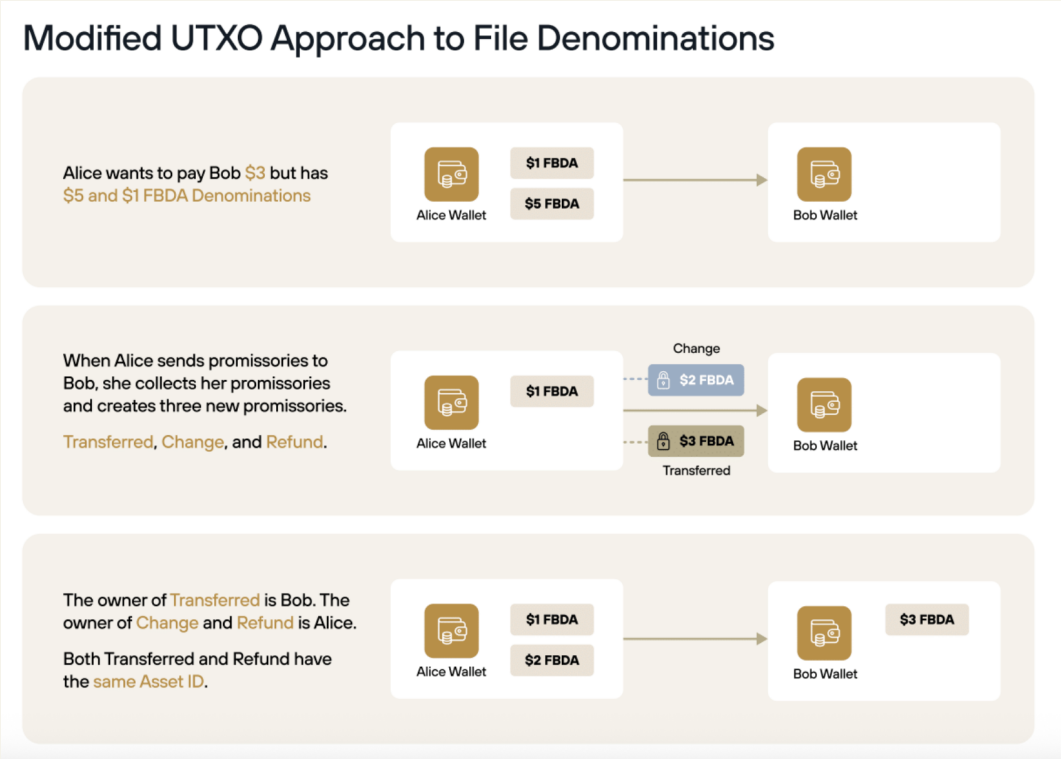
When Alice sends payments to Bob, she collects her Digital Twins and creates three new Digital Twins: **transferred**, **change**, and **refund**.

- The owner of **transferred** is Bob
- The owner of **change** is Alice
- The owner of **refund** is Alice

When these Digital Twins are locked in, the Transaction Validator authorizes the change immediately and returns it. This allows Alice to use this in a new transaction while the previous transaction is still in progress.

As for "**transferred"** and "**refund"** Digital Twins, depending on how the logic in the contract plays out, the Transaction Validator will authorize either "**transferred"** or "**refunded"** Digital Twins, but will not do both. The Transaction Validator signs and verifies Digital Twins during a transaction to confirm this.

A sample UTXO transaction is demonstrated below:



Sample Modified UTXO Transaction with Knova Digital Twins

Knova's Modified UTXO solution allows for independent transaction processing, leading to horizontal scalability. For more information on this, refer to **Scalability**.

This discussion focuses on signing and transferring Digital Twins directly on the Knova system, but Digital Twins can be transferred under various schemas. Relevant messaging standards (e.g., ISO 20022) can incorporate Digital Twin information directly as part of a message payload, for example.

Privacy and Security with Digital Twins

Digital Twins are pseudonymous, leveraging private/public key cryptography (e.g., FIPS 186-5 compliant Ed25519 by default for high performance, security, and efficiency, but extensible to other cryptographic systems such as Secp256k1 or quantum-resistant algorithms such as Dilithium, Isogeny-based, etc.). This cryptographic scheme creates an immutable chain for each Digital Twin, which, when coupled with the two-phase signature process for a transfer of Digital Twins, makes attempts at double-spending untenable. Sensitive data and keys can be stored in vaults/hardware security modules (HSMs), and only the minimal amount of data required to meet financial regulations will be granted by retail users as required.

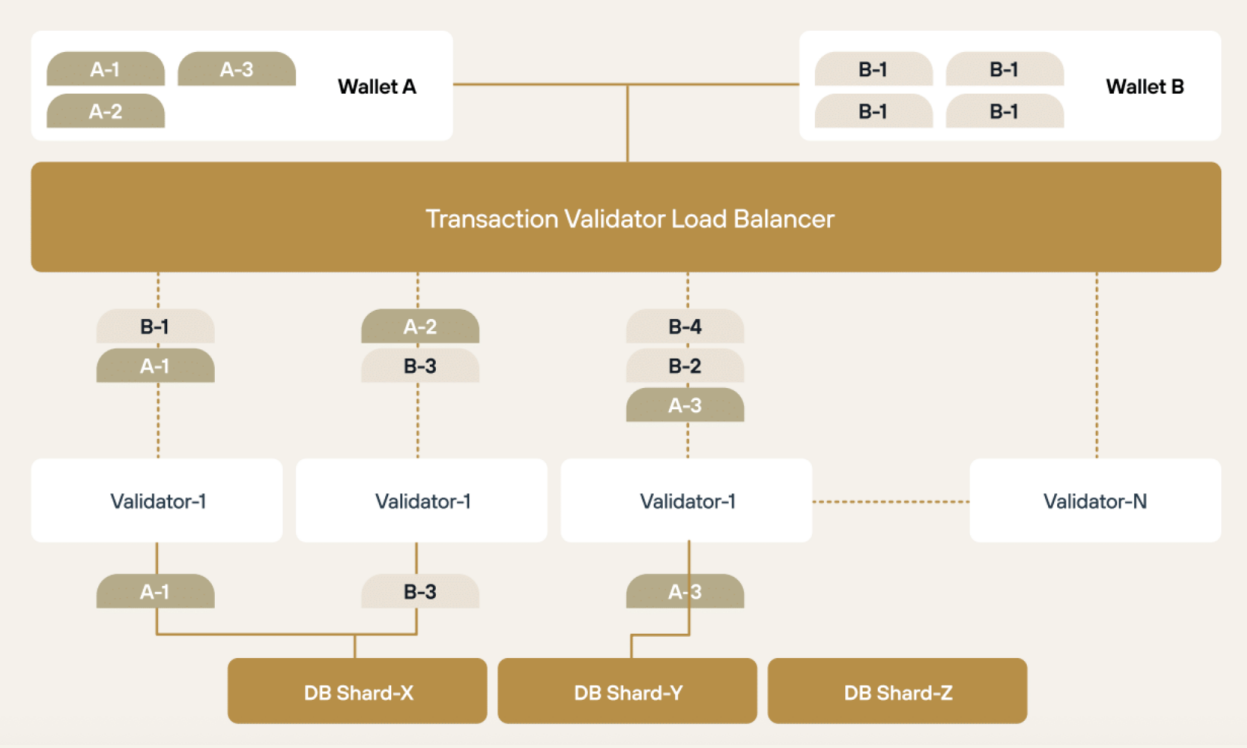
The pseudonymity of a file holder's personal data preserves privacy rights, while also allowing financial institutions to access the information needed for their compliance programs. The Digital Twin contains its own proof of ownership and authorized transfer and does not disclose any more of its provenance to transacting parties other than the transfer itself. It does not need to be published to any external chain (or public ledger) where non-transacting parties may view it. This makes data in the Digital Twin system auditable and transparent for Authorized Intermediaries but not publicly viewable.

Rust, a highly performant programming language with memory safety, is used throughout the Knova system for security. Rust can communicate over gRPC/HTTP2 for binary transport and multiplexing to enable high throughput and low latency.

Horizontal Scalability via Digital Twins

Scalability has proven to be an issue for several payment and asset systems that have tried to revamp aspects of the financial system. This ultimately stems from the need to pass every transaction through a singular point of entry, which creates a bottleneck in the system that prevents the system from scaling efficiently as the number of transactions grows. Due to fragmented back-office functions, intermediaries, and settlement times, traditional systems are not as scalable, especially at the retail level.

Through Digital Twins, Knova designed a non-account-based system that could scale to fit within an institution's regulatory and financial requirements. Knova understands that large financial institutions could be processing tens of thousands of transactions per second (TPS) for millions of customers worldwide and thus designed a system that could meet those requirements via high reliability, high throughput, and low latency.



Transaction Validators Performing Load Balancing for Horizontal Scaling

Transaction validation is distributed across horizontally scaled Transaction Validators (elaborated on later in the **System Architecture** section), ensuring high concurrency and efficiency. As Digital Twins are independent objects, they can be cryptographically signed and validated in parallel; therefore, the sequencing of Digital Twins is not important, allowing for greater flexibility in processing. The transaction validators are specifically designed for high concurrency, with non-blocking database calls that enhance performance.

When validating an asset, only the corresponding row is locked, preventing contention between files and enabling seamless parallel processing. Additionally, the use of a

sharded database architecture allows for horizontal scalability, further distributing the write load across multiple shards to enhance overall system throughput and reliability.

Increasing the throughput in the system can be achieved by increasing the number of transaction validators in the network as needed, and this horizontally scalable design removes the need for batching and expensive consensus algorithms.

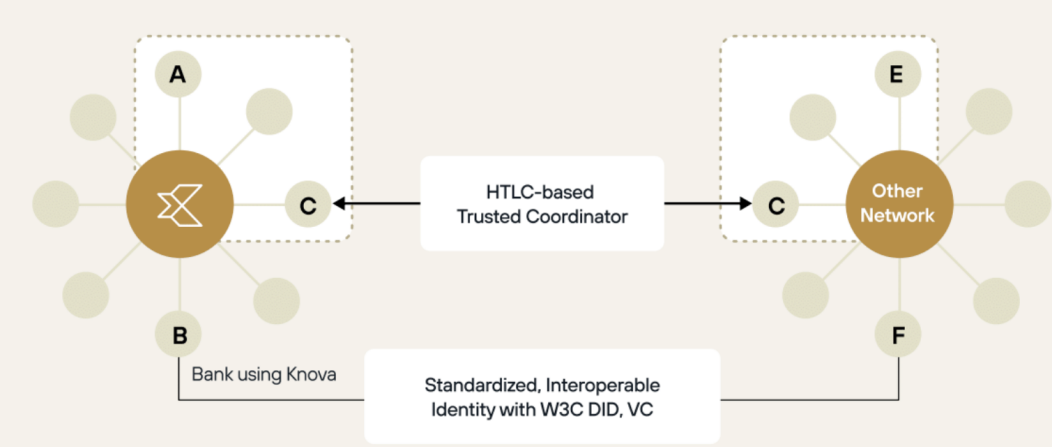
Interoperability Connectors

The financial services ecosystem consists of a variety of established and competing technological standards, which challenge the possibility of "one-size-fits-all" solutions for legacy and digital assets. Data formatting and standards can vary greatly across different networks and ledgers, which makes reconciliation of complex multi-party, multi-asset transactions across systems difficult.

In response, Knova designed a flexible and future-proofed system that could interoperate with versatile programmable ecosystems in the digital assets space and traditional legacy systems (including existing business integrations).

Knova's interoperability methods can interact with tokenization platforms, blockchains, DLTs, legacy systems, and traditional payment rails.

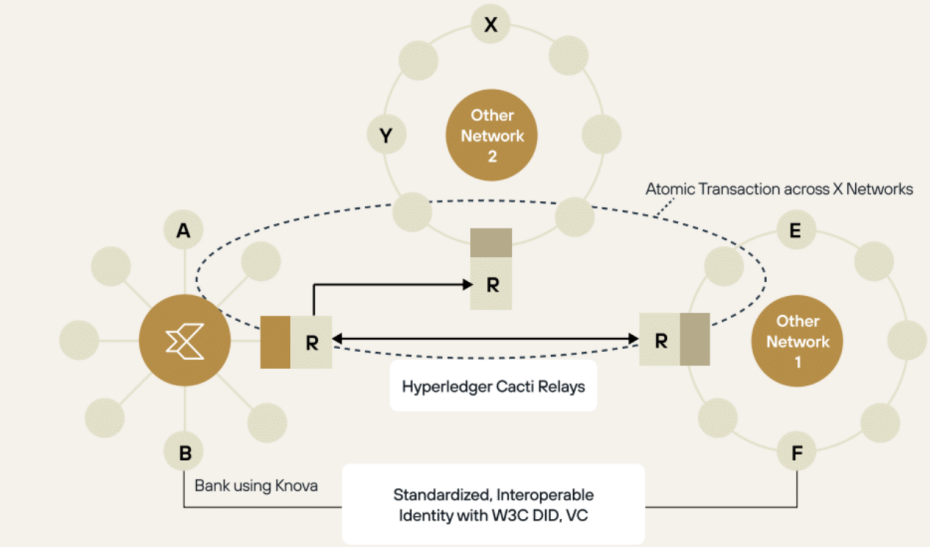
Interoperability with Blockchains and Tokenization Platforms



Interoperability using HTLCs for Cross-Chain Communications

#1 Hashed Timelock Contracts

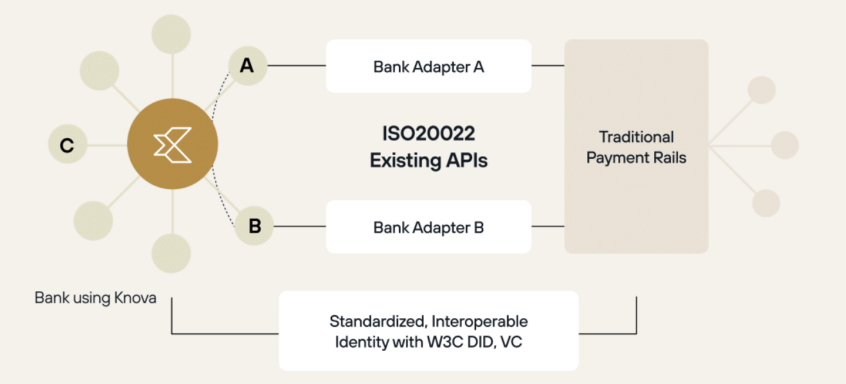
Knova supports protocols such as HTLC to bridge transactions with other ledger technologies that support HTLC, e.g., any EVM Chain, HL Fabric, Firefly, R3 Corda, as well as interaction with the ERC-20 token standard (among other standards).



Interoperability using Relay Bridge for Cross-Chain Communications

#2 Relay Bridges Cross-Chain - Knova supports relay bridges based on open-source standards such as Hyperledger Cacti, which enables interoperability with other ledgers that support the same relay mechanism.

Interoperability with Traditional Payment Rails



Rest APIs for Traditional Payment Rails

#3 Traditional APIs - Knova also supports Rest APIs for interacting with traditional systems.

Knova allows the transportation of messaging information in any standard alongside a Knova transaction. For example, ISO 20022 or SWIFT MT equivalents can be carried along with the Knova transaction.

Knova's event-driven architecture supports writing adapters that can translate back and forth from standards such as ISO 20022, SWIFT MT, FIX, and can integrate with any messaging standards. All fields from the Knova transaction are available for mapping to fields within these standards. Internally, Knova uses standards such as UETRs (UUIDV4), ISO dates and currency standards for ease of mapping to the same fields in ISO 20022 and MT messages.

These adapters can form on-ramps/off-ramps with existing messaging interface products in use at financial institutions over protocols such as message queues (MQ), file-based adapters, webhooks, or REST APIs.

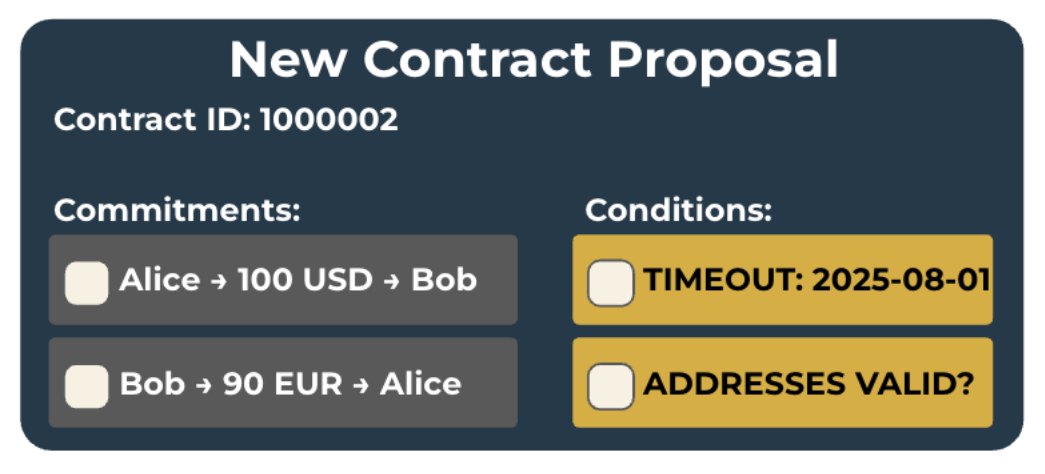
Programmability with the Transaction Engine

Knova has implemented a system that separates the *programmability layer* (Contract negotiation) from the *asset transfer layer* (Contract fulfillment). A **Contract-Based Transaction** fulfills a transfer of assets stipulated in a successfully negotiated **Contract**. Automation is added on top of this as part of the **Transaction Engine**.

Contracts help to create modular transactions that cover a wide range of use cases, including:

- Atomic multi-party and multi-asset settlements (such as PvP, DvP)
- Cross-border payments
- Escrow
- Exchange trades
- Netted settlements
- Treasury management and wallet rebalancing

Contract-Based Transactions reduce costly errors, improve revenue opportunities, limit exposure to counterparty failures, and enforce compliance by allowing institutions to stipulate regulatory requirements before any transfer of assets takes place. All assets are transferred atomically: if any participant fails to deliver on any of their commitments, then all assets will be retained by their original owner. The figure below shows a simplified view of a sample contract between two parties, Alice and Bob, during an FX conversion.



Simplified View of a New Contract Being Proposed

Contract Structure

Knova **Contracts** stipulate a series of **Commitments** and **Conditions** to be fulfilled by **Participants**.

Here is a sample **Contract** flow:

1. A Contract **Originator** proposes a **Contract** to all other **Participants.** Any participant can decide to accept or reject a proposed **Contract** based upon their own criteria.
    a. If a **Contract** is rejected, a newly proposed Contract can be created by any party.
2. All **Participants** sign the **Contract** as proof of agreement and acceptance.
3. Once a **Contract** is in place, each **Participant** submits the required assets corresponding to their **Commitments,** which are then locked (so the assets cannot be double-spent).
4. When all **Commitments** are in place (committing the respective assets to the new owner) and all **Conditions** are met, the **Transaction Validator** atomically completes the transfer of all assets. If **Participants** do not submit their assets by the timeout **Condition** specified in the contract, the system atomically reverts ownership of previously locked assets to the original owners.
    a. Examples of other **Conditions** besides timeouts include AML/CFT/Sanctions checks, valid address checks, etc.

The figure on the prior page showcases a simplified **Contract-Based Transaction** execution for a simple atomic swap between multiple parties.

Sample Contract-Based Transaction Execution Flow

Sample Contract Template

Knova uses the Resource Description Framework (RDF) to represent Contract-Based Transactions because it offers a flexible and interoperable foundation for financial agreements. RDF structures transaction data as linked statements that connect entities, obligations, permissions, and conditions in a machine-readable graph format. This allows multiple parties, protocols, or institutions to interpret and enforce contract logic with clarity and precision. Using RDF as the base schema, Knova can define parties, relationships, and transaction parameters, making it possible to configure participants, asset types, and governing conditions with ease.

This flexibility enables highly customizable transactions that can be executed simply by calling an API with RDF-based templates. Users can perform a wide range of financial operations, from payments and trades to settlement and order placement, without additional complexity. By modeling transactions in RDF, Knova supports dynamic and composable contracts that integrate with standards like FIBO and operate seamlessly across both traditional and decentralized systems. This structure enhances automation, auditability, and compliance, while remaining adaptable to diverse use cases and multi-actor workflows.

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  <urn:uuid:0088b7ba-8172-4638-bb5e-9dd39775e326#respondent>
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<signature:base64:QRWhBN0zrgCeXQ1GWMqxm8ntTHZ9MXbLzDatDsQQZqVQGS+wzRpeaATsbyb8FaAPt13vKZDrUFS1QaBLOdoWB
w==>.
}
```

Sample RDF Contract Format

Contract-Based Transactions in the Transaction Engine can also carry messages in any format (e.g., ISO 20022, NACHA) in line with the overall transaction. Knova eliminates the traditional separation between messaging and asset transfers, and messaging is available in line with the transaction.

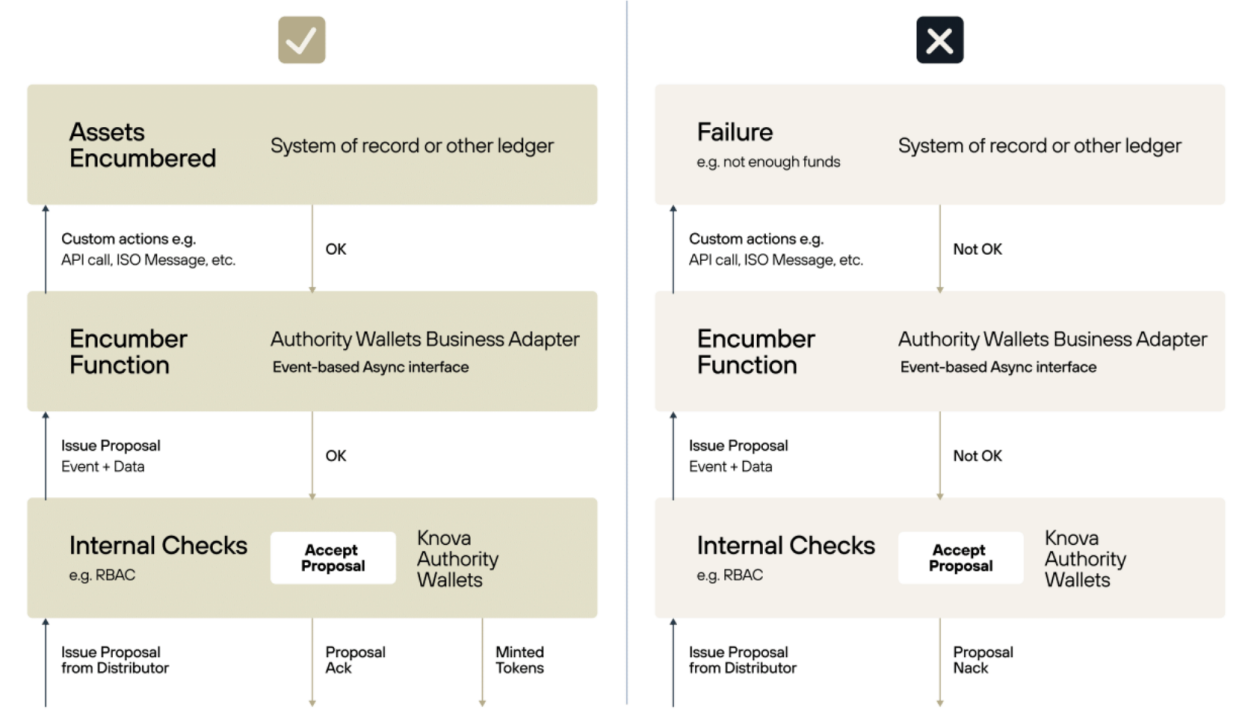
Participants in the Knova system utilize **Contract-Based Transactions** via APIs to accomplish secure and complex transactions between multiple parties. Contract-Based Transactions are based on an event-driven architecture, and at every stage in the transaction lifecycle, various events are generated with their respective details. In addition to integrating DLTs over techniques such as HTLC mentioned above, this also allows easy integration with any traditional messaging interfaces and various systems expected in a modern institutional environment, using popular techniques such as message queues or webhooks. Based on the events, flexible business and regulatory logic can be inserted into the Contract to allow for complex and conditional execution of transactions.

Knova's **Contract-Based Transactions** are executed by state machines (rather than EVMs or equivalent smart contracting evaluators). There is no need to "encode" conditional statements or loops. Failure of transactions does not require complex steps to retrieve assets committed to the failed transaction. These are automatically reinstated to the last owner.

Knova's **Contract-Based Transactions** allow for institution-specific adapters to be easily plugged in (e.g., an adapter that maps fields from Knova transactions to fields in an ISO 20022, MT, or a FIX message for on-ramps/offramps to other systems). This maximizes the potential for programmability because any ecosystems that arise, whether DLT or traditional, can easily plug into using Knova's Digital Twins as a method of payment.

Asset Encumbrance with Contract-Based Transactions

A critical challenge in asset tokenization is ensuring that the tokenized representation of an asset cannot be simultaneously spent or utilized through its original, non-tokenized form. This lack of assurance creates risks related to double-spending and financial integrity. Additionally, ambiguity surrounding asset ownership, transfer rights, and associated limitations further complicates regulatory compliance and operational transparency. Without a clear mechanism to enforce asset constraints across systems, organizations face inefficiencies and potential legal and financial exposure.



Sample Asset Encumbrance Process

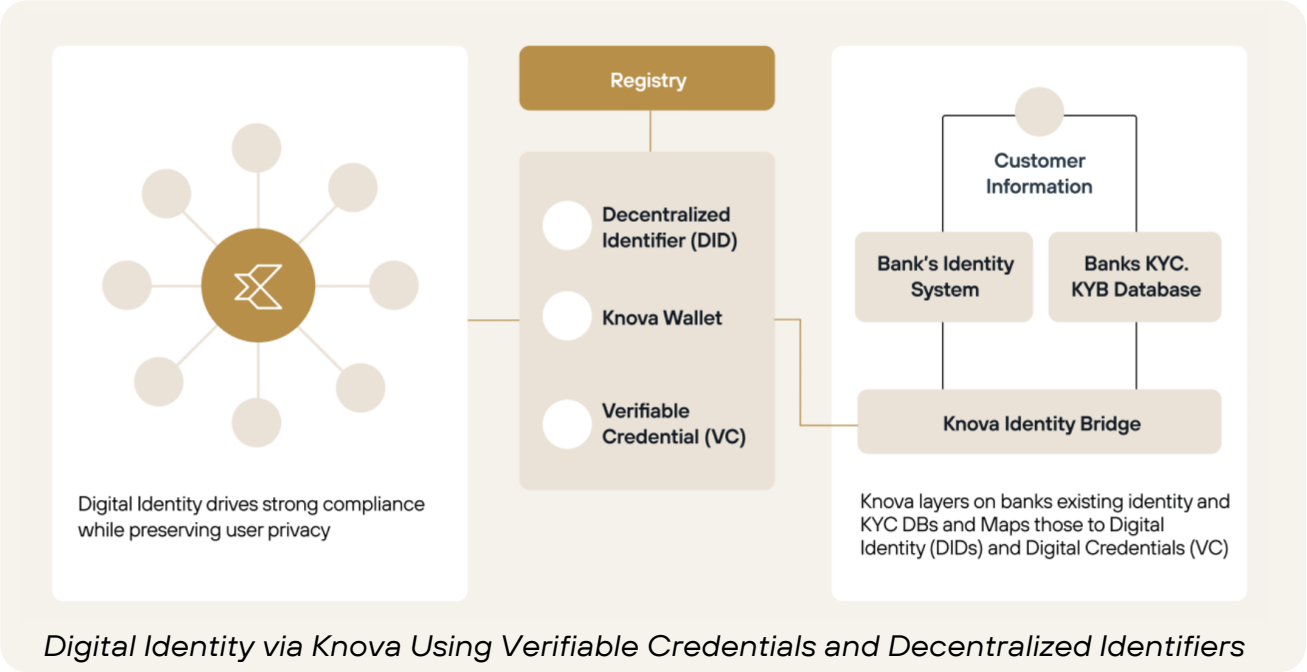
To address these issues, **Contract-Based Transactions** atomically encumber assets upon issuance and release them upon redemption. This flexible, event-driven design enables seamless interoperability with any backend system at any stage of the transaction, ensuring that assets are properly locked, unlocked, and managed across both traditional systems and distributed ledger technologies (DLTs). The framework accommodates complex asset interactions, such as minting or burning, triggered by actions on other asset types, while streamlining workflows for issuance and redemption. Additionally, it supports customizable backend actions, including automated asset movements between accounts and real-time API interactions with external financial systems such as Real-Time Gross Settlement (RTGS) networks, custody services, omnibus FBO accounts, etc. Any updates directly done to the external systems are synced with Knova via the **Interoperability Connectors** mentioned above, e.g., webhooks for on-chain transfer status updates from a custody service.

Identity Bridge

Knova's optional component is the **Identity Bridge** to help complement the baseline system.

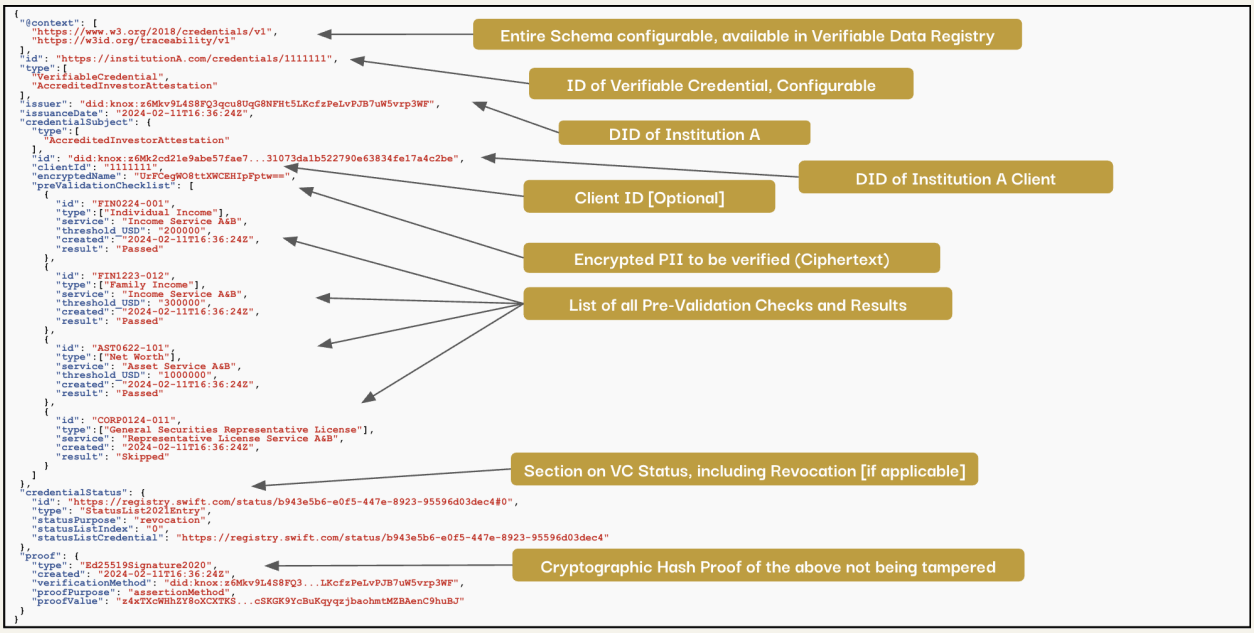
Identity is often proven today via either physical ownership of credentials (e.g., a driver's license or passport) or online via a list of usernames and passwords on centralized services over the internet. These solutions lack privacy, with both methods exposing more data than is necessary to the parties in a transaction. For example, age verification might require the showing of a driver's license, which includes additional personal information like date of birth, address, and name. In reality, the only thing that must be proven is a verifiable way of knowing the answer to the binary question, "Is this user over 21?" While showing whole credentials may be acceptable to a person who may not remember, this exposure is not a best practice over the internet. With traditional identity systems, users store usernames and passwords on external centralized servers that are easy to forget and get reused in dozens of systems, such that a single security breach exposes access to the rest of the victim's associated systems.

Knova provides a secure white-labeled identity solution that integrates with financial and government institutions' existing identity solutions to work with Digital Twins. The pseudonymity of this system preserves the privacy of the users, while still making sender and recipient information available when required for financial regulatory compliance.



Digital Identity via Knova Using Verifiable Credentials and Decentralized Identifiers

The Identity Bridge ensures sensitive data stays in the user's secure storage, authenticating and interacting with cryptographic proofs of identity data instead of usernames and passwords via a system called **Verifiable Credentials (VCs)**. **Decentralized Identifiers (DIDs)** similarly work with VCs to help ensure that cryptographic operations can occur without exposing sensitive user data.



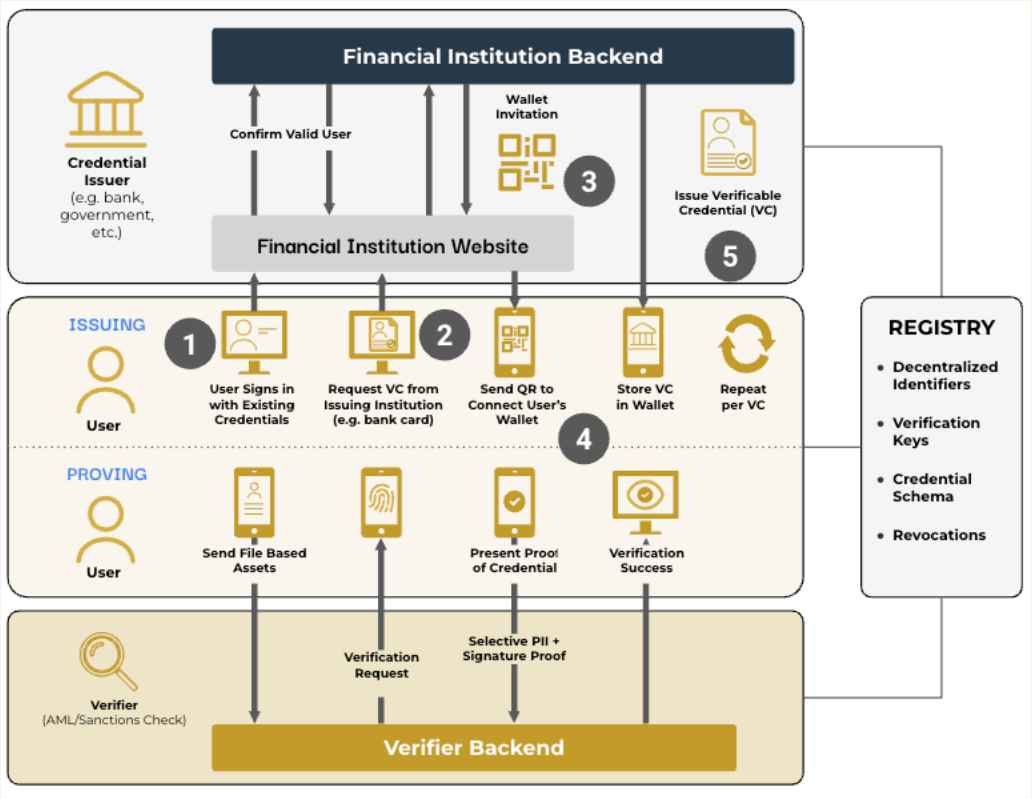
Sample Verifiable Credential for an Accredited Investor Check

The Identity Bridge integrates into existing identity systems, providing integrations for backend services, websites, and mobile apps in various programming languages.

As financial and government institutions already provide identity services for their customers, the Identity Bridge can easily integrate into the existing identity systems over standards such as OpenID Connect (OIDC)/Security Assertion Markup Language (SAML), or any other integration methods in order to set up the customers' wallets. After this one-time setup process, users can transact Digital Twins via VCs while still leveraging the financial institution or government institution's existing KYC process for AML/Sanctions checks against financial regulations. VCs can also be used to simplify the process of initially onboarding users in a cryptographically secure manner.

For example, the wallet can be a part of the financial institution's mobile app, leveraging the SDKs and an example app provided by Knova. With the mobile wallet, users can simply authenticate to the phone app locally through biometrics or a password (data does not leave the device) and then simply scan QR codes to process the verification, authorization, storage, and transaction of the Digital Twins in the system. Additionally, Knova provides the server-side Custodial Wallet Service to be hosted by the financial institution on behalf of the customer. Access can remain the same with the financial institution username and password login, and financial institutions can simply use their existing websites and integrate with Knova wallet services over backend SDKs and APIs.

As shown in the figure below, the Identity Bridge creates a powerful yet empowering solution to the ever-present problem of identity management within the financial and digital asset ecosystem.



Sample Identity Bridge Interaction Between Users and Financial Institutions

1. User is a customer of Financial Institution A and logs in through the Identity Bridge using existing institutional login credentials.
2. User is instructed by Financial Institution A to register their wallet and requests a Verifiable Credential (VC) from the financial institution to capture the user's institutional account details.
3. Financial Institution A verifies the request and prepares an invitation for the user to register the wallet and download the VC.
4. The invitation is shared with the user, who scans the QR code via the mobile wallet app. The identifier from the wallet is cryptographically verified, and the VC is specifically issued to the user as the subject and the institutional identifier as the credential issuer.
   NOTE: An institutionally-hosted Custodial Wallet Service can also be used here. The user now has this institutionally issued VC held in the wallet. This data remains in the wallet and can be requested as needed for financial regulation.

System Architecture

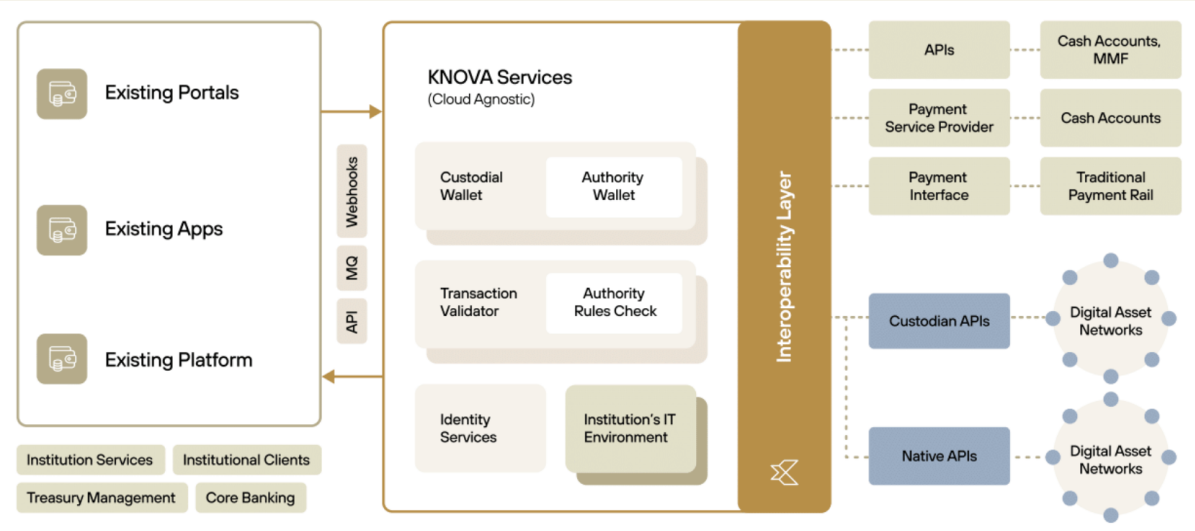
Knova's system architecture was designed to be both powerful and robust to support a variety of different use cases. Written in a microservice architecture to allow for flexible deployment in Kubernetes and accommodate horizontal auto-scaling.

Services

Services in the Knova system include:

Term	Definition
Admin UI	User interface with a dashboard, asset views, and controls that allow administrators to oversee, configure, transact, and manage their accounts, addresses, assets, systems, and automations all from one place.
Custodial Wallet Service	Transacts and holds Digital Twins and owner information. Each wallet can hold a variety of asset types. Certain wallets can also be granted the ability as an 'Authority' to create Digital Twins into existence by registering the wallet and an asset (via an asset code) with the Transaction Validator. With permission granted by the Transaction Validator, the wallet can then begin issuing assets (at limits prescribed by the wallet) via signing from the Transaction Validator. Assets issued and transacted can be subsequently redeemed against this wallet via the Transaction Validator.
Identity Bridge - Credential Adapter Service	Transforms existing KYC/KYB information into VCs issued to the DID of a wallet that cryptographically attests to having a required credential (e.g., having an Account with the institution, being an accredited investor, etc.). The service integrates with the institution's existing KYC/KYB system using a standardized webhook interface but is designed to plug in custom integrations as required.
Identity Bridge - User Management Service	Enables frictionless integration of end-user wallets with financial institutions' existing identity systems using SAML/OIDC. Provides APIs for user discovery using aliases, e.g., Phone number to Wallet Address lookup.
Identity Bridge - Registry Management	This service is a W3C-defined Verifiable Data Registry, which manages W3C DIDs and DID Documents associated with each wallet, as well as a revocation list of VCs. Attributes of the financial institutions' DIDs themselves can be searched to identify further discovery services within financial institutions as well as trusted issuers of credentials.
Supplementary Services	Services that are not core to the Knova base technology but can be added on top of the system. One example includes the **Integration Service** for interacting with external systems.
Transaction Validator Service	The Transaction Validator Service processes transactions via (1) reasoning about the status of the transaction and (2) carrying out the transfer and signing of Digital Twins.

Below is a sample architecture that accommodates Knova services within a financial institution's IT environment:



Sample Architecture in an Institution's IT Environment

For more details, check out **Knova's Developer Portal.**

What Knova Enables

Unified Transaction Management Platform

Businesses have to deal with multiple asset classes across many systems, making it difficult to get a harmonized view of the big picture. As a result, operational complexity increases, and costs and settlement efficiency are all negatively impacted.

Knova's Unified Transaction Management Platform is a product that helps multi-asset businesses to transact and interoperate with any external accounts or their own operating entities (traditional cash and custodial accounts, FBO/omnibus accounts, digital asset and stablecoin wallets) and provides a real-time, unified Transaction Management Platform to manage all forms of cash and assets via a single source of truth. This B2B software is API-based and gives clients the ability to plug into any new asset ecosystem easily while managing it alongside their existing business.

Businesses holding diverse assets spread across several custody accounts on behalf of their customers and/or their own operating entities. Traditionally, these are then managed by separate siloed systems (spreadsheets, data stores, and workflows spanning discrete systems), leading to problems and sub-optimal operations.

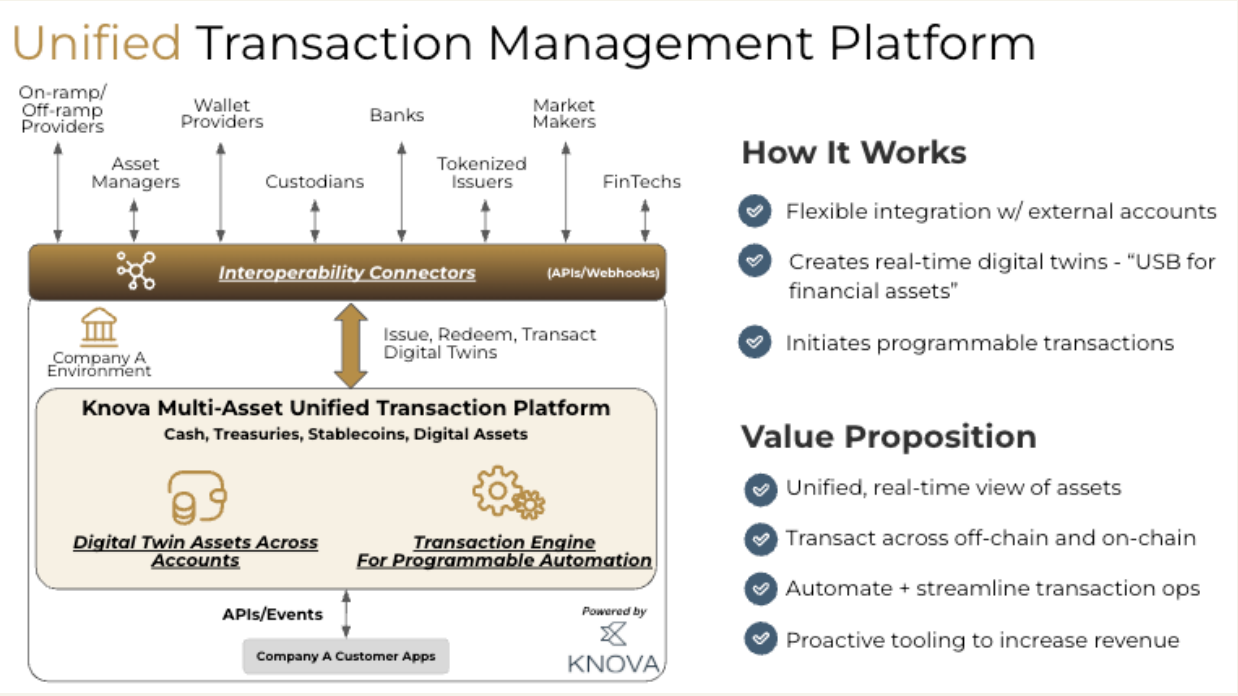
As firms invest in digital assets and stablecoins, these problems only get worse since on-chain assets and their interfaces have their own complex flows, and businesses have to manage a diversity of networks, wallet providers, on-chain fees, on/off-ramp flows, etc.

The Unified Transaction Management Platform is built to complement existing back-end systems on-prem in their environment, without requiring a rip-and-replace of current systems.

- **Integration**: Connect seamlessly with traditional and digital asset custody accounts.
- **Digital Twin**: Create a real-time digital twin of assets held in custody accounts via the Knova multi-asset Transaction Management layer, with real-time ownership details across sub-accounts.
- **Transaction Engine**: Initiate transactions through the Knova Transaction Management Platform, acting as a sub-ledger for external systems/accounts, and configure efficient settlement processes.
- **Scalability**: The platform is highly scalable, supporting multi-party, multi-asset transactions.
- **Interoperability**: Connectors simplify edge integrations without impacting the core system.

Knova's Unified Transactions Management Platform targets problems with scaling transactions, settlement efficiency, lack of interoperability, and real-time monitoring between backend systems. The Unified Transaction Management Platform provides continuous verification of assets and liabilities, allowing for tangible outcomes:

- **Unified Asset View**: Gain a real-time, harmonized view of all assets and currencies, ensuring a single source of truth for accounts.
- **Streamlined Management**: Manage assets and money through one API layer, scaling asset types without core system changes.
- **System Interoperability**: Orchestrate inflows and outflows seamlessly with both traditional finance and digital asset systems, simplifying interactions with various custody accounts and networks. Also works with your existing integrations.
- **Programmable Actions**: Automate based on triggers, conditions, and actions (If, When, Then). Execute all transaction types, including multi-party and multi-asset, using APIs and event-driven architecture.
- **Immediate Digital Asset Capabilities for All Assets**: Automate on/off-ramps between various currencies and crypto and gas to specific threshold ratios, tokenized fund purchasing, staking, sweeping, custody wallet rebalancing, reconciliation, and simplify reporting/audit.



Sample Unified Transaction Management Platform

The Unified Transaction Management Platform enables real-time ownership view and management across all traditional and digital assets, facilitating seamless bridging and transactions between off-chain and on-chain assets. It enhances the efficient use of cash and assets by orchestrating and streamlining transactions within a single, integrated system.

Conclusion

Knova is designed to bridge the gap between traditional finance and digital assets for businesses today. Knova's technology suite is designed to bring the best of digital assets to traditional finance and is supported by a technology suite to simplify the complexities of dealing with modern financial rails.

Through introducing **Digital Twins** as a universal asset representation, coupled with a horizontally scalable transaction validation model, Knova eliminates the bottlenecks and fragmentation inherent in today's financial systems.

Knova's modular architecture, spanning **Interoperability Connectors**, a programmable **Transaction Engine**, and an optional **Identity Bridge** all combine to empower institutions to integrate seamlessly with legacy systems, blockchain networks, and evolving regulatory requirements, without costly rip-and-replace efforts.

By applying cutting-edge technology to leading business problems, Knova is able to help financial firms save on costs, automate processes, interoperate with different systems, and unlock new efficiencies with assets.

To continue learning more about Knova, please check out:

- **Website**
- **Blog**
- **Developer Portal**