

GLEIF Hackathon 2025 Submission

Proposal Title

Principia: A Trust Engine for Bond Tokenization, Leveraging Veridian and vLEI

Short description

Principia is a bond tokenization protocol on the Cardano blockchain that solves the critical trust and compliance hurdles preventing institutional adoption of digital assets. The core of our solution is the Principia Trust Engine, an identity framework designed in collaboration with the Cardano Foundation's Veridian team, which aims to use vLEI. By leveraging a novel on-chain verification mechanism, we are building a secure, transparent, and regulated gateway for on-chain capital markets.

Please describe your idea in terms of process, business model, technology design and architecture as well as other relevant features.

Process

The process for an institution to issue a compliant, tokenized bond is designed to be secure and seamless:

1. **Identity Issuance:** An institution onboards via the Veridian identity flow, obtaining a DID-based credential that completes an eKYB check. In the full vision, this will evolve to a complete vLEI credential issued by a Qualified vLEI Issuer (QVI).
2. **Credential Management:** The institution securely stores and manages its credentials in a compatible, user-controlled Cardano wallet.
3. **On-Chain Interaction:** To issue a tokenized bond, an authorized representative uses the Principia DApp to construct a transaction. The required credential is included directly in the transaction's **Redeemer** field.
4. **Verification & Execution:** The Principia smart contract directly verifies the credential within the Redeemer—checking its signature, issuer, and claims against the contract's rules. If all checks pass, the transaction is executed trustlessly on-chain.

Business Model

Principia's business model is centered on creating and capturing value within a new, institutional-grade on-chain fixed-income market. Revenue streams will be derived from transparent, protocol-level transaction fees on core platform functions such as:

- Primary bond issuance.
- Secondary trading in permissioned liquidity pools.

- Lifecycle management events (e.g., automated coupon payments).

By providing the foundational trust layer, Principia becomes the essential infrastructure for this high-value market.

Technology Design and Architecture

Our architecture is a practical implementation of the concepts outlined in the "vLEI on-chain: Verifiable Smart Contracts" report (verifiablesmartcontract.com), focusing on the immediate capabilities of Phase 1: Smart Contract Provenance Attribution.

- **Blockchain:** We use the Cardano blockchain for its proven security (EUTXO model) and native support for multi-asset ledgers.
- **Identity Protocol:** The architecture is designed for deep integration with DID-based identity solutions. Our collaboration with the Veridian team is focused on a shared technical foundation, likely using **KERI** and **ACDC** protocols to ensure future compatibility with the global vLEI ecosystem.
- **Core Innovation:** Our central innovation is the on-chain enforcement mechanism. Verifiable Credentials (VCs) are passed directly into the **Redeemer** of a Cardano transaction. The smart contract validator parses and cryptographically verifies the credential on-chain before authorizing an action.

Binding Organization, Person, and Role

The vLEI's power lies in its ability to cryptographically bind the three pillars of corporate authority.

1. **Organization:** The vLEI Entity Credential establishes the legal entity's identity, anchored to its globally recognized LEI.
2. **Person:** The vLEI Legal Entity Credential links the organization's on-chain DID to the DID of a specific, authorized individual (e.g., a CFO).
3. **Role:** A QVI Role Credential delegates a specific, limited authority to that individual, such as the right to "IssueBonds" on the Principia platform.

The BondMintingPolicy smart contract verifies this entire vLEI Credential Chain in the redeemer, ensuring that the person signing the transaction has the legitimate, delegated authority to act on behalf of the organization for that specific purpose.

Cryptographic Binding of Tokens to vLEI

To solve for provenance, the token itself must be immutably linked to its issuer. Our solution implements the "Address Attribution" model described in the report:

1. During the bond issuance transaction, the BondMintingPolicy does not just mint the tokens. It also creates the main BondLifecycleManager smart contract and, as part of its initial datum, it embeds an ACDC.
2. This ACDC is a verifiable credential that contains a cryptographically signed assertion from the issuer (using their vLEI) stating, "We, ACME FZE (vLEI: ...), are the sole, legitimate issuer of the asset governed by this smart contract."
3. This creates an unbreakable, on-chain link. Any user or application can now read this embedded ACDC and, using off-chain KERI-based tooling, verify the token's provenance with absolute certainty before interacting with it.

Relevant Features

- **Automated On-Chain KYB:** Replaces slow, manual Know-Your-Business processes with instant, cryptographic verification of an institution's credential.
- **Pre-Trade Compliance:** Smart contracts enforce compliance checks *before* a transaction is executed, eliminating counterparty risk.
- **Permissioned Liquidity Pools:** Enables the creation of institutional-only secondary markets where access is restricted to verified participants.

Which stage is your product/solution at?

Advanced development stage. The Principia bond tokenization protocol, developed by Senary Labs, is more than 50% complete for its MVP, with the core on-chain lifecycle contracts and off-chain logic already built. The Veridian team has built a partial solution for DID-based eKYB.

The current focus of the collaboration is on architecting and implementing the definitive Principia Trust Engine, integrating Veridian's eKYB capabilities, and finalizing the user interface for a complete, end-to-end solution. This hackathon will accelerate the completion of this crucial compliance component.

What is the expected result from using your idea, product and/or service?

- **Immediate Hackathon Result:** A functional, end-to-end MVP on the Cardano testnet demonstrating the complete "Flow of Verifiable Trust." This live prototype will showcase:
 - Issuing a vLEI credential chain to a business entity off-chain.
 - Verifying the credential on-chain within a smart contract to initiate bond issuance.
 - Creating a compliant, identity-verified digital asset upon successful verification.

- **Short-Term:** The establishment of a standardized, reusable "compliance-by-design" framework (The Principia Trust Engine) to serve as a blueprint for other RWA projects and to champion the early adoption of vLEI standards in the UAE.
- **Long-Term:** A production-ready platform that dramatically reduces the cost and complexity for SMEs to issue bonds, while providing investors with access to a new, transparent, and compliant on-chain asset class.

Please briefly outline the critical success factors, and steps, required to bring this idea to life, and a reasonable timeline in which this can be achieved.

- **Critical Success Factors:**
 - A focused design and architecture review process with the Cardano Foundation's Veridian team. This collaborative approach is crucial for ensuring the successful integration of Veridian's identity primitives within the Principia protocol to meet the hackathon's ambitious goals.
 - Successful integration of the Veridian eKYB credential system with the Principia protocol using the "VC-in-Redeemer" model.
 - Proactive dialogue with UAE regulators (DIFC, VARA, ADGM) to demonstrate the solution and champion the early adoption of vLEI standards in the UAE, positioning the region as a global leader in compliant digital finance.
- **Steps & Timeline (Hackathon Period: Sep 7th - Oct 19th):**
 1. **Weeks 1-2 (Sep 7 - Sep 20): Architecture & Spec Finalization:** Workshops between Senary Labs and Veridian teams to finalize the technical specifications for the hackathon MVP.
 2. **Weeks 3-5 (Sep 21 - Oct 11): Core Integration:** Parallel development workstreams. Senary Labs implements the "VC-in-Redeemer" logic, while the Veridian team configures the eKYB credential flow for the specific use case.
 3. **Week 6 (Oct 12 - Oct 19): End-to-End Testing & Demo Preparation:** Deploy the integrated solution to a shared testnet. Conduct testing of the complete issuance flow and prepare the final demonstration video and submission materials.

This focused hackathon effort will run in parallel with broader development, with all components and learnings being simultaneously incorporated into the definitive Principia Trust Engine.

What are the key benefits to the wider community if we were to go ahead to implement your proposed solution?

- **For the GLEIF Ecosystem:** This project serves as a premier, real-world showcase of a protocol *architecting towards* the vLEI standard from day one. It provides a tangible blueprint for vLEI integration, driving awareness and demonstrating a clear pathway for

corporations to enter on-chain finance.

- **For the Cardano Ecosystem:** It delivers a flagship institutional RWA protocol that acts as a "trust anchor," de-risking the entire ecosystem for institutional capital. The Trust Engine becomes a reusable public good.
- **For Financial Institutions & SMEs:** It provides a standardized, lower-risk on-ramp to engage with digital assets. The framework offers a solution to the pervasive counterparty risk and compliance uncertainty that has stifled their participation.