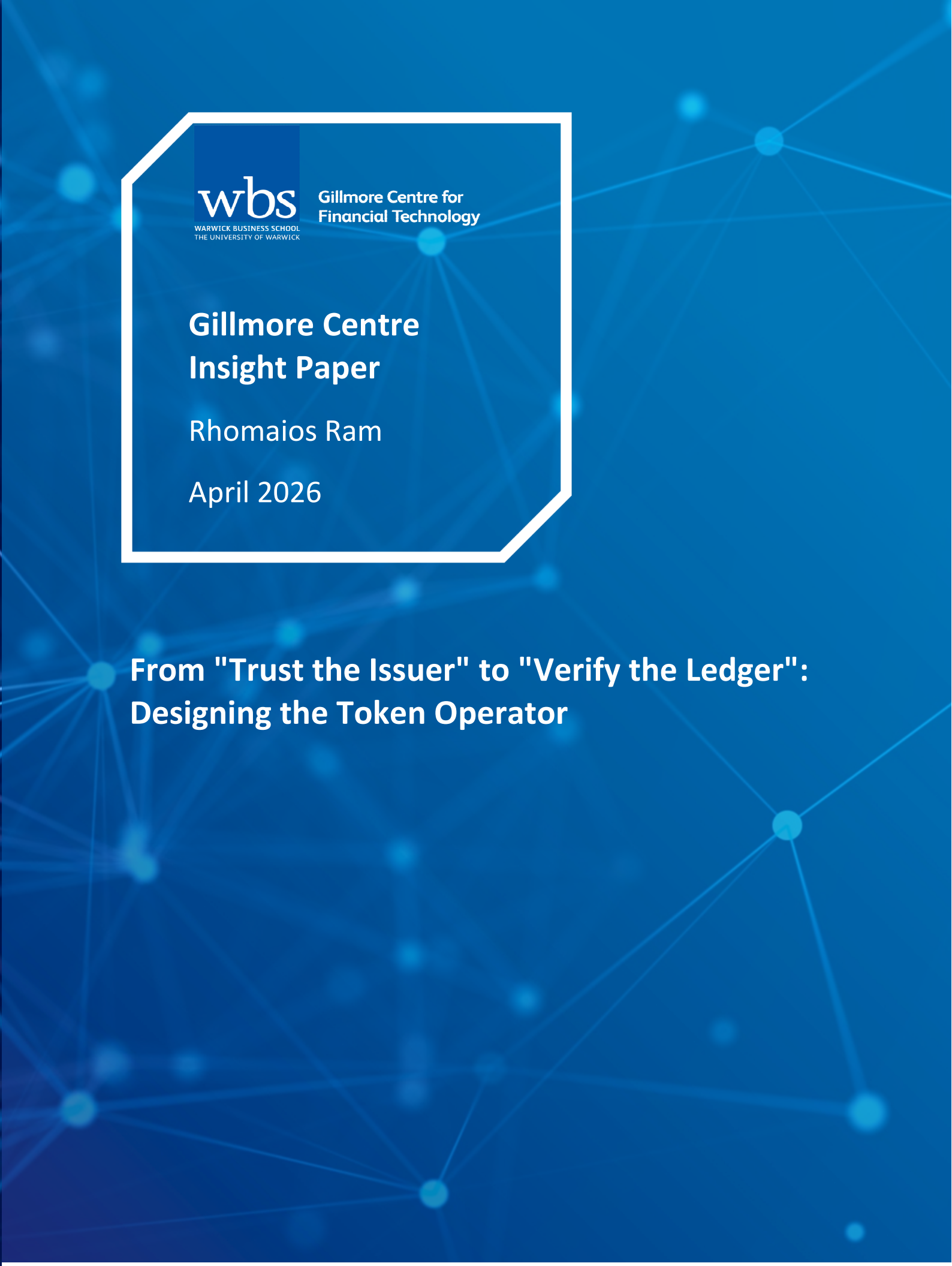

Gillmore Centre Insight Paper

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From "Trust the Issuer" to "Verify the Ledger": Designing the Token Operator

Summary

This companion paper examines the "Token Operator," the regulated entity responsible for bridging the Asset Layer and the Ownership Layer. It details the Operator's five core functions (acting as an issuer-CSD) and introduces the principle of Deterministic Record-Keeping. By computing the definitive ownership record entirely from public on-chain events, the architecture shifts the market's trust model from relying on an issuer's opaque internal books to independently verifying the public ledger.

Key points

- **The Token Operator Role:** The Operator fulfils five critical functions: asset control, identity management, compliance execution, lifecycle management, and multi-chain coordination. It acts functionally as an issuer-CSD.
- **Deterministic Record-Keeping:** The paper proposes that the Operator's records be designed as strict deterministic functions of on-chain events, meaning anyone can independently reconstruct the definitive ownership register simply by replaying the blockchain's history.
- **Shifting Trust to Verification:** By making the record a computation over the public ledger, the model shifts reliance from "believe the Operator" to "verify the ledger," ensuring high auditability, disaster recovery, and transparency.
- **Hierarchy of Precedence:** While the blockchain serves as the evidentiary substrate, the Token Operator's computed record remains the legally determinative statement of ownership in the event of a divergence (e.g., a pending corrective entry).
- **Portability of the Operator:** Because the ownership record is derived deterministically from public data, the Token Operator role is portable; a successor institution can verify the inherited state and take over the function seamlessly.

From "Trust the Issuer" to "Verify the Ledger": Designing the Token Operator

Introduction

A companion paper, *A Two-Layer Architecture for Digital Assets: Decoupling Asset Custody from the Ownership Record*, argued that the core problem in today's financial infrastructure is not simply intermediation, but the fact that ownership is recorded across multiple proprietary ledgers that must constantly be reconciled. The proposed solution is a two-layer architecture. Value remains anchored in the regulated Asset Layer. Transferable claims circulate on the Ownership Layer, where the record of ownership can be shared, verifiable, and global.

This paper examines the entity that makes that architecture work: the Token Operator.

The Token Operator is not a new invention. It is a functional role already performed, in different institutional forms, by stablecoin issuers, depositories, and securities infrastructure. Its task is to transform underlying value into a transferable on-chain book-entry record and to govern the movement of that record.

The contribution of this paper is to show that the Token Operator can be designed so that its records are deterministic functions of on-chain events. If so, the trust model changes. The question is no longer whether users must rely on the operator's internal books, but whether the record can be independently verified from the ledger itself. That is the move from “trust the issuer” to “verify the ledger”.

Blockchain's value proposition is verifiability without blind reliance on an intermediary. The Token Operator is the mechanism that preserves that property for regulated assets that still require an accountable legal authority.

What the Token Operator Does

The Token Operator is the regulated entity responsible for controlling the asset and using blockchain as the ownership ledger. It performs five core functions.

1. **Asset control.** The Operator holds or controls the underlying value in the Asset Layer. For a stablecoin, this means maintaining bank deposits and Treasury securities. For a tokenised bond, it means holding the bond in a securities account. For a tokenised deposit, the bank itself is the Operator: there is no separate underlying asset to custody, because the token represents the bank's own liability to the depositor.

2. **Identity management.** The Operator is accountable for the link between on-chain addresses and real-world identities. Not every address must be identified at all times. Holders of unhosted wallets possess contingent rights that become enforceable only upon completing identity verification with the Operator. The cadence varies by instrument. For stablecoins, identification is needed only at redemption. For instruments with periodic cash flows, holders must onboard before the next distribution date, otherwise the Operator escrows the payment. For instruments carrying voting rights, unidentified holdings at a record date may raise quorum and governance issues that the Operator must address explicitly.
3. **Compliance execution.** The Operator can freeze addresses, block tokens, and issue replacements to rightful holders, with each action recorded on-chain. If the Operator migrates to a new chain, it blocks tokens on the old chain and re-issues on the new one. These capabilities sit with the Operator, not with the blockchain itself.
4. **Lifecycle management.** The Operator handles issuance, redemption, corporate actions, interest payments, and other events in the asset's lifecycle. Blockchain records these events, but does not determine them.
5. **Multi-chain coordination.** If the Operator recognises multiple blockchains, it coordinates supply across them so that total on-chain claims never exceed the underlying asset base.

Circle performs these functions for USDC. A bank issuing deposit tokens would do the same. For tokenised securities, the role could be performed by the issuer, by a transfer agent, or by an independent depository. The Token Operator is therefore not a specific legal entity, but a functional role that someone must occupy if the architecture is to work.

Secondary market trading does not require a separate ownership ledger beyond the Ownership Layer itself. Peer-to-peer transfers on-chain are the secondary market, with the Operator's authoritative record updating deterministically as transactions settle.

The CSD Parallel and the Choice of Operator

The Token Operator is not unprecedented. It performs the issuer-CSD function: the function of transforming an asset into a book-entry record and governing the movement of that record.[1]

This is the role Central Securities Depositories have performed since securities were dematerialised. CSDs emerged because securities law requires certainty about ownership for dividends, voting, inheritance, insolvency, and transfer. They replaced physical certificate transfer with book entries, making the CSD's record the definitive statement of ownership. The Token Operator performs an analogous function for

blockchain-based assets. The ledgers the Operator recognises constitute the record of ownership. The Operator does not maintain a separate proprietary ledger; it designates which on-chain events are authoritative and retains the power to post corrective entries when legal entitlement requires.

The architecture is not tied to a single institutional form. The Token Operator can be instantiated by the issuer, by an independent depository, or through linked existing market infrastructure, depending on the asset class and the stage of transition.

In the **issuer-operated model**, the issuer or its designated agent maintains the record directly. This is how stablecoins work. Circle is both the issuer of USDC and the maintainer of the ownership record. This model is simple and aligned, but concentrates risk. For assets where the holder's primary exposure is to the issuer's own credit, such as stablecoins or deposit tokens, that concentration may be acceptable. For securities, investors may require protection against issuer failure that this model does not provide.

In the **independent depository model**, a neutral third party maintains the record. This is how traditional securities markets work. Apple issues shares while DTC maintains the record of who owns them. If Apple fails, DTC continues to operate, and investors' holdings remain preserved. This model provides independence and continuity, but requires coordination between issuer and depository.

Asset class complexity matters. Debt instruments are generally simpler to tokenise because legal and beneficial title can often unify in the token. Equity is more complex: under most jurisdictions, legal title to shares requires registration, and dematerialised holding is permitted only within approved systems.[1]

Because the Token Operator maps to an existing record-keeping function, the regulatory task is recognition rather than invention. Stablecoins fall under payment token or e-money regimes such as MiCA and the GENIUS Act. Deposit tokens fall under banking regulation. Tokenised securities fall under securities law. If an existing CSD operates the blockchain interface itself, this is better understood as deploying new record-keeping infrastructure than as outsourcing the function.

The same architecture can also accommodate legacy securities during transition. In that setting, the Token Operator connects to issuer-CSDs in other jurisdictions, immobilises securities at the source, and issues tokens on the Ownership Layer against those holdings. This is the role traditionally associated with investor-CSDs, which provide cross-market access by maintaining accounts at multiple issuer-CSDs.

In practice, this means coexistence before convergence. The same security may be held partly in traditional form and partly as tokens, with the total always equalling the issued amount. Migration can therefore be gradual rather than coordinated. As more holders move to on-chain representation, the balance shifts without requiring a single cutover event. The architecture defines the future-state logic of a shared record. The transition path is the pragmatic means of getting there.

Deterministic Record-Keeping: Resolving the Trust Problem

The Ownership Layer architecture places the Token Operator in charge of the ownership record for assets represented on blockchain. But if the Operator determines who can redeem, transfer, or exercise rights, does that not simply recreate the trust problem blockchain was supposed to solve?

The answer depends on how the record is constructed. The architecture can be designed so that the Operator's records are deterministic functions of on-chain events: independently verifiable and reconstructible from ledger data.

The principle is simple. Every state change in the Operator's record corresponds to an on-chain event. Given the sequence of those events, anyone can reconstruct the record independently. The model does not depend on fully permissionless participation. What matters is that the ledger remains readable and verifiable. For stablecoins and deposit tokens, public chains such as Ethereum and Solana already satisfy that condition. For regulated securities, the Operator may restrict which addresses can initiate transfers while keeping the ledger publicly readable. The same logic also applies to permissioned ledgers where participants are known. Public chains matter here because they maximise verifiability, not because the architecture depends on unrestricted write access.

In practice, this means:

- **Issuance.** Outstanding supply can be computed by summing mint events and subtracting burn events.
- **Transfer.** Holdings can be computed by replaying transfer events.
- **Identity linkage.** KYC completion can be recorded on-chain as a commitment or attestation, preserving privacy while creating a verifiable compliance state.
- **Compliance actions.** Freezes, blocks, and replacements can be recorded on-chain, creating a public audit trail of intervention.

If every state change is recorded this way, the Operator's record becomes a computation over the ledger rather than an opaque internal book. The Operator does not create ownership records ex nihilo. It computes them from the authorised event history. Anyone can verify them. Anyone can rebuild them from scratch. Trust therefore shifts from “believe the Operator” to “verify the ledger”.

The benefits are substantial:

- **Auditability.** Regulators can replay the ledger and verify record-date positions at any historical moment.
- **Disaster recovery.** Records can be reconstructed if the Operator's internal systems fail.
- **Dispute resolution.** Courts can test claims against an objective event history.

- **Transparency.** Aggregate information such as supply, transfer activity, and distribution can be observed without relying on Operator disclosure.

Exceptional cases remain. Fraud, court orders, lost keys, and chain migration require the Operator to exercise legal judgment. But the execution of that judgment can still be recorded on-chain. The Operator posts corrective entries that others can verify. Determinism is therefore preserved at the level of the audit trail, even where legal authority must decide when intervention is justified.

The architecture establishes a clear order of precedence. The Token Operator's authoritative record, computed from recognised on-chain events, is the legally determinative statement of who owns what. The blockchain is the evidentiary substrate from which that record is derived. If the two diverge, for example because a corrective entry has not yet settled or a chain reorganisation has altered transaction history, the Operator's record governs. This mirrors existing CSD practice: when a CSD's books and a participant's records disagree, the CSD is definitive and the participant's remedy is a claim, not unilateral correction. The Token Operator bears the same burden of accuracy, governance, and financial responsibility. Where investor-CSDs participate as delegated authorities, their records are likewise derived from the same shared ledger, creating a hierarchy of authorities rather than a network of independent ledgers that must be reconciled. Section 6 explores how this hierarchy reshapes existing intermediary structures.

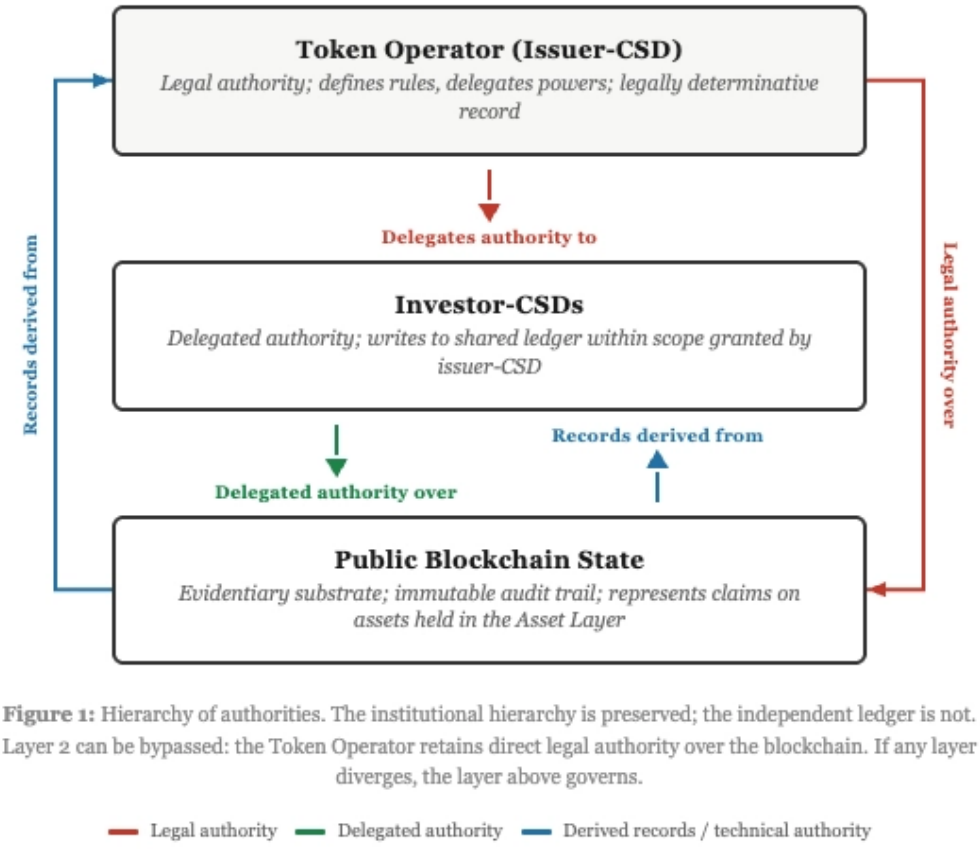

Figure 1: Hierarchy of authorities. The institutional hierarchy is preserved; the independent ledger is not. Layer 2 can be bypassed: the Token Operator retains direct legal authority over the blockchain. If any layer diverges, the layer above governs.

Boundaries of Determinism

Not everything in the Token Operator's function can be made deterministic. Some elements necessarily require off-chain judgment.

Reserve management. The Operator's off-chain assets, such as bank deposits or securities, cannot be verified from ledger data alone. They still require traditional audit, attestation, and supervision.

KYC decisions. Whether a person passes identity verification is a matter of judgment. What can be recorded on-chain is that verification occurred, not the substance of the assessment.

Compliance judgments. Whether an address should be frozen in response to a court order, sanctions requirement, or fraud claim is also an off-chain legal decision. Only the execution of that decision becomes deterministic once recorded on-chain.

Discrepancy handling. Divergence can still arise in three ways. First, the Operator's record may temporarily lag the ledger while a corrective entry is pending. Second, a chain reorganisation may disturb the transaction history the Operator intended to rely on, requiring the entry to be re-posted. Third, the on-chain record may diverge from the underlying asset base, for example because of a reserve shortfall. That last category falls outside determinism altogether and still requires conventional disclosure, audit, and, if necessary, regulatory intervention. Deterministic record-keeping cannot prevent fraud, but it does make the ownership side of the system transparent: because on-chain supply is publicly observable, any divergence from attested reserves is immediately visible, making reserve discrepancies easier to detect and harder to conceal.

If the blockchain is temporarily unavailable, settlement is delayed but the record is not lost. The state remains stored across the network. There is no separate fallback ledger, because a fallback would reintroduce the very divergence the architecture is meant to eliminate. The Asset Layer preserves the underlying value. The Ownership Layer resumes when the ledger does.

The ownership record is the core of what a CSD does. Making that record deterministic preserves blockchain's central value proposition even when other parts of the system still depend on off-chain judgment.

Implications for Regulation and Market Structure

Deterministic record-keeping changes not only how Token Operators can be supervised, but also how existing intermediary structures fit into the architecture.

Traditional cross-border securities markets rely on layered relationships between issuer-CSDs, investor-CSDs, custodians, and participants. Each layer typically maintains its own record, and those records must be reconciled through bilateral links, contractual arrangements, and

operational controls. The Token Operator model preserves the institutional hierarchy but removes the need for independent ownership ledgers. For any given issuance, there remains an ultimate authority over the authoritative record, but that need not mean a single Token Operator across all settings. In transition, a Token Operator may operate in an investor-CSD-type role, linking legacy holdings into blockchain settlement while the source-market CSD remains in place. This allows both old and new issuance to settle through the same on-chain model while existing CSDs either migrate into the new architecture or are joined by new Token Operators native to it.

This matters for cross-border holdings. In current markets, investor-CSDs provide access to multiple issuer-CSDs by maintaining accounts across jurisdictions. In the proposed architecture, the same function can persist, but its character changes. Investor-CSDs may still identify local investors, process withholding tax, handle local corporate actions, and satisfy domestic legal requirements. What they no longer need is a separate proprietary ownership ledger. Their authority becomes operational and jurisdictional, not record-constituting. Disputes resolve upward through the hierarchy of authorities, not sideways through reconciliation between inconsistent books.

The same logic applies to omnibus holding. The architecture does not require omnibus pooling, and broad reliance on it would recreate some of the fragmentation the model is designed to remove. A custodian can instead maintain a distinct address per beneficial owner while still providing custody and market access. Where omnibus structures do persist during transition, the intermediary must disclose beneficial ownership to the Token Operator or other authorised layer, so that the shared record does not collapse back into opaque pooled claims.

This points to a transition path rather than an overnight institutional replacement. Today, investor-CSDs and custodians maintain independent records that reconcile back to the issuer-CSD. In an intermediate stage, they can continue to perform local legal and operational functions while writing to a shared ledger under delegated authority. In the longer-run end state, jurisdictions may recognise the shared record more directly, reducing the need for parallel ownership books. The EU DLT Pilot Regime is an early indication of how that transition might begin.

Determinism also affects portability between operators. If an issuer appoints a Token Operator and later wants to change provider, the function should in principle be transferable. In traditional markets, issuers can change transfer agents or move between CSDs, though the process is operationally complex. The same logic applies here. Because the record is deterministic and reconstructible from ledger data, a successor operator can verify the state it inherits. The outgoing operator blocks the old contract, the incoming operator re-issues under the new one, and the ledger provides the audit trail of transition. Portability is not frictionless, but it becomes more transparent and verifiable.

A broader question follows. Could deterministic record-keeping make public chains usable for more systemically important infrastructure? The companion paper noted that projects such as Fnality have avoided public blockchains because CPMI-IOSCO principles are usually understood to require operational control over settlement finality. Deterministic Token

Operators suggest a different framing. The key regulatory question may not be whether the protocol itself is directly controlled, but whether the overall arrangement delivers equivalent supervisory outcomes: legal certainty, resilience, auditability, recoverability, and real-time visibility.

That question remains open. Public blockchain governance, validator concentration, and protocol change still matter. But the architecture changes the terms of the debate. It asks not whether public chains can themselves become regulated FMIs in the traditional sense, but whether a deterministic Token Operator can deliver the necessary regulatory outcomes while using a public ledger as the ownership record.

Conclusion

The two-layer architecture requires an entity that connects the Asset Layer to the Ownership Layer. That entity is the Token Operator.

The Token Operator is not a novel institutional category. It is a functional role: the role that controls the underlying asset, governs the ownership record, and ensures that on-chain claims remain anchored to legal and operational reality. Depending on the asset class and the stage of transition, that role may be performed by the issuer, by an independent depository, or through linked existing market infrastructure.

The paper's central claim is that this role can be designed deterministically. If every relevant state change is expressed through recognised on-chain events, the ownership record becomes verifiable, reconstructible, and auditable without relying on the Operator's internal books.

That is the significance of the Token Operator. Regulated finance still requires an accountable legal authority. But it no longer follows that ownership must be tracked through opaque, independently maintained ledgers. The Token Operator provides both: accountability through the Operator, verification through the ledger. That is the move from trust in the issuer to verification of the ledger.

About the author

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Rhomaios Ram is an Honorary Research Fellow at the Gillmore Centre. He is the Founder of Fnality International and served as CEO until the end of 2024. Prior to Fnality, Rhom worked across a wide variety of wholesale banking businesses including sales, trading, product management and technology over more than 22 years.