LANDBLOCK

Blockchain Federation Protocol for Land Registries

Master System Design Document

Version 0.4.4 | April 2026 Built on Polygon PoS | Governed by Protocol DAO *CONFIDENTIAL — DO NOT DISTRIBUTE*

Version History

Version	Date	Summary
v0.1	Apr 2026	Initial design on Kadena/Pact
v0.2	Apr 2026	Synthesized from both repos; Kadena/Pact stack
v0.3	Apr 2026	Pivot to Polygon PoS; Solidity + Foundry; Aragon native
v0.4	Apr 2026	Federation protocol model; three-layer architecture; LADM alignment; token split (LDBK / LGT); Registry Template introduced
v0.4.1	Apr 2026	Global Directory fully designed; Layer 4 placeholder added
v0.4.2	Apr 2026	LADM contract architecture resolved; RegistryDirectory.sol specified; Registry Template 7-layer design complete

Version	Date	Summary
v0.4.3	Apr 2026	Six carried-over items resolved: Legal Reference Library introduced; oracle scoped; paymaster confirmed; PropertyToken role defined; lending integration model; cross-chain deferred; Peru reference implementation; ADR governance principle established
v0.4.4	Apr 2026	Eight TBD items resolved: Registry Template deployment model (all three paths); graduation / conformance audit process; patch governance model; donated onboarding structure (Option B + Foundation future plan); Aragon reconfiguration steps documented; LGT/LDBK tokenomics (Model A, three distribution buckets, annual review); neutrality lock threshold (85% / 90-day window); DisputeRecord.sol scoped to Type 3 proof challenges

What Changed in v0.4.4

Eight previously open items resolved:

1. **Registry Template deployment model finalized.** All three deployment paths are supported: self-hosted (government operates on own infrastructure), Landblock-hosted (Landblock operates on government's behalf), and partner-hosted (DAO-certified integration partner). Government chooses whatever works best for their situation. Deployment path has no effect on federation participation or conformance tier. A Data Sovereignty Policy governs all hosting arrangements.

2. **Template graduation / conformance audit process defined.** Self-assessment + evidence package + DAO vote model. Lightweight and ac-

cessible for low-resource governments. Re-assessment triggerable by inactivity or DAO concern. Future audit capabilities and remediation services are pinned for a future version.

3. **Template governance / patch model defined.** Two-tier model: security patches carry a DAO-defined compliance window with a public `patch-overdue` flag for non-compliance; feature updates are fully opt-in. DAO classifies all releases. Governments may propose template improvements through the DAO.

4. **Donated onboarding service structure defined.** Start with Option B — DAO working group and treasury allocation. Long-term plan is a Landblock Foundation for the public goods mandate including donated services, Legal Reference Library, capacity-building, and a volunteer program. Foundation formation requires a DAO vote. All future structure is outside current scope.

5. **Aragon reconfiguration documented.** Deploy `LGTToken.sol`, configure Aragon to LGT, distribute to founding stewards, transition multi-sig to emergency veto. Execution is Phase 2; blocked on LGT contract and initial distribution.

6. **LGT / LDBK tokenomics defined.** Model A — fully separate tokens, no direct exchange mechanism. LGT distribution across three buckets: founding stewards (vesting), active registry participants (earn through participation), contributors (DAO-allocated). Specific percentages deferred. Annual review by DAO. All changes subject to ADR and DAO vote.

7. **Neutrality lock amendment threshold defined.** 85% of circulating LGT + 90-day deliberation window. Self-protecting — both thresholds require the same process to change. ADR and DAO vote required for any amendment.

8. **DisputeRecord.sol scoped.** Type 3 only — formal challenges to specific proof records in `EvidenceStore.sol`. No adjudication logic. Records challenge, challenger DID, challenged proof CID, basis, and resolution when available.

Remaining open items (to be resolved in v0.4.5): query routing full design, permissioned free access criteria, tiered disclosure schema, `CoordsValidator.sol` OGC compliance, bitemporal versioning LADM/LGAF compliance.

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1. Executive Summary

The Problem

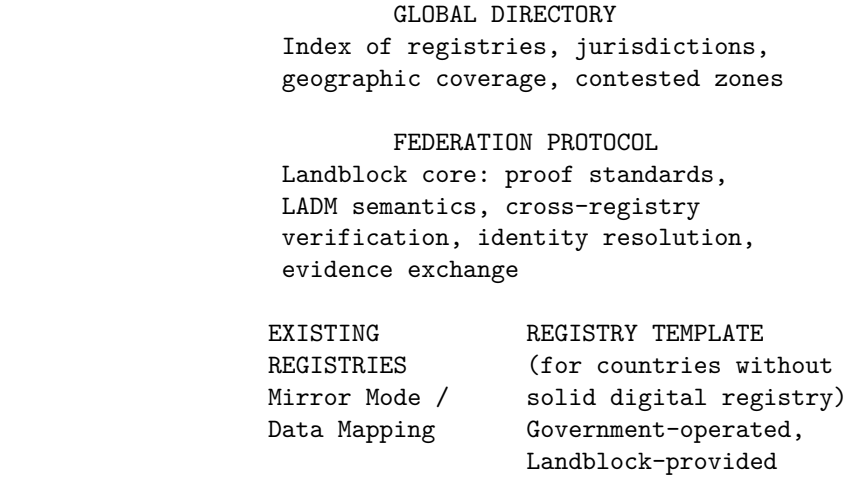
More than 70% of Africa's land is informally held. Fraud affects 30% of land transactions in emerging markets. Registration takes 6+ months in many countries. In India, 60% of court cases involve land disputes. Dead capital from informal land holdings in Latin America alone exceeds $6 trillion. The global land registry system is fragmented, inconsistent, and unable to support cross-border verification of claims.

What Landblock Is

Landblock is a blockchain-based federation protocol for land registries. It is the shared trust layer that allows registries — whether modern or legacy, government-run or template-based — to publish cryptographic proofs, verify each other's records, and cooperate across jurisdictions.

Landblock does not decide who owns land. Courts and governments decide that. Landblock records what those authorities assert, and makes those assertions globally verifiable.

The Three-Layer Model



What Landblock Is Not

- Not a replacement for courts or governments
- Not a repository of land data (only hashes and proofs go on chain)
- Not a political arbiter of contested territory
- Not a registry for jurisdictions that have functioning registries

2. Vision & Problem Statement

2.1 The Global Land Registry Crisis

The world's land information systems are siloed, inconsistent, and interoperable only through slow, expensive bilateral agreements. A mortgage lender in Germany cannot easily verify a property title in Kenya. A court in Colombia cannot quickly access verified boundary evidence from a neighboring jurisdiction. A refugee returning home cannot prove ownership against a fraudulently registered competing claim.

The problem is not the absence of registries. Most countries have some form of land registry. The problem is that those registries cannot talk to each other, cannot verify each other's records, and operate under incompatible standards, formats, and legal frameworks.

2.2 What Landblock Proves — and Does Not Prove

Landblock proves: "This record was asserted by this authority at this time, and has not been altered since."

Landblock does not prove: "This person owns this land." That determination remains with courts, governments, and community processes outside the protocol.

2.3 Why Federation Is the Right Model

Most prior blockchain land projects failed because they tried to replace registries. Landblock asks a different question: "Would you like an immutable backup of what you already have, and the ability to verify records from other registries?"

The federation model eliminates three adoption barriers: sovereignty anxiety, political resistance, and interoperability cost.

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3. Design Principles

3.1 Core Design Principles

Record, don't rule. The protocol records what authorities assert. It does not evaluate whether assertions are true.

No land data on chain. Only hashes, timestamps, signatures, and minimal metadata appear on the blockchain.

Sovereignty preserved at every layer. Government registries retain full authority over ownership decisions.

Standards over proprietary design. Landblock aligns with ISO 19152 (LADM), OGC spatial standards, and UN-GGIM FELA.

Sovereignty respected, best practices published. Landblock never forces policy decisions. The Registry Template, Legal Reference Library, and conformance tiers embody recommended standards — adopted voluntarily.

Changes require DAO vote and ADR. Any change to a resolved design decision requires a formal DAO vote and a corresponding Architecture Decision Record.

Clarity over opacity. Every claim, every change, every attestation is attributed and visible.

Resilience over fragility. The design prioritizes adaptation, tolerance of complexity, and usefulness under stress.

Explicit tradeoffs over hidden assumptions. Landblock surfaces policy choices rather than concealing them.

3.2 Functional Goals

- Cross-jurisdiction verification of land claims without bilateral negotiation
- Immutable, tamper-evident proof layer for registry records
- Privacy-preserving identity using ZKP selective disclosure
- Geospatial integrity via OGC-aligned standards
- LADM-semantic compatibility across the federation
- Neutral handling of contested territory
- Verification-as-a-service for lenders and institutions

3.3 Non-Functional Goals

- High throughput (Polygon PoS ~65 TPS)
- Predictable near-zero transaction costs (ERC-4337 paymaster)
- Fault tolerance across node, service, and data-layer failures
- Legal defensibility across institutional audit and court scrutiny

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4. International Standards Alignment

4.1 ISO 19152 — LADM

LADM Concept	Description	Landblock Mapping
Party	Person or organization holding rights	`IdentityRegistry.sol`
RRR	Rights, Restrictions, Responsibilities	`RRRRegistry.sol`

LADM Concept	Description	Landblock Mapping
BAUnit	Basic Administrative Unit	`BAUnitRegistry.sol`
Spatial Unit	Physical parcel or land area	`SpatialUnitRegistry.sol`
Source	Supporting documents	`EvidenceStore.sol`

4.2 OGC Geospatial Standards

OGC API Features, WMS/WFS/WMTS, GML, and GeoJSON. `CoordsValidator.sol` OGC compliance assessment: TBD.

4.3 UN-GGIM FELA

Informs governance model, institutional roles, and interoperability strategy across layers.

4.4 FAO VGGT

Informs customary tenure representation, public notice requirements, and vulnerable group protections in the Registry Template.

4.5 World Bank LGAF

Informs anti-corruption controls — append-only audit trails, traceable discretionary approvals, embedded oversight.

4.6 FFP LA

Informs Registry Template accuracy targets and rapid adjudication methods for limited-resource contexts.

4.7 Legal Reference Library

Introduced in v0.4.3

A DAO-governed, curated index of publicly published national property law frameworks. Used by countries without their own validation rules to inform Registry Template Layer 0 configuration. Human-reviewed, reference only, separate from Layer 4 operational intelligence.

Validation standard tiers:

Situation	Validation Basis
Country has established legal framework	Registry's own law governs

Situation	Validation Basis
Country has partial framework	Library-informed Layer 0 defaults; government customizes
Country has no framework	Landblock recommended standard applies; proofs tagged accordingly

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5. Three-Layer Architecture

5.1 Overview

Three layers with clearly separated responsibilities. No layer governs decisions belonging to another.

5.2 Layer 1 — Global Directory

Index of registries, jurisdictions, geographic coverage, and contested zones. Organized by ISO 3166-1 country codes with polygon-based coverage. DAO-governed admission. Contested zones tracked separately by coordinates — no political assignment.

Hierarchy:

```
Country (ISO 3166-1)
    State / Province / Region
          Local Registry (authoritative leaf node)
```

Registry status values: `active` / `inactive` / `contested` / `template-deployed` / `no-registry` / `patch-overdue`

Contract: `RegistryDirectory.sol` — specified. See contracts/RegistryDirectory.md.

5.3 Layer 2 — Federation Protocol

The rules and infrastructure for proof publication, cross-registry verification, identity resolution, and evidence exchange.

Federation Function 1 — Proof Publication Registry issues a signed proof to `EvidenceStore.sol`. Mandatory fields: registry DID, timestamp, normalized parcel ID, content hash (IPFS CID), cryptographic signature, LADM record type.

Federation Function 2 — Cross-Registry Verification Public query routed through the Directory to the authoritative registry. Returns Verified / Unverified / Unknown plus **Trust Context metadata**:

Field	Description
`conformanceTier`	Tier 1 / 2 / 3 of the issuing registry
`proofHistoryDepth`	Number of proof versions on record
`lastProofAge`	Time since most recent proof
`contestedZoneFlag`	Whether a contested zone covers this parcel
`validationBasis`	Registry's own law / Landblock recommended standard / not declared

Fee paid in LDBK, split between protocol treasury and issuing registry. Permissioned free access for courts, governments, and registered registries: **TBD.**

Federation Function 3 — Identity Resolution DID claims passed with full provenance. Receiving registry applies its own acceptance policy. Any W3C-compliant DID accepted. SpruceID is Landblock's recommended standard. LADM Party roles (owner, trustee, mortgagee) integrated.

Federation Function 4 — Evidence Exchange Signed request → originating registry applies disclosure policy → responds with evidence or denial + reason code. Tiered disclosure: public / restricted / sealed. Schema: **TBD.**

Federation Function 5 — Verification-as-a-Service for Lenders Lenders query the federation for a collateral verification bundle: parcel existence, borrower title, lien status, contested zone flag, and Trust Context. No `PropertyToken` required. Available via Professional Portal or Developer / API Portal.

Conformance tiers:

Tier	Name	Requirements	Capabilities
1	Mirror	Snapshot hashes anchored to EvidenceStore	Read-only; immutable backup
2	Verified	DID-based identity; LADM-structured proofs; active proof endpoint	Cross-registry verification
3	Full Federation	All Tier 2 plus identity resolution, evidence exchange, real-time events	Full interoperability

5.4 Layer 3 — Registry

Path A — Existing Registries (Mirror Mode / Data Mapping) Registries connect without changing internal systems. LADM data mapping service (AI-assisted) translates native format to federation proofs.

Peru reference implementation: SUNARP for Path A onboarding — natural Tier 1 → Tier 2 migration candidate.

Path B — Registry Template Open-source, LADM-compliant, federation-ready registry. Government deploys and operates it; Landblock provides software only.

Architecture: Monolith with clearly separated internal modules.

Seven internal layers: Layer 0 (Governance/Legal), Layer 1 (Business Capabilities), Layer 2 (Workflow), Layer 3 (LADM Data Model), Layer 4 (Geospatial Services), Layer 5 (Integration/Federation), Layer 6 (Security/Trust/Audit), Layer 7 (Channels).

Tenure Conversion Workflow: Seven-stage reusable workflow (application intake → community consent → boundary demarcation → public notice → objection resolution → rights registration → proof publication). **Peru reference implementation:** COFOPRI for workflow configuration; comunidades campesinas/nativas for community consent options.

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6. Registry Template — Deployment, Graduation, and Governance

6.1 Deployment Model

RESOLVED in v0.4.4

Three deployment paths are supported. Government chooses whatever works best for their situation. Deployment path has no effect on federation participation or conformance tier.

Path	Who operates	When to use
Self-hosted	Government on own infrastructure	Government has IT capacity
Landblock-hosted	Landblock on behalf of government	Government lacks IT infrastructure
Partner-hosted	DAO-certified integration partner	Government prefers local operator

Data Sovereignty Policy: Applies to all hosting arrangements. No data access beyond operational necessity. Government retains full administrative

control. Data is jurisdiction-isolated. Infrastructure access is separated from data access by policy and technical controls — consistent with regulated cloud provider models.

6.2 Graduation / Conformance Audit Process

RESOLVED in v0.4.4

Progression from `template-deployed` status to an active conformance tier in the Global Directory.

Process:

1. **Self-assessment** — Registry completes a structured conformance checklist mapped directly to the requested tier's requirements.
2. **Evidence package** — Registry submits evidence on IPFS (configuration, sample proof publications, operational summary). CID recorded on-chain.
3. **DAO review** — Review window opens; any DAO member can raise concerns. LGT-weighted vote follows.
4. **Tier assignment** — On approval, `RegistryDirectory.sol` updates conformance tier and status. Evidence package is permanent on-chain.

Re-assessment: Triggerable by extended inactivity (no proof publications) or a DAO member raising a substantive concern. Staleness threshold and trigger criteria are DAO-governed parameters.

Pinned for future version: Ongoing audit capabilities triggered at any time by the DAO; public registry of audit failures; Landblock remediation services to help registries resolve compliance issues.

6.3 Template Governance / Patch Model

RESOLVED in v0.4.4

Security patches — strongly recommended, publicly tracked. - DAO-defined compliance window (default 90 days; DAO-configurable) - Registries that do not apply a security patch within the window receive a `patch-overdue` flag in the Global Directory — publicly visible - Creates political and reputational pressure without overriding sovereignty

Feature updates — fully opt-in. - No compliance window, no visibility flag - Government adopts when ready

Classification: The DAO classifies every release as security patch or feature update. Any DAO member can challenge a classification. Prevents the mechanism from being weaponized.

Template codebase: DAO-owned. Contributions and major changes require DAO vote. Governments that have deployed the template can propose improvements based on operational experience.

7. Contract Architecture

7.1 Assessment Status

Contract	Layer	Decision	Notes
`LDBKToken.sol`	Federation (utility)	**Adjust**	Remove ERC20Votes; utility only
`LGTToken.sol`	Governance	**New**	ERC20Votes; Aragon voting
`LandblockPaymaster.sol`	Federation	**Keep**	Custom paymaster confirmed
`IdentityRegistry.sol`	Federation	**Resolved**	LADM Party roles integrated
`EvidenceStore.sol`	Federation	**Adjust**	Add `registryId` field
`ParcelRegistry.sol`	Registry Template	**Replaced**	ADR-0020
`SpatialUnitRegistry.sol`	Registry Template	**New**	Physical parcel / land area
`BAUnitRegistry.sol`	Registry Template	**New**	Basic Administrative Unit
`RRRRegistry.sol`	Registry Template	**New**	Rights, Restrictions, Responsibilities
`RegistryDirectory.sol`	Global Directory	**Specified**	See contracts/RegistryDirectory.md
`PropertyToken.sol`	Registry Template	**Resolved**	Optional registry-permissioned collateral instrument
`DisputeRecord.sol`	Federation	**Resolved**	Type 3 only — see Section 7.2
`CoordsValidator.sol`	Federation	**Assess**	OGC compliance TBD

7.2 DisputeRecord.sol — Scope

RESOLVED in v0.4.4

`DisputeRecord.sol` is scoped to **Type 3 disputes only** — formal challenges to specific proof records in `EvidenceStore.sol`.

What it is not: - Not an adjudication mechanism for disputes between land claimants (registry's job) - Not a contested zone tracker (handled by `RegistryDirectory.sol`)

What it records: - Challenger DID - Challenged proof CID (reference to `EvidenceStore.sol`) - Basis for the challenge - Resolution record when available (links to new proof or external resolution)

Resolution of the underlying dispute happens outside the protocol (courts, arbitration, registry process). When resolved, outcome is recorded via a new proof or a resolution record linked back to the challenge.

Changes: Subject to DAO vote and ADR.

7.3 PropertyToken.sol — Role

Optional, registry-permissioned ERC-721 collateral instrument. Not a title token. Linked to `SpatialUnitRegistry` entry and `RRRRegistry` record. Lien recorded in `RRRRegistry.sol`. Enforcement remains with registry and courts. Registries that do not enable it are unaffected.

7.4 Deployment Order

`LGTToken` → `LDBKToken` → `LandblockPaymaster` → `IdentityRegistry` → `EvidenceStore` → `SpatialUnitRegistry` → `BAUnitRegistry` → `RRRRegistry` → `PropertyToken` → `DisputeRecord` → `RegistryDirectory`

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8. Token Model

8.1 Two Tokens, Two Purposes

Token	Name	Purpose
LDBK	Landblock Token	Platform utility token — query fees, federation services
LGT	Landblock Governance Token	DAO governance via Aragon on Polygon

8.2 LDBK

ERC-20. No governance voting rights. Tokenomics: TBD.

8.3 LGT

Model and distribution resolved in v0.4.4

ERC-20 with ERC20Votes (OpenZeppelin). Used for Protocol DAO governance via Aragon on Polygon.

Model A — Fully separate from LDBK. No direct exchange mechanism at this stage. Governance influence is not purchasable via the utility token.

Distribution — three buckets:

Bucket	Recipients	Mechanism
Founding stewards	Protocol builders and launchers	Grant with vesting schedule
Active registry participants	Registries publishing proofs and participating in governance	Earned through participation
Contributors	Developers, researchers, Library curators, community	DAO working group allocation

Specific percentages and vesting schedules: Deferred to Phase 2 / Phase 5 — set when network size is known.

Annual review: DAO reviews tokenomics annually. All changes subject to ADR and DAO vote.

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9. Governance: The Landblock Protocol DAO

9.1 The Foundational Separation

The DAO governs the protocol and standards. It does not govern land outcomes. Courts decide land. Governments decide policy.

9.2 What the DAO Governs

- Federation conformance standards and conformance tier requirements
- Global Directory admission criteria and contested zone policy
- Registry Template codebase, patch classification, and update process
- Protocol contract upgrades (via proxy governance)
- Treasury allocation, paymaster policy, and public goods working group
- Neutrality clause interpretation
- LGT distribution, voting weight policy, and annual tokenomics review
- Legal Reference Library — additions, updates, editorial standards
- Oracle fallback rate and staleness threshold parameters
- Template deployment partner certification
- All design changes (ADR + DAO vote required)

9.3 What the DAO Does Not Govern

- Who owns any specific parcel of land
- Which registry is correct in a dispute between registries
- Any outcome within a participating registry's sovereign jurisdiction
- Legal interpretation of land rights in any jurisdiction

9.4 ADR Governance Principle

Any change to a resolved design decision requires: 1. A formal DAO vote (LGT-weighted, Aragon on Polygon) 2. A corresponding Architecture Decision Record

This applies to all items resolved in v0.4 and beyond.

9.5 Neutrality Lock

RESOLVED in v0.4.4

The neutrality clause — that the DAO governs the protocol only, never land outcomes — is protected by a constitutional supermajority:

- **Amendment threshold:** 85% of all circulating LGT (not just participating voters)
- **Deliberation window:** Minimum 90 days before a vote can close
- **Self-protecting:** Lowering either threshold requires the same 85% + 90-day process + ADR + DAO vote

9.6 Governance Tooling

Aragon on Polygon PoS. Must be reconfigured to use LGT as the voting token.

Aragon reconfiguration steps (Phase 2): 1. Deploy `LGTToken.sol` 2. Configure Aragon voting plugin to reference LGT contract address 3. Distribute LGT to founding stewards (minimum viable for governance function) 4. Transition Gnosis Safe to emergency veto role only

9.7 Governance Phases

Phase 1 (Proto-DAO): Complete. Constitution ratified. Founding steward multi-sig deployed on Amoy.

Phase 2 (Aragon Transition): Deploy LGT, reconfigure Aragon, distribute to founding stewards, transition multi-sig. Required before mainnet.

Phase 3 (Full On-Chain Governance): Full LGT distribution. Complete transition to Aragon. Multi-sig to emergency veto only; M-of-N set by DAO at transition.

9.8 Landblock Foundation (Future)

Pinned — outside current scope

Long-term plan: establish a Landblock Foundation as the legal vehicle for the public goods mandate — donated onboarding services, Legal Reference Library maintenance, capacity-building for low-resource registries, and a volunteer program. Foundation formation requires a DAO vote to initiate. No entity created now.

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10. Oracle Design

Pyth Network scoped to **fee and gas pricing only** (LDBK/USD, MATIC/USD). Compliance checks belong to individual registries via Layer 5 integrations.

Fallback: DAO-configured static rate. Staleness threshold is a governance parameter. Transactions proceed at the fallback rate on oracle unavailability.

Expansion: Requires ADR and DAO vote.

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11. ERC-4337 Paymaster

`LandblockPaymaster.sol` kept as custom paymaster. No third-party vendor. If scaling demands change, ADR evaluates options at that time.

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12. Lending Integration

12.1 Verification-as-a-Service

Any verified institution queries the federation for a collateral verification bundle (Federation Function 5). No `PropertyToken` required.

12.2 Tokenized Collateral (Registry-Permissioned)

Registries that choose to enable it can issue `PropertyToken` (ERC-721) as a collateral instrument. Opt-in. Lien recording in `RRRRegistry.sol`. Enforcement with registry and courts.

12.3 Governance

Any expansion requires DAO vote and ADR.

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13. Cross-Chain Evidence Portability

Deferred. Off-chain API verification serves all near-term use cases. Future ADR will scope the approach (Polygon native bridge, LayerZero, or other) when a specific on-chain integration use case is identified.

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14. Donated Onboarding Service

RESOLVED in v0.4.4

Current structure — Option B: DAO working group with treasury allocation funds donated services for countries that cannot afford the data mapping / onboarding service. No separate legal entity.

Future structure — Landblock Foundation: DAO vote required to initiate formation. The Foundation will hold the full public goods mandate: donated onboarding, Legal Reference Library, capacity-building, and a volunteer program. Outside current scope.

Service model: - Commercial registries / well-funded governments: fee-based - Countries that cannot afford it: donated via DAO working group (current) / Foundation (future)

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15. Identity & Privacy

SpruceID DIDs with ZKP-based selective disclosure (W3C DID). Three identity tiers: Self-Asserted, Community-Verified, Authority-Verified. LADM Party roles integrated. Cross-registry identity resolution via DID provenance passing — receiving registry applies its own policy.

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16. Off-Chain Storage & Geospatial

IPFS with Filecoin pinning. GeoJSON primary boundary format. OGC API Features and WMS/WFS/WMTS for spatial services. `CoordsValidator.sol` OGC compliance: TBD.

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17. Security & Anti-Fraud Design

- Immutable records; amendments create new versions
- Content-addressed document integrity via IPFS CIDs
- Multi-signature authorization (OpenZeppelin AccessControl)
- Sybil resistance via tiered identity gates

- Solidity security: OpenZeppelin, Foundry invariant tests, Slither, Certora, third-party audit before mainnet
- Bitemporal versioning: TBD

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18. Government Adoption Model

Phase	Description
1 — Mirror Mode	Records hashed and anchored. Zero operational change.
2 — Audit Mode	Proof-of-history consulted in disputes.
3 — Federation Participation	LADM-structured proofs published. Cross-registry verification active.
4 — Registry Template	Government deploys template. Landblock provides software only.
5 — Endemic Trust Layer	Landblock verification becomes baseline expected practice.

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19. Reference Implementation — Peru

Peru serves as the named reference implementation. No Peru-specific assumptions in contracts or code.

- **SUNARP** → Path A / Mirror Mode onboarding documentation
- **COFOPRI** → Tenure Conversion Workflow configuration documentation
- **Comunidades campesinas / nativas** → Layer 0 community consent configuration
- **Peru legal framework** → initial Latin American entries in the Legal Reference Library

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20. Infrastructure

- **Server:** VPSDime, 104.251.222.69
- **Domains:** landblock.app, explorer.landblock.app, investor.landblock.app
- **Process management:** PM2 + nginx
- **Database:** Neon DB (Postgres)
- **Testnet:** Polygon Amoy
- **Repos:** brockhager/landblock-core (private), brockhager/landblock-public (public)

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21. Roadmap

Phase 1 — Foundation

Governance constitution ratified. Founding steward multi-sig deployed (Polygon Amoy).

Phase 2 — Federation Architecture (Current)

- v0.4.x design document series
- LADM data model alignment and contract restructuring
- `RegistryDirectory.sol` specification
- Legal Reference Library — initial structure and Latin American entries
- `LGTToken.sol` development
- Aragon reconfiguration to LGT
- Initial LGT distribution to founding stewards
- Multi-sig transition to emergency veto

Phase 3 — Core Protocol Build

- All contracts restructured/developed per v0.4 assessment
- `RegistryDirectory.sol` deployed to Amoy testnet
- LADM-compliant data model live
- EvidenceStore updated with registry identity and Trust Context
- `DisputeRecord.sol` scoped and deployed
- Federation proof publication and verification flows
- Lending verification-as-a-service API
- Security audit

Phase 4 — Registry Template & Government Adoption

- Registry Template development (all 7 layers + Tenure Conversion Workflow)
- Legal Reference Library published
- Mirror Mode deployment with pilot registry partner (Peru SUNARP reference)
- Federation conformance testing
- Template deployment process (all three paths operational)
- Conformance graduation process live

Phase 5 — Tokenization & Full Governance

- `PropertyToken` module
- Full LGT distribution (all three buckets)
- Aragon full on-chain governance activation
- Tokenomics percentages and vesting schedules finalized
- Open protocol specification published
- Cross-chain portability ADR (if use case identified)

- Landblock Foundation formation vote

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22. Cross-Cutting Infrastructure

Component	Purpose
Off-chain polygon validation service	Overlap detection for Directory admission
The Graph subgraph	Indexes all on-chain events
IPFS / Filecoin	Off-chain storage for all documents and messages
Pyth Network	Fee/gas pricing feeds
ERC-4337 Paymaster	Gas sponsorship
AI-assisted mapping tool	LADM onboarding for existing registries
Legal Reference Library	Curated national property law frameworks

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23. Layer 4 — Network Intelligence & Registry Development

Placeholder — pinned for future version.

Aggregates anonymized patterns from federation data across all participating registries. Turns network-wide data into actionable intelligence no single registry can produce alone. Distinct from the Legal Reference Library (which is curated legal research, not operational data).

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24. Open Questions & TBD Items

Architecture TBDs

Item	Priority	Status	Notes
LADM Rights Parcel separation	High	RESOLVED	ADR-0020
`RegistryDirectory.sol` specification	High	RESOLVED	contracts/RegistryDirectory.md
Federation conformance requirements	High	RESOLVED	Three-tier system

Item	Priority	Status	Notes
Contested zone admission	High	RESOLVED	LADM/federation-mapping.md
`IdentityRegistry.sol` LADM Party	Medium	RESOLVED	Party roles integrated
Cross-registry identity resolution	Medium	RESOLVED	DID provenance passing
Validator quorum policy	Medium	RETIRED	v0.3 artifact
Oracle scope and fallback	Medium	RESOLVED	Fee/gas only; static fallback
Custom vs. third-party paymaster	Medium	RESOLVED	Custom confirmed
`PropertyToken.sol` role	Medium	RESOLVED	Registry-permissioned collateral
Lending integration model	Medium	RESOLVED	Verification-as-a-service + optional token
Cross-chain portability	Medium	DEFERRED	Future ADR
Pilot flow generalization	Medium	RESOLVED	Peru reference implementation
`DisputeRecord.sol` scope	Medium	RESOLVED	Type 3 proof challenges only
`CoordsValidator.sol` OGC compliance	Medium	**TBD**	Full standards review required
Bitemporal versioning compliance	Medium	**TBD**	Transaction time vs. valid time
Query routing full design	Medium	**TBD**	Routing logic across Directory hierarchy
Permissioned free access criteria	Medium	**TBD**	Courts, governments, registered registries
Tiered disclosure schema	Medium	**TBD**	Public / restricted / sealed

Registry Template TBDs

Item	Priority	Status	Notes
Registry Template 7-layer design	High	RESOLVED	v0.4.2
Monolith vs. modular architecture	High	RESOLVED	Monolith with separated modules
VGGT customary tenure	High	RESOLVED	Configurable at Layer 0
FFP LA accuracy targets	Medium	RESOLVED	Sketch / GPS / Survey-grade
Secure Case Messaging	Medium	RESOLVED	Layer 7; IPFS-stored
Tenure Conversion Workflow	High	RESOLVED	Seven-stage generic workflow
Template deployment model	High	RESOLVED	All three paths; Data Sovereignty Policy
Template graduation process	Medium	RESOLVED	Self-assessment + evidence + DAO vote
Template patch model	Medium	RESOLVED	Two-tier; security flag; opt-in features
Donated onboarding structure	Medium	RESOLVED	Option B now; Foundation future

Governance TBDs

Item	Priority	Status	Notes
ADR governance principle	High	RESOLVED	All changes require DAO vote + ADR
Aragon reconfiguration	High	RESOLVED	Steps documented; Phase 2 execution
LGT / LDBK tokenomics	Medium	RESOLVED	Model A; three buckets; annual review

Item	Priority	Status	Notes
Neutrality lock threshold	Medium	RESOLVED	85% circulating LGT; 90-day window
LGT distribution percentages	Medium	**TBD**	Deferred to Phase 2/5

Pinned for Future Session

Item	Notes
Layer 4 — Network Intelligence	Pinned — not in scope for v0.4.x
Cross-chain portability	ADR when use case identified
Audit capabilities and public failure registry	Outside current scope
Landblock Foundation formation	Requires DAO vote; outside current scope
Volunteer program	Outside current scope
Query routing, free access, tiered disclosure	Target v0.4.5
`CoordsValidator.sol`, bitemporal versioning	Target v0.4.5

Appendix A: Reference Architecture Layers

Layer	Purpose	Key Standards
0 — Governance / Legal	Authority, roles, dispute policy	FELA, VGGT, LGAF
1 — Business Capabilities	Intake, adjudication, registration, search	FELA, FFP LA
2 — Workflow / Rules	BPM, public notice, objections, SLA	FELA, VGGT, LGAF
3 — Data Model	Party, RRR, BAUnit, SpatialUnit, Source	ISO 19152 (LADM)
4 — Geospatial Services	Parcel fabric, topology, map services	OGC, INSPIRE
5 — Integration	API gateway, event bus, cross-agency	FELA
6 — Security / Trust	IAM, signatures, audit, privacy	FELA, VGGT, LGAF

Layer	Purpose	Key Standards
7 — Channels	Public portal, professional portal, mobile	VGGT, FFP LA

Appendix B: Glossary

Term	Definition
ADR	Architecture Decision Record — formal record of a design decision, rationale, and DAO vote
BAUnit	Basic Administrative Unit — legal unit subject to a right, restriction, or responsibility
COFOPRI	Peru's agency for formalizing informal property; reference for Tenure Conversion Workflow
Data Sovereignty Policy	Governs all template hosting arrangements — no data access beyond operational necessity
Federation	The Landblock protocol layer enabling registries to interoperate
FFP LA	Fit-For-Purpose Land Administration
FELA	Framework for Effective Land Administration (UN-GGIM)
Global Directory	Landblock's index of participating registries and their coverage
LADM	Land Administration Domain Model — ISO 19152
Landblock Foundation	Planned future entity for public goods mandate — donated services, Library, volunteers
Legal Reference Library	DAO-governed curated index of national property law frameworks
LGAF	Land Governance Assessment Framework (World Bank)
LGT	Landblock Governance Token — Protocol DAO voting token
LDBK	Landblock Token — platform utility token

Term	Definition
Mirror Mode	Path A registry participation — cryptographic anchoring without system changes
PropertyToken	Optional ERC-721 collateral instrument; not a title token
Registry Template	Open-source LADM-compliant registry software for governments
RRR	Rights, Restrictions, Responsibilities
Spatial Unit	Physical parcel or land area in LADM
SUNARP	Peru's national public registry; reference for Path A onboarding
Tenure Conversion Workflow	Reusable workflow for converting informal/communal tenure to formal title
Trust Context	Metadata object returned with every verification result
VGGT	Voluntary Guidelines on Responsible Governance of Tenure (FAO)

— End of Document v0.4.4 —

This is a living document. Sections marked TBD will be resolved in v0.4.5. All design changes require a DAO vote and a corresponding ADR. Version history is maintained in this document header.