CONCEPT WHITEPAPER · FAMILY & FRIENDS

ProvenArc

Digital provenance, trust and market infrastructure for art and collectibles

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ProvenArc

TL2N integration planned under separate agreements

Project stage. This document presents ProvenArc's thesis, product design and proposed architecture. The associated website and demonstrator use synthetic data. There is no offering of asset participations, promise of return, artwork authentication or live financial operation at this stage. Round amounts and terms remain REDACTED for private discussion.

Contents

Executive summary

Art and collectibles accumulate histories that affect trust, value, circulation, rights and obligations. Those histories rarely exist as a single coherent record. They are scattered across documents, emails, catalogues, contracts, photographs, closed systems and personal memory. Each sale, exhibition, service engagement or custody change may add another layer, while context is often lost as the parties change.

ProvenArc proposes digital infrastructure for organizing this ecosystem. The product connects actors, assets, events, claims, evidence, signatures, rights, services and jurisdictions in an auditable historical graph. It is designed to serve an independent artist publishing a first work, as well as collectors, galleries, museums, companies and specialist professionals.

The entry point is intentionally simple. A user may describe the history of a work or collectible in natural language. The artificial intelligence layer identifies people, organizations, dates, places, events and documents, searches permitted sources, suggests pre-registrations and converts the narrative into a structured proposal. The user reviews a diff before any material write operation. Artificial intelligence assists; it is not authorized to invent facts, sign on behalf of people, disclose private documents or execute irreversible actions without policy controls and approval.

ProvenArc records claims and evidence rather than declaring an absolute truth. A historical event begins as unverified. Referenced actors may later confirm, limit, reject or contest specific portions. A gallery may confirm that it received a piece without confirming authorship. A third-party custodian may confirm physical custody during a period without asserting ownership. An external authenticator may issue an opinion within a defined scope. The timeline preserves those distinctions.

Privacy is a core capability. A participant may have a protected civil identity, a public persona, an artistic name, a representative and identities known to compliance or payment entities. A small artist or a major collector may operate publicly under a pseudonym. Real identity is disclosed only when required by purpose, contract, KYC/KYB or law, using minimum access and a complete audit trail.

The product combines four reinforcing lines:

1. **provenance and collection SaaS**, to register, preserve and manage histories, documents and relationships;
2. **professional network**, to discover, engage and document third-party services;
3. **marketplace**, for sale, rental and exhibition of whole works and collectibles;
4. **future fractional participation infrastructure**, subject to legal structure, governance, financial operators and regulatory validation.

As a premium first-wave capability, ProvenArc may issue a **Signed Portable Provenance Record**: a PDF snapshot of the registration chain, timeline and supporting graph, with a cutoff timestamp, manifest, hashes, privacy profile and verifiable signatures. The record supports offline review and validation without publishing private documents or replacing the live graph.

ProvenArc never touches art or collectibles. It does not transport, store, authenticate, restore, photograph, appraise, insure or provide physical custody. Those activities belong to independent professionals. The platform organizes discovery, engagement, documents, signatures, obligations, partner-enabled payments and the resulting history.

The architecture starts with deliberately understandable choices: a modular monolith in Node.js, a framework-free frontend, PostgreSQL as the source of truth and relational graph structure, private objects in S3-compatible storage, PostgreSQL queues, disposable in-memory cache and stateless endpoints. TL2N - Tachyon Layer 2 Network - is planned as the native identity and signature engine, complemented by evidence such as gov.br, ICP-Brasil, notarial deeds, contracts and certificates from other jurisdictions. Commercial, licensing and intellectual-property arrangements among ProvenArc, Deep Tech Labs and TL2N remain to be formalized.

Monetization does not depend on a single premium transfer fee. The thesis combines SaaS subscriptions, storage, artificial intelligence processing, signatures, portable records, reports, compliance, APIs, enterprise services, professional marketplaces, whole-asset commerce and, only after applicable gates, participation administration.

The Family & Friends round offers investment exclusively in ProvenArc. Deep Tech Labs and TL2N are related but separate initiatives. Licensing, support, continuity and intellectual-property terms will be documented independently before operations. Amount, valuation, instrument and other economic terms remain `REDACTED` for private discussion.

> **Core thesis.** ProvenArc converts fragmented history into usable infrastructure for trust, services, compliance and commerce, preserving privacy without replacing the professionals who act on the physical object.

1. History as infrastructure

1.1 The problem is broader than certification

A work of art, manuscript, watch collection or historic vehicle does not have only a registration card. It has a sequence of relationships: creation, commission, publication, exhibition, acquisition, inheritance, loan, transport, conservation, insurance, custody, dispute and resale. Each relationship may generate different documents and testimony.

Solutions reduced to a single certificate capture only one moment. A document may prove that someone made a statement on a date, but it does not organize what happened before, what changed later, which sources support the statement or which people had authority to confirm it.

The opportunity is to treat history as persistent infrastructure. A registered asset becomes a meeting point for documents, services, professionals, events and transactions. The history does not need to be complete at inception. It may begin with a partial narrative and improve as new evidence and participants arrive.

1.2 Fragmentation and lost context

Important information commonly exists in incompatible forms:

- paper invoice;
- gallery email;
- exhibition photograph;
- old catalogue;
- rights-assignment agreement;
- notarial deed;
- report produced by an external professional;
- social-media publication;
- transport record;
- insurance policy;
- memory of a previous owner.

The problem is amplified by asymmetric access. A collector may hold documents they do not wish to publish. A gallery may know one event but not the earlier history. A professional may confirm an intervention but not ownership. Without structure, those pieces remain disconnected or are flattened into a binary seal.

1.3 Progressive entry

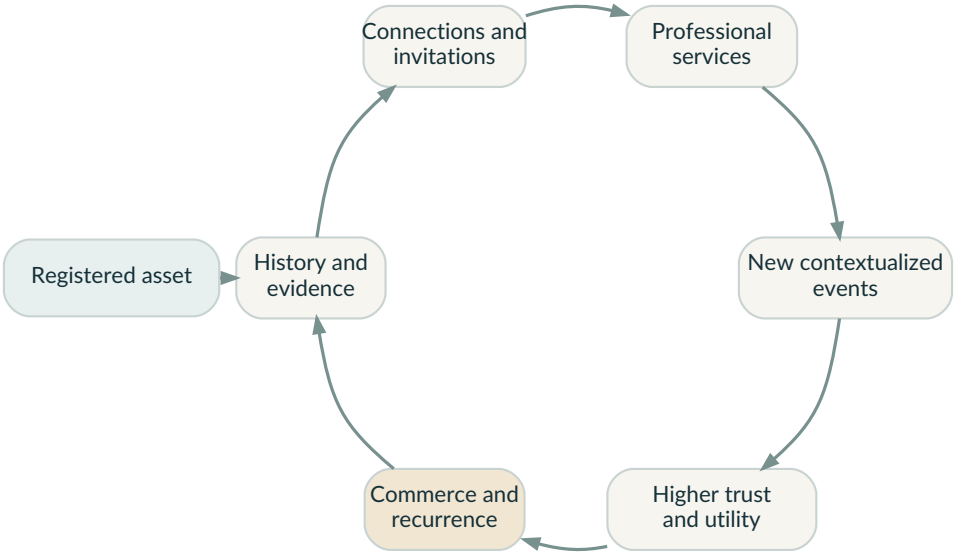
ProvenArc accepts different levels of maturity. An artist with no formal registration may create a public persona and publish a work. Later, the artist may be contacted by a photographer, authenticator, curator, gallery or another professional. Each service can produce new events and evidence. The history matures with the asset.

Documentation is therefore not an admission requirement. The platform helps build it.

1.4 Accumulative value

Utility grows through reinforcing cycles:

- the registered asset receives history and evidence;
- the history creates connections and invitations;
- connections make professional engagement easier;
- services generate documents and events;
- documentation improves diligence and trust;
- trust increases commercial utility and recurring use;
- new transactions update the history.



ProvenArc conceptual flywheel

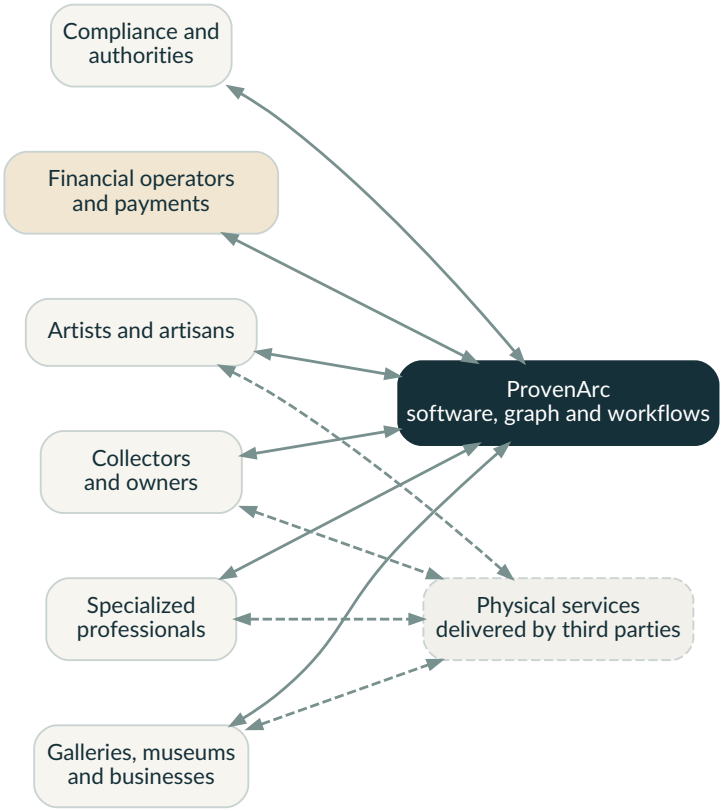
Record volume alone does not create value. Value depends on context, permissions, quality, authority and the ability to interpret disagreement.

2. Product principles

2.1 Software, never physical operations

ProvenArc is a software company. Every physical activity belongs to independent third parties: artists, authenticators, experts, conservators, carriers, insurers, galleries, museums, custodians and other service providers.

The platform may record that a service was requested, contracted, delivered and signed. It may preserve documents and organize obligations. It does not perform the service and does not declare that a technical result is correct merely because it was registered.



Ecosystem and operational boundary

2.2 Private by default

Civil identity, documents, ownership relationships, values and sensitive information begin protected. Publicity is a controlled projection, not the database default.

A public timeline may show that a validated transfer occurred without disclosing buyer, seller, value or document. An authorized counterparty may receive additional information. Compliance may access a different projection. The same core produces different views according to purpose and permission.

2.3 Claims before conclusions

The system records who stated what, when, in which role and with which evidence. A verification states its scope and authority. The platform avoids a generic “verified” label without identifying by whom and for what purpose.

2.4 Preserved history

Corrections do not silently erase the past. Contests, retractions, replacements and merges leave an audit trail. The goal is to preserve integrity without unnecessarily exposing personal data forever.

2.5 Assistive artificial intelligence

Artificial intelligence reduces the effort required for registration, research, translation and organization. High-impact actions remain subject to deterministic policies, permissions and human review.

2.6 Jurisdiction as data

Privacy, signature, cultural-property, consumer, payment and copyright rules vary by country and context. Jurisdiction accompanies actors, assets, events, documents, contracts and processing.

2.7 Interoperability

The product must import and export data, attach external evidence and support API integration. A user’s history should not be trapped in an indecipherable proprietary format.

2.8 Deliberate technical simplicity

The architecture begins simple enough to be understood by a small team. Distribution, additional databases and specialized components are introduced only when a measurable problem justifies the complexity.

3. The ProvenArc ecosystem

3.1 Participants

The platform models people, organizations, authorities and profiles that have not yet been claimed. The same actor may perform different roles depending on the event:

- artist or craftsperson;
- owner or collector;
- gallery, museum or exhibition house;
- curator;
- external authenticator or expert;
- conservator or restorer;
- photographer;
- appraiser;
- insurer or broker;
- carrier;
- professional custodian;
- auctioneer or intermediary;
- representative, attorney-in-fact or family office;
- authority or compliance team.

A role is contextual. A person may be an artist for one asset and a collector for another. An organization may act as a gallery in one event and custodian in another. Each action must indicate on whose behalf it was performed, under which authority and during which period.

3.2 Claimable pre-registrations

The history of a work references actors who may never have created an account. ProvenArc supports pre-registration to preserve those relationships without requiring immediate adoption.

Pre-registrations for natural persons begin private. Organizations may begin with a public projection based on commercial information, subject to compliance and jurisdictional rules. When the real actor joins, they may claim the profile and review historical mentions.

Claiming does not mean automatic approval. The actor receives a pending-items inbox and may confirm, limit, contest or reject events in which they were referenced.

3.3 Profiles and discovery

An artist may maintain a lightweight profile with an artistic name, biography, catalogue and external links. A professional may publish scope, jurisdiction, credentials and services. A collector may remain invisible to the public while requesting proposals.

Discovery must respect privacy. The platform can match a need to compatible professionals without revealing the requester before the appropriate stage.

3.4 Collections, subcollections and relationships

Assets may belong to multiple collections: personal, curatorial, historical, commercial or temporary. An exhibition may relate many artists and works, including items not yet registered. Couples, collectives and workshops may create both individual and joint relationships.

The graph represents those structures without duplicating the asset.

4. Provenance model

4.1 Separating work, object and rights

ProvenArc distinguishes elements that are frequently conflated:

- **intellectual work**: the abstract creation;
- **copy or specimen**: a specific physical or digital manifestation;
- **edition or series**: a bounded set of copies;
- **composite object**: an item formed by parts;
- **digital file**: documentation, representation or native digital work;
- **material ownership**: title to the object;
- **possession**: factual control at a given time;
- **custody**: physical safekeeping assigned to a third party;
- **copyright and licenses**: reproduction, display, publication and other uses;
- **economic participation**: contractual or legal rights concerning revenue, expenses or disposal.

Buying an object does not automatically transfer every right associated with the work. The model records these layers separately.

4.2 Events with multiple roles

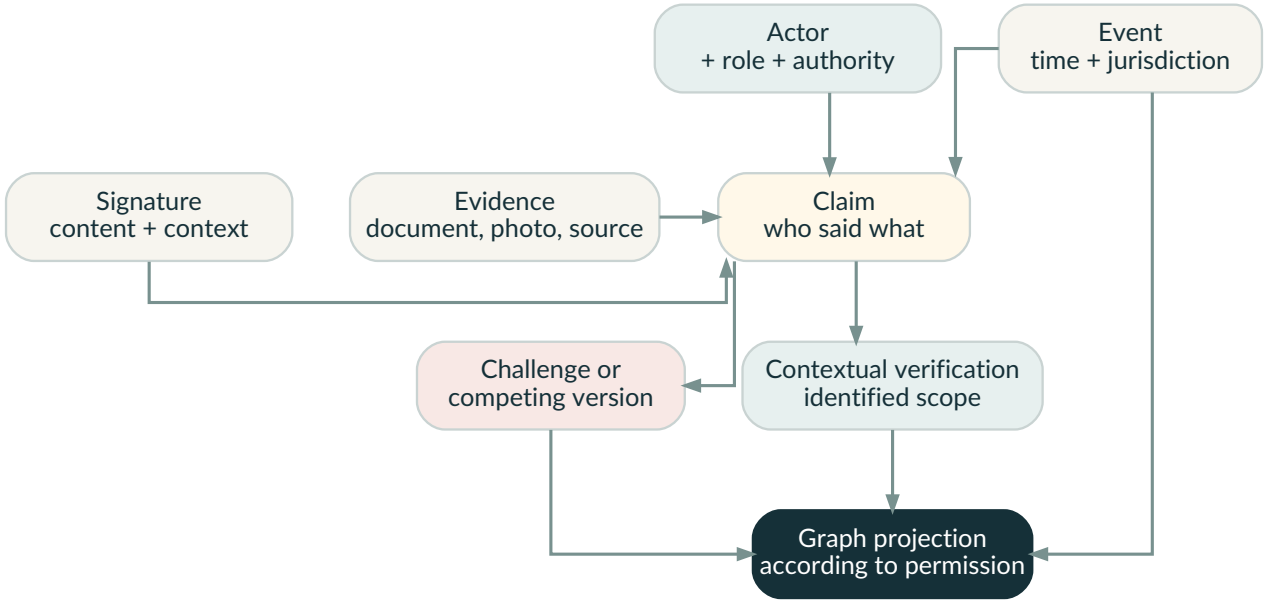
A transfer may involve the previous owner, purchaser, representative, gallery, carrier, custodian and witness. The event is its own entity with participants and roles, rather than a simple update to a “current owner” field.

The model distinguishes:

- when the fact is said to have occurred;
- when it was declared;
- when it entered the system;
- when it was signed;
- when it was verified;
- period of validity;
- precision of the date.

This is essential for retrospective registration. An event that occurred in 1998 and was entered in 2026 has two different temporal dimensions.

4.3 Claims, evidence and verification



Conceptual provenance model

A claim may be supported, contradicted or contextualized by evidence. Evidence may remain private while still producing a verifiable cryptographic commitment. A signature records an expression of intent regarding defined content. A contextual verification states what was confirmed, by whom, in which role and by what method.

Possible public states include:

- registered, not yet verified;
- confirmed by one party;
- confirmed by multiple actors;
- verification limited to specific fields;
- contested;
- superseded by correction;
- suspended for review;
- revoked or retracted.

The status never replaces the explanation.

4.4 Competing histories

Works and collectibles may have incompatible narratives. The system preserves competing versions, sources and contests. A judicial, administrative or arbitral decision may be attached as a new event without erasing the fact that a dispute existed.

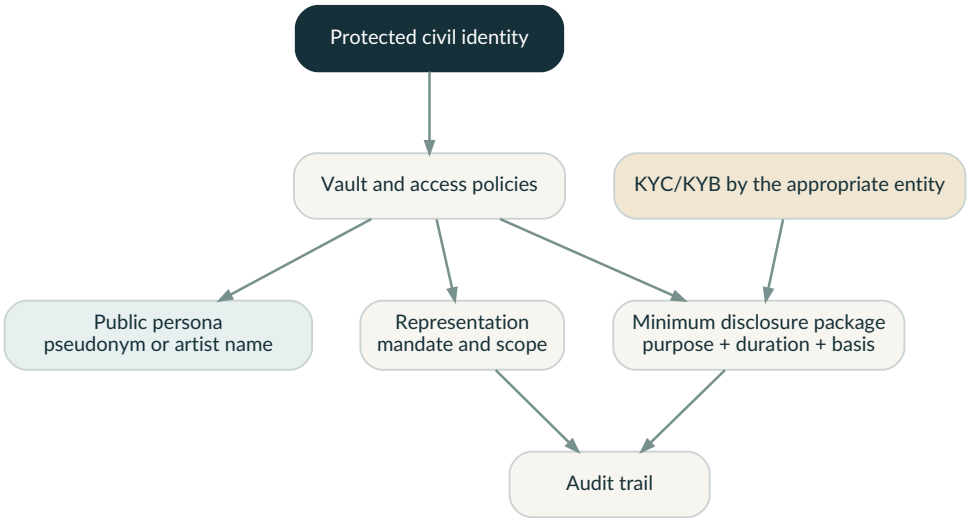
4.5 Asset lifecycle

The timeline may record creation, publication, exhibition, loan, transport, custody, external authentication, appraisal, conservation, damage, theft, recovery, seizure, export, import, insurance, loss, destruction, fragmentation and market withdrawal.

Condition reports produced by third parties may compare physical state between delivery and return. ProvenArc records the document, authorship and context; it does not conduct the inspection.

5. Identity, pseudonymity and disclosure

5.1 Layered identities



Identity layers

An access account is not the same as a public identity. An actor may have:

- protected civil identity;
- public persona;
- pseudonym or artistic name;
- institutional identity;
- representation by an agent or attorney-in-fact;
- identity known to compliance;
- financial identity known to the KYC operator;
- minimum disclosure package for a counterparty.

5.2 Negotiation without public exposure

A seller may list an asset through an opaque persona. A buyer may express interest without revealing a civil name. The platform opens a controlled channel, collects consent and, when necessary, discloses only the information required for contract, diligence or payment.

For premium transactions, identity may remain protected until seriousness, confidentiality and compliance requirements are met. Commercial designs involving deposits or engagement fees require legal and contractual validation.

5.3 KYC does not require publicity

KYC/KYB means that the appropriate entity knows and has verified relevant information. It does not mean that other users or the public can access it. The platform separates proof of compliance from civil disclosure.

5.4 Access audit

Every material disclosure records who accessed the data, the reason, legal or contractual basis, data set, time limit and policy decision. Authorizations may expire. Later revocation does not erase lawful past access, but it prevents new access where applicable.

> **Communication limit.** ProvenArc provides pseudonymity and exposure minimization, not absolute anonymity against legal duties, KYC, fraud prevention or competent orders.

6. Artificial intelligence across the platform

6.1 Narrative-based registration

Long forms create a particularly high barrier for older histories. A user may write or dictate a free narrative, attach documents or indicate sources. The LLM layer proposes a structure:

- actors and organizations;
- assets and collections;
- dates and intervals;
- places and jurisdictions;
- events and roles;
- documents and evidence;
- pre-registrations;
- possible duplicates;
- missing or inconsistent fields.

The proposal is shown as a diff. The user may edit, reject or approve it in parts.

6.2 Research and enrichment

When a user mentions an exhibition, institution or public event, the LLM may research permitted sources and suggest details. Every enrichment must retain:

- URL or source reference;
- consultation date;
- excerpt or data used;
- confidence level;
- distinction between user-provided and researched content;
- approval before integration into the canonical record.

6.3 Graph organization

The assistant may explain relationships, suggest paths, summarize history, identify gaps and prepare projections. It may also propose merges of similar registrations. A merge remains reviewable, auditable and reversible.

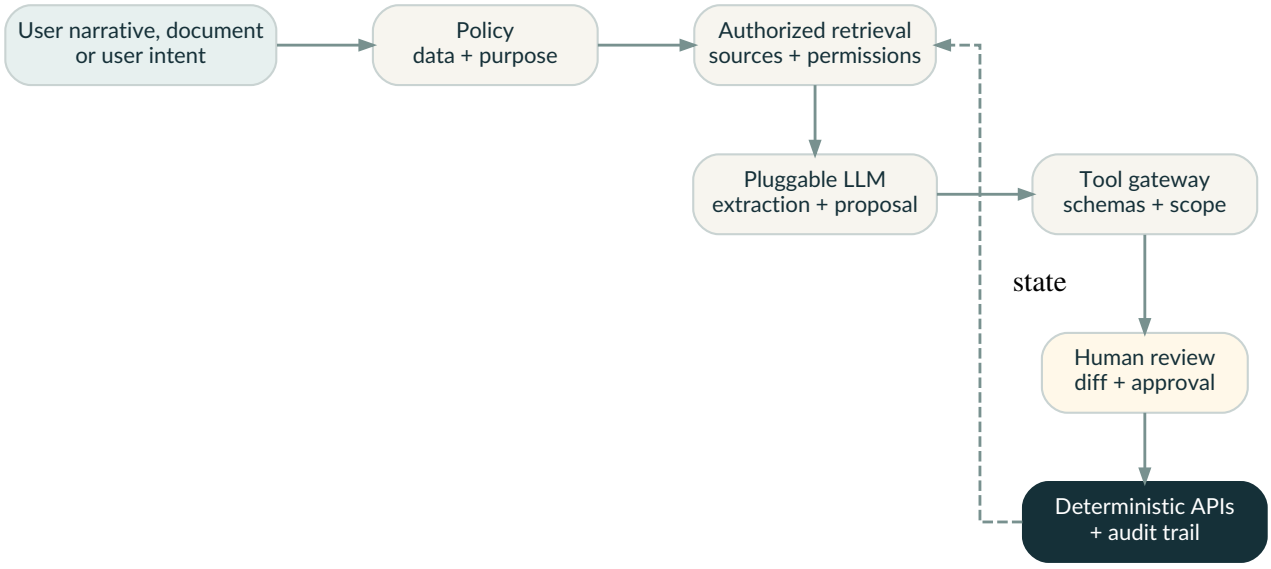
6.4 Compliance and abuse

Models may assist with triage of spam, vandalism, fraud, conflicting data and risk. Decisions affecting rights require deterministic rules, evidence and human review. The model does not replace a compliance officer or authority.

6.5 Translation and internationalization

Texts may be translated by LLM and cached. The system preserves the original, language, model version, instructions, date and human revisions. Legal or contractual translations require appropriate review before binding use.

6.6 Secure tool architecture



Artificial intelligence orchestration

The model does not receive broad credentials. Every call passes through a tool gateway that validates schema, identity, purpose, policy and resource. Read and write scopes are separate. Write operations create a proposal and require approval when the risk warrants it.

Retrieved documents are treated as untrusted data. Hidden instructions in pages, PDFs or metadata do not gain authority. Prompt-injection defense is part of the design.

6.7 Pluggable providers

The platform is not structurally dependent on one model. A gateway standardizes capability, cost, residency, retention policy and evaluation. Private data may be sent only to providers compatible with the information class and applicable region.

7. TL2N, identities and signatures

7.1 Integrated engine

ProvenArc plans integration with TL2N - Tachyon Layer 2 Network - for native identities, credentials and signatures. The architecture is described as Bitcoin-like in the sense of cryptographic commitments, keys and verifiability, without automatically turning records into financial assets. ProvenArc, Deep Tech Labs and TL2N remain separate initiatives; licensing, support, continuity, exclusivity and intellectual property require dedicated agreements.

7.2 Contextual signature

A signature must define:

- exact content signed;
- hash and canonicalization;
- signer and identity used;
- role and represented organization;
- scope and purpose;
- date and timestamp;
- jurisdiction;
- related credentials;
- revocation status;
- attachments and complementary evidence.

7.3 Complementary evidence

TL2N does not exclude other mechanisms. A record may attach a gov.br signature, ICP-Brasil certificate, notarial deed, contract, power of attorney, foreign signature or administrative decision. The platform preserves these as composite evidence.

ProvenArc does not declare any mechanism universally valid. Acceptability depends on law, contract, purpose, authority and context.

7.4 Immutability without exposure

A shared or immutable layer receives only cryptographic commitments, hashes, timestamps and opaque identifiers. Content, personal data and correlation keys remain outside it, protected by encryption and retention policies.

A hash related to identifiable data may still be pseudonymous personal data. Privacy is therefore not solved merely by excluding the original text from the immutable layer.

7.5 Institutional separation

The investment round concerns ProvenArc. Deep Tech Labs and TL2N are not automatically part of the offering. Licensing, support, intellectual property, continuity and exit arrangements must be formalized in separate agreements.

8. Signed Portable Provenance Record

8.1 Purpose

Potential clients may need an offline version of the registration chain for internal archives, diligence, succession, insurance, audit, negotiation, institutional preservation or presentation to third parties. ProvenArc may generate a signed record representing the known state of the graph at a defined date and time.

The portable record is a **verifiable snapshot**, not an autonomous copy of the entire platform. It preserves authorized content and integrity proof for material that cannot be disclosed.

8.2 Contents

The PDF may contain:

- identification of the asset, edition, specimen or collection;
- unique record identifier and version number;
- cutoff date and time;
- jurisdiction and language;
- privacy profile used for the export;
- timeline of events, claims, verifications and contests;
- visual graph of actors, organizations, collections and relationships;
- contextual roles and authority of signers;
- list of included, omitted or referenced evidence;
- hashes of private documents not embedded;
- file and signature manifest;
- notices concerning scope, limitations, supersession and consultation of the latest version.

Generation should favor a preservation-oriented format, such as PDF/A where technically compatible with the required signatures and attachments.

8.3 Export profiles

An export may be public, pseudonymized, intended for a counterparty, audit, legal review or custom configured. The same registration chain may produce different records according to purpose and authorization.

Private documents are never included automatically. Embedding requires explicit and granular authorization from the publisher and any other applicable rights holders. Without authorization, the record may identify the existence and category of evidence, a protected publisher identity, access status and hash without revealing content.

8.4 Composite signatures

The record may receive a TL2N signature from ProvenArc, the requester or authorized participants. It may also attach or embed complementary evidence such as PAdES/ICP-Brasil, gov.br, foreign certificates, notarial deeds and documents required in a particular jurisdiction.

Each signature identifies the exact content, the signer's role and the scope of assent. Signing the portable record does not mean agreeing with every claim reproduced in it unless expressly stated.

8.5 Offline verification and online consultation

Offline verification confirms integrity, signatures, the manifest and hashes of included files. An optional online consultation indicates whether a later version, new contest, revoked credential or supersession exists.

A later version does not erase the historical value of an earlier snapshot. The previous record continues to show what was registered and authorized at its cutoff time.

8.6 Machine-readable package

An expanded product may accompany the PDF with:

Structured files enable migration, analysis and verification by other systems. A signed manifest connects all representations without requiring private documents to be published.

8.7 Pricing and positioning

The portable record is a premium capability with clear additional pricing. Charges may vary by issuance, volume, graph complexity, languages, signatures, authorized attachments, machine-readable package, batch or API. Reissuance after new events is a new operation while preserving version history.

> **Legal and technical limit.** The record is a signed snapshot of the records, claims, evidence and verifications available at the stated time. Its issuance does not by itself constitute material authentication, expert examination, appraisal, a universal certificate of title or legal opinion.

9. Professional network and marketplace

9.1 Services marketplace

Independent professionals may publish services with scope, jurisdiction, pricing or quotation method, credentials and deliverables. Users may request proposals under a pseudonym.

Possible flows include:

1. private request;
2. selection of compatible professionals;
3. questions without civil-identity exposure;
4. proposal and contract;
5. performance outside the platform;
6. delivery of documents or evidence;
7. confirmation and signature of the event;
8. timeline update.

The platform may charge subscriptions, commissions, qualified-lead fees, document processing or enterprise fees according to the validated model.

9.2 Whole-asset marketplace

Works and collectibles may be offered for:

- whole sale;
- rental;
- exhibition;
- institutional loan;
- private negotiation;
- auction through an authorized structure or suitable partner.

For lower and moderate values, online payments may be processed by a partner. For premium transactions, the flow may preserve established market practices, using the platform for connection, diligence, contractual deposits and provenance updates.

ProvenArc does not organize transport. The parties engage their own providers. The system may hold or instruct release of funds through financial integration only where the contractual model and responsible entity permit it.

9.3 Neutrality regarding quality

Paying for a listing, plan or promoted placement does not purchase authentication, reputation or verification. Sponsored results must be identified. Credentials and ratings need anti-manipulation controls.

9.4 Disintermediation

A transaction may move outside the platform after introduction. ProvenArc reduces this risk by providing real utility: contracts, privacy, documents, history, partner-enabled payments, signatures and dispute support. Penalties or deposits require proportionate contractual design.

10. Fractional participations - conditional vision

10.1 Concept

An asset held in physical custody by a specialized third party may support participations among multiple holders. Each participation may carry rights, obligations, votes, expenses, revenue and transfer rules.

A holder may seek economic exposure, long-term participation or diversification. Public language must avoid promises of yield, liquidity or appreciation.

10.2 Custody and administration

The professional custodian is a third party. It may charge for storage, insurance, maintenance, inspection or related services. ProvenArc records contracts, invoices, documents and events without possessing the object.

Revenue from rental or exhibition may follow a contractual waterfall covering taxes, expenses, reserves, fees and net distribution. The term “dividend” will be used only if legally correct for the selected structure.

10.3 Default

Possible rules include notice, cure period, transfer restriction, reserve use, voluntary sale, forced liquidation and application of proceeds to debt. No rule will be implemented as automatic forfeiture without a valid legal instrument, contractual due process and consumer and property analysis.

10.4 Governance

The structure must define:

- voting thresholds;
- exhibition and lending;
- whole-asset sale;
- conservation and extraordinary expenses;
- replacement of the custodian;
- insurance and loss;
- periodic valuation;
- conflicts of interest;
- rights of first refusal;
- succession, judicial restriction and incapacity;
- termination and redemption;
- the case of one holder reaching 100 percent.

10.5 Splits and recombination

The number of units may change through an approved split without altering each holder’s economic proportion. Consolidation of 100 percent may permit termination of the fractional structure and physical release after settlement of obligations and closure of corresponding records.

10.6 Independent gates

The capability advances only after approval for four separate layers:

1. ownership or rights structure;
2. offering and communication model;
3. payments and monetary custody;
4. secondary trading and settlement.

A payment partner solves only part of the third layer. Corporate separation also does not automatically alter the functional nature of the activity.

> **Conditional future.** This whitepaper describes a possible architecture. ProvenArc does not offer participations in works or collectibles in this round and does not depend on this capability to validate the initial business model.

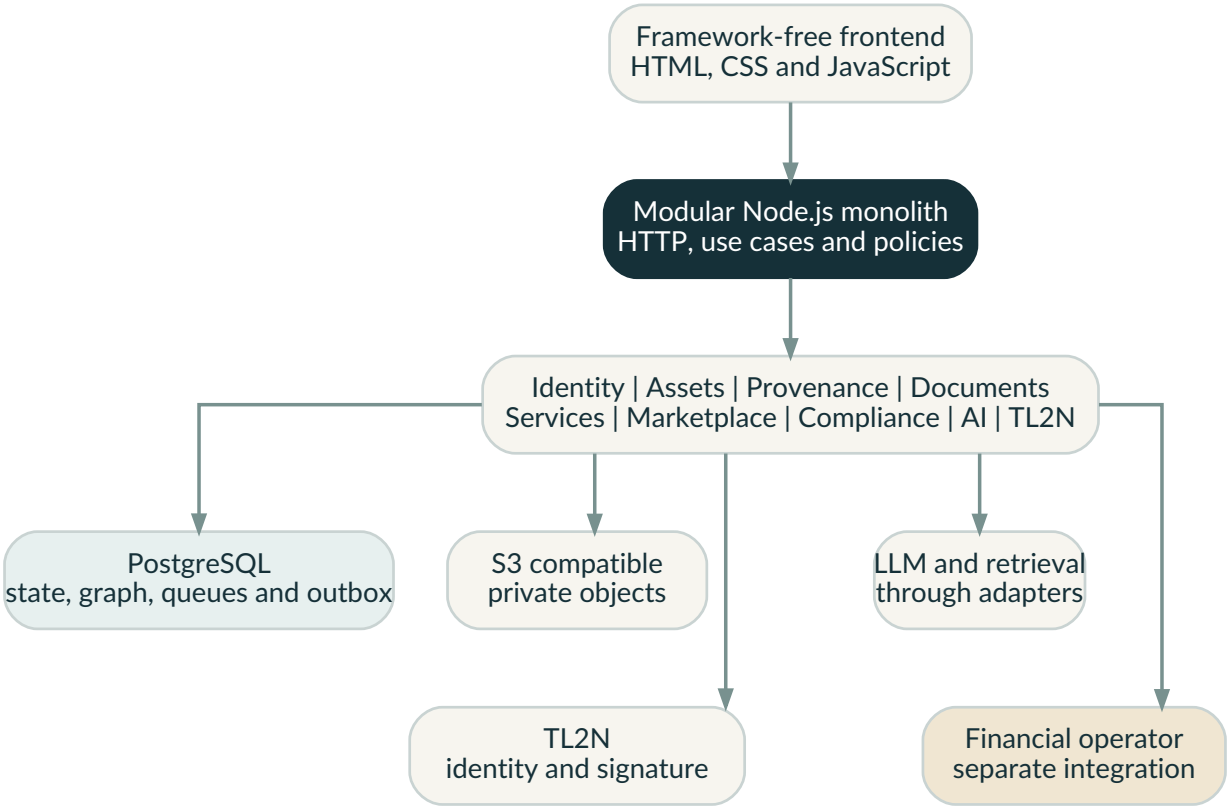
11. Technical architecture

11.1 Modular monolith

The backend begins as one deployable system with clear internal modules. Each module has contracts, use cases and data ownership. The architecture avoids coupling through unrestricted table access.

Planned modules include:

- identity, accounts and representation;
- actors and organizations;
- assets, works and rights;
- provenance, claims and disputes;
- documents and evidence;
- signatures and TL2N;
- services and marketplace;
- compliance;
- artificial intelligence;
- billing and financial adapters;
- audit and administration.



Logical architecture

11.2 Node.js and a framework-free frontend

The backend uses plain Node.js with selected libraries. The frontend uses HTML, CSS and JavaScript without an application framework. The decision reduces dependency, improves code readability and keeps performance predictable. Internal components may use ES modules, custom elements and progressive enhancement when useful.

11.3 PostgreSQL as source of truth

PostgreSQL stores canonical state, graph relationships, queues, outbox records and structured audit data. The graph is modeled through relational tables, indexes and appropriate path queries. A separate graph database will be considered only after a demonstrated need.

Queues use locks, leases, idempotent attempts and dead-letter states. External effects originate from outbox records created in the same transaction as the business state.

11.4 Private objects in S3-compatible storage

Documents and media remain outside the relational database, with metadata and hashes in PostgreSQL. Uploads pass through quarantine, validation, scanning and classification. Access uses authorization and temporary URLs or controlled streaming.

11.5 Cache and selective horizontal scaling

In-memory cache is disposable. It never decides authorization, balances, signature validity or canonical state. Endpoints remain stateless regarding durable state. Session affinity or routing is used only when a local cache provides measurable benefit.

11.6 Regions and residency

The initial region is Brazil. European expansion considers databases, objects, backups, logs, keys, support and artificial-intelligence processing. Residency is broader than hosting the primary database in a geography.

11.7 Degraded mode

Dependency failures must not simulate success. Without TL2N, signature requests remain pending. Without an LLM, manual forms remain available. Without object storage, attachments are not accepted as complete. Without a financial operator, payment is unavailable or pending.

12. Security, privacy and compliance

12.1 Privacy by design

The platform processes identities, documents, ownership relationships and risk signals. This requires minimization, purpose limitation, segregation, retention controls, data-subject rights and impact assessments from the design stage.

LGPD and GDPR are cross-cutting requirements. Architecture must distinguish controller, processor, subprocessor and independent entity for each flow. Pre-registrations, fraud detection, automated decisions and external research need their own analysis.

12.2 Encryption

Data is protected in transit and at rest. Keys have rotation, scope, audit and regional segregation. Documents may use keys per tenant, class or object according to risk. Backups and logs follow equivalent protection policies.

12.3 Document vault

Documents remain private by default. The publisher defines explicit and granular sharing, subject to legal bases and competent orders. Integrity proof may be shared without sharing content.

12.4 Contextual authorization

Access combines roles, attributes and relationships. Being an organization administrator does not automatically grant access to every civil identity. Being the current owner does not grant unrestricted access to all historical private documents. Every resource has specific policies.

12.5 Fraud, spam and vandalism

Controls include limits, reputation, review, duplicate detection, merge protection, quarantine, contest procedures, rate limiting and abuse response. Pre-registration cannot become a mechanism for harassment or inappropriate publication of personal data.

12.6 Market compliance

The platform provides workflows and evidence for KYC/KYB, source of funds, source of object, PEP, sanctions, beneficial ownership, cultural property and professional duties. ProvenArc's legal role varies by service and jurisdiction.

In Brazil, activities involving art, antiques, payments, anti-money laundering, consumer rights, copyright and possible participations require specific review. In Europe, GDPR, marketplace rules, payments, AML, cultural property and financial regimes will be assessed by country and activity.

12.7 Artificial-intelligence security

The threat model covers prompt injection, data leakage, compromised models, supply chain, excessive agency, planted sources and incorrect entity resolution. Material executions record model, version, prompt, sources, tools, cost and human decision.

13. Business model

13.1 Recurring revenue

Plans may serve individuals, professionals, organizations and enterprise clients. Differentiators include asset volume, team members, advanced privacy, storage, artificial intelligence processing, integrations, SSO, SLA, reports and compliance.

13.2 Usage revenue

- document processing;
- LLM usage beyond allowance;
- storage and preservation;
- signatures and credentials;
- reports, exports and signed portable records;
- advanced sharing;
- APIs and automation.

13.3 Transaction revenue

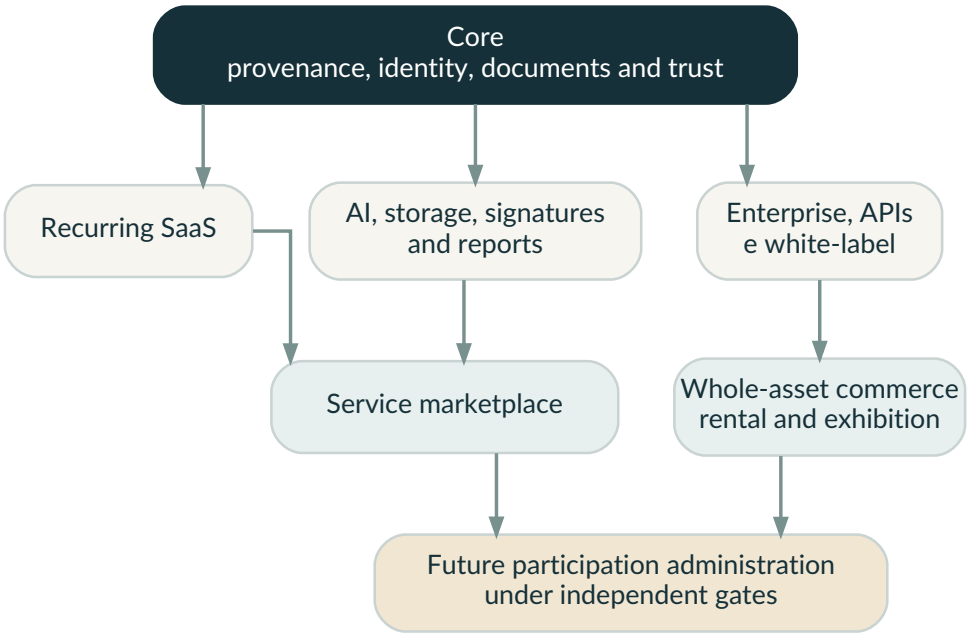
- services commissions;
- whole-asset sales;
- rental and exhibition;
- premium negotiation;
- auctions through an appropriate structure;
- transparent partner referrals.

13.4 Enterprise revenue

Galleries, museums, registrars, insurers, custodians, family offices and companies may purchase multi-user access, imports, integrations, dedicated environments, regional residency, customized policies and white-label deployments.

13.5 Conditional future revenue

Participation administration may include setup, obligation management, voting, transfer, reporting, redemption and financial integration. Total asset value is not revenue. GMV is not revenue either.



Monetization layers

13.6 Economic principles

- payment does not buy verification;
- personal data is not the product;
- each revenue stream belongs to the responsible entity;
- take rate must account for payment cost, fraud, disputes and support;
- unlimited AI usage should not be subsidized by entry plans;
- pricing remains a hypothesis until interviews and pilots.

13.7 Monetization sequence

The proposed order reduces regulatory dependence:

1. profiles, collection management and SaaS;
2. documents, AI, signatures, compliance and portable records;
3. services marketplace;
4. whole-asset commerce;
5. enterprise and APIs;
6. participations, only after the relevant gates.

14. Go-to-market and network effects

14.1 Beachhead

The first segment will be selected through interviews and willingness to pay. Strong hypotheses include independent artists who need cataloguing and sales, professionals seeking presence and qualified leads, and smaller organizations managing collections with generic tools.

The initial objective is not to capture the entire luxury market. It is to validate a repeated workflow that creates value and invites additional actors.

14.2 Artist entry

An artist may begin free of charge or through an accessible plan, publish works and build documentation. The profile creates discovery and commercial surface. As activity increases, potential revenue appears through cataloguing, documents, AI, signatures, services and commerce.

14.3 Professional entry

Specialist professionals join to publish services and participate in events. Each engagement can generate evidence and invite owners, galleries and other participants.

14.4 Organization entry

Galleries, museums, registrars and companies may import collections, manage teams and respond to historical mentions. Enterprise contracts increase recurring revenue and graph quality.

14.5 Pre-registration as invitation, not capture

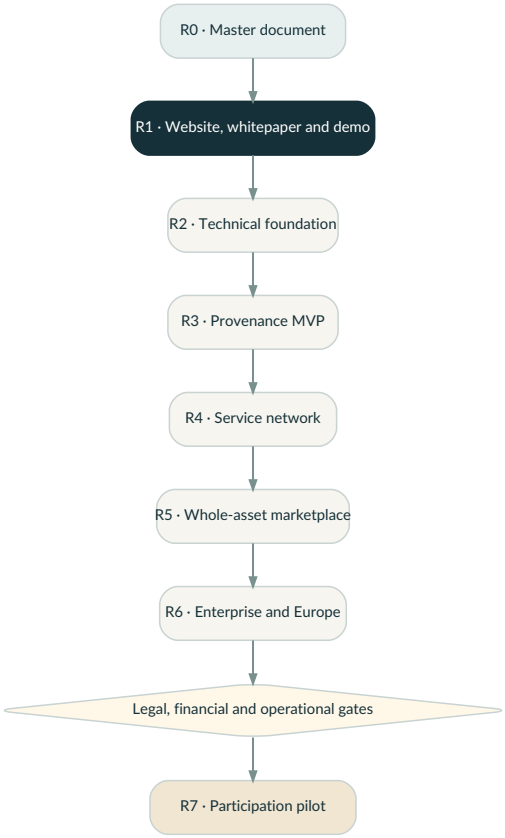
A mention creates an opportunity to claim a profile, but it needs limits. The message must explain why the profile exists, who referenced it, which data is visible and how to contest or remove projections where legally applicable.

14.6 Pilots

Pilots should measure registration time, approval rate for LLM proposals, entity quality, professional adoption, signed events, shared documents, portable records issued, conversion and willingness to pay. Demonstration data is not traction.

The first beta hypothesis involves a confidential Brazilian design partner specializing in art-market registrations and transfers. The scenario demonstrates complementarity: ProvenArc expands digital capacity, imports, APIs, privacy, documents and services without replacing the partner's technical or institutional authority.

15. Roadmap



Roadmap by releases and gates

15.1 Round preparation

The master documentation, bilingual whitepapers, website, demonstrator and private investor kit form the Family & Friends preparation. Materials distinguish implemented capability, prototype, proposal and conditional future.

15.2 Twelve-month execution hypothesis

The reference plan considers twelve months, subject to team, budget, hiring and legal validation:

- **M1-M2:** operational setup, executable architecture, environments, foundational security and discovery with the design partner;
- **M3-M4:** identities, pseudonymity, actors, assets, events, documents and audit;
- **M5-M6:** TL2N signatures, assisted registration, disputes, portable record, staging and beta preparation;
- **M7-M8:** assisted beta launch, controlled imports and close support;
- **M9-M10:** stabilization, operational compliance, metrics, corrections and first paid flows;
- **M11-M12:** pilot maturity, commercial evidence, preparation for scale and decisions on subsequent modules.

The second half continues to include development. A real beta produces corrections, security work, performance improvements and product decisions.

15.3 Later expansions

After the provenance core:

1. professional services network;
2. whole-asset marketplace;
3. enterprise, APIs and European expansion;
4. fractional participations only after legal, financial, operational and communication gates.

15.4 Gates

Each advance depends on observable criteria: security, data quality, authorization, support, contracts, willingness to pay and the ability to operate without making promises inconsistent with the stage of the product.

16. Risks and limits

16.1 Broad scope

The product combines many capabilities. Dispersion is a risk. The roadmap establishes dependencies and keeps fractional participation outside the initial critical path.

16.2 Regulation

Legal characterization depends on the actual activity, not only the contract or corporate entity. Payments, marketplace activity, AML, consumer protection, cultural property and participations may require different structures.

16.3 Privacy and security

Documents and ownership relationships increase the impact of incidents. Encryption reduces risk but does not replace access control, minimization, incident response and governance.

16.4 Artificial intelligence

Models may be wrong, incomplete, biased or manipulated. Human approval and evaluation reduce risk without eliminating failure.

16.5 Network and trust

Pre-registrations may generate disputes. Fake profiles, spam and vandalism may degrade the graph. Growth must be constrained by quality policies.

16.6 TL2N dependency

The relationship with Deep Tech Labs requires licensing, SLA, governance and a continuity plan. An adapter reduces technical coupling but does not eliminate commercial dependency.

16.7 Market and monetization

The thesis still requires interviews, pilots, pricing and conversion evidence. Generic market-size figures do not prove capturable revenue.

16.8 Third-party operations

The platform does not directly control service quality, logistics, storage or authentication. Contracts, evidence and reputation reduce risk but do not automatically make third parties employees or agents of ProvenArc.

17. The Family & Friends round

17.1 Investment object

The opportunity presented is an investment in ProvenArc. It is not an investment in Deep Tech Labs, TL2N, works of art, collectibles or future participations.

17.2 Use of funds

Capital is intended to finance:

- company formation and round documents;
- product validation and interviews;
- design and website;
- demonstrator and bilingual materials;
- technical foundation and MVP;
- security and privacy;
- TL2N integration and formalization of the intellectual-property relationship;
- legal opinions and compliance;
- infrastructure and pilots;
- selective hiring.

Amount, instrument, valuation or cap, rights and governance remain `REDACTED` at this stage. They will be defined in dedicated documents under Alexandre's leadership and with appropriate advisers.

17.3 Progress criteria

The round should reduce risk through evidence:

- published website and bilingual whitepapers;
- navigable demonstrator;
- interviews and letters of interest;
- MVP with a complete vertical slice;
- real pilots;
- first revenue or contract;
- opinions concerning regulated capabilities;
- usage and quality metrics.

17.4 What is not promised

- guaranteed return;
- a fixed deadline for every capability;

- regulatory approval;
- operational fractional participation;
- a closed financial partnership;
- universal validity of signatures;
- guaranteed authentication;
- asset liquidity.

18. Conclusion

The history of an artwork or collectible is built by many people. Current infrastructure places each relationship in a different system or lets information disappear. ProvenArc proposes a common layer for organizing those relationships without centralizing physical activity.

The product begins with basic utility: allowing an artist, collector or organization to register an asset and preserve its history. It grows into documents, signatures, portable records, services, commerce and compliance. More complex financial capability remains separated, progressive and conditional.

The combination of evidence-oriented provenance, layered identity, auditable artificial intelligence, TL2N signatures and a deliberately simple architecture creates a technical foundation that may serve both independent artists and international institutions.

ProvenArc is the digital layer for trust, organization and markets in art and collectibles.
A tool that helps people and professionals meet, document what they know, preserve what they can prove and conduct business without unnecessary public exposure.

Appendix A - Status matrix

Status	Meaning	What it does not mean
`draft`	content remains private or incomplete	registered fact
`unverified`	claim registered without sufficient validation	false
`partially_verified`	specific fields or scopes confirmed	full validation
`verified`	identified and bounded verification	universal truth
`contested`	an active contest exists	claim automatically invalid
`superseded`	a newer record replaces current use	deletion of the former record
`revoked`	signature, credential or statement was revoked	removal from historical trail
`restricted`	visibility is limited by policy	record does not exist

Appendix B - Synthetic example

An artist publishes a painting under an artistic name. The platform creates the asset and a creation event declared by the artist. Private photographs are attached and the record is signed through TL2N.

Two years later, the work appears in an exhibition. The artist describes the event in natural language. The LLM finds the institution and public catalogue, suggests a date and curator and separates the sources. The artist approves the proposal. The event remains unverified by the institution.

The gallery creates an account months later and claims its pre-registration. It confirms that it received and exhibited the work, but makes no statement about authorship. The timeline now displays contextual verification of the exhibition.

A collector buys the work under a pseudonym. Payment is processed by a partner and logistics are contracted directly by the parties. The collector authorizes the gallery to know the identity needed for the contract without publication. The transfer records participants, private documents and signatures.

Later, an external authenticator is engaged. The professional delivers a private report and signs the conclusion. ProvenArc records the service and opinion. The platform does not become the authenticator.

Before a new negotiation, the collector requests a Signed Portable Provenance Record using a counterparty profile. The PDF includes the timeline, pseudonymized graph, manifest and hashes of private evidence. The expert report is embedded only after explicit authorization from its publisher. The buyer validates the package offline and checks online whether a later version exists.

Appendix C - Short glossary

Asset: a registrable work, object, collectible, document, vehicle, file or group. The term does not imply financial classification.

Claim: a statement attributed to an identified actor or process.

Contextual verification: confirmation, rejection or limitation of a claim within an identified scope.

Evidence: material that supports, contradicts or contextualizes a claim.

Fractional participation: a contractual or legal unit of rights and obligations over an asset or vehicle, subject to the applicable structure.

Immutability: preservation of integrity and time evidence without requiring content publication.

Physical custody: material safekeeping performed by a third party.

Pre-registration: representation of an actor who has not yet joined the platform.

Provenance: documented history of origin, relationships, events, possession, custody, exhibitions, interventions and transfers.

Provenance graph: navigable set of actors, assets, events, roles, evidence and relationships.

Pseudonym: a public identity that does not necessarily reveal a civil name.

Signed Portable Provenance Record: versioned PDF snapshot, optionally accompanied by machine-readable data, containing authorized history, a manifest, hashes and signatures.

Appendix D - Selected references

This whitepaper is conceptual and is not a legal opinion. The sources below guide the validation program:

1. Brazil, Law No. 9,610/1998 - Copyright.
2. Brazil, Law No. 13,709/2018 - General Personal Data Protection Law.
3. Brazil, Law No. 9,613/1998 - prevention of money laundering.
4. Brazil, Law No. 6,385/1976 - securities market.
5. Brazilian Securities and Exchange Commission, Guidance Opinion No. 40.
6. Central Bank of Brazil, materials on payment institutions and arrangements.
7. IPHAN, CNART and references for art and antiques dealers and auctioneers.
8. European Union, Regulation (EU) 2016/679 - GDPR.
9. European Union, Regulation (EU) 2020/1503 - European crowdfunding service providers.
10. PostgreSQL, current official documentation.
11. Node.js, official documentation and security practices.
12. OWASP ASVS and security guidance for web applications and LLM systems.

The complete register of URLs, consultation dates and purpose is maintained in `docs/11-research/000-source-register.md`.

Appendix E - Disclosures

- ProvenArc is at an early stage.
- This document describes a vision and proposed architecture.
- Demonstrated capabilities may be simulated.
- The portable record is a proposed capability and does not replace the live graph, expert examination or legal opinion.
- ProvenArc does not perform physical services on assets.
- A verification is contextual and does not equal universal authenticity.
- Public pseudonymity does not eliminate KYC or legal obligations.
- Documents are private by default, subject to authorization and legal bases.
- Fractional participations are a conditional future capability.
- The round offers investment only in ProvenArc.
- Deep Tech Labs and TL2N are separate initiatives; licensing, support, continuity and intellectual property depend on dedicated agreements.
- This document is not a public offering of securities, investment recommendation, promise of return or legal opinion.