TWN

Identity-Native AI Twin Platform

Revolutionizing digital identity through decentralized AI twin technology, enabling secure and seamless interactions across all digital worlds and beyond.

TWN Labs

Identity-Native AI Twin
Platform

Own your data. Operate voice, text, and task flows

twnlabs.com

TWN Labs — White Paper

Identity-Native AI Twin Platform

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TWN Labs leverages on-chain identity to power creator-owned AI twins and agents, with integrated governance and verifiable provenance.

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1) Executive Summary

TWN Labs is an identity-native AI twin platform where each user's AI Twin is anchored by an iNFT (Identity NFT) that cryptographically binds ownership, entitlements, and provenance on-chain. Identity comes first: every twin, agent capability, and transaction is verifiably tied to on-chain identity, ensuring creator sovereignty and transparent attribution. Twins start with

voice, appearance, and persona, and gain policy-gated, opt-in agent capabilities over time. They deploy across web, mobile, social, live broadcast, games, and VR with safety, latency, and auditability baked in. Operations are radically transparent—monthly CSV/JSON reports with checksums, wallet-level distributions, and multisig + timelock controls. Utility-first economics couple subscriptions/APIs and a marketplace with a fair bonding-curve token launch (no whitelist/private sale), with liquidity mechanics aligned to platform graduation. Result: a secure, extensible, verifiable identity-native stack for building, operating, and monetizing creator-owned AI twins.

Foundational principles:

- **User sovereignty:** Twins and agents are creator-owned and verifiably bound to on-chain identity.
- **Fair market design:** Bonding-curve launch; no whitelist or private sale; LP lock/burn designed to improve liquidity resilience and transparency.
- **Radical transparency:** Monthly public reports (CSV/JSON + checksums) including routes, slippage and aims to provide comprehensive tx-hash coverage.
- **Utility-first economics:** Subscriptions, APIs and a marketplace provide sustainable, usage-driven demand.
- **Secure, stable delivery:** A **quarterly** execution cadence with auditable milestones and service levels.

2) Mission, Tagline & Vision

Tagline: *TWN Labs leverages on-chain identity to power creator-owned AI twins and agents, with integrated governance and verifiable provenance.*

Mission: Empower creators and users to build AI twins and agents that reflect their voice, persona and appearance, to **operate safely** across platforms, and to participate in a **fair, transparent** on-chain economy.

Vision: Progressively decentralize into an on-chain governed **ecosystem**—a "virtual state" metaphor—where iNFT (Identity NFT) holders are citizens with rights and responsibilities, rules are explicit and machine-verifiable, and twins/agents interoperate with games, VR/AR, and future metaverse layers. The scope is intentionally open-ended: over time, twins will achieve **full virtual-world integration** while development remains **security- and stability-led**.

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3) Market Context (Why Now?)

- **AI + Identity Convergence:** Generative AI adoption is accelerating, yet user-owned identity and voice/persona portability remain fragmented across platforms.

- **Web3 Foundations, Shallow Behavior Layer:** Identity/NFT solves ownership and transfer, but **behavioral AI** (voice, appearance, persona, agent policy) lacks standardized, secure surfaces.

- **Mobile Wallet Shift:** Native wallets and deep links (UL/Intent) enable mainstream flows on iOS/Android; few stacks provide robust, encrypted, session-safe mobile auth for AI use cases.

- **Performance Expectations:** Real-time AI (TTS/voice clone) and live experiences require **sub-second UX** and predictable latency; high-throughput/finality profiles are well-suited for verifiable interactions.

- **Data Governance Pressure:** Privacy rights and immutable records require clear boundaries: on-chain provenance vs. off-chain personal data controls for AI artifacts.

- **Developer Ergonomics:** Teams need versioned APIs/SDKs, deterministic distribution/reporting, and clear guardrails to integrate

AI+Web3 without bespoke plumbing.

- **Economic Transparency:** Communities expect repeatable, auditable allocation logic (snapshots, carryovers) and operational reporting that is programmatically consumable.
- **Opportunity:** A twins-first platform that standardizes voice/appearance/persona, layers policy-guarded agents, and couples **verifiable ownership** with **transparent, reproducible** economic mechanics.

4) Problem Space & Opportunity

Problems

- Cross-platform identity binding: consistent authentication/authorization across web, mobile, and internal services without brittle client assumptions.
- End-to-end abuse prevention: effective rate limiting, per-resource quotas, and anti-automation controls that protect the platform without degrading UX.
- On-chain provenance is strong, but off-chain AI artifacts (voice samples, generated media) need verifiable linkage and misuse safeguards.
- Real-time AI workloads (TTS/voice clone) face cold-start penalties, GPU contention, and streaming latency; users expect interactive speeds.
- Data governance tension: immutable records vs. user deletion/objection rights for personal data; need clear boundaries for PII and auditability.
- Smart-contract lifecycle: versioning, PDA management, migrations/upgrades, and secure governance controls are complex to operate.
- On-chain ↔ off-chain consistency: deterministic accounting and reconciliation between programs and backend services (snapshots, carryovers, reports).

- Developer ergonomics: versioned APIs/SDKs, deterministic monthly allocations, and reproducible reporting are often missing.
- Security hardening: CSRF/session integrity, signature verification, nonce/expiry, and replay protection must be applied consistently across flows.

Opportunities

- Unified identity & access: purpose-scoped sessions, nonce/expiry challenges, and short-lived intents that work consistently across surfaces without brittle client coupling.
- Rate-limit & anti-abuse platform: layered quotas, IP/device heuristics, and per-capability budgets to protect UX while curbing automation.
- Twin-first architecture: modular persona/voice/appearance with policy-guarded, opt-in capability packs (agents) that expand over time.
- Deterministic accounting: month-end snapshots, carryover tracking, and machine-readable reports for verifiable distributions.
- Anchor operations: opinionated patterns for PDAs, upgrades, and governance controls with minimal operational overhead.
- Production hardening: TLS/HSTS, edge-aware real IP handling, IP allowlisting, rate limiting, CSRF/session integrity, signature verification and replay protection, Redis caching, and structured logging.
- Observability & SLOs: request timing headers, health endpoints, and background cleanup services to keep latency and reliability in check.

5) Product & Experience — TWN Labs Solution

User flow (twins-first)

1. **Create Twin:** Users provide voice samples and persona parameters; the system generates an on-chain iNFT (Identity NFT) representing

ownership. Persona, voice, and appearance modules are configurable and improved over time.

2. **Extend Capabilities (optional):** Users can enable modular capability packs as the platform matures. These are policy-guarded, opt-in, and include human-in-the-loop approvals. Examples include communications assistance and monitoring/notifications. Final categories and scopes evolve with community feedback and safety reviews.

3. **Publish & Monetize:** Users activate subscription tiers, obtain API keys, and list services in the marketplace as features become available. Public dashboards surface usage and earnings. All flows respect safety, privacy, and compliance guardrails.

Developer flow

Developer capabilities evolve progressively alongside platform maturity. Initially, a read-only OpenAPI specification provides access to twin metadata, collection information and transparency data. As the platform advances through Phase 2 and beyond, the API surface expands to include state-changing operations such as twin configuration updates, capability pack activation and subscription management.

Future API capabilities will include metered access to core AI services: voice synthesis and cloning (TTS with custom voice models), visual avatar generation and video rendering for live presence, language model orchestration with prompt generation and model routing, and agent capability invocation with approval-gated actions. These APIs will be introduced progressively as the underlying platform features mature, with clear documentation, usage limits, and transparent pricing for metered endpoints.

- Versioned SDKs and REST endpoints with sandbox keys, rate limits, and error budgets
- Event-driven integrations via webhooks and structured event schemas
- Staging environments and example surfaces for RPC and mobile deep-link flows
- Clear capability scopes and approval gates for state-changing actions

Transparency & operations

- Fair bonding-curve launch; LP lock/burn designed to improve liquidity resilience
- Multisig + timelock for program wallets and parameter changes (via Squads v4)
- Monthly public reporting with wallet-level distributions and machine-readable artifacts (CSV/JSON + checksums)

6) Twins in Action — From Assistants to Virtual Worlds

Twins are the product's core; agent capabilities are optional, modular extensions. Each capability pack is governed by explicit scopes, least-privilege access, auditable actions, and human-in-the-loop controls. Enablement is progressive and guided by safety, performance, and compliance reviews.

Current capabilities (Phase 1)

TWN Labs currently delivers core twin functionality focused on identity and voice:

- **Voice cloning & persona configuration:** Users can clone their voice and define personality traits, creating a personalized AI twin that reflects their communication style.

- **Real-time conversational interaction:** Twins support both voice and text conversations with sub-second latency across web and mobile platforms.
- **iNFT-anchored identity:** Each twin is anchored to an Identity NFT (iNFT), ensuring verifiable ownership and on-chain provenance.
- **Basic twin modules:** Core functionality includes voice synthesis, persona parameters and configurable behavioral guardrails.

Future directions (Phase 2–4)

As the platform matures, additional capabilities will be introduced progressively:

Appearance & visual presence (Phase 2):

- Visual avatar generation: appearance cloning with consent, enabling lifelike video representations.
- Video twins: real-time video interaction with cloned appearance and voice.

Agentic capabilities (Phase 2+):

- Communications assistance: inbox triage, summarization, calendar/task linkage that saves time without taking control away from users.
- Monitoring & notifications: threshold/anomaly alerts across on-chain and app signals to keep users informed.
- Live co-presence: captioning, Q&A cues, and highlight suggestions that enhance streams and community sessions.
- Game/NPC presence: your twin can greet guildmates or deliver quest hints via supported plugins and SDKs—always scoped and permissioned.
- VR co-presence: join a virtual hike with friends and have your twin narrate with your cloned voice through spatial audio.

- Branded activations: social presence and content planning that respect tone and approvals while scaling creator reach.

- Trading assistance: user-configured and approval-gated strategies such as recurring buys and time-sliced execution signals with strict budgets and spend limits; availability may vary by jurisdiction; not financial advice.

How we roll out

- Progressive, opt-in enablement with clear scopes and approvals
- Safety, privacy, and auditability as default settings
- Public dashboards and monthly reports that show adoption and impact

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Anomaly Detection (z-score)

$$z\_t = |x\_t - \mu\_w| \; / \; \sigma\_w \;\; \Rightarrow \;\; \text{alert if } z\_t \geq \tau$$

Sliding window mean μ_w and std σ_w; typical threshold $\tau \in [3,4]$.

7) Achievements to Date (2024–2025)

- **2024 Q4:** Architecture and security baseline; snapshot and distribution rules; DevSecOps environments and observability plan.

- **2025 Q1:** Core application modules; authentication and session management; Anchor project structure and versioning approach.

- **2025 Q2:** Twin Interactions MVP online (voice and text); voice cloning engine v1 integrated; iNFT minting flows wired with Metaplex collections and durable storage; programmable iNFT rules and multisig/timelock configuration established; API security baseline in place.

- **2025 Q3:** Live voice and text experience validated against latency targets; resilience drills and audit readiness completed; direct iNFT mint→publish path verified.

- **2025 Q4 (in progress):** Public access for core platform; direct iNFT mint and publish; monthly snapshot→allocation→direct distribution engine operational (carryover/retry); monitoring/alerts in place; slot/UTC-anchored transparency (CSV/JSON + checksum; site + GitHub mirrors); token launch via fair bonding-curve mechanism with liquidity pool creation and LP lock/burn; public dashboards and monthly reports released.

8) Roadmap Summary

Phase 1 — Foundation (2024–2025)

Q4 2024 — Idea, Concept & Architecture. Establish a lean baseline for 2025 execution: vision/KPIs, high-level architecture (Core Platform, Solana Programs, AI/TTS/LLM, Airdrop/Reporting, Auth), API-first versioning (IDL/PDAs, SemVer), initial token/governance scaffolding (Squads multisig + timelock), model/latency targets and minimal eval, security/privacy baseline (threat model v0, HSM/KMS, WAF/CSP, validation & rate limiting), airdrop transparency format (CSV/JSON + checksum; optional on-chain MEMO), environments + CI/CD and observability plan, ADR index, and a single architecture diagram placeholder.

Q1 2025 — Foundation Kickoff. Platform core (auth/session, API skeleton), Anchor smart-contract architecture (IDL/PDAs/versioning), multisig groundwork, and metadata studies.

Q2 2025 — Programs & AI. Devnet/testnet programs (Locker, iNFT minting, multisig/timelock), programmable iNFT and single-tier "1-account-1-iNFT" rule, 2-of-3 multisig with 2-day timelock, XTTS + 7B–13B LLM endpoints, twin interactions MVP (voice + text; voice cloning v1), Metaplex

collections/verification with Arweave (Bundlr), JWT/rate-limit/validation and baseline WAF/CSP, key/DB/report backups and disaster recovery.

Q3 2025 — Live Features & Operations. Validate "live" voice/text experience and latency/SLOs; run load tests and incident drills; full DR tests; verify direct iNFT mint→publish path; audit-prep artifacts current; Public Site launch (unauthenticated): public-facing site live; TWN Verse browsing (read-only) enabled.

Q4 2025 — Public Launch & Transparency. Finalize security baseline (WAF/CSP, SCA) and launch readiness review; open platform core access, early access to AI features, direct iNFT mint + publish, and initial reports; stand up monthly snapshot→allocation→direct distribution engine (carryover/retry); monitoring/alerts and log policies; slot/UTC-anchored transparency (CSV/JSON + checksum; site + GitHub mirrors); **TWN Token Launch** via fair bonding-curve mechanism with no whitelist or private sale, followed by liquidity pool creation and LP lock/burn designed to improve resilience and transparency; public dashboards and monthly CSV/JSON reports.

Phase 2 — Enhancement (Q1–Q2 2026)

Q1 2026 — Foundation for Growth. Avatar generation (first rollout), appearance cloning v1 (consent/safety; collection-aware UX), LLM orchestration (routing/fallback/eval), subscriptions & API monetization, public docs & SDKs with CSV/JSON exports, OAuth linking for twins to user apps, real-time disclosures over WebSocket (scoped auth/backpressure/replay).

Q2 2026 — Hardening & Expansion. Off-chain early-unlock vote on twnlabs.com (Phase 2) executed via Squads v4 multisig + timelock; rewards model rollout; publish DAO vs Squads scope and complete migration prep; release Authority & Vault Map; enhanced security (SCA, CSP, advanced WAF; private bug-bounty); begin cross-chain research/pilots.

Phase 3 — Expansion (Q3–Q4 2026)

Q3 2026 — Governance Go-Live & Ecosystem. Launch a community-focused DAO (community vault/policies; connect Locker signer where applicable), expand governance/voting surfaces, ship marketplace features and ecosystem integrations, release developer portal & API marketplace (initial), and **mobile app (beta)**.

Q4 2026 — Productization & Compliance. Add compliance surfaces (KYC/AML, transaction monitoring), **mobile app (GA)**, Agentic Modes v1 (opt-in; per-twin scopes/budgets; human approval by default), roll out **custom AI model** (first-party production LLM), and run metaverse integration pilots/SDK hooks.

Phase 4 — Ecosystem (2027+)

Cross-platform twin interoperability; metaverse/VR & games integrations (Unity/Unreal SDKs; NPC twins); spatial-audio/avatar hooks and live co-presence (opt-in, safety-gated); partnered rollouts, creator programs & tooling; cross-platform deep-links and localization; selected **cross-chain** production integrations and wallet/UI compatibility; decentralized identity integrations; global expansion and partnerships.

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Targets & Milestones (Public)

SLOs. Airdrop targeted within 7 days after month-end; transparency report targeted within 7 days; carryovers published and reconciled monthly.
Reliability. <0.1% failed transfers after retries (target) and best-effort comprehensive tx-hash coverage.
Security. Multisig + timelock (via Squads v4) intended to remain active; independent audits before major upgrades (planned). **Governance checkpoint.** Community governance readiness targeted for Phase 2.
Ongoing. Annual + pre-major smart-contract audits; monthly report pipeline and public dashboards operational.

9) Platform & Technology

- **Blockchain:** Deployed initially on Solana, a high-throughput, low-fee L1 with fast finality; portability under evaluation.
- **Identity/NFT:** Standardized NFT protocols, verified collections, on-chain provenance.
- **Storage:** Durable object storage and operational caches for artifacts and metadata.
- **Security:** Multisig and timelock controls, role-based permissions, scheduled audits and reviews.
- **AI:** Voice cloning engine and language model endpoints; orchestration roadmap for multi-provider use.
- **Clients:** Wallet integration surfaces, real-time event delivery, mobile deep-link flows.
- **Infrastructure:** Containerized services behind an application gateway; in-memory caching; rate limiting and CSRF/session integrity; structured logging and observability.

End-to-end latency model

```
L_tot = L_net + L_queue + L_pre + L_inf + L_post
```

Decomposition across network, queuing, pre/post-processing and inference.

Embeddings & Matching — Cosine Similarity

```
sim(q, d) = (q · d) / (||q|| · ||d||)
```

Used for retrieval and (authorized) speaker/identity verification; equals dot-product if normalized.

10) Token Economy (TWN)

10.1 Supply & Parameters

- **Total supply (fixed):** 1,000,000,000 TWN
- **Decimals:** 6
- **Inflation/additional mint:** None

10.2 Launch & Liquidity

- **Bonding-curve** launch; no whitelist/private sale.

- Upon completion of the bonding-curve phase, the project intends to create a liquidity pool and target LP lock/burn designed to improve liquidity resilience and transparency.

10.3 T$_0$ Team Acquisition & Vesting
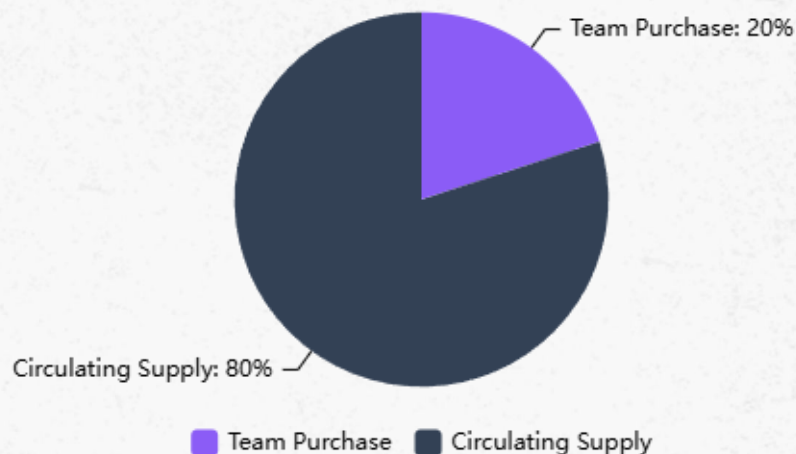
- **T$_0$ acquisition:** At TGE, the team purchases on the public bonding-curve targeting **20% of total supply (200,000,000 TWN)**. Purchased tokens are immediately locked and vest linearly over six months; the vested portion is programmatically routed at the published split — **50% Treasury / 35% Community / 15% Developer**. All addresses and tx-hashes are published in monthly reports; additional policies and disclosures apply.
- **Vesting: 6-month linear**; indicative monthly unlock **≈33.33M TWN**.
- **Monthly allocation of unlocks: 50% Treasury / 35% Community / 15% Developer**.

10.4 Community Distribution — iNFT (Identity NFT) Tiers

- **Rule: 1 account = 1 iNFT** (designed to be enforced by smart contracts and platform policy; best-effort anti-Sybil controls apply).
- **Transferability & Locks:** iNFTs are non-transferable for the first 6 months (immutable program/policy lock). From month 6, an early-unlock

off-chain vote is held among iNFT holders on TWN Labs platform; vote weights respect tier weights (Gold 10, Silver 5, Bronze 1). If early unlock passes, **multisig + timelock** executes the change; otherwise, locks open automatically and immutably at month 12. During the lock period, snapshot-based monthly distribution eligibility remains in effect. Parameters, addresses and vote results/tx-hashes are published in monthly reports.

- **Tier config (immutable weights & caps): Gold (100 @ 5 SOL)**, **Silver (250 @ 2.5 SOL)**, **Bronze (1000 @ 0.5 SOL)**. Weights (**10:5:1**) and caps (**100/250/1000**) are immutable; mint prices may change.

- **Future tiers (policy):** As the platform grows, new tiers may be introduced. Any future tier will respect the established weighting hierarchy and SHALL NOT carry a weight greater than the current core tiers (Gold/Silver/Bronze). The **10:5:1** ordering is preserved; any added tier must have a weight strictly below the next-higher tier so that existing tiers are not diluted.

- **Monthly iNFT distribution budget (vesting period, first 6 months): ≈5.83M TWN** (funded solely from the vesting-derived Community allocation; platform revenues are not used during this period) allocated by price-aligned weights **10:5:1** (Gold:Silver:Bronze). This figure applies only during the 6-month vesting window.

- **Post-vesting (Month 7+):** Distributions continue from **Platform Revenues → TWN** and are therefore variable; there is no fixed nominal monthly amount. The split logic and transparency/reporting remain in effect.

- **Per-twin shares (post-vesting):** Within each tier, distributions are performance-weighted based on transparent usage and outcome metrics (e.g., active users, sessions/minutes, API requests, engagement and retention). Tier weights (**10:5:1**) and caps (**100/250/1000**) remain immutable.

- **Snapshot & Direct Airdrop (monthly):** End-of-month snapshot. **During Months 1–6 (vesting), equal per-wallet** within each tier (deterministic rounding at 1e-6; SOL in lamports = 1e-9 SOL); **carryover** of remainders; **no cross-subsidy** if a tier has N=0. **From Month 7 onward (post-vesting), distributions are performance-weighted within each tier** as above.

10.5 Monthly Revenues → TWN Conversion

- **Source:** Platform NFT mint revenues (SOL).
- **Conversion:** Monthly time-sliced execution and recurring conversions (MEV-aware/private routing when possible).
- **Distribution: 50% Treasury / 35% Community / 15% Developer**; all swaps and tx hashes reported.

## 10.6 Liquidity & Safety

- LP lock/burn per Pump.fun graduation mechanics; multisig; transparent operations; no VC/insider allocations.

10.7 Chain Fees & Operational Notes

- **Distribution: Direct airdrops** (no claim).
- **ATA funding:** We intend to fund required ATAs where feasible; budgets may be adjusted.
- **Fees:** Costs may vary with network conditions.
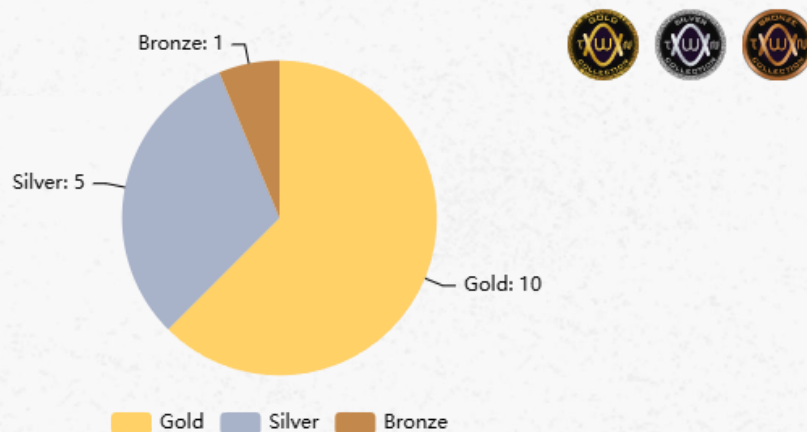
10.8 Post-Vesting (Month 7+)

- After vesting-sourced Community budgets complete, monthly distributions continue from **Platform Revenues → TWN** at the same **50/35/15** split.
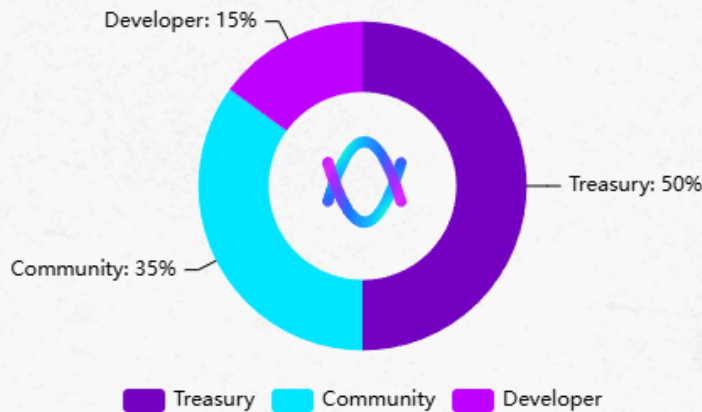
10.9 Eligibility (Snapshot-Based)

- Eligibility is determined at snapshot time; transfers affect the next month.

10.10 Parameter Changes

- Caps and **10:5:1** weights are fixed.
- No future tier may be assigned a weight greater than those of the current core tiers; the **10:5:1** hierarchy is preserved for any additional tiers.
- Other parameters are updated via **multisig**; iNFT identity/transfer policy changes additionally require a **48h timelock**. All changes are forward-dated (never retroactive) and take effect from the next period.

10.11 Reporting (Monthly & Quarterly)

- **Monthly:** Revenues, expenses, swap routes, slippage, full tx hash list, and per-tier carryovers (CSV/JSON + checksums).
- **Quarterly:** Treasury/Community/Developer summaries; revenue breakdowns; distribution overview; security updates; artifacts (PDF + CSV/JSON) and SHA-256.

10.12 Anti-Sybil & Community Rules

- Platform protections against sybil behavior; breaches may result in account termination.
- Misinformation and abusive conduct are prohibited; community respect is a core value.

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11) Governance & Transparency (DAO)

Core Structure

- **Multisig:** Default for all treasury/program wallets and upgrade authority (2-of-3).
- **Timelock:** Applied only to non-spending iNFT identity/transfer controls (see §12).
- **Transparency:** Monthly/quarterly reports; wallet-level distribution; CSV/JSON + checksums.
- **SLAs:** Snapshot/airdrop and monthly report publication target within 7 days.

DAO Vision — a "Virtual State" Metaphor

- **Citizenship:** iNFT-holding wallets; explicit rights/responsibilities.
- **Constitution v0:** Powers, budgets, ethics, transparency rules.
- **Budgeting:** Thematic programs funded from Treasury; annual cycle + in-quarter change proposals.

- **Law/Regulation:** Proposal → vote → enactment (timelock applies only to non-spending iNFT identity/transfer changes; see §12); all actions leave **on-chain traces**.
- **Roles:** Proposers, auditors, technical council, community moderators.
- **Safety:** Multi-threshold protections (quorum, delay, emergency brakes).

Progressive Decentralization

- **2026 Q1–Q2:** Parameter votes (off-chain signal mirrored on-chain); rewards-model refinement.
- **2026 Q3: DAO Go-Live**; proposal/vote/tasking surfaces.
- **2026 Q4+:** DAO influence on product; development funds and bounties.

Quorum & Supermajority (pass rule)

```
W_present / W_total ≥ q  ∧  W_yes / W_present ≥ m
```

Weighted votes (e.g., iNFT citizenship). Example targets: q ∈ [0.2, 0.4], m ∈ [0.60, 0.67].

12) Operational Controls — Multisig & Timelock

Controls

- **Multisig (2-of-3):** All treasury/program wallets and the upgrade authority require 2-of-3 approvals. Any change that moves funds or alters code paths must be co-signed.
- **Timelock (48h / 2 days) — iNFT-only:** Applies only to non-spending iNFT identity/transfer controls (e.g., iNFT transfer-lock early-unlock execution, collection/registry updates, iNFT policy/metadata schema versioning). Flow: propose → queue (timelock) → execute. Effective

from the next snapshot/period; tx hashes are published in the monthly report.

- **No timelock — financial/market operations:** Monthly SOL→TWN conversions (TWAP/DCA), airdrops, LP create/add/rebalance, approved in-budget treasury transfers, and operational payments run without timelock under multisig control. Executions use slippage limits, (where available) MEV-aware/private routing, and route diversification; all tx hashes are disclosed in the monthly report.
- **No timelock — emergency actions:** Immediate non-spending interventions (e.g., emergency-pause/disable, key revocation/rotation) are timelock-free and require multisig.
- **Announcement & effective time (parameters):** Financial parameter changes (e.g., distribution cadence, operational limits) are not timelocked; they are multisig-approved and announced forward-dated (never retroactive) to take effect in the next period.

Rationale

- **Security:** Multisig removes single-key risk on funds and upgrade authority.
- **Transparency where safe:** iNFT rule changes are non-spending; a 48h window provides community visibility without market harm.
- **Market integrity:** Timelocking swaps/LP moves would telegraph intent on-chain, increasing MEV/front-running/price-impact risk; therefore, no timelock.
- **Emergency readiness:** Timelock delays emergency intervention; critical stops must be immediate under multisig.
- **Fairness:** Parameter changes are forward-dated and never retroactive; this preserves snapshot/distribution fairness.

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TWAP Execution — Slippage Guard

```
Buy:    P̄ ≤ (1 + s_max) · P_TWAP
Sell:   P̄ ≥ (1 – s_max) · P_TWAP
```

P̄: VWAP over slices; P_TWAP: time-weighted ref; s_max: max slippage
(%). Reports include P̄, s_max, routes, tx-hashes.

13) Compliance & Legal Framework

- **Token nature: Utility token**; rewards are not investment returns.

- **KYC/AML:** Staged rollout during 2026 as required by jurisdiction.

- **Biometrics & privacy:** Explicit consent for voice/appearance samples; deletion and objection rights. Biometric samples are stored off-chain with explicit consent, regional residency where required, and defined retention/deletion schedules.

- **Regulatory monitoring:** Policies updated as regulations evolve.

- **Jurisdiction & availability:** Feature access may vary by jurisdiction; geofencing and age/identity checks are applied where required.

- **Sanctions & PEP screening:** Sanctions/PEP screening and risk-based customer checks are performed in line with applicable regulations.

- **Transaction monitoring:** Suspicious activity monitoring and reporting (as required) are conducted under documented policies and procedures.

- **Data retention & records:** Retention schedules cover biometric consent and access logs; off-chain personal data supports deletion/objection rights, while on-chain records are immutable.

- **Policy transparency:** Public Acceptable Use, Privacy, Security, and Distribution policies are maintained and updated regularly.

14) Security & Risk Management

- **On-chain:** Program isolation, PDA safety, account validation; multisig + timelock.

- **Application:** OWASP practices; input validation; WAF/CSP; rate-limits; content safety.
- **Infra:** Backups; disaster-recovery drills; observability; configuration management.
- **Audits:** The project expects to commission annual audits and plans pre-major-release reviews; penetration tests.
- **Trading agent risks:** Hard limits, manual approvals, quarantine/suspension; clear disclaimers.
- **Key management & secrets:** Managed key rotation, access separation, and least-privilege controls.
- **Supply-chain integrity:** Dependency governance and verified release artifacts.
- **Edge and origin protection:** Coordinated edge WAF and origin rate limiting; IP allowlisting as needed.
- **Data protection:** Encryption at rest and in transit, PII minimization, and log redaction.
- **Incident response & recovery:** Defined escalation paths, recovery objectives, and immutable backups.
- **Change management:** Dual control for sensitive changes and approval gates for production.

Rate limiting (Token Bucket)

$$T' = \min(C, T_{t-1} + r \cdot \Delta t)$$
$$\text{accept iff } cost(req) \leq T'$$
$$T_t = \max\{ 0, T' - cost(req) \}$$

Capacity C and refill rate r; requests admitted iff tokens cover their cost, else rejected/deferred.

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15) Privacy & Data Approach

- **Scope boundaries:** On-chain records are immutable and used for provenance; off-chain personal data (including biometrics) is governed by privacy controls and subject rights.

- **Data minimization:** Collect only what is necessary; prefer pseudonymization and redaction for logs and analytics.

- **Explicit consent (biometrics):** Clear consent for voice/appearance samples with revoke mechanisms; withdrawal stops future processing and triggers applicable off-chain deletion workflows.

- **Retention schedules:** Published schedules for off-chain data, aligned with reporting/audit cycles; on-chain pointers/metadata may be updated where appropriate.

- **Transparency:** Document data flows and all third-party processors; publish processor list and policy updates.

- **Access & controls:** Role-based access, least-privilege permissions, encryption in transit and at rest.

- **Data subject rights:** Access/export/correction/deletion for off-chain personal data within defined timelines.

- **Regional considerations:** Where required, data residency and localization are honored; geofencing may apply.

- **Incident response:** Privacy incidents follow documented escalation and notification procedures.

16) Business Model & Revenue Streams

Primary

- **Subscriptions (usage-based):** Revenue accrues from actual usage of twins and enabled capability packs.
  - Twin interactions: conversational sessions, voice/playback minutes, notifications delivered.

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- Agent enablement: approved actions, monitored channels, automation runs under defined budgets/limits.
- Notes: Usage signals drive creator recognition (rewards-based), not profit sharing; tiering/packages are introduced progressively.

- **APIs (metered):** Programmatic access to AI capabilities and media.
  - Speech: text-to-speech generations, streaming minutes, and voice cloning workflows.
  - Models: base model API usage and third-party model orchestration (pass-through + platform fee where applicable).
  - Visuals & presence: cloned appearance via API for live presence or video rendering; compliant data flows.
  - Pricing: per-feature schedules published by TWN Labs to ensure fair, transparent service delivery.

- **Marketplace:** Platform-native listings and sales tied to ownership and capability.
  - iNFT primary sales; secondary royalties per policy.
  - Agent capability packs and templates; usage-gated add-ons.
  - Service offerings powered by twins (e.g., session bundles, content packs).

Secondary

- Partnerships and integrations; developer add-on economy; enterprise enablement and compliance-aligned deployments.

Pricing principles

- Usage-based model with transparent metering and billing. Tiering and packages will be introduced progressively. Creator recognition is rewards-based and driven by usage signals of their twins; it does not constitute profit sharing.

17) Metrics & KPIs

All targets are non-binding and tracked on monthly/quarterly cadences; see Legal Notice & Disclaimers.

- **Product:** Active twins/agents, retention, subscription conversion; latency/error budgets with p95/p99 tracking.
- **Economy:** Monthly revenues → TWN conversion, 50/35/15 distributions, per-tier carryovers; reconciliation completeness.
- **Community:** iNFT distribution by tier, participation per wallet, engagement indicators.
- **Developers:** API request volume, success rate and throttling ratio; integrations; SDK downloads/contributions.
- **Agents:** Approved-action rate, budget-exceed events (downward trend), monitored channel coverage.
- **Creator recognition:** Usage-driven recognition indices for twins (rewards-based; not profit sharing).
- **Security & compliance:** Incident counts and time-to-closure; audit finding closure timelines.
- **Transparency:** Report timeliness vs target; tx-hash coverage; published audit/pen-test summaries.
- **Privacy-safe analytics:** Aggregated and pseudonymized reporting; no personal data in KPI artifacts.

ASR Quality — Word Error Rate (WER)

$$WER = (S + D + I) / N$$

S=substitutions, D=deletions, I=insertions over N reference tokens; tracks speech accuracy.

18) Real-World Use Cases

Examples below are indicative. Availability is phased per the roadmap (opt-in, approval-gated) and may vary by jurisdiction.

- **Creators (Podcast/Video):** 24/7 Q&A, premium tiers, sponsor segments, highlight/clip drafting.
- **Education/Institutions:** after-hours tutoring twin, LMS integrations, institution-grade licensing.
- **Branded activations:** voice/appearance activations, community quests, usage-gated campaigns.
- **Games/NPC presence:** twins make characters feel "alive"; player Q&A and event guidance via APIs.
- **Monitoring & notifications:** threshold/anomaly alerts across on-chain and app signals to keep users informed.
- **Live co-presence & community:** live captioning, Q&A cues, highlight suggestions; community events.
- **Trading assistance:** user-configured recurring buys and time-sliced execution signals with approval gates and strict budgets/limits; availability may vary by jurisdiction; not financial advice.
- **Communications:** email/social classification, summarization, drafting; multi-platform scheduling and moderation.
- **Support & commerce:** FAQ deflection, ticket enrichment, order/subscription lookups; privacy-first data handling.
- **Knowledge & search:** citation-backed search/answers over authorized corpora; RAG pipelines.
- **Developer operations:** notifications, runbook guidance, and approved actions.
- **Analytics & reporting:** periodic KPI digests and campaign snapshots; privacy-safe metrics.

- **VR/metaverse co-presence:** spatial-audio narration and event co-presence; phased rollout with safety and maturity.
- **Marketplace:** iNFT primary sales; secondary royalty flows; twin/agent-powered service bundles.

19) Go-to-Market & Partnerships

- **Early adopters:** Creators, education, gaming and live-streaming verticals.
- **Community channels:** Discord, X; monthly report announcements and public dashboards; developer challenges.
- **Partnerships:** Wallet ecosystems, digital marketplaces, model providers, and data oracle networks.
- **Growth loops:** Quest-based rewards, bounties, hackathons.
- **Launch communications:** Align announcements with core public access and token launch milestones; reference public dashboards and monthly reports; avoid investment claims.
- **Phased access:** Waitlist/beta cohorts (opt-in, approval-gated), then broader access as safety and performance benchmarks are met.
- **Developer program:** Time SDKs/docs and OAuth availability per roadmap; provide sample apps and integration guides.
- **Compliance guardrails:** Regional availability and legal/marketing review before co-marketing; partner due diligence.
- **Measurement (non-binding):** Track conversion to activation, retention, and partner integration counts in aggregate, privacy-safe form.

20) Community & Developer Ecosystem

- **Equitable design:** 1 account = 1 iNFT (enforced by smart contracts and platform policy).

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- **Developer support:** Versioned SDKs and reference apps with roadmap-aligned guides; sandbox keys and example integrations (webhooks, staging flows).
- **Community programs:** Developer challenges, quests and bounties aligned with growth loops; add-on economy for creators and developers.
- **Transparency culture:** Wallet-level distributions; public dashboards and monthly reports.
- **Feedback & governance inputs:** Community feedback informs category/scoping; off-chain signals mirrored on-chain per the governance roadmap.
- **Policy & safety:** Community guidelines and anti-sybil protections enforced per policy.

21) Operational Model (SRE, Observability, Reporting)

- **Observability & alerts:** End-to-end coverage for snapshot/distribution/reporting jobs; request-timing headers and health endpoints.
- **Logging:** Rotation/retention, structured logs, anomaly detection, and clear escalation paths.
- **Background services:** Scheduled cleanup and maintenance jobs with monitoring and safe rollbacks.
- **Incident response:** Error budgets, RCA, post-mortem publication discipline, and on-call escalation aligned to recovery objectives.
- **Change management:** Runbooks and dual control for sensitive changes; approval gates for production.
- **Reporting pipeline:** Timeliness tracked against non-binding targets; public dashboards and monthly reports.
- **Privacy-safe telemetry:** Aggregated/pseudonymized metrics; data minimization by default.

Latency SLO (p95)

$$Pr[\ L\_tot \le T\ ] = 0.95$$

Evaluated over a defined window; violations consume error budget.

Model Server Capacity (QPS)

$$QPS\_max \approx C\ /\ (\bar{t}\_pre + \bar{t}\_inf + \bar{t}\_post)$$

C is number of concurrent workers (GPU/CPU threads). Theoretical peak QPS from average service time components; for stability ensure $\lambda <$ QPS_max.

22) FAQ

- **Is there a whitelist?** No—everyone participates on the bonding-curve.
- **How do I receive airdrops?** End-of-month snapshot → **direct to wallet** (no claim).
- **When governance?** Parameter votes in 2026; **DAO Go-Live** targeted for 2026 Q3.
- **What is the token utility?** Platform usage, payments/incentives for subscriptions and integrations; community reward mechanics.
- **How do I enable agent capabilities?** Opt-in only; sensitive actions are approval-gated with strict budgets/limits.
- **How is my data handled?** On-chain records are immutable; off-chain personal data supports subject rights. See Privacy & Data Approach.
- **Where can I track progress?** Public dashboards and monthly reports; quarterly summaries as scheduled.

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23) Glossary

- **Airdrop:** A direct token distribution to eligible wallets; no claim step required.
- **AI Twin:** A user-owned digital identity with voice/appearance/persona modules.
- **Agent:** Optional, modular capability packs that perform scoped, approval-gated actions.
- **Approval-gated:** Sensitive actions must be confirmed by the user at execution time.
- **ATA (Associated Token Account):** A wallet's standard token account for a specific token mint.
- **Bonding-curve:** A price mechanism where token price changes algorithmically with supply.
- **Carryover:** Unallocated remainder amounts that roll forward to the next period within the same tier.
- **DAO (Decentralized Autonomous Organization):** Community governance structure with on-chain proposals and votes.
- **Human-in-the-loop:** User approvals or reviews required for sensitive actions.
- **iNFT (Identity NFT):** In TWN Labs, iNFTs also embody intelligent capabilities (AI-enhanced twin modules/behaviors governed by on-chain policy); "intelligent" is a property of the asset, not part of the acronym's expansion. Generally, iNFT may refer to NFTs augmented with AI/metadata enabling interactive or autonomous behaviors while serving as a durable identity/provenance record.
- **KPI:** Key Performance Indicator; tracked in aggregate, privacy-safe form.
- **KYC/AML:** Know-Your-Customer and Anti-Money-Laundering processes, applied where required by law.
- **L1 (Layer 1):** Base blockchain layer providing consensus, data availability, and settlement.

- **LLM (Large Language Model):** A generative model used for text understanding and generation; exposed via endpoints and orchestrated across providers and local models.
- **LP (Liquidity Pool):** A pool of assets enabling on-chain swaps; may be subject to lock/burn mechanics.
- **MEV (Maximal Extractable Value):** Value extractable by transaction reordering; routing aims to minimize its impact.
- **Multisig:** Multiple signatures required to approve an action or transaction.
- **OAuth:** An authorization standard enabling secure delegated access to user resources.
- **On-chain provenance:** Verifiable ownership/history recorded on a blockchain.
- **Oracle:** A service that relays external data to on-chain programs.
- **PDA (Program-Derived Address):** Deterministic on-chain address generated from seeds and a program for secure account mapping.
- **RAG (Retrieval-Augmented Generation):** A pattern that retrieves facts from authorized corpora and feeds them to a model to produce citation-backed answers.
- **Recurring buys:** Buying a fixed value/quantity at regular intervals (usage-based strategy).
- **SDK (Software Development Kit):** Software Development Kit is versioned client tools for integrations.
- **SLA/SLO:** Service Level Agreement/Objective; targets for reliability and latency (non-binding in this document).
- **Snapshot:** A recorded state at a specific block/slot/time used for distribution eligibility.
- **TGE (Token Generation Event):** The token's initial issuance/launch moment; the bonding-curve start time.

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- **Time-sliced execution:** Splitting an order into equal parts over a time window to approach the time-weighted price.
- **Timelock:** A delay applied to on-chain actions/changes before execution.
- **TTS (Text-to-Speech):** Synthesizing speech from text, including cloned voice generation and streaming playback.
- **TWAP/DCA:** Time-weighted/periodic dollar-cost averaging execution used to reduce price impact and MEV risk.
- **Webhook:** An HTTP callback for event-driven integrations.

24) Conclusion

TWN Labs unites **AI Twins & Agents** with **on-chain ownership and governance** to create a sustainable, transparent and creator-centric economy. Our quarterly roadmap, utility-first token mechanics and progressive decentralization plan establish a pragmatic path from today's live features to tomorrow's VR/metaverse integrations. We will keep building with security and stability at the core—expanding scope as the ecosystem matures and the community's voice grows stronger.

25) Legal Notice & Disclaimers

- Targets and timelines in this document are non-binding and may change based on technical, market, or regulatory conditions.

- Tx-hash coverage, reliability metrics, and service-level timings are best-effort and subject to network conditions.

- References to third-party platforms (e.g., Pump.fun, PumpSwap, Raydium, Arweave, Squads) reflect their current mechanics and may change without notice.

- Security reviews and audits are planned activities; scope and cadence may vary.

- Enforcement mechanisms (e.g., 1-account-1-iNFT, anti-Sybil) combine smart contracts and platform policies and cannot guarantee the absence of abuse.

- Key/wallet responsibility: Keys and wallets are your responsibility; lost private keys and unauthorized on-chain transactions are generally irreversible and cannot be recovered by TWN Labs.

- Smart-contract/MEV/network risk: On-chain transactions may fail, be reordered (MEV), or execute with slippage; transactions are typically final and non-reversible once confirmed.

- Age/eligibility: Access may require that you are of legal age and otherwise eligible under local law; availability varies by jurisdiction.

- Brand/IP notice: Third-party marks and names are used for identification only and are the property of their respective owners.

- No fiduciary duty; no guarantee of listing/liquidity or price performance.

- Jurisdictional restrictions: Availability is subject to applicable law; offerings are not available where prohibited.

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