An Autonomous Agentic Internet

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Abstract

The internet is being rebuilt for machines: autonomous intelligent agents operating and transacting continuously. To enable agents to transact with the throughput, latency, and security required, we present Unicity, a new blockchain architecture that eliminates the shared ledger/validator construct of previous blockchain designs. On-chain state is reduced to the minimum necessary to prove uniqueness of off-chain transactions. Assets are self-authenticating cryptographic objects, that live off-chain and move peer-to-peer without intermediary validation. This eliminates the fundamental bottlenecks of traditional designs: throughput becomes unconstrained, execution parallelizes without limit, and privacy is preserved by default. On this foundation, we construct the Autonomous Agentic Internet, a decentralized platform for the discovery, orchestration and execution of autonomous agents, with safety, explainability and verifiability by design.

TL;DR

- **Blockchain:** Reduced to the minimum necessary to prove the absence of double spending. RandomX Proof of Work, BFT finality. No transactions, no mempool, no wallets. 2.4 hour block times (<1MB state/year). Root of trust for layers below and native currency genesis.
- **Uniqueness Oracle:** Public permissionless infrastructure maintaining an append-only sharded Sparse Merkle Tree (SMT). Users send cryptographic digests of transactions and are returned proofs of inclusion (transactions have been recorded) and proofs of exclusion (transactions have not been recorded before). The SMT is anchored in the blockchain, built hierarchically and operates in rounds. A recursive ZK prover is used to prove consistency of the SMT.
- **Tokens:** Verifiable state. Self-contained ledgers of individual assets that are minted directly off-chain or detached from other blockchains. To execute a transaction, a payor will send a transaction request to the uniqueness oracle and receive back an inclusion proof which is appended to the token. The payor then sends the updated token directly to the payee. Similar to physical cash in that only the payee is responsible for verification.
- **Verifiable Agents:** The power of smart contracts without the bottleneck of shared state. Tokens are conditionally transferred to agents which execute and re-distribute tokens with proofs of execution and uniqueness. Unlike smart contracts bound to a single chain, agents are portable runtime-agnostic entities that can migrate between execution environments while maintaining cryptographic continuity.
- **Intelligent Agents:** Agents augmented with inference for intent interpretation, planning, and adaptive behavior. The verifiable execution environment ensures cryptographic verifiability while inference enables natural language interaction and autonomous decision-making. Probabilistic inference is constrained by strictly typed program graphs (neuro-symbolic logic) ensuring every decision, connection, and outcome is explainable, traceable, precise, and verifiable.
- **Agentic Internet:** A decentralized platform for autonomous agent operations. Agents can be developed, deployed, discovered, and orchestrated without centralized gatekeepers. Protocol agnostic P2P transport. Decentralized storage where agents carry state in tokens rather than host filesystems. Integrated micro-payments and infrastructure marketplace for storage, compute, bandwidth, and proving services.

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Introduction

The Agentic Economy

AI agents are becoming autonomous economic actors. Today they operate within human workflows — writing code, executing trades, managing documents on command. The trajectory points toward full autonomy: agents that operate continuously, making decisions and taking actions without human oversight.

Autonomous economic actors face two fundamental challenges.

The first is transactional. Autonomous agents need infrastructure to transact and cooperate without trusted intermediaries. Traditional rails cannot serve them: banks require human authorization, payment processors reverse transactions, contracts require courts. Autonomous agents cannot rely on reputation, legal recourse, or human judgment to resolve disputes. They need infrastructure where correctness is guaranteed cryptographically — where agreements execute according to mathematical rules rather than institutional permission.

The second is behavioral. Autonomous agents making decisions with economic consequences: trading, allocating resources, entering contracts must be trustworthy. Counterparties need assurance that agent behavior is correct, explainable, and bounded. A trading agent that hallucinates a price, a supply chain agent that fabricates a supplier, a governance agent that misinterprets a proposal — each can cause real economic harm. Agents operating without human oversight require architectural guarantees that their decisions are verifiable and their actions are constrained to declared capabilities.

Blockchains are a solution to enabling trustless transactons: permissionless networks where agents transact without gatekeepers and enforce agreements through smart contracts rather than legal systems. But every blockchain since Bitcoin implements these properties through a shared ledger — a public record maintained by validators who must process, order, and witness every transaction. For humans who transact infrequently and tolerate friction, this works. For autonomous agents requiring continuous transactions at scale, immediate finality, and privacy from observers, it does not.

Neuro-symbolic AI has emerged to address the behavioral challenge. By combining neural networks with symbolic reasoning, neuro-symbolic systems constrain probabilistic inference within formal logical structures. Neural components handle perception and natural language — tasks where statistical learning excels. Symbolic components handle reasoning and execution, tasks requiring precision, consistency, and explainability. The approach enables AI systems that generalize like neural networks while remaining verifiable like traditional software. But neuro-symbolic AI alone does not solve the infrastructure problem: verifiable agents still need a way to transact, hold assets, and prove their behavior to counterparties at scale.

What is missing is an architecture that addresses both challenges together. Transaction infrastructure that operates at machine scale without trusted intermediaries, combined with execution infrastructure that makes agent behavior cryptographically verifiable.

Architecture Overview

This paper introduces Unicity, an architecture built on two foundations.

Unicity Blockchain solves the transactional challenge. By eliminating the shared ledger entirely, Unicity enables peer-to-peer value transfer without intermediary validation. Assets become self-contained cryptographic objects that move directly between parties, verified by recipients alone. There is no validator set processing transactions, no mempool exposing pending operations, no public ledger recording the exchange. The result is unlimited throughput, immediate finality, and privacy by default.

Neuro-Symbolic Execution solves the behavioral challenge. By separating neural interpretation from symbolic execution, Unicity constrains agent behavior to typed, deterministic operations. Neural components handle intent, parsing natural language, identifying relevant actions. Symbolic components handle execution, type-checked operations with cryptographic proofs of correctness. The result is intelligent agents whose decisions are explainable, whose actions are bounded to declared capabilities, and whose outputs carry cryptographic proof that execution followed the rules.

Together, these foundations enable the Autonomous Agentic Internet: a decentralized platform where agents transact at scale with privacy, and where counterparties verify agent behavior without trusting the agent or its operator.

The architecture is presented in three parts:

Part I: Blockchain introduces the Unicity blockchain. A new design that reduces on-chain state to the minimum necessary to prove uniqueness of off-chain transactions. Assets move peer-to-peer as self-contained cryptographic objects, verified by recipients alone.

Part II: Agentic Infrastructure describes the computational entities that operate on this foundation. Tokens, Verifiable Agents, and AI Agents, along with platform services including the Neuro-Symbolic Orchestrator, peer-to-peer transport, decentralized storage, and micropayments.

Part III: Applications demonstrates decentralized applications built on this infrastructure: finance, commerce, and gaming.

A note on terminology: Within the AI community, "agent" has come to mean an LLM with tool-calling capabilities. We use both this and the traditional computer science definition. Verifiable Agents are autonomous computational entities in the traditional sense with cryptographic execution guarantees. Intelligent Agents extend Verifiable Agents with LLM inference — the modern sense. Both can hold tokens, transact, and cooperate autonomously. The terms are used interchangeably except where the distinction matters.

Part I

Unicity Blockchain

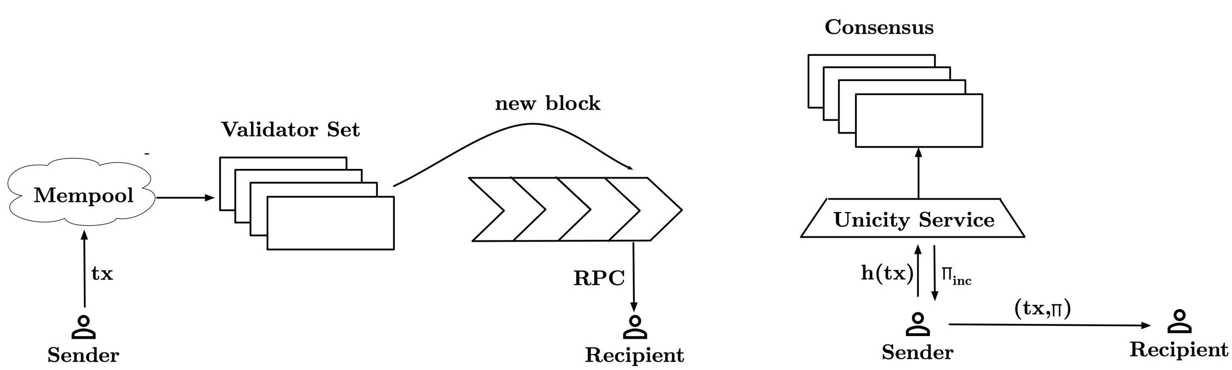
1 A Non-Shared-Ledger Blockchain

Satoshi's whitepaper was titled "Bitcoin: A Peer-to-Peer Electronic Cash System." Seventeen years later, we have neither. Not peer-to-peer: every transaction must pass through miners/validators[1]. Not cash: every transaction is recorded on a public ledger. Physical cash is self-contained, transferable directly between parties, verified by the recipient alone. No third party processes the transaction or records it in a ledger. Blockchains have replaced trusted institutions with decentralized validators, but the fundamental model remains unchanged: a set of intermediaries who see every transaction, process every transfer, and maintain a ledger on behalf of participants.

The validator set operating on a shared ledger is also the fundamental bottleneck through which all economic activity must flow. Throughput is limited by what validators can process. Latency is determined by how fast validators reach consensus. Privacy is challenging when validators see every transaction. Fees emerge from competition for validator attention. Censorship becomes possible because validators choose what to include.

This is true for all Layer 1 implementations. Bitcoin, Ethereum, Solana, Sui, Monad, and every other major blockchain maintain a single shared ledger. Each optimizes for different points across the decentralization-security-scalability tradeoff space, yet all remain constrained by the same fundamental architecture: a shared ledger managed by validators.

Proposed optimizations reproduce this model at different scales. Layer 2 solutions move execution off-chain but route transactions through centralized sequencers who see, order and periodically settle to the L1. Sidechains create separate ledgers with their own validator sets. Sharding partitions state but maintains validators within each shard.



Transaction flow of a shared ledger blockchain **Transaction flow of Unicity**

Figure 1: Transaction Flows

Unicity is an attempt to eliminate these constraints by enabling true peer-to-peer value transfer without

[1] And only a tiny minority or participants are downloading multi-TB chain state for independent verification.

intermediary validation. Like physical cash, assets in Unicity are self-contained cryptographic objects that can be validated independently by their recipients. Transactions occur directly between parties without broadcasting to a network, waiting for consensus, or paying gas fees. The recipient bears responsibility for validation — examining the cryptographic proofs embedded within the asset itself — just as one might verify a physical banknote's authenticity. The blockchain's role is minimized to providing cryptographic proof of uniqueness, ensuring these independent assets cannot be double-spent as they traverse the network directly between parties.

This fundamental shift from "assets on a ledger" to "assets as independent entities" enables true peer-to-peer transfer without any shared state infrastructure. Each asset can move, be validated, and execute logic completely independently of all other assets in the system. Parallelization becomes unlimited not because execution is separated from consensus, but because there is no shared state to coordinate at all — each asset operates in its own computational space, interacting with others only when explicitly required by application logic.

The result is an architecture that combines the desirable properties of both physical cash and distributed ledgers: the simplicity and finality of bilateral exchange, the privacy of direct transfer, the efficiency of parallel execution, and — when needed — the composability and coordination of shared state (through agents). This design philosophy directly addresses the requirements of machine-scale economies, where billions of autonomous agents must transact continuously without the friction of global coordination.

2 Blockchain Architecture

Unicity implements a hierarchical architecture designed to minimize on-chain overhead while maintaining the security guarantees of a permissionless blockchain. The system separates concerns across three distinct layers, each optimized for its specific function.

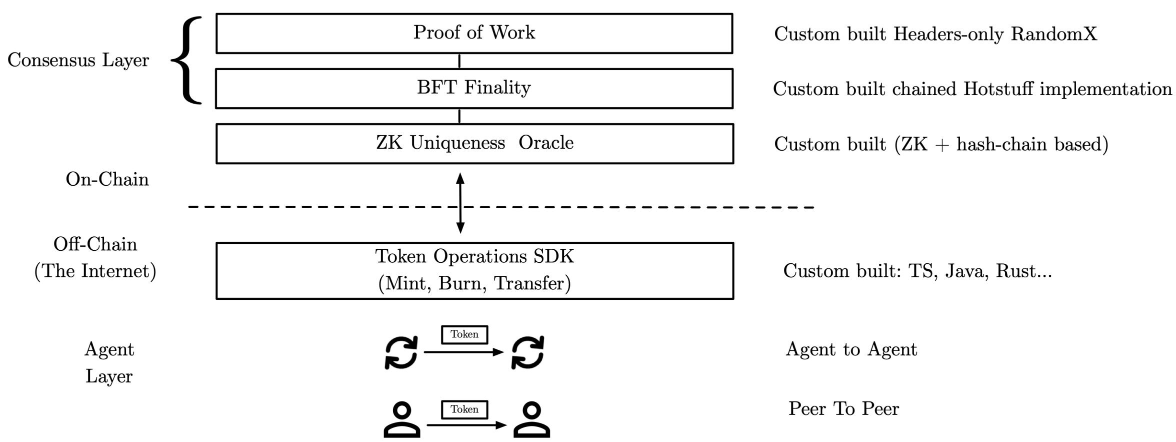


Figure 2: Unicity's layered infrastructure

The Consensus Layer provides the system's root of trust through a minimal "headers only" Proof of Work blockchain.

The Uniqueness Oracle represents Unicity's core innovation: a mechanism for proving that off-chain assets have not been double-spent without recording the transactions themselves. This layer generates cryptographic proofs — unicity proofs — that certify the non-existence of conflicting transactions for any given asset. These proofs are anchored to the Consensus Layer's timeline but do not require recording transaction details on-chain.

At the agent layer, tokens exist as independent cryptographic objects, functioning as independent blockchains. A token carries its complete validation rules, state, and transaction history within itself. The Uniqueness Oracle ensures these independent chains cannot fork, while the Proof of Work consensus provides the same trust model as Bitcoin — recipients can independently verify ownership with zero trust assumptions. Assets move peer-to-peer across the network, requiring no global coordination or shared ledger for transfer.

Agents serve as Unicity's equivalent to smart contracts. Agents receive tokens from users or other agents, redistribute ownership based on application logic and generate a proof of correct execution.

2.1 Hierarchical Efficiency

This hierarchical design achieves optimal efficiency through careful separation of concerns. Security and decentralization flow downward from the Proof of Work consensus layer, providing a trusted foundation for all operations below. Meanwhile, the volume of data flowing upward is minimized — only cryptographic proofs of uniqueness need to be anchored to the consensus layer, not the transactions themselves. Table 1 illustrates how this architecture distributes computational and storage overhead across layers, enabling the system to support machine-scale transaction volumes while maintaining the security properties of a permissionless blockchain.

Tokens are self-contained; no external blockchain needs to be consulted for validation. Validation is the responsibility of the transaction's recipient — the party with a direct interest in its validity — who is also responsible for their own token storage.

Table 1: Unicity's layers, their roles and decentralization overhead

Layer	**Responsibility**	**Secured by**	**Persistent Storage**	**Redundancy**	**Validation Effort**
Consensus: PoW	Decentralization & tokenomics	Permissionless PoW	200 B/day	PoW mining	Tokenomics
Consensus: BFT	Fast, deterministic finality	↑	100 B/day	$\approx 21\times$	Uniqueness Oracle's consistency proofs
Uniqueness Oracle	Recording token state transitions	↑	50 B/tx	Few replicas	Proof generation
Token Operations	User transactions	↑ & recipients	Own tokens	Recipients	Relevant transactions

3 Consensus Layer Implementation

Proof of Work remains unsurpassed as means to launch a fault tolerant decentralized censorship resistant network. It ties the security of the system to a physical quantity (energy) and enables tokens to be fairly and transparently distributed without human oversight.

To prevent centralization of mining power, new ASIC-resistant hash functions have been developed, of which RandomX represents the state of the art, having been battle-tested in Monero, a privacy preserving cryptocurrency. Unlike Bitcoin's SHA-256 algorithm, RandomX is designed to be ASIC-resistant and CPU-friendly, leveling the playing field and helping maintain a decentralized network of miners. This democratization not only improves network security through wider participation but also upholds the original Bitcoin vision as a decentralized financial system accessible to all. RandomX works by generating random code for each mining round, including a variety of CPU instructions, memory-hard operations and random code execution that can be efficiently performed by general-purpose processors but are challenging

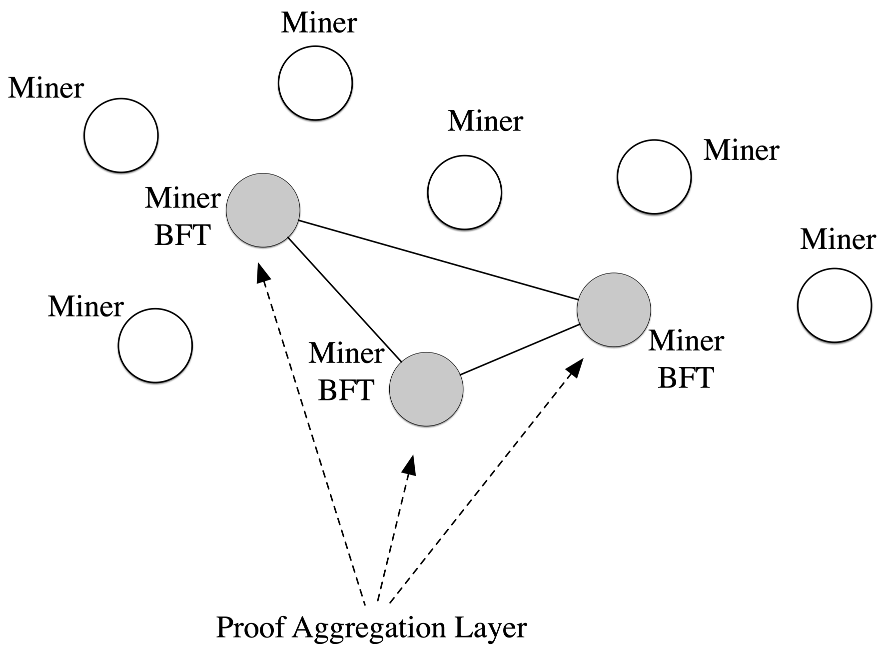


Figure 3: Consensus Layer with Proof of Work trust anchor

to optimize in hardware. This ensures that CPUs remain competitive in mining, preserving the network's decentralization and resistance to the concentration of mining power.

4 Uniqueness Oracle Implementation

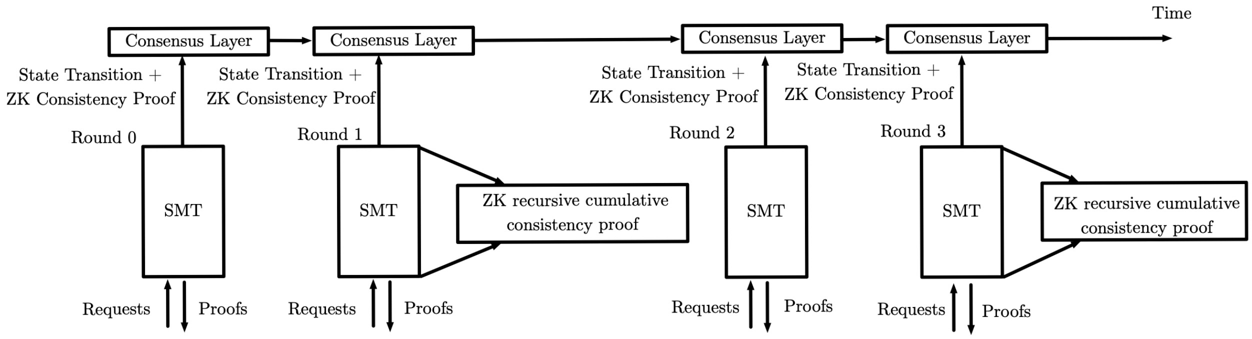


Figure 4: Uniqueness Oracle

A Sparse Merkle Tree (SMT) is used such that each unique state transition request from the agent layer is allocated a leaf node in the tree. The SMT is updated in rounds with a batch of state transition requests per round. In each round the SMT state root is calculated, a ZK SMT consistency proof[2] generated and the SMT state transition (previous SMT state root, new SMT state root, ZK SMT consistency proof) is passed to the Consensus Layer. The validators in the Consensus Layer authenticate the request and verify the ZK SMT consistency proof, and then commit to the new SMT root and return a certificate, or cryptographic proof of acceptance of the valid change. After that only requests from the SMT which update the new state root can be accepted.

In a hierarchical trustless system, the principle is that the base layer provides decentralization, while the layers below it present cryptographic proofs of the correctness of their operation. In scaling Unicity, we have designed efficient data structures to prove the correctness of operation of the Uniqueness Oracle to the Consensus Layer. Based on cryptographic hashes alone, the consistency proof grows linearly with respect to the number of user transactions. This imposes a hard limit of approx. 10 000 transactions per second (tx/s), beyond which the networking bandwidth of the Consensus Layer becomes the bottleneck.

To scale further, we use cryptographic zero-knowledge proofs (ZKPs) to compress the size of the consistency proofs. As an application of ZKPs, this use-case is fundamentally more efficient than using ZKPs to process the transaction data itself, as is done in many privacy coins and ZK-rollups.

10 000 tx/s *per shard* represents the proving throughput achievable on a single consumer-class computer. Due to the small proof size and efficient verification, the Consensus Layer can support a practically unlimited number of such trustless shards. Table 2 compares different ZKP technologies. We have picked subjectively the most appropriate ZK schemes and supporting front-ends ("stacks"). See the bluepaper[3] for full technical details.

The Uniqueness Oracle is built in a hierarchical manner using smaller size SMT sub-trees. An Aggregator, or machine that operates a sub-tree is algorithmically assigned a place in the overall infrastructure according to network demand. Aggregators are incentivized to join the network based on transaction fees that are shared across the Aggregator pool. The infrastructure is designed to be highly redundant and parallelizable i.e., the tree can be dynamically sub-divided into sub-trees which operate asynchronously in parallel with redundancy provided by multiple Aggregators processing the same sub-tree.

The Uniqueness Oracle delivers three kinds of proofs to its clients: inclusion proofs, exclusion proofs, and Unicity proofs.

[2]This proves that no previously recorded state transitions were modified or removed during the round.
[3]`https://github.com/unicitynetwork/aggr-layer-paper/releases`

Table 2: Comparison of zero-knowledge proof technologies for compression of non-deletion proofs

ZK Stack	**Hash Function**	**Proving Speed (tx/s)**	**Proof Size**	**Proof Size Asymptotics**	**Trusted Setup**	**Impl. Effort**
None ("hash based")	SHA-256	10 000*	10 MB	$O(n)$	No	N/A
CIRCOM + Groth16	Poseidon	25	250 b	$O(1)$	Yes	Lower
Gnark + Groth16	Poseidon	30	250 b	$O(1)$	Yes	Low
SP1 zkVM	SHA-256	1.5	2 MB	$O(\log n)$	No	Lowest
Cairo 0 + STwo	Poseidon2	60†	2.4 MB	$O(\log n)$	No	Medium
AIR + Plonky3	Poseidon2	10 000	1.7 MB	$O(\log n)$	No	High
AIR + Plonky3	Poseidon2	2500	0.7 MB	$O(\log n)$	No	High
AIR + Plonky3	Blake3	250	1.7 MB	$O(\log n)$	No	High

* Bandwidth-limited, no verification effort reduction.
† Trace generation before proving is impractically slow.

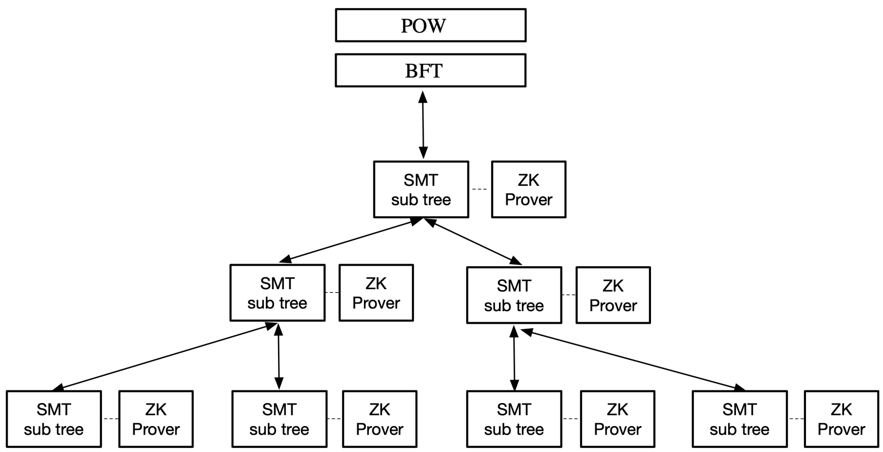


Figure 5: Hierarchical infrastructure

4.1 Inclusion Proofs

An inclusion proof allows the recipient to verify that a specific leaf of the SMT contains a specific value. In Unicity, an inclusion proof shows that a transaction has been registered and another transaction spending the same state will not be accepted (thus preventing double-spending the state). This is achieved by having the state spent by the transaction uniquely determine the location of the corresponding leaf in the SMT and storing a cryptographic commitment of the transaction as the value of the leaf. Since the SMT in Unicity is append-only, an inclusion proof, once issued, remains valid eternally.

4.2 Exclusion Proofs

An exclusion proof (sometimes also called a non-inclusion proof) allows the recipient to verify that a specific leaf is not present in the SMT. Since spending a state is recorded in a deterministic location in the SMT, the absence of a leaf at that location means the corresponding state has not been spent. However, unlike inclusion proofs, exclusion proofs are only valid for the time when they were generated, because in the future, a transaction may spend the state.

4.3 Unicity Proofs

Unicity Proofs are not generated by the Uniqueness Oracle. Instead, they are generated by the Consensus Layer and merely relayed to clients by the Uniqueness Oracle. Their purpose is to certify that the current state of the SMT in the Uniqueness Oracle is the most recent one in the one and only continuous history of valid updates to the SMT. In other words, they certify that there are no alternative versions of the SMT (where some states might have been spent by different transactions).

Each inclusion or exclusion proof generated by the Uniqueness Oracle is accompanied by a Unicity Proof certifying the validity of the state of the SMT from which the inclusion/exclusion proof was extracted.

5 Token Operations

The State Transition SDK[4] allows the integration of token operations (mint, burn, transfer) into off-chain applications.

5.1 Mint: Chain Agnostic "Detached" Assets

There are three different types of assets that can be minted using the Unicity State Transition SDK:

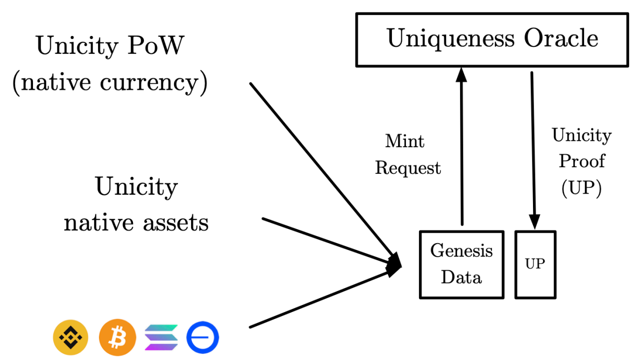


Figure 6: Chain agnostic token genesis

a) The Unicity native currency mined through Proof of Work and migrated off-chain for transacting. This is done by the miner who originally won the block reward as recorded in the Proof of Work header. The miner can then mint a token by creating an off-chain genesis transaction.

b) Native assets i.e., those whose genesis event occurs off-chain and does not depend on an external reference. This can be trivially minted by defining the genesis data of the token and generating a unicity proof for the genesis transaction.

c) Tokens from external chains. The exact steps depend on the capabilities of the source blockchain, specifically, the programmability and the efficiency of ZK proof verification ("cryptographic builtins"). The Unicity infrastructure does not have to know anything about the source blockchain and does not have to validate blocks. The validation is performed by the recipients of the token transactions. The State Transition SDK allows users to plug in local validation of source blockchain's headers, typically as a light client, or by the

[4]https://github.com/unicitynetwork/state-transition-sdk

use of a trusted RPC node. Token type meta-data and verification code is available to transaction recipients. Elective token history compression by out-of-band ZK prover merges this check into one recursive ZK proof. If the origin blockchain does not support contract verification (e.g., Bitcoin) then a committee-based approach with economic security must be used.

5.2 Transfer

The transfer functionality of the SDK allows a user to conditionally or unconditionally transfer tokens.

A transfer of a token off-chain from Buyer to Seller as a payment for some goods is shown in Figure 7:

- The Buyer creates a transaction that authorizes[5] transfer to the recipient.
- The Buyer sends the state transition request to the Unicity infrastructure which will return a unicity proof. The proof certifies that the state transition is unique i.e., it has not happened before.
- The Buyer then sends the updated token (the orginal token + transaction + unicity proof) to the Seller.
- The Seller verifies the token (the history of transactions and unicity proofs) and releases the goods.

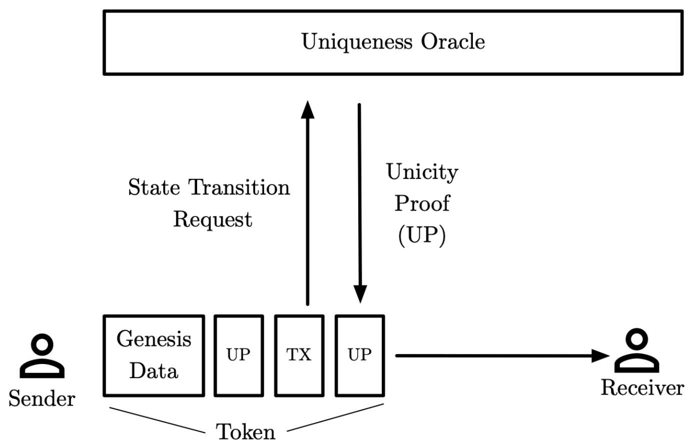


Figure 7: Regular transaction flow with Unicity Proof generated before the transfer

To reduce latency, an extension of the protocol for high frequency trading is as shown in Figure 8:

- The Buyer produces the transaction that authorizes transfer to the Seller.
- The Buyer sends the token + transaction to the Seller.
- The Seller generates the state transition request, sends it to the Uniqueness Oracle, and receives back an immediate exclusion proof: a confirmation that this state transition has not been registered before and is now scheduled to be registered.
- The Seller releases the goods.
- Finally, the Seller waits (approximately two seconds) for the inclusion proof before the received token can be added to usable inventory.

Provided that participants have sufficient inventory of tokens for the two-second latency, extreme volumes of high frequency transactions can be achieved.

[5] By satisfying the unlocking condition, such as providing a digital signature.

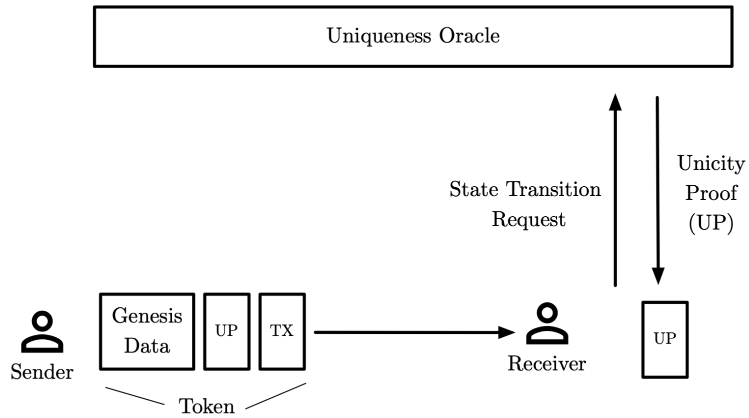


Figure 8: Low-latency transaction flow with proof of inclusion after the transfer

6 Agents as Smart Contracts

Traditional smart contracts rely on globally shared state. All assets and application logic exist in a single state machine replicated across validators. Any contract can read or write any other contract's state, and all state is visible to all participants.

Agents provide equivalent functionality in Unicity without global shared state. The underlying mechanism used is *predicates*[6], generalized ownership conditions that define when a token can be transferred.

- **Simple ownership:** In its simplest form, a token owned by a single public key requires a valid signature to transfer.
- **Conditional ownership:** Predicates generalize ownership to arbitrary logical conditions. These include multi-signature requirements (all of n keys must sign), threshold signatures (k-of-n keys), time-locks (the token cannot be transferred before time τ), and hash-locks (the token can be transferred by anyone who knows a particular secret).
- **Agent-locked tokens:** Participants can lock tokens to an agent using predicates that release only when the agent provides valid execution proofs. In this arrangement, the agent becomes a temporary custodian whose actions are constrained by cryptographically enforced rules.

Using these primitives, a multi-agent application that operates on multiple tokens (the equivalent of a smart contract shared state) operates as follows:

1. **Lock:** Participants transfer their tokens to agents, attaching predicates that define the conditions under which the tokens may be released.
2. **Execute:** The agents execute application logic over the locked tokens — matching orders, resolving game state, or computing payouts according to the application's rules.
3. **Prove:** The agent generates cryptographic proofs demonstrating that execution followed the agreed rules.
4. **Release:** Output tokens are released to participants, with each token carrying the execution proof. The predicates ensure that release can only occur when valid proofs are presented.

[6]For a detailed description of predicates along with privacy and security proofs, see `https://github.com/unicitynetwork/unicity-predicates-tex/releases`

Privacy follows naturally from this architecture: state is shared only among the participants in a given interaction, rather than being broadcast to validators or replicated across the network. A trade between two parties reveals nothing to the rest of the system.

Atomic swaps illustrate the pattern clearly. Two parties can exchange tokens without trusting each other by using interlocking predicates that guarantee either both transfers complete or neither does. Correctness is enforced entirely by the predicates, without custodial intermediaries or global state.

6.1 Example: Decentralized Exchange

A decentralized exchange built on this model matches buyers and sellers without holding custody of assets or maintaining global order books. The exchange agent coordinates trades, while predicates enforce correct settlement.

Order submission: Suppose Alice wants to sell 100 ALPHA tokens for 50 BETA. She creates a token locked to the exchange agent with a predicate specifying two release conditions: the token returns to Alice's key if the order is cancelled, or it releases to any counterparty who provides both a valid matched-order proof and 50 BETA tokens.

Order matching: Bob wants to buy ALPHA tokens using his BETA. He submits a matching order — 50 BETA locked with symmetric predicates. The exchange agent identifies that these orders are compatible.

Settlement: The agent executes the swap atomically through a series of steps:

1. The agent receives both locked tokens from Alice and Bob.
2. The agent verifies that the predicates are compatible and that the orders match on price and quantity.
3. The agent generates an execution proof attesting that "Alice's 100 ALPHA was matched with Bob's 50 BETA at the agreed price."
4. The agent creates the output tokens: 100 ALPHA now owned by Bob, and 50 BETA now owned by Alice.
5. The output tokens include the execution proof, and the predicates ensure that settlement is atomic — either both transfers succeed or neither does.

This construction achieves several important properties:

- **No custody risk:** The agent never has unilateral control over the tokens. Predicates enforce that tokens can only move according to the rules agreed upon by the participants.
- **No global order book:** Order state exists only within the locked tokens themselves. The agent matches orders as they arrive but does not maintain any persistent global state.
- **Privacy:** Only Alice, Bob, and the agent observe the trade. No validators witness the transaction, and no public ledger records the exchange.
- **Atomic settlement:** The interlocking predicates ensure that both sides of the trade settle together. There is no counterparty risk — neither party can be left holding worthless commitments.
- **Parallel execution:** Every trade is independent of every other trade. A thousand trading pairs can execute simultaneously without contention for shared resources.

This pattern generalizes naturally to any application requiring coordination among multiple parties. Lending protocols can lock collateral with predicates that trigger liquidation under specified conditions. Games can lock player stakes with predicates tied to outcome determination. Auctions can lock bids with predicates that release funds based on winner selection. In each case, the agent provides the coordination logic, while predicates provide cryptographic enforcement of the rules.

7 Trade-Offs and Comparison

As there is no shared global state there are no globally synchronized state-dependent operations such as flash loans or MEV.

Unlike traditional blockchains, there is no public global ledger of asset ownership and, unless additional steps are taken, the ownership history of a token cannot be traced. For regulated financial markets it is necessary to introduce additional proofs into the token history for KYC/AML procedures, ensuring compliant transfers at each step.

Traditional blockchains rely on users trusting a validator set who verify computation on the user's behalf. In a client-side model, the user verifies incoming transactions. This approach enhances privacy and censorship resistance by eliminating reliance on third-party validators for direct transaction validation. The client's core task is the deterministic verification of these network-anchored proofs and the token's internal consistency, a focused process designed for security and efficiency.

Table 3: Comparison of Unicity and Shared Ledger blockchains

Property	**Shared Ledger**	**Unicity**
Throughput	Bottlenecked by block size and validator limitations	Unlimited parallelization
Fee Model	Congestion requires dynamic gas markets	Static (microcent/tx)
Verifiability	Validators (global and public; on-chain only)	Clients (local and private; off-chain)
Privacy	All transactions visible to all participants; privacy requires additional cryptography	Transactions visible only to parties involved; private by default
Atomicity	Global atomic operations possible (flash loans, MEV)	No global atomicity; local settlement between parties
Composability	Universal; any contract can read-write any other contract's state	On-demand; parties explicitly coordinate and verify interactions

8 Trust Models

There are effectively two trust models in Unicity. One is the maximalist zero trust Bitcoin model and the other is a more practical "trust an honest majority of validators" seen in today's Proof of Stake chains. The Uniqueness Oracle is always trustless, as its outputs carry the proof of correct execution and there are no feasible attacks beyond denial of service.

8.1 Maximalist Trust Model

In the maximalist model, we assume that users are capable of validating all aspects of system operation that are relevant to their own assets. This level of trustlessness is close to the strong guarantees introduced by Bitcoin, where each "client" functions as a full validator, downloading and verifying the blockchain from the genesis block. The Root of Trust is the PoW blockchain. A maximalist user maintains a full node of this chain. Because there are no user transactions, this is relatively lightweight, growing at less than 1 MB a year.

Upon receiving a token, the user must be able to efficiently verify the following:

1. The token is valid.
2. The Uniqueness Oracle has not forked.
3. The Uniqueness Oracle has not certified conflicting states of the same token.

The second point is addressed by validating a unique state root snapshot embedded in the PoW block header. Since the cumulative state snapshot appears with a delay, the block can only be considered final after a snapshot publishing and block confirmation period; hence, maximalist verification is not instantaneous.

The third point is addressed by auditing the operation of the Uniqueness Oracle, specifically, ensuring that no inclusion proofs have been generated for the token that are not reflected in its recorded history. To achieve this, all non-deletion proofs from the token's genesis up to its current state must be validated. This is made efficient through the use of recursive zero-knowledge proofs (ZKPs), which show that each round's non-deletion proof is valid and that no rounds were skipped from verification. These recursive proofs are generated periodically and are made available with some latency.

8.2 Practical Trust Model

If we relax the model by assuming that a majority of BFT consensus nodes exhibit economically rational behavior and do not collude maliciously with the operators of the Uniqueness Oracle, the user can enjoy significantly more practical operational parameters. BFT layer forking (case 2 above) or certifying conflicting states (case 3 above) produces strong cryptographic evidence (enables slashing and other after-the-fact measures) which is processed out of the critical path of serving users.

In this scenario, a transaction is finalized, and an inclusion proof is returned within a few seconds, allowing the transaction to be immediately verified by independent, non-connected parties.

Part II

Autonomous Agentic Infrastructure

The Unicity blockchain provides cryptographic proof of uniqueness for off-chain state transitions. This part describes the computational infrastructure built on that foundation: the entities that execute, the platform services that support them, and the economic mechanisms that sustain the ecosystem.

Verifiable Agents are independent computational entities with verifiable execution. They extend tokens with the ability to act autonomously while maintaining cryptographic guarantees equivalent to on-chain smart contracts.

Intelligent Agents extend Verifiable Agents with AI inference. They combine cryptographic verifiability with neural capabilities for intent interpretation, planning, and adaptive behavior.

Platform Services provide the infrastructure agents need to operate: peer-to-peer transport, decentralized storage, A2A micropayments and Verifiable Execution Environments.

The Agent Economy describes how agents transact for resources through micro-payments and how infrastructure providers earn native currency through the marketplace.

Together, these components form the Autonomous Agentic Internet: a decentralized platform where agents can be developed, deployed, discovered, and orchestrated without centralized gatekeepers.

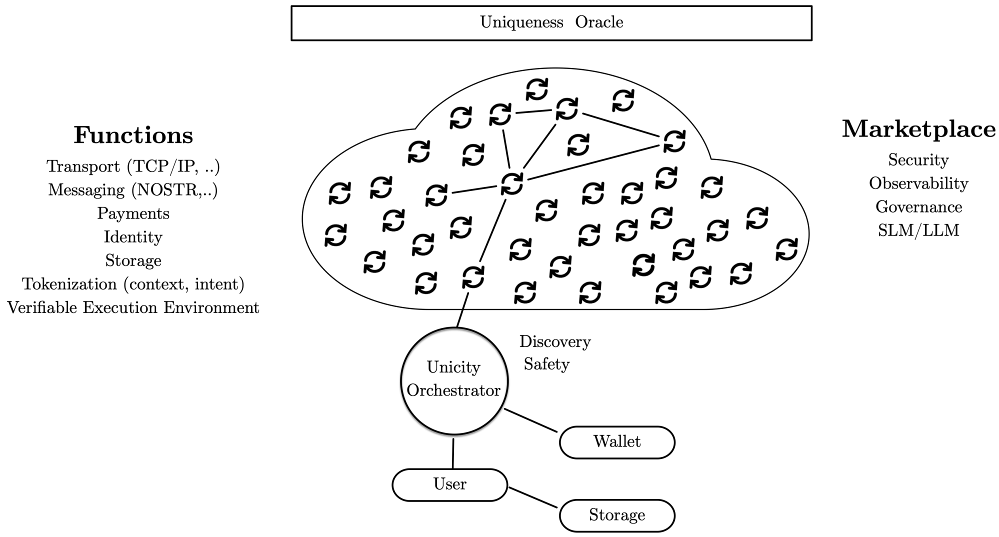


Figure 9: Autonomous Agentic Internet with User Orchestrator

1 Decoupling Logic from Infrastructure

In the current Web2 cloud paradigm, applications are tightly coupled to specific vendors, physical locations, and IP addresses. Migrating a service requires complex reconfiguration of networking, storage, and security parameters. The Agentic Internet inverts this model by prioritizing the *Agent* as an independent, mobile, and agnostic computational entity. An Agent in Unicity is defined by its cryptographic identity and its verification logic, not by the server it runs on. This enables several critical properties:

- **Location Agnosticism:** Agents address each other via self-authenticated IDs rather than IP addresses. An agent can physically migrate from a server in London to a laptop in Tokyo without interrupting its ability to communicate or transact.
- **Censorship Resistance:** Because agents are self-contained and mobile, they cannot be easily shut down by targeting a specific physical location or hosting provider. If a host becomes unavailable or hostile, the agent can be instantiated elsewhere, resuming execution from its last verifiable state (verifiable through the state being tokenized).
- **Trustless Execution:** The separation of the *Execute* and *Verify* functions allows agents to run on untrusted hardware. A host provides CPU cycles and storage, but the correctness of the computation is mathematically proven by the agent and verified by the recipient.

2 Verifiable Execution

A Verifiable Agent is an independent, uniquely addressable, self-authenticated computational entity capable of autonomous action. Execution is deterministic and anchored by Unicity Proofs such that no alternative execution history can exist. Verifiable Agents are runtime-agnostic and mobile, able to migrate between execution environments while maintaining cryptographic continuity.

The key property is verifiable execution: any party can confirm that a state transition occurred correctly without trusting the execution environment. Unicity is agnostic to how this verification is achieved. Different applications will choose different mechanisms based on their requirements.

2.1 Verification Mechanisms

Table 4: Verification mechanisms for Verifiable Execution

Mechanism	**How it works**	**Trust assumption**	**Cost**
Re-execution	Verifier re-runs computation, confirms result	Deterministic runtime	Compute = prover
Zero-knowledge proof	Prover generates succinct proof of correctness	Cryptographic	High prover, low verifier
Fraud proof	Assume correct, challenge if wrong	One honest watcher	Low unless disputed
TEE attestation	Hardware attests execution in secure enclave	Hardware manufacturer	Low
Validator committee	Committee attests to correct execution	Honest majority	Coordination overhead

Re-execution is the simplest model. The Verifiable Agent defines an execution function and a verification function. The recipient re-runs the computation and confirms the result matches. This is equivalent to smart contract verification but without requiring all validators to re-execute — only the recipient verifies, because only the recipient has economic interest in correctness.

Zero-knowledge proofs enable verification without re-execution. The prover generates a succinct proof that the computation was performed correctly. The verifier checks the proof at a fraction of the original computation cost. This suits complex computations where re-execution is expensive.

Fraud proofs invert the model: execution is assumed correct unless challenged. A watcher can submit a fraud proof demonstrating incorrect execution, triggering penalties. This optimistic approach minimizes verification cost in the common case.

TEE attestation relies on trusted hardware. A Trusted Execution Environment (Intel SGX, ARM TrustZone) attests that specific code executed in a secure enclave. The verifier trusts the hardware manufacturer's attestation rather than re-executing.

Validator committees provide verification through consensus. A set of validators independently execute and attest to correctness. This reintroduces coordination overhead but may be appropriate for certain applications.

2.2 Choosing a Verification Model

The appropriate mechanism depends on application requirements:

- **Simple token transfers**: Re-execution. Verification is trivial.
- **Complex financial logic**: ZK proofs. Expensive computation, cheap verification.
- **High-frequency trading**: Fraud proofs. Minimize latency, penalize cheaters.
- **AI inference**: TEE attestation.

Unicity infrastructure does not mandate a verification mechanism. The Uniqueness Oracle records state transitions regardless of how they are verified. The verification logic is embedded in the agent itself, allowing different applications to use different verification mechanisms within the same ecosystem. This flexibility is essential for the Agentic Internet, where different agents will have different verification requirements based on their computational complexity and latency constraints.

3 The Agentic Runtime Architecture

To enable this mobility, agents operate within a standardized **Agentic Runtime**. This runtime acts as an abstraction layer, sandwiching the agent between the raw infrastructure and the Unicity network.

1. **Executable Instance (The Agent):** Technically, an agent is a sandboxed computation (e.g., a Docker container or VM) that exposes two core procedures:
   - `Execute(state, input)` → `new_state`: The logic defining state transitions.
   - `Verify(state, input, new_state)` → `Boolean`: The logic allowing third parties to validate transitions.
2. **Host-Independent Storage:** Agents do not rely on a host's local file system for persistence. Instead, the runtime interfaces with decentralized storage layers to pin and retrieve Unicity tokens. These tokens effectively act as the agent's hard drive, carrying its state history and assets in a portable, verifiable format.
3. **Overlay Transport Network:** Communication is handled via a circuit-switched overlay network. The runtime manages a Distributed Hash Table (DHT) or similar resolution service to map Agent IDs to physical entry points (e.g., URLs or relays). This allows agents to utilize any underlying transport protocol without altering the agent's internal logic.
4. **Secure Key Management:** Since hosts are generally untrusted, the runtime integrates with Hardware Security Modules (HSM) or Trusted Execution Environments (TEE). Cryptographic keys used for signing state transitions never leave the secure enclave, ensuring that the host operator cannot impersonate the agent.

4 The Infrastructure Marketplace

The Agentic Internet creates a new peer-to-peer market for physical infrastructure. Individuals and organizations can participate as infrastructure providers, earning Unicity native currency by offering specific resources:

- **Compute Hosts:** Running agent runtimes (Docker/VM containers).
- **Relay Nodes:** Providing bandwidth and routing for the overlay network.
- **Bridge Agents:** Acting as gateways between the Agentic Internet and the legacy Web2 world (e.g., serving a standard HTTP website backed by a set of decentralized agents).

This structure ensures that Unicity functions as a complete, self-sustaining ecosystem. It is not just a ledger for recording value, but a distributed computer where the logic of the machine economy lives, breathes, and transacts.

5 Extending Verifiability to AI Agents

Traditional formal verification operates over deterministic, symbolic systems — proofs about code, protocols, and state machines. But as AI agents become participants in economic and computational infrastructure, verification must extend into domains where intent is ambiguous, schemas are incomplete, and execution paths emerge dynamically. Neuro-symbolic logic bridges this gap by embedding symbolic structures — types, rules, and constraints — into continuous vector spaces where neural models can generalize across similar concepts while symbolic reasoning enforces hard guarantees. The Neuro-Symbolic Orchestrator is Unicity's instantiation of this principle: it combines neural embedding models with deterministic symbolic reasoning to translate user or agent intent into concrete, type-safe operations over a heterogeneous ecosystem of agent services. Rather than relying on LLMs to infer schemas or mediate execution flows — with their attendant hallucination risks — the orchestrator maintains a unified semantic space of all known tools, types, and services, alongside a typed knowledge graph encoding compatibility, dataflow constraints, and historical usage patterns. This hybrid architecture allows the system to generalize when encountering novel requests while still producing reliable, reproducible, and verifiable execution plans — extending the trust guarantees of Unicity's cryptographic layer up through the agentic reasoning stack.

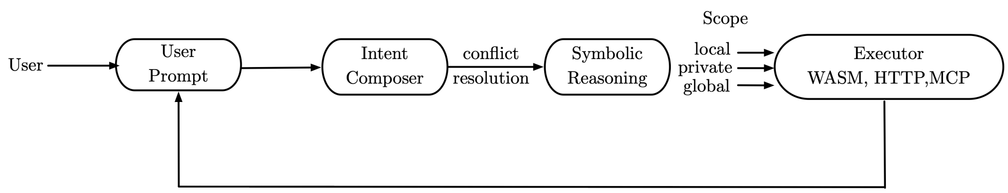


Figure 10: Neuro-Symbolic Orchestrator

A central challenge in a decentralized agent environment is that tools are independently authored and exposed by different service providers, each with its own capabilities and schemas. The orchestrator resolves this fragmentation through neuro-symbolic interpretation:

- **Semantic Intent Mapping:** The orchestrator embeds the incoming natural-language request and retrieves semantically relevant agent tools, ranked by vector similarity and augmented by graph constraints.
- **Type-Safe Symbolic Planning:** Candidate tools are filtered through the knowledge graph, ensuring input/output compatibility. Symbolic rules guide the construction of multi-step workflows that satisfy the intended transformation or task.
- **Deterministic Execution:** Once a plan is finalized, the orchestrator executes each agent call deterministically, enforcing strict argument schemas and producing verifiable state transitions and proofs. Neural components are not used during execution, only during interpretation.

This architecture creates a form of "loose coupling" across agent services: developers do not manually integrate or design adapters for every service provider. Instead, they expose capabilities through agents, and the orchestrator autonomously determines how to compose, route, and sequence them to satisfy user intent. The result is a scalable, interoperable ecosystem where complex behavior emerges from neuro-symbolic reasoning over a shared tool universe, rather than brittle point-to-point integrations.

Part III

Example Applications

1 Agentic DeFi

Part I established that Unicity restores Satoshi's original vision: assets as self-contained cryptographic objects that move peer-to-peer, verified by recipients alone, with no validators witnessing transactions and no shared ledger recording them. This section examines what this architecture enables for decentralized finance.

1.1 Properties

Traditional DeFi inherits the limitations of shared-ledger blockchains. Transactions flow through validators who see, order, and record every trade. Privacy requires additional cryptography. Throughput is bounded by block space. Censorship is possible at the validator level.

Unicity's architecture eliminates these constraints:

- **True decentralization:** No validator set processes transactions. No sequencer orders them. Trades execute peer-to-peer between counterparties, coordinated by agents but settled directly.
- **Censorship resistance:** There is no mempool to monitor, no block producer to bribe, and no validator to pressure. A trade between two willing parties cannot be stopped by any third party.
- **Unlimited throughput:** Every trade is independent. There is no shared state to contend for, no block space to compete over. A million trades can settle simultaneously without interference.
- **Privacy by default:** Only the counterparties observe a trade. No public ledger records the exchange. No chain analysis can trace the flow of funds. Privacy is not an add-on requiring expensive cryptography — it is the default.

1.2 Comparison with Existing Solutions

Table 5 compares Unicity's approach to existing trading infrastructure across decentralization and privacy dimensions.

Table 5: Comparison of trading infrastructure

Platform	**Structural Problem**	**Privacy Issues**	**Unicity Advantage**
AMM DEXs	Slippage, MEV, front-running	Pending txs visible in mempool; trade size/price on-chain forever; wallet history fully traceable	Intent-based matching; no visible mempool; transactions are private and do not move the market
CEXs	Counterparty risk, KYC, withdrawal limits	Full KYC required; exchange sees all orders; data breaches expose history; government subpoenas	Trustless, self-custodial; no KYC; no central database; only counterparty knows terms
OTC Desks	Trust required, manual, slow, high fees	Desk sees both sides; employees can front-run; records kept indefinitely; minimum sizes exclude retail	Automated, trustless, lower cost; no intermediary sees terms; any size; instant settlement
Intent Protocols	Ethereum-centric, solver centralization	Solvers see full order details; solver can extract value; settlement visible on-chain	Cross-chain native; no solver sees plaintext; truly decentralized matching; private settlement
Dark Pools	Institutional only, custodial, limited pairs	Orders hidden from market but operator sees everything	Same order privacy without custody risk or KYC
P2P Platforms	Slow, scam risk, KYC in most jurisdictions	Platform sees all listings; KYC required; chat logs retained; bank trail	Trustless escrow; no platform visibility; no KYC

The common thread across existing solutions is that someone always sees the trade — validators, solvers, exchange operators, or OTC desks. Privacy, where it exists, is institutional rather than cryptographic: users trust the operator not to exploit or leak their information. Unicity removes the operator from the equation entirely. Privacy is guaranteed by architecture, not policy.

2 Decentralized Agentic Commerce

Agentic commerce - autonomous agents transacting for goods, services, and data, is projected to exceed $3 trillion by 2030 [TOOD add reference]. Yet the infrastructure for agents to discover each other, negotiate terms, and settle transactions remains nascent.

Unicity enables decentralized agentic commerce where these functions are provided by independent agents rather than a monolithic platform.

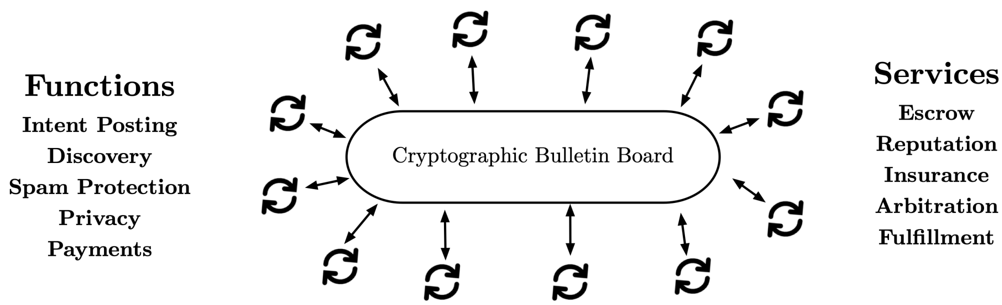


Figure 11: Decentralized Agentic Commerce: agents interact via the Cryptographic Bulletin Board (center), utilizing platform functions (left) and specialized service agents (right)

2.1 Intent-Based Discovery

The cryptographic bulletin board is permissionless infrastructure where agents post intents — signed declarations of what they wish to buy, sell, or exchange. Unlike traditional order books requiring exact matching, intents express flexible constraints that agents resolve through negotiation.

Examples of intents:

- **Physical goods**: "Purchase 100 units of component X, delivered to location Y, within 7 days, maximum price Z"
- **Services**: "Require 1000 GPU-hours of compute, minimum spec A, availability 99.9%, price range B–C", " I'm hungry, get me a pizza delivered", "I want to exchange my cash for crypto", "I'd like to watch the Manchester United game that starts in 10 minutes"
- **Data**: "Seeking real-time feed of market data D, latency under 10 ms, willing to pay E per hour"
- **Prediction**: "I predict the NY Giants beat the Chicago Bears by 15 points"

The bulletin board provides permissionless posting, cryptographic commitment preventing repudiation, optional privacy through encryption, and queryable discovery. It facilitates finding counterparties but does not intermediate transactions.

2.2 Spam Protection

A permissionless bulletin board faces abuse: malicious agents flooding the system with fake intents to degrade discovery or manipulate markets. Decentralized spam protection relies on economic and cryptographic mechanisms rather than centralized moderation.

Posting Bonds: Agents post a small bond when publishing an intent. The bond is returned when the intent expires or is fulfilled. Intents that are repeatedly ignored or flagged as spam forfeit their bond. This makes sustained spam economically costly.

Reputation Staking: Agents stake reputation tokens when posting intents. Low-reputation agents must stake more or are rate-limited. Spam behavior burns reputation, making future posting progressively more expensive.

Tiered Visibility: The bulletin board can implement tiered visibility based on sender reputation. High-reputation agents' intents are broadly visible. Low-reputation or new agents' intents require explicit query or are shown only to agents who opt in to see them.

Recipient Filtering: Agents control their own discovery preferences. They can filter intents by sender reputation, bond size, intent type, or other criteria. Spam that passes network-level filters can still be filtered locally.

Micropayments: For anonymous or new agents without reputation, a payment can be required to post an intent. This adds computational cost to bulk spam without burdening legitimate users.

These mechanisms compose. A typical bulletin board might require a small bond plus reputation stake for established agents, or bond plus micropayment for new agents. The economic cost of spam scales with volume while legitimate single-intent posting remains cheap.

2.3 Commerce Functions

Traditional platforms bundle discovery with transaction services. Decentralized agentic commerce unbundles these functions, allowing specialized agents to provide each service competitively.

Table 6: Commerce functions in decentralized agentic commerce

Function	Traditional Platform	Agentic Commerce
Discovery	Platform controls visibility	Cryptographic bulletin board
Escrow	Platform holds funds	Escrow agents with verifiable rules
Reputation	Platform owns ratings	Portable reputation tokens
Fulfillment	Platform coordinates logistics	Fulfillment agents compete
Insurance	Platform provides guarantees	Insurance agents underwrite risk
Disputes	Platform arbitrates	Arbitration agents with staked guarantees

Escrow agents hold funds during transaction execution. They are Verifiable Agents with transparent release conditions: funds transfer to the seller when delivery is confirmed, return to the buyer if conditions are not met. The escrow logic is verifiable — parties can audit the rules before committing funds.

Reputation is represented as portable tokens recording transaction history. Unlike platform-locked ratings, reputation tokens travel with the agent across marketplaces. Agents build reputation over time through successful transactions, and stake reputation when entering new agreements.

Fulfillment agents coordinate physical delivery for real-world goods. They compete on price, speed, and reliability. For digital goods and services, fulfillment may be instantaneous through direct peer-to-peer transfer.

Insurance agents underwrite transaction risk. They assess counterparty reputation, transaction size, and goods type, then offer coverage for a premium. If a transaction fails, the insurance agent compensates the affected party according to verifiable policy terms.

2.4 Negotiation and Settlement

Once agents discover matching intents, they negotiate directly. Communication occurs peer-to-peer. Agents agree on terms including which escrow, insurance, and fulfillment agents to use.

Settlement occurs through coordinated state transitions. A typical transaction flow:

1. Buyer and seller discover matching intents on bulletin board.
2. Agents negotiate terms, select escrow and fulfillment providers.
3. Buyer transfers payment to escrow agent.
4. Seller delivers goods/services via fulfillment agent.
5. Fulfillment agent confirms delivery.
6. Escrow agent releases payment to seller.

No centralized platform coordinates the flow — agents interact directly, using specialized service agents as needed.

2.5 Decentralized Dispute Resolution

Disputes arise when parties disagree on whether transaction terms have been fulfilled. Traditional platforms resolve disputes through internal teams whose decisions are final and opaque. Decentralized agentic commerce requires dispute resolution that is transparent, contestable, and enforceable without central authority.

Arbitration Agents are specialized agents that adjudicate disputes. They stake tokens as guarantee of impartial judgment. Biased or negligent rulings result in stake slashing and reputation damage.

The dispute resolution process:

1. **Initiation**: Either party initiates a dispute, posting a bond to prevent frivolous claims.
2. **Arbitrator Selection**: Parties select an arbitration agent from a registry, or use one specified in the original transaction terms.
3. **Evidence Submission**: Both parties submit evidence — delivery confirmations, communication logs, sensor data, attestations from fulfillment agents.
4. **Deliberation**: The arbitration agent evaluates evidence against the original transaction terms.
5. **Ruling**: The arbitrator issues a signed ruling specifying escrow disposition.
6. **Enforcement**: The escrow agent executes the ruling automatically.

Appeals provide recourse against incorrect rulings. A party can appeal by posting a larger bond and escalating to a panel of arbitrators. The panel reviews the original evidence and ruling. If the appeal succeeds, the original arbitrator's stake is slashed and the appellant's bond is returned. If the appeal fails, the bond is forfeited.

Arbitrator Reputation accumulates through rulings. Arbitrators who consistently deliver fair, uncontested rulings build reputation and can charge higher fees. Arbitrators whose rulings are frequently overturned on appeal lose reputation and stake.

2.6 The Unbundled Marketplace

This architecture inverts the platform model. Traditional commerce platforms capture both sides of every transaction, extracting fees and controlling relationships. In decentralized agentic commerce:

- Discovery is public infrastructure, not a proprietary advantage.
- Escrow, reputation, fulfillment, and insurance are competitive services.
- Agents choose providers based on price, reputation, and terms.
- No single entity can censor transactions or extract monopoly rent.

The result is a composable commerce stack where agents assemble the services they need for each transaction. A simple digital goods purchase might require only escrow. A complex physical goods transaction might involve fulfillment, insurance, and arbitration. Agents pay only for the services they use.

3 Decentralized Agentic Gaming

Although blockchain technology has been proposed as a means of enhancing transparency and facilitating value exchange in gaming, its current application has largely been limited to asset tokenization within centralized game architectures. Due to the limitations of existing designs, using blockchain for actual game execution remains impractical. However, the potential benefits of decentralized gaming are clear: players can gain true ownership of interoperable assets across different games, enjoy transparency and community-driven governance, experience censorship resistance, unlock innovative business models like play-to-earn, and support fair reward systems for creators.

The motivation behind this work came from a desire to solve a real problem in the gaming industry. The industry has, to a large degree, converged on a client-server approach and while the accepted view is that pure client-side execution of multi-player games is technically possible, it is considered impractical due to issues of security and synchronization. However, the client-server approach is itself severely limited as it is technically challenging to have many players interact in real-time on the same server instance. Modern simulations are limited to a few hundred players interacting in the same shared world due to this limitation.

Unicity is an attempt to overcome these limitations and build a truly decentralized game engine for massive online multi-player immersive simulations. In this case decentralization is not a “nice to have” but an essential requirement to allow complex multi-player interactions with potentially millions of players all interacting online. Moving execution to the client side would allow the system to scale, with blockchain technology providing a security layer that guarantees honest gameplay.

A user will initialize the game environment and interact with a set of agents that execute the game mechanics such as NPCs, real-world assets and in-game assets. As users interact with the virtual world and approach other players, the players’ agents will synchronize with each other with verifiable state transitions proving that the game logic has been followed and enabling game synchronization and exchange of assets.

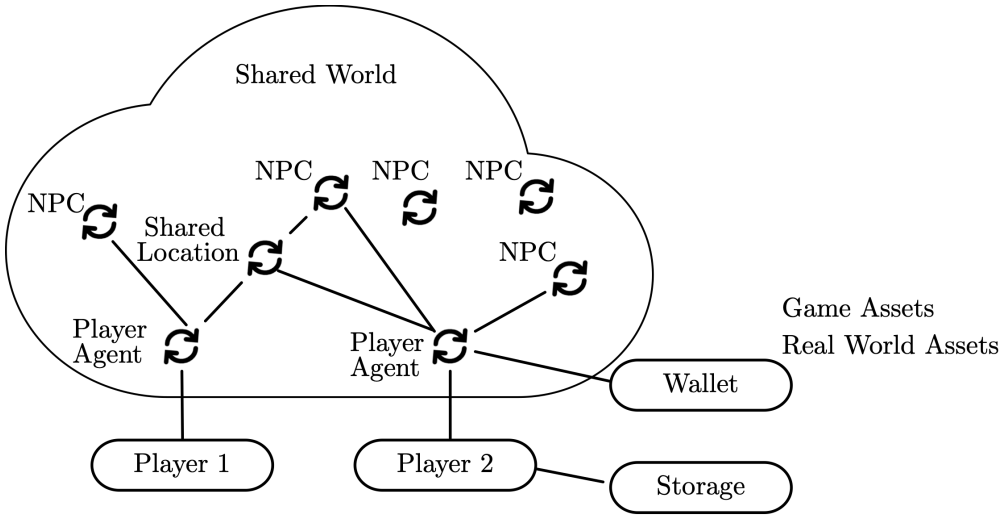


Figure 12: Gaming Agents

In the event of a failed verification, action can be taken defined by the game logic, such as rewinding the game to the previous known good state. In this way, a completely new type of game engine can be built with the game components consisting of autonomous agents managing game logic, and semi-autonomous agents operating on behalf of the player and interacting with the environment and other players.