

Ocelloids Network Specification

The Zone Council, SO/DA

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Abstract

This document outlines the functional specifications of the Ocelloids network, a system for secure and transparent leasing of software agents that observe, correlate, and respond to blockchain activity. The network comprises provider nodes hosting agents under negotiated leases with consumers. A continuous service attestation process ensures reliable agent operation, while the network registry governs onboarding and offboarding processes for service providers and auditors within a trust zone. The document details network roles, leasing processes, and attestation methods, providing a comprehensive understanding of the Ocelloids network's functionalities.

1 Introduction

The Ocelloids network operates as a real-time reactive layer with software agents that observe, correlate, and respond to blockchain activity. These program instances, hosted by provider nodes in a leasing model, naturally connect offchain data with onchain activity. Providers undergo a vetted onboarding process within a trust zone and operate within defined geographical boundaries. The **Service Attestation** process ensures the reliable functioning of the agents, enabling providers to earn leasing fees for hosting them.

2 Network

An Ocelloids network is a collection of nodes under a common trust zone with vetted access for participation.

The network is governed through an onchain registry, known as the **Network Registry**, containing participant information and their **Network Roles**.

Network participants have well-known identities tied to specific organizations, geolocations, and publicly accessible endpoints.

2.1 Network Registry

The network registry defines a trust zone characterized by designated sovereign and administrative accounts. Each of these accounts is endowed with privileges related to the onboarding and offboarding processes of service providers and auditors. These procedures play a critical role as they establish connections with entities subject to liabilities and potentially involve the establishment of legally binding contractual agreements.

Each participant of the network has an associated **Party Record**, which includes essential information for locating service providers and verifying the authenticity of digital signatures.

Table 1: Party Record

| Property | Description |
|-------------|---|
| Subject | Distinguished name[1]. |
| Accounts | Operator and treasurer blockchain accounts. |
| Endpoints | URLs[2] of the public endpoints. |
| Geolocation | Geographic point location[3]. |

| Property | Description |
|----------|------------------------------|
| Role | The node role (section 2.2). |

2.2 Network Roles

The network encompasses two node roles:

Provider Node

Negotiates service agreements, hosts **agents** in accordance with active leases and receives leasing fees.

Auditor Node

Verifies the execution of the **agents** involved in active leases and provides attestations to authorize the payment of leasing fees.

3 Service Leasing

The service leasing process involves consumers requesting service offers, depositing funds onto the blockchain for **agent** execution, undergoing continuous service attestations, managing periodic payment claims, and facilitating automatic lease renewals.

3.1 Service Agreement

The service agreement process mandates that the **consumer** deposit funds to cover at least one period before the **provider** provisions the **agent**. The high-level steps are as follows:

1. *Request Quote.* The **consumer** initiates the leasing process by submitting a quote request to the **provider**, specifying the desired **program content identifier** for execution.
2. *Service Offer.* The **provider** responds with a service offer, providing details such as the **program content identifier** to be executed, the leasing period duration in number of blocks, leasing fee, and minimum deposit required.
3. *Place Deposit.* The **consumer** submits a deposit to the blockchain, specifying the offer and the transfer amount. The funds for one leasing period are locked, with any remaining funds available for withdrawal by the consumer at any time.

4. *Confirm Deposit.* The blockchain issues a deposit receipt for the offer to the **consumer**, confirming the deposit. The **consumer** then sends this receipt to the **provider**.
5. *Provision Agent.* The **provider** verifies the deposit and provisions the **agent** based on the accepted offer.
6. *Confirm Lease.* The **provider** submits the deposit receipt to the blockchain to formalize the lease, receiving a lease receipt in response.
7. *Activate Lease.* The **provider** acknowledges the lease activation to the **consumer** upon receiving the lease receipt.

3.2 Service Attestation

The service attestation process¹ involves **auditors** continuously verifying the accurate operation and fulfillment of the agents hosted by a **providers** under the leasing duration. The attestation process operates within the timeframe of a leasing period. During the period, the provider commits a verifiable proof of the processing of each block. Since the blocks could be processed out of order, the **provider** maintains a local verifiable key-value map independent of the insertion order, such as a sparse Merkle tree[4]. The commitment to the map adds a pair (k, v) , where $k = \text{Block}_{hash}$ and $v = \text{digest}(\text{Program}_{output})$. The **provider** must anchor the top hash of the verifiable map at the end of the period. The attestation process for each period works as follows:

1. *Request Service Proofs.* The **auditor** requests service proofs for a random sample² of block hashes within the most recent anchored period. $B_{samp} = \{\text{Block}_{hash}^0, \dots, \text{Block}_{hash}^n\}$.
2. *Present Service Proofs.* The **provider** presents the requested inclusion proofs for the given block hashes. $P_{samp} = \{\text{proof}(b) : b \in B_{samp}\}$, where *proof* produces an inclusion proof for the committed value v on the key b .
3. *Verify Service Proofs.* The **auditor** verifies the inclusion proofs P_{samp} .
 - (a) Confirms the inclusion proof using the anchored top hash for the period.

¹For non-deterministic sources affecting the program output, a snapshot mechanism must be provided for reproducibility.

²A simple approach would be to use Yamane's method ($n = \frac{N}{1+Ne^2}$) for N blocks in the period, where $n \approx 400$ for a 1-month period.

- (b) Independently processes the selected blocks to verify that the digest of the resulting log output matches the value v of the requested block in the proof.

on successful verification

Record Attestation. The **auditor** submits a signed attestation of the verified period. The attestation authorizes³ the payment of leasing fees⁴ by the **provider**.

otherwise

Record Dispute. The **auditor** submits a signed dispute with details for further resolution⁵.

This continuous attestation process ensures the maintenance of verified operational records, serving as a prerequisite for claiming leasing fees.

3.3 Claim & Renewal

At the end of each leasing period, the **provider** must claim the leasing fees and an automatic renewal process is initiated.

1. *Claim Fees.* **Provider** claims the payment of the fees for the leasing period by submitting a transaction to the blockchain; e.g., *ClaimPaymentForPeriod*.
2. *Verify & Transfer.* Blockchain verifies the latest **agent** operational attestation and transfers the funds to the **provider**.
3. *Renewal Check.* **Provider** checks renewal conditions:
 - (a) The lease is active.
 - (b) Enough funds for next period in the **consumer** account.

on successful check

Renew Lease. Blockchain initiates the renewal process, locking funds for the next period.

³Variations could require signatures from multiple auditors.

⁴The authorized payment should be captured by the **provider** and could entail the deduction of a management fee accrued to the **auditor/s**.

⁵While operating in a vetted governance model (i.e., without funds at stake), the resolution is under the discretion of the trust zone sovereign entities, who are responsible for banning the misbehaving party and transferring funds to the rightful party.

otherwise

Cancel Lease. Blockchain cancels the lease, and the **provider** takes appropriate actions.

This process ensures a smooth transition between leasing periods, with automatic renewals and the flexibility to cancel if necessary. Consumers are responsible for maintaining sufficient deposit funds to cover renewals.

Glossary

agent

A program instance running on a provider. 2–5, 7

auditor

Node responsible for verifying the execution of agents involved in active leases and providing attestations to authorize the payment of leasing fees.. 3–5

consumer

Party that leases the hosting of an agent on a provider within the network. 3–5

program

Package containing executable bytecode or source code published through vetted catalogues. 2, 7

program content identifier

Content-addressable location where the program package can be retrieved; e.g., an IPFS CID. 3

provider

Node responsible for negotiating service agreements, hosting agents according to active leases, and receiving leasing fees.. 2–7

References

- [1] The directory: Selected attribute types. X.520, October 2019. URL <https://handle.itu.int/11.1002/1000/14037>.
- [2] Tim Berners-Lee, Roy T. Fielding, and Larry M Masinter. Uniform Resource Identifier (URI): Generic Syntax. RFC 3986, January 2005. URL <https://www.rfc-editor.org/info/rfc3986>.
- [3] Standard representation of geographic point location by coordinates. ISO 6709:2022, September 2022. URL <https://www.iso.org/standard/75147.html>.
- [4] Rasmus Dahlberg, Tobias Pulls, and Roel Peeters. Efficient sparse merkle trees: Caching strategies and secure (non-)membership proofs. Cryptology ePrint Archive, Paper 2016/683, 2016. URL <https://eprint.iacr.org/2016/683>. <https://eprint.iacr.org/2016/683>.