RSS3: The Open Information Layer

Natural Selection Labs

Contents

***Abstract*—Inspired by the original RSS Standard, this paper presents RSS3, the Open Information Layer for the Open Web. The paper serves as an enhanced version of the initial whitepaper titled “RSS3: A Next-Generation Feed Standard.” Following the release of the initial whitepaper, we have consistently adhered to the proposed architecture it outlines to conduct experiments and advance the development of the RSS3 Network. The Network has evolved into what is now known as the Open Information Layer, as a part of the evolving dynamics of the Open Web. This paper summarizes the research and development output since then, providing insights into RSS3’s vision and its decentralization architecture. Finally, we present the Network’s tokenomics and governance model, and discuss the future of RSS3.**

I. Introduction

RSS3 is the Open Information Layer, structuring Open Information for social, search, and AI. The Open Information Layer (OIL) is a decentralized and permissionless layer where information flows openly without any restrictions, as it is supposed to be.

It is RSS3’s mission to construct the Open Web by enhancing the free flow of Open Information.

II. RSS3 Network

The RSS3 Network is a decentralized network that is formed by two Sublayers: the Data Sublayer (DSL) and the Value Sublayer (VSL). See Section III and Section IV for details.

Open Information (OI) is typically found across various types of networks, including decentralized, federated, and centralized networks that allow permissionless access. The Data Sublayer (DSL) is responsible for indexing and structuring OI for interoperability. This is achieved by introducting a crucial standard, known as the Unified Metadata Schemas (UMS), see Section III-D, enabling network-agnostic applications to be built on top of the DSL. The DSL then leverages the Value Sublayer (VSL), see Section IV, to build an ownership economy for the Open Web (OW).

A. $RSS3

$RSS3 is the Network’s native utility token. It is used to cover gas, pay request fees, operate nodes, participate in staking, distribute incentives, and engage in various network activities. See Section V for more details.

B. Epoch (ϵ)

An Epoch (ϵ) is a period of time used as a reference to measure the RSS3 Network’s operation, during which the Network’s parameters are fixed. The duration of an epoch is determined by the Network, and is subject to potential future changes.

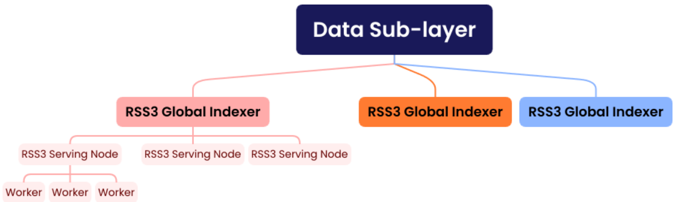

Fig. 1: A topology of the Data Sublayer.

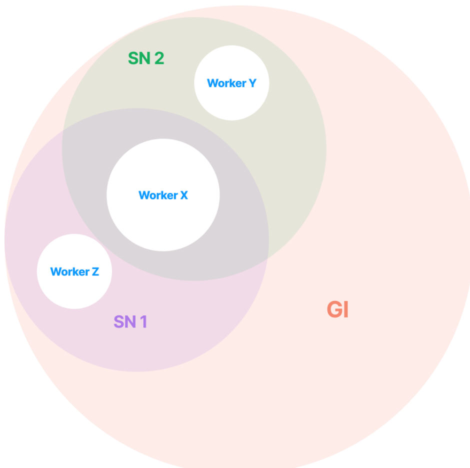

Fig. 2: A venn diagram illustrating the relationship between the worker, the Serving Node and the Global Indexer.

At the end of each ϵ, the Network will distribute the Network Rewards (R) to the RSS3 Network's participants, and update the Network's parameters when necessary.

III. Data Sublayer

The Data Sublayer (DSL) is responsible for Open Information life cycle management, which includes indexing, transformation, storage, dissemination, and consumption [1]. In this section we introduce the DSL and its fundamental components, see Figure 1.

The DSL is formed by two components (see section III-A and section III-B), and uses the UMS (see section III-D) to structure the information for applications in social, search, AI and beyond.

A. RSS3 Serving Node (SN)

An Serving Node (SN), also known as an RSS3 Node, is responsible for indexing, transforming, storing, and ultimately serving the Open Information to the end users.

The operation of an SN is permissionless, and is subject to a set of requirements set by the Network.

1) Indexing

Each SN operates a number of workers that index and structure OI from Permissionless Data Source (PDS). Workers are community-maintained "rules" that define how OI is indexed and transformed into the UMS format.

Since each SN is independent, it is possible for different SNs to employ different combinations of workers to cover different PDSs. This design enables node operation to be flexible, accessible and affordable, in turn, offering a high degree of decentralization and robustness.

2) Serving

Each SN operates a standard set of interfaces that serve structured OI in UMS to the end users via an Global Indexer (GI).

Each successful request served on the DSL is recorded and the corresponding Request Fees paid by the requesters are distributed to the SN, see Section V-A1 for more details.

B. RSS3 Global Indexer (GI)

A GI is responsible for facilitating coordination among SNs and engaging with the VSL, and performs critical functions to ensure the DSL is robust and reliable.

Given the importance of the GI to the Network, its operation is subject to a set of stringent requirements set by the Network.

1) Performance Assurance

A GI acts as a load balancer and query router for end users to retrieve information from SNs. The unique architecture of the DSL demands GIs to be equipped with more computational capabilities, in order to work out the optimal route for end users to retrieve specific information from SN, and frequently from a group of SNs simultaneously.

2) Quality Assurance

A GI acts as a supervisor for SNs to ensure the quality of service. With the DSL being a permissionless Sublayer, the quality needs to be maintained strictly to ensure RSS3 Network's robustness and reliability. A GI monitors the quality of SNs, and slashes the SN if it fails to meet the requirements.

3) Proof Onchain

A GI keeps track of the work and slash records of SNs, and submits them to the VSL for settlement and reward allocation.

C. Reliability Score

A GI routes requests to SNs based on their information coverage and a Reliability Score (σ). The calculation of σ is based on a range of factors, including but not limited to the SN's uptime, work and slash records, operation deposit, and staking/trust pool size. SNs with a higher σ have an increased likelihood of receiving requests.

D. Unified Metadata Schemas (UMS)

Open Information, indexed from multiple PDSs, is structured by SNs into the UMS format for interoperability.

PDSs use different data structures, within a PDS, there might be multiple products, services and protocols that leverage a different data structure to suit their needs. This lack of standardization means limited interoperability, limiting the creation of scalable applications.

The UMS addresses this issue by offering a unified set of data structures that serve as an abstraction. This abstraction simplifies the integration process, making it more manageable and scalable for developers to work with data across various PDSs.

For the complete set of the UMS, refer to https://docs.rss3.io/docs/unified-metadata-schemas.

IV. Value Sublayer

The Value Sublayer (VSL), commonly referred to as the RSS3 Chain, is an Ethereum Layer 2 blockchain built with OP Stack using Celestia as the data availability layer. It is responsible for handling value derived from Open Information activities and applications, establishing a healthy ownership economy for the Network.

In this section, we focus on the intentions behind the VSL's incentive mechanism, which is designed to promote stable Node Operations to maintain the Network, and to encourage network participants to secure the Network via staking $RSS3. We introduce the detailed tokenomics separately in Section V.

The RSS3 Network allocates a portion of $RSS3's total supply to incentivize network participants, referred to as the Network Rewards (R), are allocated into reward pools: the Staking Pool (P_s) for Normal Nodes, or the Public Good Pool (P_p) for Public Good Nodes. See Figure 3 for an illustration and Section V-A for details on Reward Pools. The calculations of Network Rewards are described in Section V-B.

A. Node Operation

Node Operators are incentivized to operate and maintain the Network by receiving $RSS3 as rewards.

1) Anyone can become a Node Operator to launch an RSS3 Node and join the RSS3 Network without requiring prior permission.
2) A Node Operator has the ability to configure Node's coverage, which directly influences the Node's capability to respond to various types of requests. A broader coverage means more computational resources are required, and an increased likelihood of receiving requests.
3) A Node can be operated in either a Normal mode as N, or a Public Good mode as N_p. A Normal Node is eligible for Network Rewards, but requires a deposit of $RSS3 into its P_o. A Public Good Node is ineligible for Network Rewards, but requires no deposit.
4) A Normal Node has a corresponding P_o and a P_s. All Public Good Nodes collectively share a single P_p.

B. Node Staking

Network participants are incentivized to stake $RSS3 to secure the Network by receiving $RSS3 as rewards.

1) A Normal Node accepts staking into its P_s, the amount of staked $RSS3 signifies its quality. Higher quality Nodes has an increased likelihood of receiving requests.
2) A Public Good Node does not have Reward Pools and does not participate in any form of incentivization. Staking into a Public Good Pool is accepted, and the stakers can assign their trust to any Public Good Node. Higher trust Nodes has an increased likelihood of receiving requests.

V. Tokenomics

In this seciton, we introduce the detailed tokenomics of the RSS3 Network. We present the concept of Reward Pools, the Network Rewards's calculation and allocation formulas, and the slashing mechanism employed to enforce the Network's security and stability.

A. Reward Pools

This section introduces the three reward pools: the Operation Pool (P_o), the Staking Pool (P_s), and the Public Good Pool (P_p). See Figure 3 for an illustration.

1) Operation Pool (P_o)

An Operation Pool (P_o) is used to store tokens that are allocated to a Normal Node from two sources:

1) The Request Fees (F) collected from requests served on the DSL
2) The Operation Tax (T) collected from the Node's P_s

The Node Operator can set a tax rate, τ, which is applied to its P_s, in conjunction with its D to determine the amount of Tax collected from its P_s. See Section V-B4. The tax applies to the Network Rewards allocated to the Node's P_s, not the staked tokens.

Only the corresponding Node Operator can withdraw tokens from its P_o, and the withdrawal is subject to a waiting period imposed by the Network.

2) Staking Pool (P_s)

A Staking Pool (P_s) is used to store staked tokens for a Normal Node. Network participants can stake tokens into a Normal Node's P_s to increase the Node's chance to receive requests on the DSL.

The allocation of Network Rewards into a Node's P_s at the end of each epoch ϵ, is determined by two factors:

1) Operation Rewards (R_o), the Node's normalized work contribution W in proportion to the total work done on the DSL (See Section V-B2)
2) Staking Rewards (R_s), the Node's P_s size in proportion to the total staked tokens on the VSL (See Section V-B1)

A tax T set by its Node Operator is then applied to the received Rewards.

3) Public Good Pool (P_p)

A Public Good Pool (P_p) is a unique reward pool that is shared by all Public Good Nodes.

As Public Good Nodes do not have their own P_s, network participants entrust their tokens to the P_p and signify their support to a designated Public Good Node.

	Node in Normal Mode	**Node in Public Good mode**
Who can operate?	Anyone	Anyone
Is a deposit required for operating a Node?	Yes	No
Is the deposit considered as staking, making it eligible for rewards from its own P_s?	No	N/A
Will the Node be slashed?	Yes, its deposit and P_s will be slashed. A Node may be demoted to receive fewer requests.	No, but a Node may be demoted to receive fewer requests.
Does the Node accept staking?	Yes. The staked tokens go to the Node's P_s. RSS3-X (X being the Node's name) Chips are issued to the stakers after staking.	No, as such a Node does not have a P_s. Instead, stakers stake to the P_p. RSS3-Public Good Chips are issued to the stakers after staking.
Can the Node Operator set a tax τ?	Yes	No, a universal tax is determined by the Network.
Does it have an Operation Pool P_o?	Yes	No, its Operation Rewards go to [X]
Does it have a Staking Pool P_s?	Yes	No, but a Public Good Pool with a universal incentive rate.

TABLE I: Comparison of two Node Operation modes.

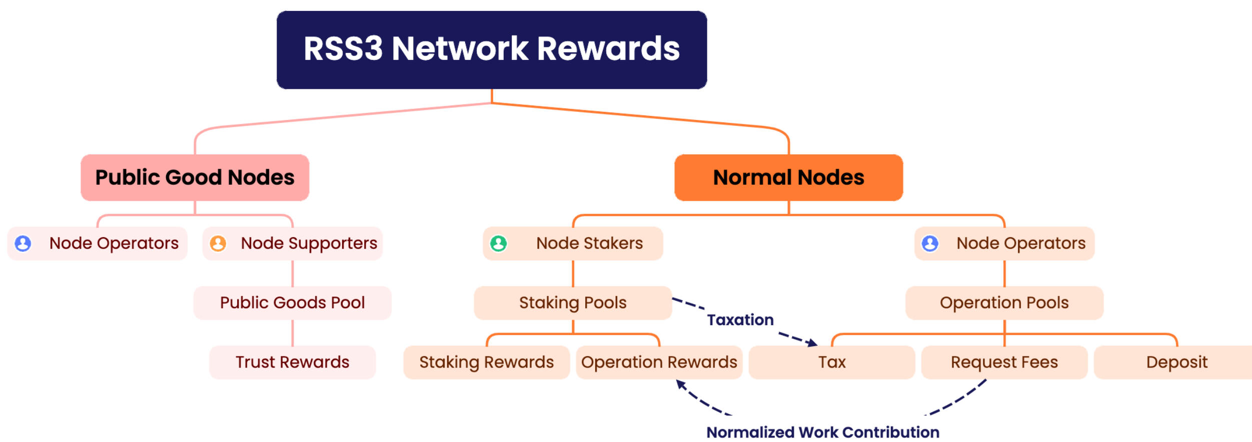

Fig. 3: The RSS3 Network Rewards are allocated differently to Normal Nodes and Public Good Nodes. See Section V-A for details.

B. Network Rewards (R)

In Section IV, we describe the intentions behind the VSL's incentive mechanism, here we introduce the detailed Network Rewards calculation and allocation formulas separately.

The Network Rewards R consists of three parts:

$$R = (R_o + R_s) + R_t \tag{1}$$

See Figure 3 for an illustration. The allocation to each part is determined by the Network, and is subject to potential future changes.

1) Operation Rewards (R_o)

To encourage Normal Nodes to operate reliably and consistently to maintain the Network, R_o is allocated to a Node's P_o in proportion to its Request Fees (F) collected on the DSL during the last ϵ.

$$W_{N,\epsilon} = \log_2\left(\frac{F_{N,\epsilon}}{\sum_{x=0}^{\infty} F_{x,\epsilon}} + 1\right) * G \tag{2}$$

$W_{N,\epsilon}$ denotes the normalized work contribution for a given Normal Node N, at the end of a given epoch ϵ. G is a constant equal to $\ln(2) \approx 0.693147$ used to offset the effect of replacing $\ln$ with $\log_2$, as the former is more costly in terms of gas when it comes to on-chain computation.

$$R_{o|N,\epsilon} = \frac{W_{N,\epsilon}}{\sum_{x=0}^{\infty} W_{x,\epsilon}} * R_{o,\epsilon} \tag{3}$$

$R_{o|N,\epsilon}$ therefore denotes the Operation Rewards for a given Normal Node N, at the end of a given epoch ϵ.

2) Staking Rewards (R_s)

To encourage participation from all network participants to increase the Network's reliability, R_s is allocated to a Normal Node's P_s in proportion to the amount of staked tokens in the entire Network during the last ϵ.

$$R_{s|N,\epsilon} = \frac{P_{s|N,\epsilon}}{\sum_{x=0}^{\infty} P_{s|x,\epsilon}} * R_{s,\epsilon} \tag{4}$$

$R_{s|N,\epsilon}$ therefore denotes the Staking Rewards for a given Normal Node N, at the end of a given epoch ϵ.

3) Trust Rewards (R_t)

To encourage participation from all network participants to increase the Network's reliability and support Public Goods provision, R_t is allocated to the P_p in proportion to the amount of entrusted tokens in the entire Network during the last ϵ.

$$R_{t|N_p,\epsilon} = \frac{P_{t|N_p,\epsilon}}{\sum_{x=0}^{\infty} P_{t|x,\epsilon}} * R_{t,\epsilon} \tag{5}$$

$R_{t|N_p,\epsilon}$ therefore denotes the Trust Rewards for a given Public Good Node N_p, at the end of a given epoch ϵ.

4) Taxation (T)

The tax rate τ is set by the Node Operator of a Normal Node, and is applied to the Network Rewards allocated to its P_s. The amount of tax collectible is capped at a maximum of c times the amount of the current deposit. c is set by the Network.

$$T_{N,\epsilon} = \min(D_{N,\epsilon} * c_\epsilon, (R_{s|N,\epsilon} + R_{o|N,\epsilon}) * \tau_{N,\epsilon}) \tag{6}$$

5) Final Allocations

The total amount of tokens allocated to a Normal Node's P_o for a given epoch ϵ is therefore:

$$F_{N,\epsilon} + T_{N,\epsilon} \tag{7}$$

The total amount of tokens allocated to a Normal Node's P_s for a given epoch ϵ is therefore:

$$R_{o|N,\epsilon} + R_{s|N,\epsilon} - T_{N,\epsilon} \tag{8}$$

The total amount of tokens allocated to a Public Good Node's P_p for a given epoch ϵ is therefore:

$$R_{t|N_p,\epsilon} \tag{9}$$

Refer to Figure 3 for a visual illustration of the Network Rewards allocation.

C. Chip

A Chip C is an ERC-721 Non-Fungible Tokens (NFTs) representing a network participant's stake in a particular Node. When a network participant stakes or entrusts tokens to a Node N, the participant receives Chips RSS3-N (C_N) in return.

1) Minting

The number of Chips minted for a particular staking or entrusting st is determined by:

$$C_{N_{\text{mint}}} = \frac{st * \max(1, C_{N_{\text{total}}})}{P_s} \tag{10}$$

Where $C_{N_{\text{mint}}} \in \mathbb{Z}_{>0}$ is always a non-negative integer.

2) Redemption

A Chip can be redeemed for its underlying staked or entrusted tokens at any time, subject to a waiting period imposed by the Network. The redemption amount may be different from the original staking or entrusting amount due to the change of the underlying P_s balance, which follows the same formula as Equation (10):

$$st_{\text{redeem}} = \frac{C_{N_{\text{redeem}}} * P_s}{\max(1, C_{N_{\text{total}}})} \tag{11}$$

D. Slashing Mechanism

The slashing mechanism is used to enforce the Network's security and stability. It is applied to both Normal Nodes and Public Good Nodes, albeit in slightly different ways.

1) Demotion

A demotion is automatically triggered when a Node failed to meet the requirements set by the Network. This can be due to a variety of reasons, including but not limited to: 1) the Node is offline for an extended period of time; 2) the Node is not serving requests in a timely manner; 3) the Node is serving requests but with incorrect information.

The Node's σ will be negatively impacted, diminishing its likelihood of receiving requests on the DSL. This in turn will reduce the Node's potential R_o and R_s allocated from the VSL.

2) Slashing

A slashing is automatically triggered when a Node is repeatedly demoted. Should a slashing occur, the Node's P_o and P_s will be slashed by precentages determined by the Network. Public Good Nodes are not subject to token slashing.

The Node's σ will be set to 0, effectively preventing it from receiving requests on the DSL during the current epoch.

The disposition of the slashed tokens is as follows:

- a portion of the slashed tokens will be burned, the amount is determined by the Network
- a portion of the slashed tokens will go to the reporter, provided the Node's misconduct was not auto-detected by the Network
- the remaining portion of the slashed tokens will go to the P_p

3) Challenge

When a Node is slashed, its Node Operator has the ability to challenge the slashing within a certain period of time. A successful challenge will result in the slashed tokens being returned to the Node's P_o and P_s.

VI. Governance

A. RSS3 Evolution Proposal (REP)

B. Roles

C. Process

VII. Conclusion

At the heart of Natural Selection Labs, we firmly believe in the freedom of information allocation: No organizations or authorities shall prohibit the free exercise of the right of people to create, store, and distribute their information.

References

[1] National Institute of Standards and Technology. Information life cycle. https://csrc.nist.gov/glossary/term/information_life_cycle, 2016.

GLOSSARY

Data Sublayer - DSL
: A decentralized network where the Open Information flows from its source to its destination. 1–5

Epoch - ϵ
: A period of time used as a reference to measure the RSS3 Network's operation. 1

Request Fees - F
: Fees paid to SNs for delivering Open Information from its Permissionless Data Source to the requesters. 3, 4

Global Indexer - GI
: A Data Sublayer component that facilitates coordination among Serving Nodes and engages with the Value Sublayer. 2

Network Rewards - R
: Tokens allocated by the RSS3 Network to incentivize network participants. 2, 3

Open Information - OI
: Information that is typically found across various types of networks, including decentralized, federated, and centralized networks that allow permissionless access. 1, 2

Open Information Layer - OIL
: A decentralized and permissionless information layer where information flows openly without any restrictions. 1

Operation Pool - P_o
: A pool of $RSS3 that consists of 1) Fees collected from serving Data Sublayer requests; 2) Network Rewards allocated based on the Node's work; 3) Tax collected from its Staking Pool. 3

Operation Rewards - R_o
: Tokens allocated to Operation Pool by the RSS3 Network to incentivize Node operation. 3

Open Web - OW
: The next-generation Internet where information flows openly without any restrictions, as it is supposed to be. 1

Permissionless Data Source - PDS
: A repository of data that can be accessed without the need for authorization or authentication. 2, 3

Public Good Pool - P_p
: A collective pool of staked $RSS3 that is used to improve the RSS3 Network by assigning trust to Public Good Nodes. 3

Reliability Score - σ
: A score used to determine the allocation of requests to Serving Nodes. 2

Serving Node - SN
: A Data Sublayer component that indexes, cleans, stores, and ultimately serves the Open Information to the end users. Denoted as N when it is in Normal mode, and N_p when it is in Public Good mode. 2, 7

Staking Pool - P_s
: A pool of staked $RSS3 that is used to improve the RSS3 Network by assigning trust to Normal Nodes. 3

Staking Rewards - R_s
: Tokens allocated to Staking Pool by the RSS3 Network to incentivize network participation. 3

Operation Tax - T
: A tax collected from the Network Rewards that are allocated to a Node's Staking Pool, by its Operation Pool. 3

Unified Metadata Schemas - UMS
: A unified set of data structures for interoperability. 1–3

Value Sublayer - VSL
: A blockchain where the value created by Open Information activities is recorded and distributed. 1–5