# Stratos Token Economy

A Troposphere Economy Model

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Abstract

Stratos, as the next generation of Decentralized Data Mesh, heavily rely on community participation to maintain self-sustainability. We propose here a **Troposphere Economy Model** which revolves around: 1) Resource/Meta Node miners, 2) End users, 3) Blockchain participants to achieve its business value.
All aspects are maintained through the use of Stratos Tokens (STOS). The former corresponds to the supply side and provides storage, database, and computing resources to receive incentives. The middle corresponds to the demand side, which consumes the related services, and pays fees to the Stratos network. The latter corresponds to the ledger layer who distributes the incentives based on the workload of the resource miners, facilitates transfer, etc. We tune the relationship between different stakeholders with three consensus protocols, including Proof-of-Traffic, Proof-of-Stake and Proof-of-Authority, to incentivize the stable growth of the ecosystem.

## Terminology

**Stratos Chain (SC)**: The Stratos blockchain facilitates all decentralized ledger transactions and functionalities.

**Validator node**: A validator is a node that participates in the Stratos Chain block generation by voting. To become a validator, the node owner needs to self-delegate a certain amount of STOS tokens.

**Blockchain node**: All nodes that participate in the Stratos Chain.

**Follower node**: A node that participates in the Stratos Chain as a blockchain node, but does not work as a validator.

**Stratos Decentralized Storage (SDS)**: A file based decentralized storage system.

**Stratos Decentralized Database (SDD)**: A tree based decentralized database system.

**Stratos Decentralized Computation (SDC)**: A Trusted Execution Environment based decentralized computation system.

**Value Network**: The Stratos Chain, the network that circulates all values in the Stratos Ecosystem.

**Resource Network**: Includes Decentralized Storage, Decentralized Database and Decentralized Computation

**Resource Node**: Nodes that participate in the Stratos Resource Network by providing their disk/bandwidth/computation power to earn rewards in the Proof-of-Traffic model.

**Meta Node**: Nodes that manage the tasks in the Resource Network between all Resource Nodes. Used for indexing all content, auditing the traffic report and communicating between Resource Network and Value Network through a relay mechanism.

**Active Resource Node**: A Resource Node that has finished the activation process by depositing to the Value Network and registering to a Meta Node, and currently receives tasks assigned by the Meta Node.

**Suspended Resource Node**: A Resource Node that has not satisfied the performance KPI evaluation criteria and is suspended from receiving further tasks from the Meta Node.

**Gas**: Stratos Chain transactions consume gas to be committed in blocks. The gas is used to avoid transaction spamming.

**Traffic**: The data volume evaluated in the Resource Network. The incentive for all participants in the Stratos Ecosystem will be based on the traffic.

**Stratos Tokens (STOS)**: Stratos Tokens, the native token facilitating value circulation in the Stratos Ecosystem.

**Ozone(Oz)**: The traffic unit in the ecosystem.

**Epoch**: The Proof-of-Traffic evaluation periodic window. The traffic for the Resource Network is evaluated at the end of each epoch.

**Volume Pool**: The collective pool of all prepay.

**Mining Pool:** The reserved STOS to incentivize the public to participate in the network in the early stage.

# 1. System Economic Income

After launching the Stratos Data Mesh V1 (Storage), V2 (database), and V3 (computation), each module will generate corresponding economic income. The whole Stratos economy is based on a Proof-of-Traffic model that evaluates the traffic generated by users' actions. Settlement and payment of the traffic is conducted in the form of Stratos Tokens through the Stratos Blockchain. The traffic price changes dynamically based on a **constant product formula.**

1. Purchased Ozone

If any user wants to use the Stratos Resource Network, he needs to prepay on the Stratos blockchain by sending a PREPAY transaction. The PREPAY transaction will let this user buy the traffic(Ozone) at a marginal price at the time **t** computed by dividing the sum of the initial genesis deposit and the current unissued prepay volume pool by the remaining total Ozone limit.

$$price_t^{oz} = \frac{s + p_t}{l_t}$$

The remaining total Ozone limit $l_t$ is the upper bound of the total Ozone that users can purchase from the Stratos blockchain.

$s$ is the initial genesis deposit by all Resource Nodes and Meta Nodes at t=0, $l_0$ is set to an amount based on the initial genesis deposit to reflect the STOS market price and the total SDS resources at the mainnet launch time.

The current unissued prepay Volume Pool $p_t$ is the total remaining prepay STOS kept by the Stratos Network but not yet issued to Resource Nodes as rewards. At time t=0, $p_t = 0$

If one user PREPAYS a total amount of x STOS token at time t, then he will get the following Ozone amount if there is no slippage:

$$dl_t = \frac{dx}{price_t^{oz}} = \frac{l_t}{s + p_t} \times dx$$

Where $dx$ is the derived x that is small enough to not make the price change**.** Because the **constant product formula** guarantees that the product of available STOS and Ozone is constant.

$$constant = (s + p_t) \times (l_t) = (s + p_{t+dt}) \times (l_{t+dt})$$

Where $p_{t+dt} = p_t + X$, so we can calculate the total amount of Ozone the user gets as:

$$\Delta l = l_t - l_{t+dt} = \frac{l_t \times X}{s + p_t + X}$$

And the new price of Ozone will become:

$$price_{t+dt}^{oz} = \frac{s + p_t + X}{l_t - \Delta l}$$

2. Consumed Ozone converted to Traffic Rewards

Users can utilize all services provided by the Resource Network by consuming Ozone. At the end of each epoch the total amount of consumed Ozone will be sold back to the Volume Pool to generate the traffic rewards to issue to all Resource Nodes:

$$price_t^{oz} = \frac{s + p_t}{l_t}$$

If the total consumed Ozone in an epoch is Y, it will generate traffic rewards as:

$$dR = dy \times \frac{s + p_t}{l_t}$$

Where $dy$ is the derived Y that is small enough to not make the price change. Since the **constant product formula** guarantees:

$$constant = (s + p_t) \times (l_t) = (s + p_{t+dt}) \times (l_{t+dt})$$

We can calculate the total generated traffic rewards based on the total consumed Ozone Y as:

$$R = p_t - p_{t+dt} = \frac{(s + p_t) \times Y}{l_t + Y}$$

Thus at the end of epoch time $t + dt$, the Ozone price will become:

$$price^{oz}_{t+dt} = \frac{s + p_t - R}{l_t + Y}$$

As people keep buying Ozone without consuming it, the price of Ozone will keep increasing compared to STOS.

## 2. Income and Mining incentive distribution

The traffic reward $R$ is distributed to 1) Resource Node miners(60%), 2) Meta Node miners(20%) 3) blockchain participants(20%). The detailed distribution plan is described in section 3, 4, 5.

The Stratos Foundation has reserved 40% of the 100M total STOS supply as a mining rewards pool. The mining rewards are issued at the end of each epoch, with the same schedule as traffic rewards. The mining reward for each epoch will be 80 STOS, until the total issued amount reaches 16819200 STOS which will be achieved in roughly 4 years. Then the mining rewards will be halved, which makes the mining rewards become 40 STOS. Once the mining rewards are halved, the Meta Node share will be decreased by 2%, and this 2% will be added to Resource Node miners. The halving continues roughly every 4 years, for 5 times. Then the mining rewards will be 2.5 STOS until full issuance of 39M STOS. The full mining rewards pool will last roughly 68.8years. We will allocate the rest 1M STOS for incentive testnet.

| Total Mined | Mining reward (per epoch) | Years | Resource/Meta Node/ Blockchain Percentage |
|---|---|---|---|
| 0 - 16,819,200 | 80 | 0-4 | 60%/20%/20% |
| 16,819,200 - 25,228,800 | 40 | 4-8 | 62%/18%/20% |
| 25,228,800 - 29,433,600 | 20 | 8-12 | 64%/16%20% |
| 29,433,600 - 31,536,000 | 10 | 12-16 | 66%/14%/20% |

| | | | |
|---|---|---|---|
| 31,536,000 - 32,587,200 | 5 | 16-20 | 68%/12%/20% |
| 32,587,200 - 39,000,000 | 2.5 | 20- 68.8 | 70%/10%/20% |

All traffic rewards and mining rewards will have a lock-up period of 14 days. An Active Resource Node needs to send a transaction to unregister from the Stratos blockchain when it wants to exit, and it can only shutdown after the 14-day cooling-off period. If the requirements are not met, the locked reward will be fully canceled and returned back to the pool.

All the Transaction gas fees that are collected in the blockchain will only be distributed to blockchain participants, based on validator nodes self-delegation and delegators delegation. It will not be given to Resource Nodes and Meta Nodes.

## 3. Proof-of-Traffic Mechanism

Based on the traffic(Ozone) consumed by the whole network, Stratos will issue traffic rewards and mining rewards to participants. In this section, we only talk about the 60% share given to Resource Nodes(the percentage increases as the mining rewards keep halving).
1 Ozone can be considered as: 1GB* data traffic in SDS or 1 million record touches* in SDD(Subject to be changed before mainnet).

1) User charges
All charged user traffic will be deducted from user's available Ozone balance.

- Upload:

  Uploading data will consume two parts of traffic, the initial uploading and the replication. The SDS is set to replicate 3 copies by default, which means that by uploading a file of 10MB to SDS, the user will consume 30MB of traffic. Users can configure a higher initial replica number, which will increase the number of replicas while uploading, thus consuming more traffic.

- Download:

  Downloading data will consume the total traffic actually generated by this action. If higher download requests for one copy of data triggers the automatic replicas incrementing, users will not be charged for that traffic, but only for the traffic for the final delivery.

- Database Query:

  Database Queries will consume two parts of traffic, the final delivery and the record touches.

- Computation:

  Computation is very complicated, it deserves a standalone paper to cover the calculation.

2) Resource Node traffic record
When a user triggers an action of UPLOAD/DOWNLOAD/QUERY/etc, the Meta Node will randomly assign the task to one/multiple Resource Node(s) which has enough

resources(data, storage, and bandwidth) to facilitate this action. The assignment chance for each node is based on their weight$w$ maintained by Meta Node. The weight is adjusted by Meta Node based on the performance for the tasks fulfilled by the node. The initial weight for each node is determined by node's initial deposit which is discussed in section 4.
Once a Resource Node has completed the task, the traffic generated by this task is recorded as traffic contribution for this Resource Node.

3) Resource Node settlement
At the end of every 10 minutes epoch, Meta Nodes settle the traffic with Resource Nodes. The Resource Nodes that provide the top 80% of total traffic will be eligible to settle to get the traffic and mining rewards. Their traffic contribution will be set back to zero once settled. The unsettled traffic will accumulate to the next epoch.

Let's take SDS as an example during the first 4 years. Suppose that during one epoch, there are 5 Resource Node miners in the SDS network, respectively providing 500GB, 300GB, 200GB, 80GB, 20GB of traffic contribution. That's equivalent to 1100oz, but only the top 3 nodes will be eligible to get settled because 80%*1100=880. Thus 1000 oz is settled in the epoch. The total traffic and mining rewards of this epoch is:

$$R = 1000 \times \frac{s + p_t}{l_t + 1000} + 80$$

It's safe to assume that $\frac{s + p_t}{l_t + 1000}$ = 1/50 which makes the total rewards 100STOS. 60%(60STOS) will be issued to the Resource Nodes that have been settled. The top 3 nodes will get 30STOS, 18STOS and 12STOS respectively.

## 4. Proof-of-Authority Mechanism

1）Meta Node Registration
Stratos Foundation will verify the Meta Node operator and then there will be a vote by all existing Meta Nodes. The verification includes but is not limited to: Meta Node machine specs, internet specs, server location, security and operation management. Meta Nodes that pass this verification will need to deposit a certain amount of STOS with a registration transaction on the Stratos Blockchain. All existing Meta Nodes will need to vote to approve the registration of the new node.

2) Resource Node Activation
Anyone can launch a Resource Node, however it will not receive any tasks from Meta Nodes until it completes the activation process. Resource Node owners need to deposit a certain amount of STOS tokens by sending an activation transaction to the Stratos Blockchain. Once this is done, the Meta Nodes will start to treat it as an active Resource Node. All the deposit STOS will be locked for at least 180 days.

3) Deposit increase total Ozone limit
Once a new Meta Node or Resource Node deposits Z STOS for registration/activation, the

remaining total Ozone limit will be increased by an amount calculated by:

$$\Delta l_t = \frac{l_t}{s} \times Z$$

The new Ozone price will become:

$$price^{oz}_{t+dt} = \frac{s + p_t}{l_t + \Delta l_t}$$

As more Resource Nodes are added to the network, the Ozone price will decrease compared to the STOS price.

The increased Ozone limit $\Delta l_t$ for a Resource Node deposit will be evaluated by the Meta Nodes as the initial Resource Node weight in task assignment. This weight will be affected later based on the Resource Node performance. We can consider that the deposit is the self claimed machine power of the Resource Node. So the owner should consider depositing more STOS if he owns a more powerful Resource Node machine. The $\Delta l_t$ to weight calculation equation can only be determined by incentive testnet testing results.

4) Resource Node Deactivation

If a Resource Node follows the process of deactivation by sending a unregister transaction to stratos blockchain, the remaining total Ozone limit will be decreased by an amount calculated by:

$$\Delta l_t = \frac{l_t}{s} \times Z$$

Where Z is the initial deposit of this Resource Node before any slashing/fee is applied. Once a Resource Node has deactivated, the Ozone price will increase.

The Resource Node can get his deposit STOS back 14 days after deactivation if the locked 180 days period has passed or 14 + remaining days from the 180 days lock period.

Example: if a Resource Node deposits 1000 STOS to activate on day 1 of the year, and deactivate on day 150 of the year, he can only get his deposit back on day 194 of the year. Or if the node deactivates on day 190 of the year, he can only get his deposit back on day 204 of the year.

The Resource Node will also cover the data replica migration traffic fees with his unvested reward and deposit, since the whole network will consume resources to properly backup the data held by the quitting resource node. The traffic is charged the same way as user upload/download.

5）Meta Node Incentive

Meta Nodes will participate in all data indexing, task distribution and settlement of traffic with Resource Nodes. All Meta Nodes will equally share 20% of the total traffic rewards and mining rewards for each epoch. Given the example in section 3, all Meta Nodes would share the 20 STOS tokens.

## 5. Proof-of-Stake Mechanism

Stratos extended the Delegated Proof-of-Stake into Hybrid Delegated Proof-of-Stake. 20% of

the total traffic and mining rewards will be allocated as stake rewards to the Proof-of-Stake beneficiaries, which include:
1) Validators self-delegate and Delegators delegate
2) Resource Nodes and Meta Nodes deposits
The whole stake rewards will be split between 1) and 2) based on the total amount of delegation and deposit.

The share of stake rewards for Resource Node and Meta Node will be distributed purely based on their deposit.

The share of stake rewards for Validators and Delegators will be distributed based on their delegation with a configured commission for validators. The transaction gas fees mentioned in section 2 will also follow the same distribution mechanism.

Let us take an example where we have 10 validators with equal voting power and a commission rate of 1%. Let us also assume that the gas fee reward for a block or the stake rewards of an epoch is 1000 STOS in total for 10 validators and that each validator has 20% of self-delegated STOS. These tokens do not go directly to the block proposer. Instead, they are evenly spread among validators. So now each validator's pool has 100 STOS. These 100 STOS will be distributed according to each participant's stake, for each validator:
Commission: 100*80%*1% = 0.8 STOS
Validator get: 100*20% + Commission = 20.8 STOS
All delegators get: 100*80% - Commission = 79.2 STOS

## 6. Summary

We have achieved several key features:

1. As more people prepay to utilize the services provided by the Resource Network, Ozone price will increase which reflects the increasing demand.
2. As more people become Resource Nodes, the Ozone limit will increase which reflects the increasing supply, and Ozone price will decrease because of that.
3. Ozone is the measurement of all activities in the Resource Network.
4. STOS is the value circulating in the Stratos Ecosystem.

With all the aspects above, the Stratos Ecosystem guarantees a stable and healthy growth.

## Disclaimer