

# Ontology Staking Incentive Calculation

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# 1 Staking Incentive Structure and Overview

Neither the incentive rules nor the distribution methods of the network fee incentive have changed for nodes and stakers.

The released ONG of the entire network is now only distributed to staked ONT instead of both staked ONT and regular ONT through ONG unbinding. From July 7, 2020 (UTC) onwards, this change has taken place and Ontology releases 1 ONG per second into the released ONG incentive pool. This incentive adopts the same rules and calculation methods as the network fee incentive and is distributed to the nodes and stakers along with the network fees at the beginning of each consensus round.

From 2018 to 2021, the Ontology Foundation provides 10 million ONG every year as incentives for the top 49 nodes with the highest total staked amounts. The last distribution was in August 2021 and marked the end of the Ontology Foundation Bonus.

## 1.1 Staking Incentive Structure

Ontology **Triones nodes**, including consensus nodes and candidate nodes, will receive three types of staking incentives:

1. Network fee incentive: This incentive's rules remain unchanged. This incentive will be shared amongst all 343 Triones nodes.
2. Released ONG incentive: This incentive's rules will be the same as the network fee incentive rules. This incentive will be shared amongst all 343 Triones nodes.

**Users** can earn staking incentives by staking to the Triones nodes and receiving a share of the nodes' staking incentives under rules set by the nodes. For instance:

1. Nodes can promise to distribute network fees and released ONG to their stakers according to a set sharing ratio.
2. Nodes can promise to distribute their own OEP-4 tokens to stakers according to their own set of rules.

## 1.2 Staking Incentive Overview

We shall explain Ontology's staking incentive calculation method from a high level below. The concrete calculation formula can be found in Section 3.

### 1.2.1 Network Fee Incentive

**The network fee incentive rules remain unchanged.**

All the consensus nodes collectively receive 50% of the total accumulated network fees in a consensus round, and all the candidate nodes collectively receive the other 50%. The consensus nodes and candidate nodes split the received fees amongst each node according to specific rules in their respective sets.

The consensus nodes calculate an incentive coefficient for each node according to the Ontology Incentive Curve, and then linearly distribute the fees according to their incentive coefficients. That is, the larger the incentive coefficient of a consensus node, the more network fees will be allocated to that node. According to the current Ontology Incentive Curve, the maximum incentive coefficient is reached when the staked amount of a consensus node reaches twice the average staked amount of a consensus node. When the staked amount is too high or too low, that node's incentive coefficient will be reduced, which means they will receive a reduced allocation of the network fees.

For candidate nodes, the network fee incentive is linearly allocated according to the total staked amount in each node. The higher the total stake a node has, the more network fees are allocated to it.

Stakers will receive a share of the network fees according to the sharing ratio set by the consensus or candidate nodes they are staking with.

### 1.2.2 Released ONG Incentive

As mentioned earlier, the released ONG of the entire network is now only distributed to staked ONT instead of both staked ONT and regular ONT through ONG unbinding. Ontology releases 1 ONG per second into the released ONG incentive pool. This incentive **adopts the same rules and calculation methods as the network fee incentive** and is distributed along with the network fees at the beginning of each consensus round.

The consensus nodes collectively receive 50% of the total ONG released in a consensus round, and the candidate nodes collectively receive the other 50%. The consensus nodes and candidate nodes split the received released ONG amongst each node according to specific rules in their respective sets.

The consensus nodes calculate an incentive coefficient for each node according to the Ontology Incentive Curve, and then linearly distribute the released ONG according to their incentive coefficients. That is, the larger the incentive coefficient of a consensus node, the more released ONG will be allocated to that node. According to the current Ontology Incentive Curve, the maximum incentive coefficient is reached when the staked amount of a consensus node reaches twice the average staked amount of a consensus node. When the staked amount is too high or too low, that node's incentive coefficient will be reduced, which means they will receive a reduced allocation of released ONG.

For candidate nodes, the released ONG incentive is linearly allocated according to the total staked amount in each node. The higher the total stake a node has, the more released ONG is allocated to it.

Stakers will receive a share of the released ONG according to the sharing ratio set by the consensus or candidate nodes they are staking with.

Since the duration of each consensus round varies, the amount of released ONG during each consensus round will also vary.

## 2 Notations

The following notations are used in detailed calculations.

- $\bar{\sigma}_s$ : the average staked amount of consensus nodes
- $\sigma_d$ : the total staked amount across all the candidate nodes
- $S_i$ : the total staked amount in node  $i$
- $p_i$ : the sharing ratio of node  $i$ 's promised network fees incentive and released ONG incentive to stakers
- $G_T$ : the total amount of ONG released in a consensus round, which equals the release (1 ONG/s) times the number of seconds in the round
- $F_T$ : the total amount of network fees accumulated in a consensus round
- $R_i$ : the released ONG received by node  $i$  in a consensus round
- $G_i$ : the network gas fee received by node  $i$  in a consensus round

### 3 Calculation Formula

#### 3.1 Node Incentive Calculation

The consensus nodes collectively receive 50% of the network fees and released ONG in a consensus round, and the candidate nodes collectively receive the other 50%. The network fees and released ONG are distributed every round.

##### 3.1.1 Network Fees Incentive and Released ONG Incentive

- If  $i$  is a **consensus node**, then it will receive the following network fees and released ONG:
  - According to the Ontology Incentive Curve (see Appendix), the incentive coefficient  $\alpha_i$  of consensus node  $i$  can be computed as follows, where  $\bar{\sigma}_s$  is the average staked amount of consensus nodes and  $S_i$  is the total staked amount of node  $i$ :

$$x_i = \frac{\eta}{\bar{\sigma}_s} \cdot S_i, \quad \eta = 0.5$$

$$\alpha_i = x_i \cdot e^{-x_i}$$

Assume  $A = \sum_{j \in [\text{consensus nodes}]} \alpha_j$ , namely  $A$  is the sum of the incentive coefficients of each consensus node.

- According to the incentive coefficient of each consensus node, linearly allocate from the total network fees  $F_T$  and from the total released ONG  $G_T$  for node  $i$ :

$$G_i = \frac{50\% \cdot F_T}{A} \cdot \alpha_i$$

$$R_i = \frac{50\% \cdot G_T}{A} \cdot \alpha_i$$

- If  $i$  is a **candidate node**, then linearly allocate from the total network fees and the total released ONG for node  $i$  according to the total staked amount  $S_i$  of that node divided by the total staked amount across all candidate nodes  $\sigma_d$ :

$$G_i = \frac{50\% \cdot F_T}{\sigma_d} \cdot S_i$$

$$R_i = \frac{50\% \cdot G_T}{\sigma_d} \cdot S_i$$

##### 3.1.2 Expected Total Node Incentive

In summary, the total expected annual incentive for node  $i$  is:

$$R_i + G_i \cdot \text{Annual Expected Rounds}$$

It is worth noting that this calculation does not deduct the incentives promised to the stakers. For example, say node  $i$  promises to distribute a portion of received fees and released ONG to stakers according to a sharing ratio  $p_i$ , then its final expected annual incentive is:

$$(R_i + G_i) \cdot (1 - p_i) \cdot \text{Annual Expected Rounds}$$

## 3.2 Stakers' Incentive Calculation

### 3.2.1 Network Fees and Released ONG

Node  $i$  may promise a sharing ratio  $p_i$  to stakers. Thus, if stakers stake on that node, the total fees and released ONG incentive received by the stakers are:

$$U' = (G_i + R_i) \cdot p_i$$

The network fees and released ONG incentive received by an individual staker will have a linear relationship with their staked amount. That is, if the ratio of staker  $a$ 's stake to all the stakers' stake on node  $i$  (excluding the initial staking amount of the node) is  $\beta_{a,i}$ , then the network fees and released ONG incentive received by the individual staker are:

$$U'_{a,i} = (G_i + R_i) \cdot p_i \cdot \beta_{a,i}$$

### 3.2.2 Other Incentives Promised by the Nodes

Some nodes may promise additional incentives, such as distributing their own tokens to stakers according to their own set of rules.

## Appendix

### A. The Ontology Incentive Curve

The Ontology Incentive Curve shows the relation between the node stake ratio and the incentive coefficient in the consensus node network fees incentive and released ONG incentive. The formula for the Ontology Incentive Curve is:

$$x_i = \frac{\eta}{\bar{\sigma}_s} \cdot S_i,$$

$$\alpha_i = x_i \cdot e^{-x_i}.$$

Currently,  $\eta = 0.5$ . If the number of consensus nodes is  $n$ , and the ratio of the staked amount  $S_i$  in node  $i$  to the average staked amount  $\bar{\sigma}_s$  across all consensus nodes is  $P_i$ , that is,  $P_i = \frac{S_i}{\bar{\sigma}_s}$ , then we have  $P_i \in (0, n)$ . The figure below shows the relation between  $P_i$  and the incentive coefficient  $\alpha_i$ . It can be seen that when  $P_i = 2$ , that is, when the total staked amount of node  $i$  is twice the average staked amount across the consensus nodes, its incentive coefficient reaches a maximum of  $e^{-1}$ , at which time it receives the highest possible allocation of network fees and released ONG relative to the other consensus nodes.

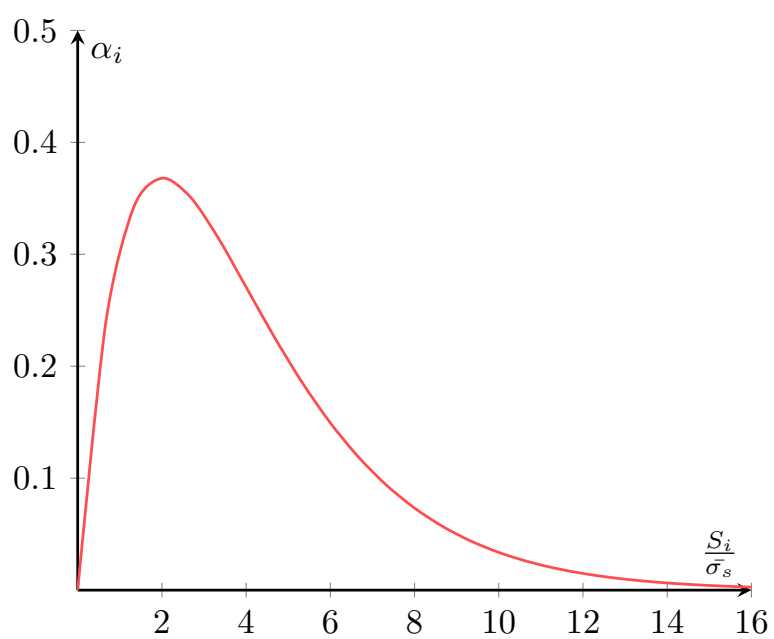


Figure 1: Ontology Consensus Nodes Incentive Curve