XIP4 – NODE INCENTIVE FRAMEWORK

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INTRODUCTION

A framework is introduced to incentivize individuals to run nodes on the XYO network. Such incentivization is necessary for the network to fulfill its stated purposes as a people powered heuristics network. The framework is designed to ensure economic rationality in the choice to run a node, mitigate risks inherent to node operation, and foster a network that is stable and mature from its onset. A cohesive community, incentivized to start and stay the course, improves the validity of the network and the likelihood of success for commercial viability. Success of the network and its operators becomes formulaically self-fulfilling when bounded by the Node Incentive Framework (NIF). The NIF may provide the tools necessary to intelligently solicit desirable nodal characteristics from the network such as launching nodes, maintaining nodes, and continuing node operation during low transaction volume. Its implementation is useful for marketing material and commercial adoption.

This paper does not provide complete context about what the XYO Network and its nodes do. See the XYO white paper, yellow paper, and lime paper to understand the network, nodes, and cryptoeconomics respectively.

MOTIVATION

EXPECT RATIONAL ACTORS

Currently, a node operator is not rewarded beyond his or her stake and the following problem arises: It makes more economic sense for any rational individual to stake someone else's node while saving their own time and money to increase their own stake. In other words, contributing to the network's ability to provide a service to a customer is an economically irrational decision.

DO NOT EXCLUDE POSSIBLE CONTRIBUTORS

The financial circumstances of potential node operators should not prohibit the growth of the network. Giving upside exposure to people with little to invest in staking, but means of operating a node, provides growth incentive without leaning on the wallets of the community, (tired) investors, and overly ambitious crypto geeks "doing it for fun"

ECONOMIC PRINCIPLES

Staking and token burning, in and of themselves, only add value to the token through the economic principle of scarcity while ignoring the quality of the service advertised by the network and provided by the nodes. This fact does not foster an environment of participation and/or expansion which is necessary to fulfill the basic promise of the network. Ultimately, staking and burning tokens will not compensate for the lack of value of the networks services that will arise without node participation. The network must add value to its customers before scarcity plays a role in token value.

STABILITY TO SUPPORT EARLY COMMERCIAL VIABILITY

The entire crypto economy is plagued by the adoption vs. maturity challenges characterized by the chicken and egg. Providing a stable and ***persistent*** node network is essential to mitigating the risks perceived by commercial ventures considering adoption of the XYO Network. Transactional volatility should be isolated from node operator incentives at the onset.

REQUIREMENTS

The requirements below, when fulfilled, address all motivations listed above.

1) The framework shall make the following acts economically rational for anyone:
    - Start a node
    - Start a node sooner rather than later
    - Continue operating a node
    - Provide favorable hardware
    - Provide favorable reputation
    - Solicit stake from non-operators
    - Provide all items above despite a lack of initial market demand

2) The framework shall enable stability and persistence of the XYO Network in the face of transient and volatile transactional environments that characterize emerging markets – particularly in the cyptoeconomic space.

DESCRIPTIONS & DEFINITION OF THE NODE INCENTIVE FRAMEWORK

The Node Incentive Framework (NIF) consists of two main parts – node creation rewards (CR), and node transaction rewards (TR). They are described below and expressed mathematically so that they can be represented via smart contract.

NODE CREATION REWARDS

Node creation rewards are sourced from the cryptoeconomic reserve and intend to reward early participation and incentivize continuous service to a network with limited commercial use at its onset. Although the XYO Network can be conceived of as a self-sustaining system in the long term, there is a steady state assumption involving some balance of adoption and stability. At the onset, it may not be appropriate to view the network as self-sustaining since neither adoption nor stability are guaranteed. Providing rewards to early node operators independent of transactional volume buys down the risk of an unstable node ecosystem thus attracting adoption.

Node creation rewards serve two related purposes – create and continue node operation, create a low risk environment for early commercial adoption.

CREATE AND CONTINUE NODE OPERATION.

Creation rewards are intentionally exclusive from transaction rewards to incentivize consistent service despite the expected volatility of transactions during XYO's introduction to the market as a commercial service. These rewards can also be viewed as a subsidy for enduring the hardships and speculations inherent to nascent projects. The guarantee of income despite transactional volume is key to establishing essential stability discussed below.

CREATE A LOW RISK ENVIRONMENT OF EARLY COMMERCIAL ADOPTION

These rewards ensure a supply of nodes despite a lack of network demand during early adoption. The existence of this "stability despite transactional volume" is a necessary property of the network for early adopters. Commercial ventures may be averse to investing their processes and capital in a network that will go down if other, unrelated ventures underutilize the network. Providing **persistent** node support in austere economic environments is key to XYO's value proposition to prospective commercial users and will catalyze adoption.

CREATION REWARDS (CR) IN THE NODE INCENTIVES FRAMEWORK (NIF)

The CR side of the NIF takes the following form to be implemented via smart contract:

$$DailyCreationReward = C * D$$

D = The number of days the node has been active

C = A constant that can be defined by specifying the maximum cumulative award achievable over the maximum amount days the reward can be collected.

$$\sum_{D=0}^{D_{maximum}} D * C = A_{CumulativeMax} \ (eqn. 1 - CR)$$

$D_{maximum}$ = the maximum number of days an operator can expect their daily reward to increase.

$A_{CumulativeMax}$ = the maximum amount of XYO a node operator can potentially accumulate via creation rewards.

For example:

If it is desired that after 5 years (1825 days) a node operator could earn a maximum of 10M XYO for providing continuous operation, we solve the CR equation for C. It is converted into a continuous integral to allow for an analytical solution.

$$C * \int_0^{1825} DdD = 10{,}000{,}000 \ \ (eqn. 1 - CR)$$

$$C\frac{1}{2}1825^2 = 10{,}000{,}000$$

$$C = \frac{32000}{5329} \cong 6$$

Day	DailyCreationReward	Cumulative Reward	Effective Daily Average
	$C * D = 6 * D$	$\int_0^{D_n} C * DdD$	$\frac{\int_0^{D_n} C * DdD}{D}$
1	6	6	6
2	12	18	9
3	18	36	12
…	…	…	…
1825 (5 years)	10,950	10,000,000	5480

Daily rewards and the effective daily average increase each day the node has been active without withdrawal. Node operators are incentivized to provide continuous support to earn the following day's increased reward. If the operator withdraws their cumulative XYO from the CR bucket or interrupts service for longer than a few days, their day count starts over, and their daily creation reward starts over - thus incentivizing long term staking and operation.

The creation rewards remain in effect until the cryptoeconomic reserve (or some allocated portion of it) is depleted. It is feasible, that if enough nodes join the network, none of them would realize the full reward potential. When the reserve is depleted, the nodes are paid out what they've earned thus far. Ideally, this occurs when the network has achieved transactional stability and commercial relevance. Because the reserve will deplete, a sense of urgency is imparted on potential operators incentivizing quick mobilization. However, if too many nodes deplete the reserve before market adoption occurs, there is risk of losing this stabilization force prematurely. The extreme example would be in awarding the entire reserve to the first node online, this would accomplish very little.

The values of $A_{CumulativeMax}$ and $D_{maximum}$ should be set with the intention that reserve funds won't be depleted until the nodes are sustaining a commercially viable network. At such a point of viability, the only reward for operators should come from the transaction rewards described below. When the economic reserve is depleted, it should be economically rational for a node operator to run a node incentivized by transactional rewards alone (discussed below). Therefore, the setting of $A_{CumulativeMax}$ and $D_{maximum}$ within the creation rewards are crucial to the longevity of the network and will define the transition to a self-sustaining network.

It should be noted that it may be value to link network transactional volume to the value of C in the CR. This could potentially ensure smooth transition into a self-sustaining economy and automate the management of the reserve dedicated to CR. This is considered out of scope for now.

It is feasible to develop a tool that would illustrate when a node operator would expect to 'break even' on his/her operations if node costs are known and we assume a particular value for XYO.

Node Transaction Rewards

Node transaction rewards (TR) exist to incentivize continued operation and decentralization throughout the life of the network. Without this incentive, staking another's node becomes more economically rational. The best engineering assumptions are 'worst case.' The worst case assumption made here is that people are naturally selfish and will prefer to stake another's node to operating and paying the cost of their own node for the sake of network decentralization. Therefore, there must be an advantage to running a node in addition to simply staking it.

Transaction rewards (TR) in the node incentives framework (NIF)

The TR side of the NIF takes the following form to be implemented via smart contract:

$$TransactionalReward = SR * (W_{RLI} * RLI + W_{SPI} * SPI) \quad (eqn. 2 - TR)$$

$$Rate\ Lock\ Index = RLI = 1 - \frac{n}{N_{sat}} \quad (eqn. 3)$$

$$if\ n > N_{sat}, then\ n = N_{sat}, RLI\ goes\ to\ 0\ for\ non - necessary\ nodes.$$

$$Stake\ Preference\ Index = \frac{S}{S_{maximum}} \quad (eqn. 4)$$

$$if\ S > S_{maximum}, S = S_{maximum}, \quad SLI\ goes\ to\ 1$$

SR = the total reward sent to the node for distribution to its stakers for participating in a transaction.

W_{RLI} = the weighting factor applied to RLI. How much should early participation be rewarded throughout the life of the network?

W_S = the weighting factor applied to the operators staking duration preferences.

RLI = the rate lock index favors early node participants in the network.

SPI = the stake preference index favors operators who stake longer.

S = the number of days an operator stakes their rewards before withdrawing them.

$S_{maximum}$ = the maximum number of days an operator can stake while improving their transactional reward.

n = The number of nodes, including the operators, that are registered when the operator's node first came online.

N_{sat} = the number of nodes that are needed for the network to be adequately saturated. This can be adjusted down the road to attract new devices if there is a perceived need.

FOR EXAMPLE:

Network Settings

- Let's say we desire at least 10,000 nodes to power the network, then we set N_{sat} =10,000.
- Let's say we desire to enable operators to stake for up to 3yrs (1095days), the we set $S_{maximum}$ = 1095.
- Let's give a maximum reward of 5% to the earliest adopters.
- Let's give a maximum reward of 7% to those who stake their reward for all 3 years after the transaction settles.

Operator Definitions

- Let's say we have the 80th archivist to come online, n =80
- Let's say this operator chooses to stake for 1 year (365days), S=365

Finally, lets say that the total rewards sent to this archivist for a particular transaction is 500 XYO.

$$RLI = 1 - \frac{80}{10000} = .992$$

$$TransactionalReward = 500 * \left(.05 * .992 + \frac{.07 * 365}{1095}\right) = 500 * .073 = 36.5\ XYO$$

The combination of the operators RLI and staking time resulting in a 7.3% reward based on the networks weighting of RLI and maximum staking time.

The cumulative returns of a nodes transactional rewards are expressed below:

$$\sum_{T=1}^{n} SR_T * (W_{RLI} * RLI + W_{SPI} * SPI_T) \qquad (eqn. 5)$$

Where T represents each transaction.

THE NODE INCENTIVE FRAMEWORK

The entire framework is expressed below.

$$Cumulative\ Node\ Rewards = CreationRewards + TransactionRewards$$

$$Cumulative\ Node\ Rewards = \sum_{D=0}^{n} D * C + \sum_{T=0}^{n} SR_T * (W_{RLI} * RLI + W_{SPI} * SPI_T) \qquad (eqn. 6)$$

A variety of desired nodal behaviors can be solicited by making key adjustments to the framework's specifications. Adjustments to the specifications should be a community governance decision. The author will work on an larger annotated version calling out how each variable may affect nodal properties of the network.

BROADER PERSPECTIVE

Ideally, a node operator's earnings will transition smoothly from CR to TR while remaining continuously profitable. Therefore, setting the network values for the NIF ($D_{maximum}$, N_{Sat}, etc.) is crucial to success. It should be noted that these values ought to be changeable over time within the governance system to enable necessary adjustments along the way. This would affect the earnings for all existing nodes once a new value is approved.

Part of the cryptoeconomic reserve is to be allocated to creation rewards. Creation rewards will cease once this is depleted. However, it is recommended to keep another allocation of the reserve to support transactional downtimes in the long term. Should the transactional volume decrease at some point in the life of the XYO Network, this second reserve can be utilized with the same functionality and properties (network persistence) as the creation rewards reserve.

The current framework speaks strongly to archivists and diviners. A similar approach could be taken for sentinels and bridges. However, such an approach should emphasize volume and diversity of bound witness interactions. This is considered out of scope of now, but some cryptoeconomic reserve could reasonably be allocated to the collection nodes.

CONCLUSION

Proper management of the cryptoeconomic reserve and the staking environment should not exclude node operators since they provide the foundation for the network's short- and long-term viability. The NIF may provide the tools necessary to intelligently solicit desirable nodal characteristics from the network.

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