SingularityNET – 3 Coin Logic – Overview and Simple Equational Model

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1 Introduction

This document outlines the "economic logic" of the 3 interlinked currencies proposed to serve as part of the SingularityNET. In its current form, this document is a draft and should still be considered subject to revision.

SingularityNET is a decentralized network of nodes that provide AI services to each other or to outside agents, with a goal of providing an efficient venue for the provision of diverse AI services fulfilling various practical needs, and also for the self-organization of emergent beneficial artificial general intelligence. Each node in the network will provide AI services via a subset of an overall set of API calls, where the overall set is determined via a democratic process involving the nodes themselves.

The purpose of having 3 currencies underlying the SingularityNET is to serve multiple coupled goals: a tool for real-time transactions with nodes providing AI services, a tool for securing access to (near or far) future AI services, and a tool for channeling a percentage of the overall network's resources to causes of broad benefit. Correlated with these goals, the interests of multiple different parties have been carefully considered in creating the economic logic:

- customers of nodes in the network
- creators and providers of nodes in the network

- donors providing funds for network infrastructure
- humanity at large, other creatures within Earth's natural environment, and other sentient beings (e.g. AGIs) that may emerge in the SingularityNET or elsewhere

2 T, B and S Coins

The basic idea of the 3 coins (aka currencies or tokens) proposed for SingularityNET is as follows:

- **T-Coins (Transactional coins)**: Each T-coin denotes a fixed amount of Tnergy, e.g. 1 units of Tnergy or 5 units of Tnergy. These are used for routine interactions between agents in the Net, including for external entities (or internal agents) to contract AI services from agents in the Net.
- **B-Coins (Benefit coins)**: A benefit coin confers the holder the right to direct a certain quantity of Tnergy from the Reserve to some Node to carry out some task classified as a Benefit Task. So a benefit coin with denomination "5" confers the holder to direct T-coins worth 5 units of Tnergy from the Reserve to any Benefit Tasks.
- **S-Coins (Singularity Coins or Storage Coins)**: An S-Coin is like a backup store of Tnergy. A certain percentage pS of Tnergy is allocated initially to S-Coins. A S-Coin denominated "5" can be redeemed into T-Coins containing a total of 5% of the total number of units of Tnergy existent at the time of its redemption. There is a certain small percentage fee for backing up a set of T coins as a S-Coin. S-Coins can be "locked up" for certain periods of time, meaning that they can only be converted to T-Coins once their maturation date has been reached. Maturation dates may be very near or very far.

In accordance with these ideas, the total amount of Tnergy in the system is equal to

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Total Tnergy of all T-coins in existence +
Total Tnergy of the Reserve
= Total Tnergy
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More concisely, we may write this:

$$T^{tot} = T^c + T^r$$

(where the "c" is for "circulation"), and different manifestations of Tnergy have different restrictions on their usage, i.e.

- T-Coins correspond to Tnergy that can be used unrestrictedly but must be used rapidly (or they transform into S-Coins with a near-term maturity).
- S-Coins correspond to Tnergy that must be in the Reserve when the maturation date is reached, at which point it can be released.
- B-Coins correspond to Tnergy that must be used for specific purposes (Benefit projects).

A conservative strategy would be for the Reserve to always contain as many T-coins as the total number of T-coins that would need to be paid out if all the S coins and B coins were redeemed. However, this will not in general be the best growth strategy.

3 Aspects of the Economic Logic

In this section we outline some specific rules for management of T, S and B coins and their interactions. The following section will incorporate these into a simple set of equations.

3.1 T-Coin Expiration

T coins are meant to be spent rapidly; so if a T-coin is not used after a certain period of time, it expires and is converted to a S-Coin (with a near-future maturation time) automatically, after deduction of a small penalty fee. So if a T-coin has value x, and the fee percentage is λ_{expiry}, then after the expiration we have:

- An S-coin with value $(1 - \lambda_{\text{expiry}}) * x$
- An increase to the Reserve of amount $\lambda_{\text{expiry}} * x$

3.2 Transaction Fees

When Node a sends to Node b some T-Coins with total Tnergy amount x, what happens is:

- b receives a T-Coin with Tnergy amount $(1 - \lambda_{\text{operational}}) * x$
- The Reserve increases by amount $\lambda_{\text{benefit}} * x$
- The Operations Fund increases by amount $\lambda_{\text{operational}} * x$
- b receives B-Coin denominated with amount $\nu_{\text{benefit}} * x$

Here $\lambda_{\text{operational}}$ is a fee to fund operations of the Net, and λ_{benefit} is a fee that feeds the Reserve, which enables benefit projects. ν_{benefit} indicates how much benefit currency is actually given to the recipient of the transaction to spend.

The parameters ν_{benefit} and λ_{benefit} do not necessarily need to be equal at each point in time, though in the long term the impact of q and the impact of s need to balance out. If the Reserve has an extra lot of Tnergy for some reason, it might be optimal to have $\nu_{\text{benefit}} > \lambda_{\text{benefit}}$ for a while.

To repeat for clarity: A B-coin with face value X, gives the bearer the right to shift X amount of Tnergy from the Reserve to Nodes for Benefit tasks. Some B-coins might have a maturation, meaning they can only be used after a certain period of time has passed.

3.3 B-Coin Expiration

B-Coins are intended to be used within a reasonable period of time (e.g. not to be held onto for 10 years). However, it should also be OK to accumulate B coins for a little while to be able to fund a larger benefit project. Once a B coin reaches its expiration time, then it simply becomes invalid. This invalidation allows the system to issue more new B coins without increasing the Reserve.

It may also be useful to issue B-coins with a maturation period, i.e. they cannot be used immediately but only after a certain period of time has passed.

3.4 Dynamics of the Reserve

The Reserve is increased a little bit (via fee payment) with each T-coin transaction, and with each expiration of a T-coin.

The Reserve is decreased with each redemption of a B coin. So for the economy to be viable, the total amount of Tnergy in the set of existing B coins, must be less than the total Reserve amount.

Depending on the amount of funds in the Reserve, there may be some adjustment to the parameters ν_{benefit} and λ_{benefit}.

The Reserve is also decreased with each redemption of an S-Coin into T-Coins.

3.5 Sale of S-Coins

S-Coins can be granted to individuals or other entities in exchange for fiat currency, cryptocurrency, or other goods or services.

If the S-Coins granted have a near-term maturation date, then the transaction must be for fiat currency, cryptocurrency or some other liquid instrument, and financial instrument provided as part of the transaction is likely to be held by the Foundation underlying the SingularityNET.

If the S-Coins granted have a maturation date that is significantly further in the future, then the currency, goods or services granted may be utilized for the general benefit of the SingularityNET. The logic here is that the S-Coins are being used to obtain future AI services; and the funding used to purchase them used to boost the SingularityNET so that it will be able to provide these services better in future.

3.6 Sale of T-Coins

T-coins can be purchased from the SingularityNET for immediate usage, in exchange for fiat currency, cryptocurrency or other liquid financial instruments. When a T-coin is thus purchased, the currency or other instrument provided as part of the transaction is likely to be held by the Foundation underlying the SingularityNET. The Tnergy needed for the purchased T-coins must be subtracted from the Reserve.

T-coins can also be sold to the SingularityNET, in exchange for fiat currency or cryptocurrency (or potentially other liquid financial instruments). In this case the T-coins sold go into the Reserve, and the funds are paid to the seller from the funds obtained via prior exchanges of T-coin for external funds.

Note that the exchange rate of T-coins for external currencies, is only indirectly related to the exchange rate of S-coins with future maturation dates for external currencies. T-coins get present services, whereas S-coins with future maturation dates get future services.

3.7 When S-Coins Mature

What happens when S-coins reach maturity? At the point an S-coin matures, it can be exchanged for T-coin, which can then be either used to get AI services or exchanged for external currency such as Ether or USD. The S-coin holder will profit if the exchange rate of T-coin for USD has increased since the time of purchase of the S-coin.

Consider a simple example. An S-coin denominated x, is a right to obtain x% of the total amount of T-coins at a certain point N years (or N minutes, etc.) in the future.... So if the total Tnergy is 1000, then an S-coin denominated 10 with a 10 year maturation, gives a right to obtain 1% of the Tnergy existing 10 years in the future. If there is 100,000 Tnergy total 10 years in the future, then the S-coin holder has a right to get 1000 T-coins at that point. The Reserve has got to have that many T-coins in it. And the S-Coin holder profits if 1000 T-coins at the point 10 years later, is worth more in USD than 10 T-coins at the time of purchase. This will happen, roughly speaking, if the total amount of "USD equivalent" in daily transactions in the system (the USD equivalent amount of "transaction volume") is higher 10 years later than it was at time of purchase.

4 Basic Equational Model

We now give a few simple equations encapsulating the phenomena reviewed above.

The amount of T-coin owned by agent a at time t and created at time s may be denoted $T_{a,s,t}$; we then have

$$T_t^c = \sum_{a,t} T_{a,t} = \sum_{a,s \in [t,t-t_{exp}]} T_{a,s,t}$$

where t_{exp} is the time it takes a T-coin to expire.

The amount of T-coin transferred from agent a to agent b during time interval I may be denoted M_{abI}.

We then have

$$T_{a,t} = T_{a,t^*} - \sum_b M_{ab(t^*,t)} + (1 - \lambda_{\text{transaction}}) \sum_b M_{ba(t^*,t)} - T^{\text{expiry}}_{a(t^*,t)} + S^{\text{redeem}}_{a(t^*,t)} + T^{\text{purchase}}_{a(t^*,t)}$$

where

- $t^* < t$ is a time point prior to t
- $T^{\text{expiry}}_{a(t^*,t)}$ is the amount of a's T-coin that has expired in the interval (t^*, t)
- $T^{\text{purchase}}_{(t^*,t)}$ is the amount of a's T-coin that has been purchased via external agents in the interval (t^*, t)

Here $\lambda_{\text{transaction}}$ is the transaction fee, which decomposes into

$$\lambda_{\text{transaction}} = \lambda_{\text{operational}} + \lambda_{\text{benefit}}$$

The amount of benefit-rights ("B-coin") possessed by agent a at time t is

$$B_{a,t} = B_{a,t^*} - B^{\text{redeem}}_{a(t^*,t)} + B^{\text{reward}}_{a(t^*,t)} + \lambda_{\text{benefit}} \sum_b M_{ba(t^*,t)}$$

On the other hand, the amount of S-coin possessed by agent a at time t is given by

$$S_{a,t} = S_{a,t^*} - S^{\text{redeem}}_{a(t^*,t)} + S^{\text{purchase}}_{a(t^*,t)} + (1 - \lambda_{\text{expiry}}) T^{\text{expiry}}_{a(t^*,t)}$$

where λ_{expiry} is the expiry fee. Here S^{redeem} and S^{purchase} refer to the amount of S-coin redeemed and purchased at a given point in time (noting that each S-coin may have a different maturation date). One could also write an analogous equation for the amount of S-coin with maturation date t' held by agent a at time t, i.e. $S_{a,t',t}$.

The amount of Tnergy reserve possessed at time t is

$$R_t = R_{t^*} - B^{\text{redeem}}_{(t^*,t)} - S^{\text{redeem}}_{(t^*,t)} + \lambda_{\text{expiry}} T^{\text{expiry}}_{(t^*,t)} + \lambda_{\text{transaction}} \sum_{a,b} M_{ba(t^*,t)} + + \sum_{t'} S^{\text{purchase}}_{(t^*,t,t')}$$

Here e.g. B_I is the total amount of Tnergy that is converted to T-coin for expenditure on benefit tasks in time interval I, summed over all agents a; i.e. $B_I = \sum_a B_{aI}$.

The amount of external currency reserve (considering for simplicity the case where there is just one external currency type involved) is

$$F_t = F_{t^*} - F^{\text{cost}}_{(t^*,t)} + F^{\text{profit}}_{(t^*,t)} + \sum_{t'} c^S_{t,t'} S^{\text{purchase}}_{(t^*,t,t')} + \sum_{t'} c^T_t T^{\text{purchase}}_{(t^*,t)}$$

where

- $c^S_{t,t'}$ is the cost (in external currency) of buying one unit of S-coin, at time t, with maturation date t'
- c^T_t is the cost (in external currency) of buying one unit of T-coin at time t
- F^{cost} refers to external expenses, e.g. server time, paying for work done in fiat currency, etc.
- F^{profit} refers to external profits, e.g. interest on fiat currency that is invested while being held

5 Brief Comments on Voting and Rating

While this document mainly pertains to economic logic, brief mention of the related issues of voting and rating may be worthwhile.

SingularityNET will involve a democratic governance mechanism, in which different issues are voted on by different classes of shareholders:

- Some by holders of S-coins with maturation dates beyond a certain minimum time period. Voting on issues especially pertinent to the long-term nature of the network may appropriately be voted on by S-coin holders.
- Some by holders of "T-points," where an agent's T-points are a time-weighted sum of the face values of T-coins they have recently utilized to pay for transactions in the network. Voting on specific points regarding the detailed near-term operation of the network (e.g. the specific APIs used for obtaining AI services and exchanging data, etc.) may appropriately be voted on by T-point holders.
- Some by holders of "B-points," where an agent's B-points are a time-weighted sum of the face values of the B-coins they have received for carrying out benefit tasks. Voting on issues related to Benefit projects may be done according to benefit points. (Nodes that carry out undesirable behavior may also potentially receive negative benefit points.)

Some issues may require voting by more than one class of shareholders. For instance, criteria regarding what qualifies as a benefit project may sensibly be determined via a combination of B-point holders and S-coin holders; whereas specific mechanics of B-coin utilization may be determined by B-coin holders directly.

Ratings of agents by other agents may also be given in various dimensions, e.g.

- quality of results provided (either in general, or for a particular API call or class of API calls)
- timeliness of results provided (either in general, or for a particular API call or class of API calls)
- degree of agreement of this agent's ratings with other agents' ratings (either in general, or for a class of API calls)
- degree of agreement of this agent's ratings with other agents' *future* ratings (either in general, or for a class of API calls)

Potentially, the ratings of an agent's services may be used to weight their votes (presumably via some nonlinear formula). This may be especially appropriate for voting based on T-points.