Implementation of a new stablecoin system based on sophisticated AI and blockchain for multiple ecosystem usage

[Notice]

The grapical resources in this document are not yet updated, and they will be fixed soon. ANX in the figures is just an arbitrary name, and it is not related with the erc20 token named ANX.

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[Abstract]

TOKA is a stable token that maintains the stability of the currency price by controlling the amount of money of the main token through a new AI-based decentralized algorithm. The main token of ANET is designed to respond flexibly to changes in market conditions, and to promote “stable value increase” in terms of taking into account the inflation in an ecosystem while maintaining the core values of cryptocurrencies such as decentralization, security, and scalability. Additionally, our multiple supply decision algorithm (MSDA) is designed such as that it can be implemtented and applied also to other existing ecosystems stabilizing their corresponding token. Moreover, our solution enables different existing ecosystems with different tokens to interact to each other, thereby, increasing the stability of the whole ecosystem.

1. Introduction

(1) Background

Recently, the stability of cryptocurrencies and its underlying blockchain and AI technology are considered to be the most important and critical fundamentals for the success of cryptocurrencies and their mass adaption in all industries. However, due the current inherent value volatility, cryptocurrencies are limited of being adopted as a means of payment (money) in real life. Therefore, the design of stable coins to eliminate the instability of cryptocurrencies has been the focus of new stable currencies (i.e. Tether, Digix, Petro, BitShares, MakerDAO) which can be differentiated into three stable coin models such as (a) Fiat collateralized, (b) Crypto collateralized, and (c) Non collateralized. However, these models still have disadvantages and limitations as shown in the table below.

	Description	Limitation
Fiat - collateralized model	Each and every token is collateralized by an equal amount of fiat currency held by a central custodian (such as a bank). Holders are guaranteed to redeem their token at any point for the stable value denominated in fiat.	In an effort to increase transparency, reserves are held in escrow accounts which offer daily auditing and legal protection for holders. The foundation platform, TrustToken, actually collaborated with different law firms (Cooley and WilmerHale) to develop a legal framework for TrueUSD.
Crypto - collateralized model	Crypto collateralized stable coins are backed by reserves of another cryptocurrency. This is done to address the centralization aspect of fiat collateralized tokens and achieve price stability in a completely decentralized ecosystem.	The biggest flaw is quite obvious here: the coin is backed by a potentially equally unstable cryptocurrency. To counteract this, crypto collateralized coins are often over-collateralized to absorb price fluctuations with the excess reserves.
Non - collateralized model (Algorithmic supply stable model)	Non-collateralized stable coins aim to closely mimic fiat currencies by not having any asset-backed collateral. Instead, price stability is achieved through an approach called seigniorage shares. It works on a foundational economic principle called supply and demand. If the coin is trading too high, the smart contract will mint more tokens to increase supply and therefore reduce the value of the coin.	But if the seigniorage is too low to buy enough tokens to increase the value to an adequate level, shares can be issued which gives the holder rights to future seigniorage (excess profits in the smart contract).

Tab. 1.1: *Stable coin models*

(Source: https://cointelegraph.com/news/stable-coins-analysis-is-there-a-viable-solution-for-the-future)

Above table has shown, that the main problem of overcoming the value volatility still remains due to monetary centralization, the limitation of simplified algorithm applied and difficulties of matching the core values of a decentralized blockchain. To solve this problem, it is necessary to implement an algorithm that can reflect various values and maintains a decentralized network.
Our new stable coin (ANET's TOKA) overcome these flaws by implementing a new algorithm based on blockchain and AI which reflects real economy values while maintaining the core values of cryptocurrencies such as decentralization, security, and scalability. Additionally, we also envisioned a multiple supply decision algorithm (MSDA) as a stablizer for different distributed ecosystems. This enables to easily interoperate our stable monetary sytem (TOKA-TOKA2 token system) to other blockchain projects.

(2) Features of our stable coin

1) ANET's TOKA is a stablecoin that contains a sophisticated AI methodology for the decision making process to estimate the currency value
    - Our stablecoin excludes the human intervention and inflexible algorithm, and adopts an AI-based decision making process.
2) The currency value is not bound to a specific currency (e.g. CNY, USD, BTC, ETH)
3) TOKA can be regarded as a new currency unit that reflects the market economy state and policy
    - Re-training ensures that our stablecoin actively reflects the necessary market economy and policy variables
4) Our "supply decision algorithm" (SDA) can be regarded as a set of flexible AI algorithms, and is designed to adapt to market conditions flexibly. Additionally, flexible monetary policy and governance are implemented through training and re-training processes.
5) Currency policy neutrality and stabilization via decentralized calculation
    - Decentralized stability calculation by AI engine on blockchain
6) Sub-chain's usage coefficient such as number of transaction can be set as input data to reflect the blockchain productivity to the currency value
    - Mutual reflection of the ecosystem via communication between Public chain and Private chain

7) Additionally, our “multiple supply decision algorithm” (MSDA) is designed such as that it can be implemtented and applied to interoperate with to other existing ecosystems stabilizing their corresponding token.
8) Moreover, our solution enables different existing ecosystems with different tokens to interact to each other, thereby, increasing the stability of the whole ecosystem.

(3) ANET’s Ecosystem

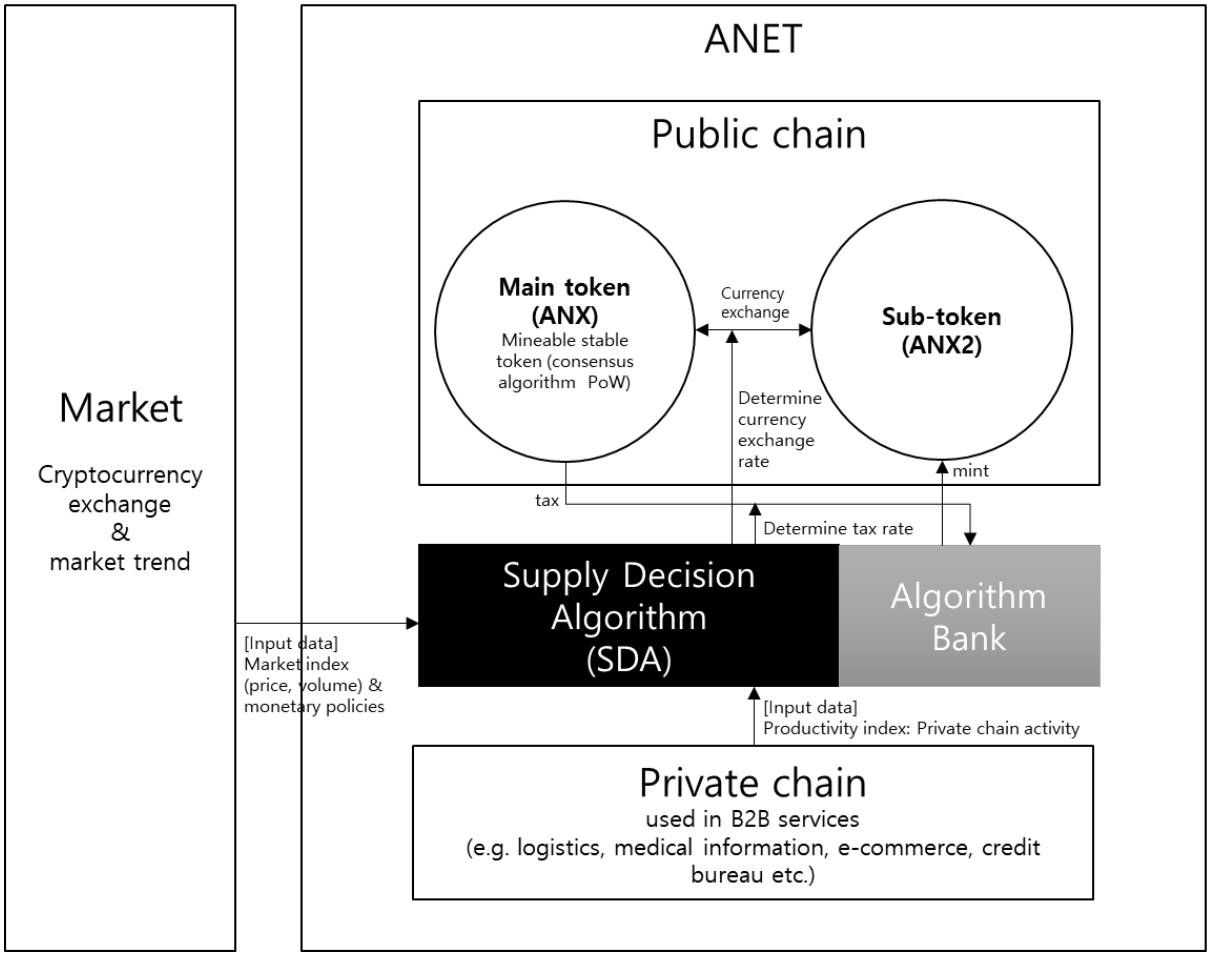


Fig. 1.1: ANET’s ecosystem (single-side)

ANET’s main token TOKA is an alternative currency that is designed to show the ideal increase in currency value so that it can be used in real life. Unlike the existing fiat money, it excludes centralized banks’ intervention, and maintains the neutrality of currency with the help of decentralized network (public blockchain) and decentralized algorithm (so called ‘Supply Decision Algorithm’, shortly SDA).

ANET target price is set according to the market index, productivity index, and monetary policies. *Market index* includes the price (demand and supply) and the trading volume. *Productivity index* is the activity of B2B private chains which are economically linked with ANET such as sub-chain's transaction usage.
Activity of the blockchains economically linked with ANET are used as the input data for the SDA to decide the currency value of the main token. *Monetary policies* keep the currency value more stable considering market volatility and liquidity. It is applied to the SDA training and the re-training process to make it react more flexibly to the market economy state. ANET's main token (TOKA) retains the structural stability with the reflection of various index on its evaluation.
Unlike other stablecoins, TOKA is a minable cryptocurrency. The SDA's algorithm bank flexibly controls the total supply of the cryptocurrency by taxing the mining. Taxing maintains optimal supply of the main token, and it also decides the quantity of the sub-token mining. Also, tax can be used for additional B2B service like airdrop-company-token model (* details about airdrop-company-token model are described in the use case section).

(4) Supply Decision Algorithm (SDA)

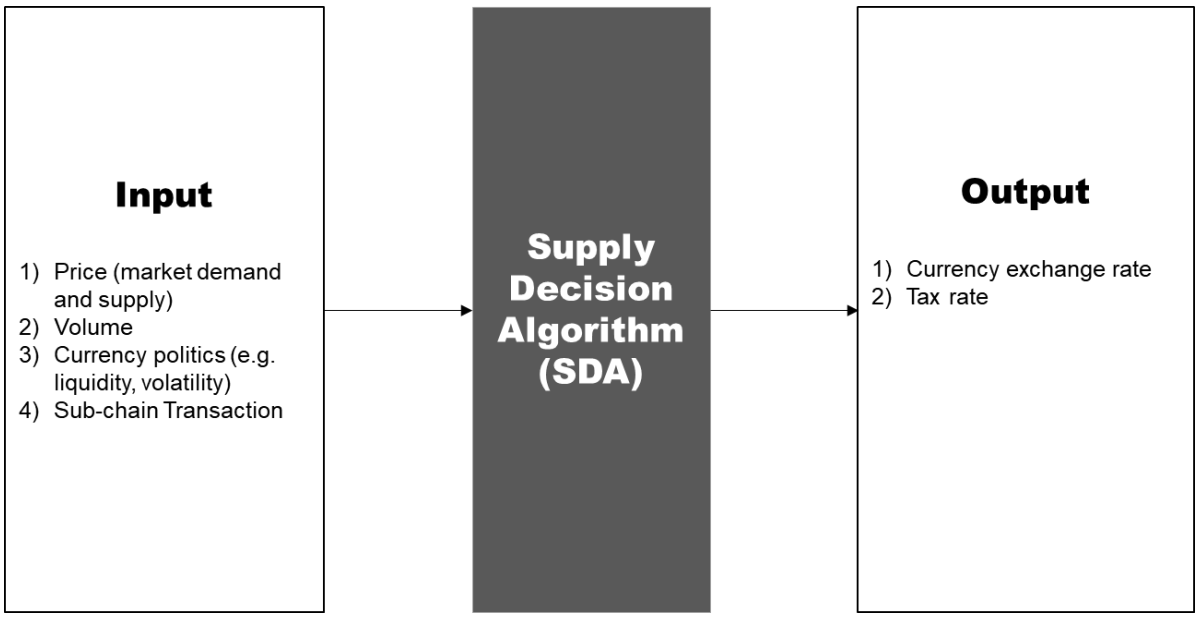


Fig. 1.2: *Single side "supply decision algorithm" (SDA)*

The SDA (Supply Decision Algorithm) is a Q-learning-based algorithm to keep the stability of the currency value. The algorithm detects market and blockchain states at intervals reflecting market demand/supply (price), trading volume, volatility and flexibility

according to the monetary policies, and it is trained to reach the target price by controlling the currency exchange rate and the tax rate.
Input data includes not only trading indices such as price and volume, but also monetary policies and sub-chain transaction amount.
Currency exchange rate between the main token(TOKA) and the sub-token(TOKA2) calculated by SDA economically encourages the token holders in exchanging tokens.
Tax rate determined by SDA decides the tax rate for mining of the main token. SDA controls the main token's circulating supply, and thus, it controls the token price by adjusting the currency exchange rate. The relationship betwenn the currency supply and the value is based on the "Quantity Theory of Money"

(4) Multiple Supply Decision Algorithm (MSDA)

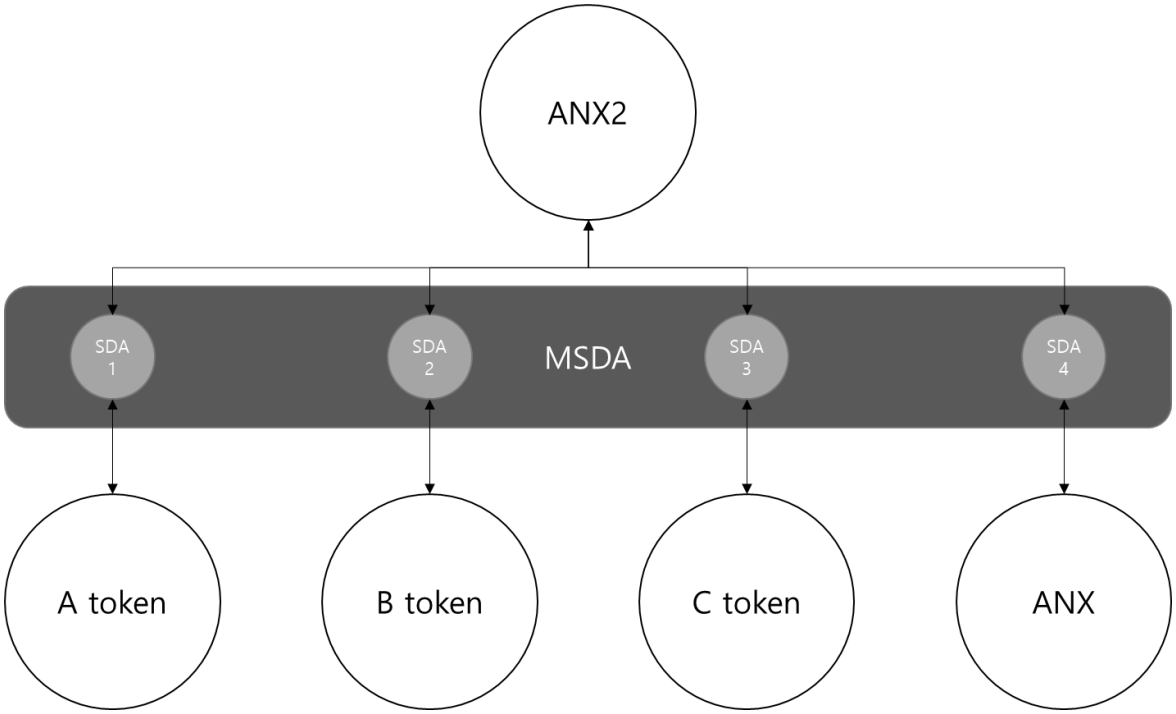


Fig. 1.3: "Multiple supply decision algorithm" (MSDA) that functions as a stabilizer

The "multiple supply decision algorithm" (MSDA) consists of different independent SDAs (stabilizers), each responsible for the stabilization of different tokens. This MSDA structure enables the interoperation of different token ecosystems through our "stabilized TOKA-TOKA2 token system". The exchange rate between each token and TOKA2 is set by different SDA algorithms acting independently.

The decision output of the MSDA (state which contains the currency rate) is recorded in ANET's public blockchain to prove that there is no error in each token’s exchange rate. The blockchain corresponding to each token and ANET’s public blockchain can maintain the data connectivity by the relay node. The relay node also allows the exchange of tokens to proceed in a decentralized network.

2. Operation Flow for Decision Making

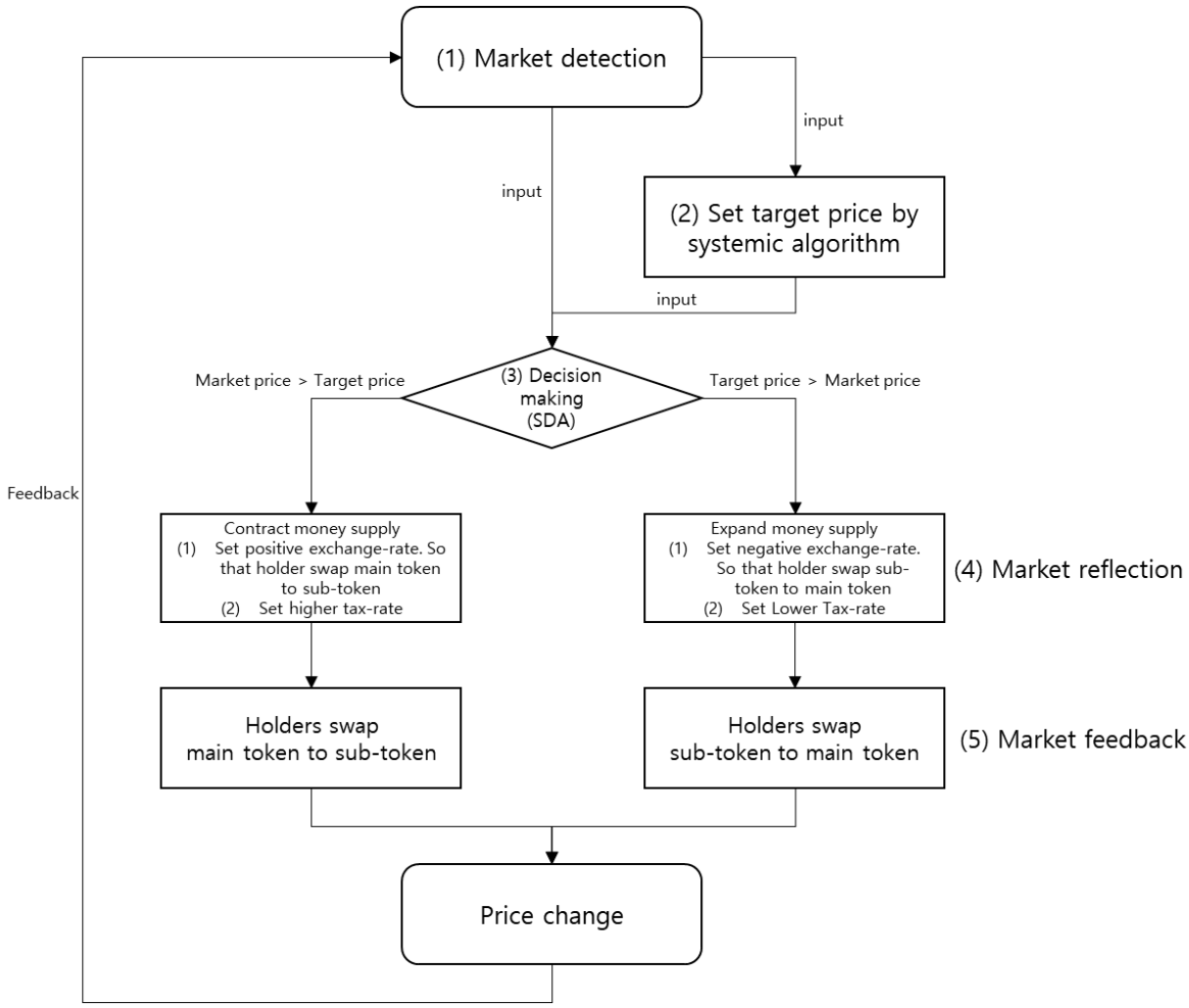


Fig. 2.1: Operation flow for decision making of supply decision algorithm (SDA)

(1) Market detection

Not only market index (price, volume) and sub-chain productivity (transaction activity) but also the liquidity and the volatility of market are detected on a daily basis. The detected value becomes the input data of the algorithm that is based on a learning system for setting up the target price. Moreover, It also becomes the input data value that participates in the SDA decision process to determine the currency exchange rate and tax rate.

(2) Set target price by systemic algorithm

Target price is computed by an algorithm based on a learning system. The detected market price in periodic cycle set the ideal price that is determined by monetary policy and aims for a stable annual rise of k % of the next cycle. Participation of decentralized

algorithms and blockchain nodes determines the monetary policy and it allows the SDA algorithm to respond to market situation flexibly.

(3) Decision making

The SDA engine makes the decision based on the input data from detecting the market and the targeting price. It determines the currency exchange rate and the tax rate.

(4) Market reflection

Currency rate and tax rate which are determined by the SDA engine are reflected to the market. It opens a market for exchanging based on the exchange rate between the main token(TOKA) and the sub-token(TOKA2), and it reflects the public chain mining tax rate.

(5) Market feedback (price change)

Token holders act reasonably according to the tax rates in the exchange market between the main token(TOKA) and the sub-token(TOKA2). As a result of market participation, currency circulation changes, and the price of the currency reaches the target price (the relationship between currency circulation and the value of the currency). The price set from market feedback returns to the first point (1) to participate in the market detection process.

3. Structure - AI Engine, Token, Blockchain

3.1. AI engine structure

The SDA algorithm is basically comprised of following three AI engine models: (a) *Deep learning engine*, (b) *Probablistic engine*, and (c) *Reinforcement learning engine*.
The decision making of SDA is calculated through an ensemble process of these three engines.
1) The deep learning engine computes thes rates such as the tax rate and the exchange rate quantity
2) The probablistic engine, the most powerful decision making engine, determines the tendancy of the tax rate and the exchange rate (binary decision: applied or not be applied)
3) The former two engines make decisions based on trained data, whereas, the reinforcement learning engine is an unsupervised learning engine that deals with unexepected situation of the market (e.g. default, bankruptcy, unexpected excessive fluctuation)
The structure of the decision engine based upon artificial intelligence (AI) is as below.

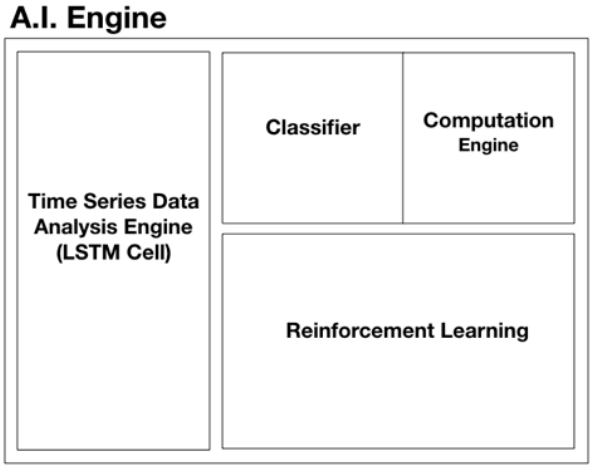


Fig. 3.1: AI engine structure

(1) Time Series Data Analysis Engine (Deep learning Engine)

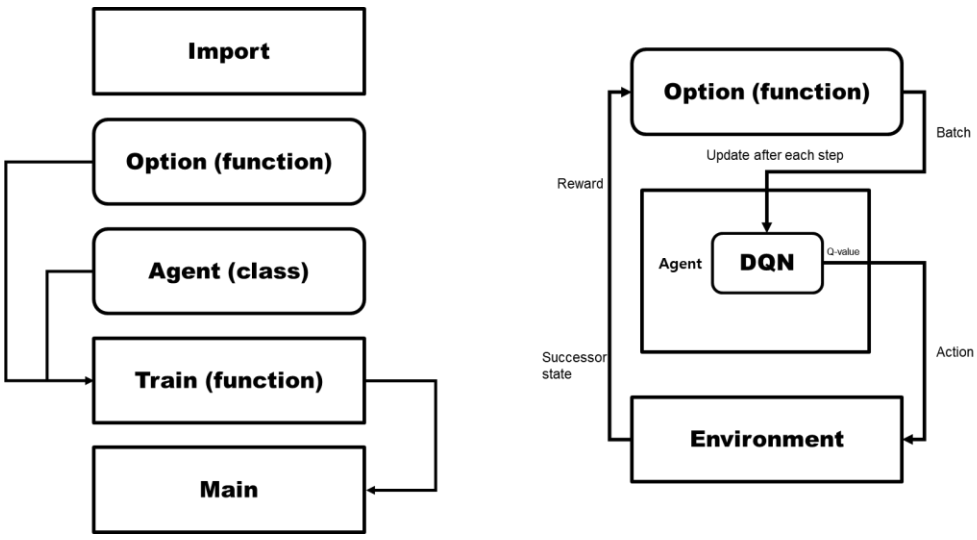
This engine analyzes and trains time series data, and computes real time decision through historical data and decisions. The input for this engine consists of [Price, Volume, PVC, etc.], and the output follows the form of [Tax_rate , Exchange_rate]. With the “Gradient Descent Algorithm”, loss function is computed as Loss = -exp(Profit) with the function of profit as Profit = (delta P * Decision) / Volume. The algorithm described above is operated with the AdamOptimizer, and the LSTM Cell is used to analyze and to train time series data.

(2) Classifier, Computation Engine (Probablistic Engine)

Classifier uses the method of the Gaussian Process, GMM, K-MC and the Regression to divide the situation of the coin market and the blockchain using historical data. Through this classified decision, numerical data including information of tax rate and exchange rate is arithmetically operated by computation engine.

(3) Reinforcement Learning Engine (RL Engine)

The learning of the SDA algorithm is based on the 'Q-learning' algorithm based on the value of the 'Q-function' of the 'Deep-Q-Network (DQN)' that belongs to the 'Agent'. 'Agent' selects the action by the 'Epsilon greedy method'. This action is applied to the 'ANET blockchain environment' to calculate the 'Reward' and the 'Next state'. This history is stored in the 'Replay memory' and updates the internal variables of DQN through the 'Experience replay' method. In the above learning and internal variable updating process, 'Q-learning' is performed through the optimization method by the 'slope descent method' as follows. The diagram below is the structure of the SDA engine and the error function used in the learning.



$$target = reward + \gamma \times \max_{a'} Q(s', a')$$
$$prediction = Q(s, a)$$
$$Loss = \frac{1}{2}[target - prediction]^2$$

Fig. 3.2: SDA engine structure and the applied error function

The entire decision of the engine is computed with the ensemble method of each engine.

3.2. Token structure

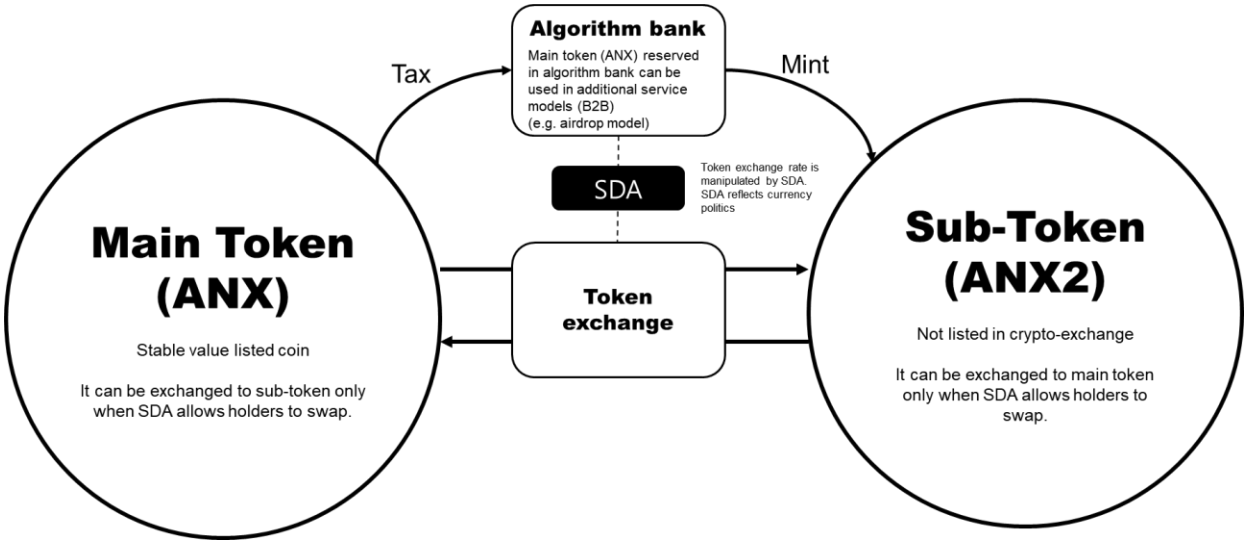


Fig. 3.3: Token structure

The price of the main token is maintained by the method of “Elastic Coin Supply” based on the “Quantity Theory of Money”. The Quantity Theory of Money is the theory of money supply that can effect the market price. The details are as below.

Expand the money supply.
If a central bank sees that prices are going down, it can expand the money supply to bring them back up.
Contract the money supply.
If a central bank sees that prices are going up, it can contract the money supply to bring them back down.

Based upon this theory, currency exchange protocol operates as below.

SDA engine detects circulating supply and price of token on blockchain environment and assigns this information to AI computation engine periodically.
In case of basis, central market detects the aggregate demand = (coin price) * (number of coins in circulation), and decides the number of coins in circulation corresponding to k% change of the coin price.

demand_before = (coin price) * (number of coins in circulation_before)
demand_after = (coin price*(1+k/100)) * (number of coins in circulation_after)

For satisfying demand_before = demand_after, the supply manipulation of demand_after = demand_before * (1+k/100) is needed.
The manipulation of supply of coin is applied to the blockchain system by the “Three-Token System”.

Even stabilization algorithm of basis can have an advantage of reflecting the blockchain environment very accurately. However, its weaknesses are the inflexibility of decision process, and the difficulty of assignment of new variables except supply and price, whereas, the SDA algorithm can train other influential factors and responds to unexpected events flexibly.

* The SDA algorithm can manipulate token supply by exchanging the main token and the sub token.

When supply expansion is needed
Exchange from sub token to main token is required. In this case, the exchange rate is 1:1.
When supply contraction is needed
Main token holders can buy 1 sub token for less than 1 main token at auction. In this case, sub token is guaranteed to be exchanged to 1 main token, so the efficiency of SDA algorithm is ensured.

3.3. Blockchain structure

(1) Overall Structure

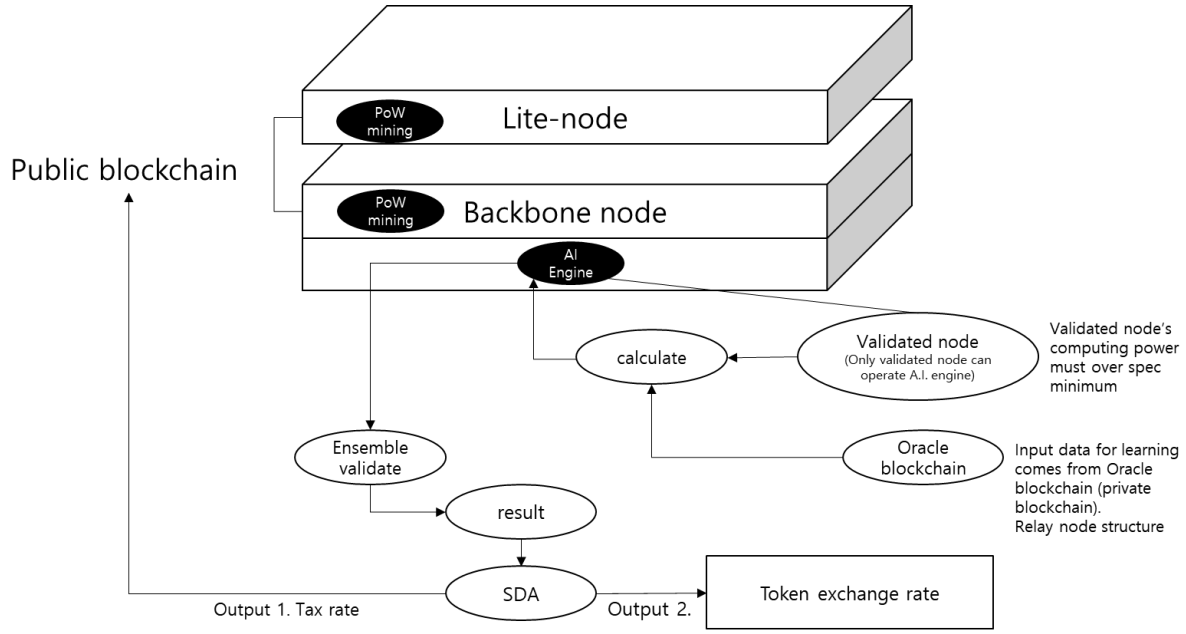


Fig. 3.4: *Blockchain structure*

ANET introduces the mini-blockchain structure to improve blockchain scalability and block processing speed. The mini-blockchain structure consists of three components which are 1) the mini-blockchain, 2) the account tree, and 3) the proof chain. In the structure, non-empty accounts and their balances are stored in an account tree that is a decentralized balance sheet.

The main advantage is that it removes the necessity of storing old transactions. Each block of a mini-blockchain uses the master hash for proof of work calculation as the existing blockchain block uses its genesis block. Therefore, we only need to maintain a mini-blockchain, a part of the blockchain instead of the whole blockchain. Even so, it is secure as it requires significant resources for an attacker to fabricate a mini-blockchain. However, the weakness is that older blocks will be deleted. In order to solve this vulnerability, we discard only the transaction data and save the block header in the proof chain when we delete older blocks. With the proof chain, we can verify the mini-blockchain with the highest accumulated difficulty as we could with the existing blockchain.

The nodes which maintain the public chain are of two kinds - Lite Node and Backbone Node. Lite Node makes good use of the mini-blockchain and keeps only a part of the entire blockchain, requiring low computing power; it can work even on a browser.

Backbone Node processes the whole blockchain and works as a web server for the Lite Node working on a browser. Some of backbone nodes with more power participate in the AI calculation. AI calculation input comes from a separate Oracle blockchain. Oracle blockchain is a private blockchain that supports private chain service for businesses, and it transmits the coefficient of private chain usage to the AI engine. Pre-trained AI engine on a backbone node calculates the token exchange rate based on the incoming private chain usage coefficient and decides the final token exchange rate through P2P communication among AI engines based on the “ensemble algorithm”.

(2) SDA Algorithm with Blockchain

SDA algorithm interacts with blockchain environment as the way below. SDA engines is spread with ANET’s blockchain nodes and go through the computation process of dispersion.

Through the ensemble method, the SDA algorithm is able to expect stable computation with each AI engine.

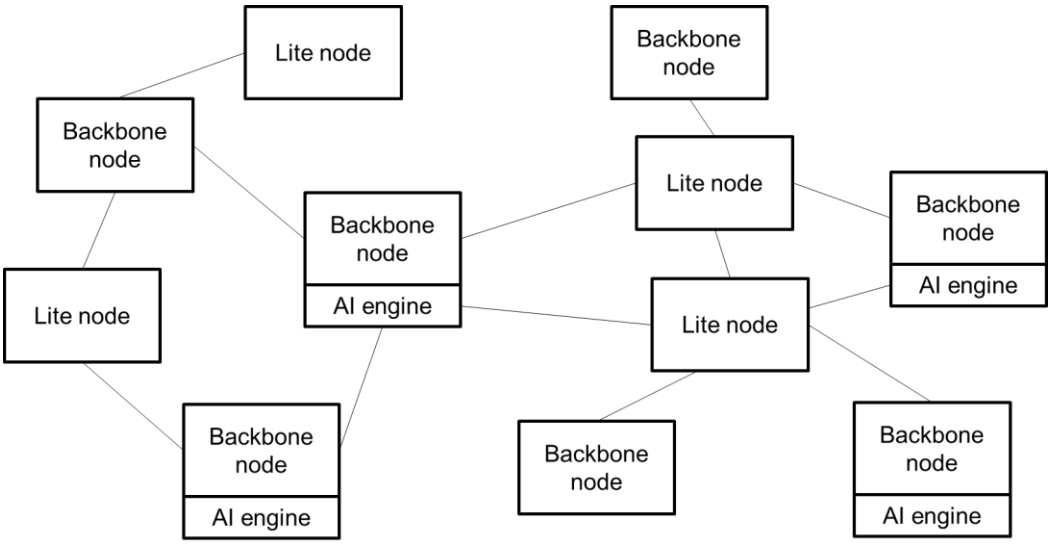


Fig. 3.5 *Interaction of the SDA algorithm with blockchain environment*

(Some of backbone nodes with more power have AI engine attached.)*

Trained AI engines are interlocked with a few backbone nodes which have strong computing power. By doing so, AI engines can compute each decision in a dispersed way and the decision of engine linked to the P2P network is applied to the entire blockchain.

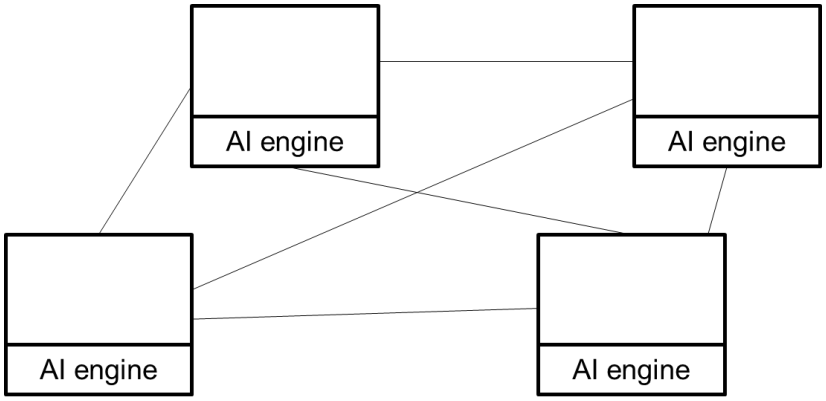


Fig. 3.6 Decision of AI engines linked in a P2P network

(Each AI engine calculates the "productivity control value" to stabilize the coin)*

Some of backbone nodes are pre-selected based on their computing power to load the AI engines. So each AI engine holds the peer list of other AI engines. AI engine-loaded nodes communicate with other AI engine-loaded nodes which are registered on the peer list, sharing their calculated result. Each node picks the mode of the shared calculated results and its own calculated results as the final value, and broadcasts the value and its frequency to the others. Lastly, each node compares the transmitted calculated results and their frequencies with its own calculation, and adopts the more frequent value as the end result.

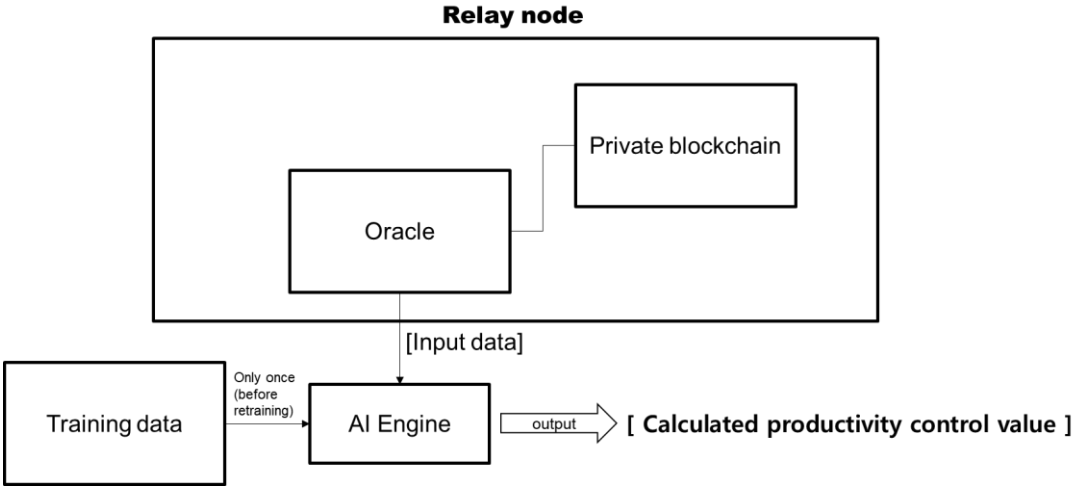


Fig. 3.7 Dataflow from private to public chain using the relay node"

The quantity information such as the number of transaction from the private chain is transferred to AI computation nodes of the public chain via Oracle. The illustration above describes the dataflow of how the information from private chain is assigned to the computation nodes of public chain using the relay node.

4. Test Results

This simulation is about the efficiency of engine that reflects various indexes. The plots below shows the SDA engine's decision simulation results of dealing with price fluctuation for four month. The data set is comprised with ethereum price information of 2017.

4.1. Deep Learning Engine

After training the machine with a data set of eight months, we have checked the reaction of the Tax_rate and the Exchange_rate from the Deep learning engine responding against the price fluctuation of the next four months.

1) Tax_rate

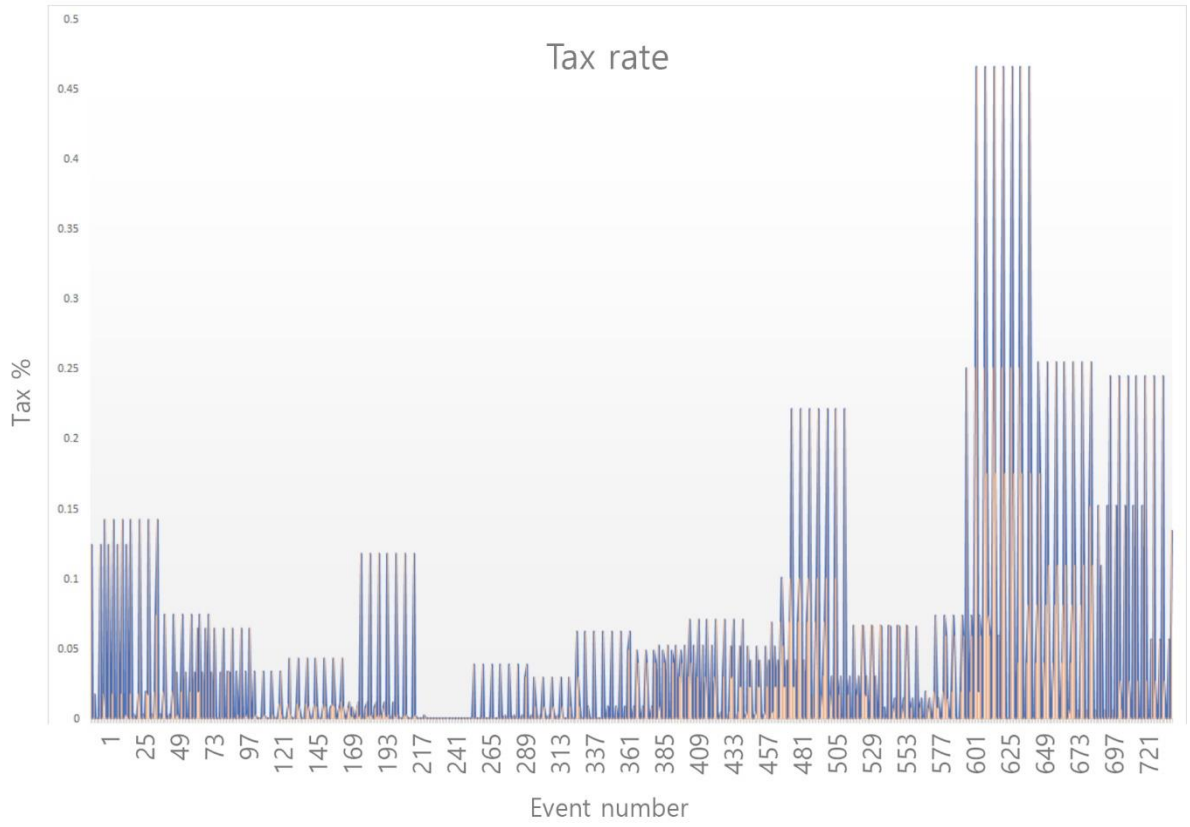


Fig. 4.1 *Simulation reaction of Tax_rate from the deep learning engine*

On the whole, the ideal tax rate plot and deep learning engine's decision bear a similarity with each other, and it has very low RMSE error of 0.00283.

2) Exchange_rate

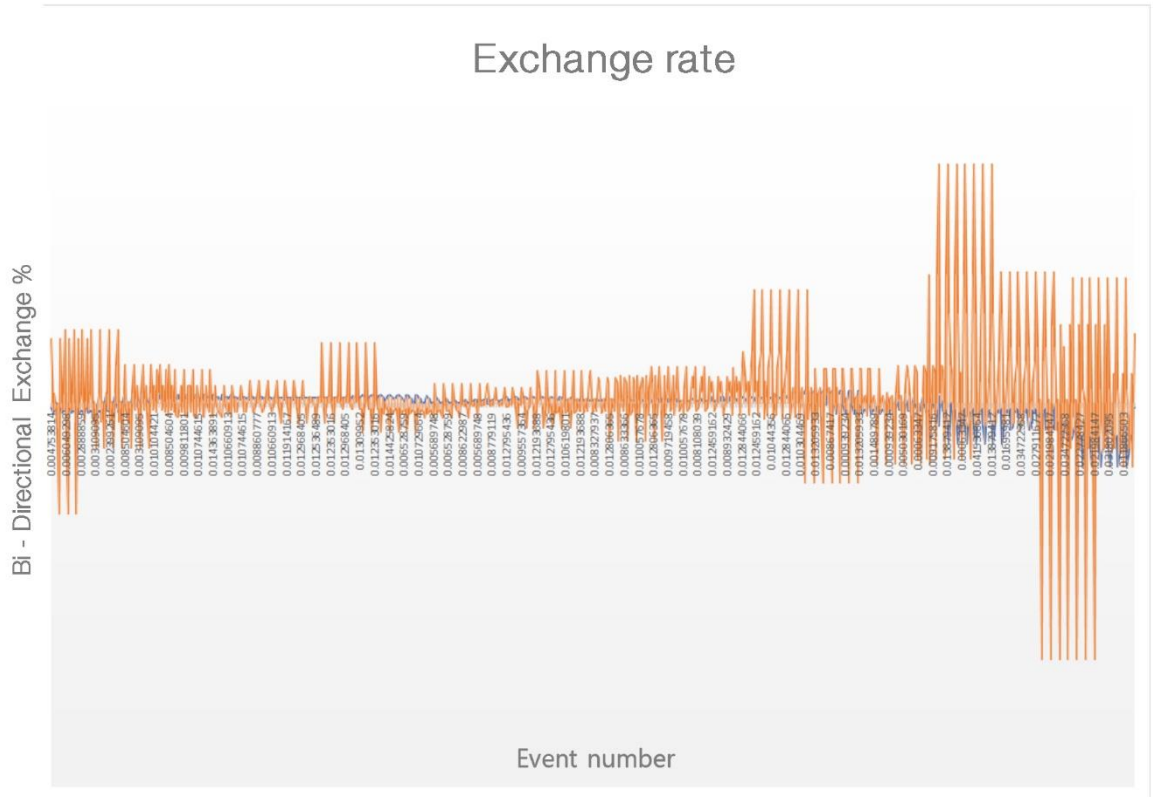


Fig. 4.2 Simulation reaction of Exchange_rate from the deep learning engine

The deep learning engine's exchange rate decision has the 88% accurate tendency with ideal exchange rate, and the RMSE error is 0.0192.

4.2. Probablistic Engine

The second engine (probablistic engine) consists of multiple classifiers and one computation module. The plots below are the results of simulation of classifiers.
The results describe how well classifiers discriminate the situations and make decisions.
After training 8 months data, 4 months data is used to test the efficiency of the classifiers.

1) Tax intensity

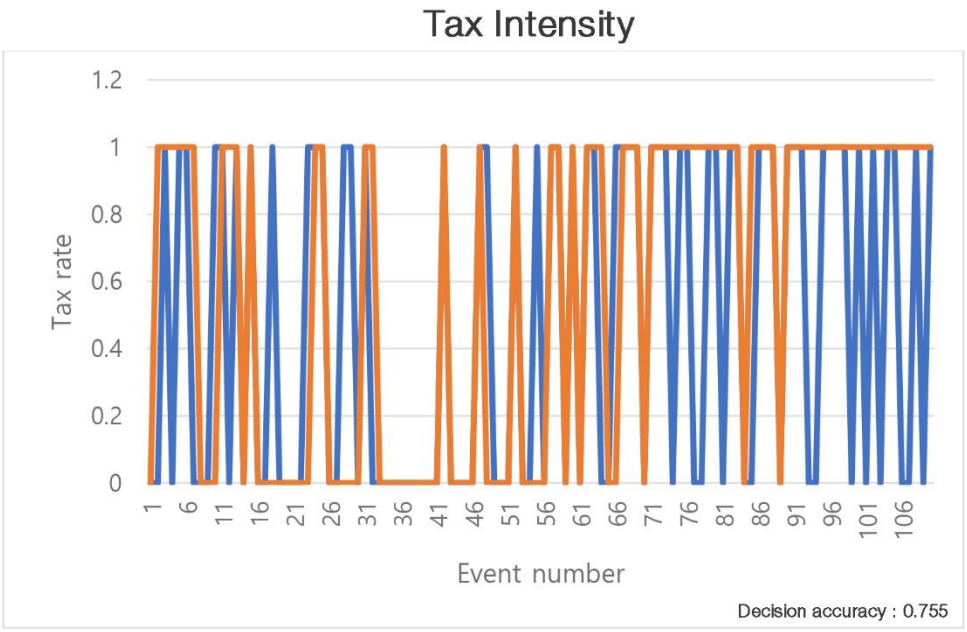


Fig. 4.3 *Simulation reaction of Tax_Intensity from the probablistic engine*

The intensity of binary value of 0 and 1 of ideal and decision values were compared. The decision accuracy is around 0.756.

2) Exchange Intensity

Fig. 4.4 *Simulation reaction of Exchange_Intensity from the probablistic engine*

The intensity of binary value of -1 and 1 of ideal and decision values were compared. The decision accuracy is around 0.836.

Through the result of simulation, we have proven the efficiency of the decision from the SDA engine. This means thatour designed AI engine is able to deal with unexpected price fluctuation by reflecting various situations and indexes to currency politics.

5. Use Case

Airdrop-company-token model (use case for mining tax)

The “Airdrop-company-token model” is a business model that issues a company token that is economically correlated to the main token, and receives a main token airdrop depending on the activity of the company’s private blockchain. A company can raise money through a token sale system using the main token, and participate in private blockchain based services.

* Company Token is an asset token that does not function in a block chain service.

- **B2B E-commerce platform**

Blockchain solution for transaction payment between e-commerce companies with different borders.

This model is well suited for issuing guaranteed cash based on private chain operated through certificated nodes.

The company secures funds through the company’s token fundraising, and the foundation issues guaranteed cash to the company with the amount of money raised by the company as a guarantee.

E-commerce companies use guaranteed cash to pay commodities between companies.

Guaranteed cash supports trustless instant payment through smart contract.

With this blockchain solution, e-commerce companies can overcome problems such as inconvenience of contract, delay of payment, difficulty of payment for payment.

- **Token Structure in Airdrop-company-token model (example)**

Layer1: Main token	The cryptocurrency maintained through the public blockchain. Means of raising the company token. Maintaining structural stability based on SDA. Stable token that maintains an ideal price increase rate. Reserve main token on algorithm bank through mining tax. Airdrop to company token holders according to dividend rate. * The nodes of the public blockchain have the right to monitor whether the private chain transaction is normally performed.
Layer2: Guaranteed cash	Private token for payment between companies. Value assurance through the foundation. As a private blockchain, it performs the function of the service.
Layer3: Company token	It is an asset token that does not function in a block chain service. Investors buy company tokens through main token. Later, investors will receive main token airdrop according to the criteria of the algorithm bank. The company's private blockchain activity and company's credit rating will determine the dividend rate. (Credit analysis)

Details

(1) The company communicates with the foundation to raise funds through main token.

(2) The foundation raises funds for the company.

(3) Participation of investors (individual or fund)

- Purchasing main token from foundation or exchange
- Purchasing the company token with the main token

(4) Funding result

- Investor: Holding the company token. Receiving the Main token later.
- Company: Holding the main token.
- Foundation: Acquiring the asset through the sales of main token

(5) Issue of guaranteed cash: Main token owned by company should be frozen. The foundation issues the guaranteed cash equal to the amount of collected cash, and gives it to the company. (If you want more issues, the company should have more main token)

(6) Exchange of guaranteed cash to fiat money: Foundation receives the CBT coin equal to the amount of guaranteed cash and gives back the fiat money of the equal value.

Features

(1) Sustainable fundraising model

(2) Increasement of demand of main token as increasement of utilization of service

[Summary and Conclusion]

Stablecoins are of high importance and critical for the sustainable success of cryptocurrencies and their mass adaption in the token economy. Existing stablecoins are centralized (e.g. Tether, Maker) and implements unflexible algorithms (e.g. Basis, Fragments) which do not critically reflect economic crisis or unexepected situation of the market such as default, bankruptcy, unexpected excessive fluctuation. Moreover, stablecoin solutions which ensures the interoperation of different token ecosystems do not exist.

ANET has shown that its stable token TOKA maintains the stability of the currency through a new AI-based decentralized algorithm. TOKA is designed to respond flexibly to changes in market conditions, and to promote “stable value increase” in terms of taking into account the inflation in an ecosystem while maintaining the core values of cryptocurrencies such as decentralization, security, and scalability. Additionally, the interoperation of different token ecosystems is ensured through our multiple supply decision algorithm (MSDA) as a stablizer.

With the process of training AI engines whose price regulation factors are tax rate and exchange rate between two different tokens, the simulation have shown meaningful results. The AI based algorithms are able to make a decision for long term efficient price regulations using blockchain with successive re-trainig processes. Moreover, reflection of index which can not be included to the training process on existing systemic algorithm and numerical (quantitative) data from qualitative data is the most valuable advantage of our proposed stabilization solution.

Current stablecoin models based on existing algorithms have no collateral and face difficulties to obtain wide public trust and acceptance, but they provide benefits such as seignorage for exchange of money. TOKA-TOKA2 token system based on AI algorithm have shown to overcome the flaws of existing stablecoin models, and additionally, solve the role played by the central bank through reliable artificial intelligence, and to implement a monetary system that operates in a distributed blockchain, that is stable, trustless, and reflects the real economy. How to get the public's trust 'is the biggest challenge of the stablecoin.

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