Unlocking the Potential of Time Tokenization for the Decentralized and Community Market

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***Abstract*—We have developed a modern solution for time tokenization in Decentralized Finance (DeFi), where anyone can create value from time simply by waiting for its passage, as the concept suggests, and using or exchange it on an open and community first-tier market. Our novel approach for time tokenization, the TIME token, is an Ethereum Request for Comments 20 (ERC-20) token whose value is directly related to the users' engagement, while the community can also take substantial economic advantage from its adoption. With the potential to become a well-established asset, it can improve the current state of DeFi and time tokenization in terms of system design and market cases.**

***Index Terms*—Community markets, DeFi, EVM environment, smart contracts, tokenization.**

I. Introduction

Time is a valuable resource, both for its use and management. It is essential for calculating interest, releasing assets, setting conditions, pricing, and more. In situations where all other resources are abundant, time presents itself as a constraint that can be challenging to manage.

We propose a practical and reformulated approach to time tokenization that allows anyone to handle time in a tangible form. Despite the idea of turning time into a tokenized asset is not new, we noticed that existing approaches lack proper mechanisms for value creation while maintaining public openness. So, with our approach, we recognize that the tokenized time, like any other asset, should be accessible to anyone while also being scarce and limited to prevent excessive inflation and preserve its core value.

Why tokenize time? It is a valid question. But, we can pose another: why not? Time is a finite resource like any other, and the primary function of a token is to capture the economic value within an ecosystem [1]. So, why not capture the value of time in a tokenized form? In a world where everything can and is being tokenized [2]–[6], proposing an open, fair, egalitarian, and accessible environment for the pricing, trading, and offering of time by any interested party is something that aligns with today's expectations.

The real challenge lies in turning time into a tangible asset while preserving all the characteristics mentioned before. Everyone receives and consumes the same amount of time every day, so how can it be treated and measured like cash or cryptocurrency while still maintains its value despite being constantly produced? Can time really be considered money? Here we aim to provide a good solution with our approach for time tokenization.

We present TIME, a smart contract developed to manage time as an Ethereum Request for Comments 20 (ERC-20) token. This smart contract regulates the production of time as an asset and controls stakeholder engagement in a sustainable manner, also it offers a decentralized public market for the token fully supported by the community. The code is simple, open, independent, not upgradable (immutable), and has no administrator, ensuring that all parties interact equally with the contract.

This paper solely covers the functions of the smart contract. Nevertheless, by connecting the wallet to the provided application [7], users can easily identify three main services: production, exchange, and community pool. We will briefly and objectively address each of these services in this paper, while keeping the technical implementation details limited to the source code. The source code is verified, linked to the contract address, and publicly available for review on the block explorers of the respective networks where it is deployed.

At the end of this paper, we delve further into the potential of time tokenization by outlining several practical use cases that can be explored by our tokenized time solution in the near future. Our aim is to present the community a foundational and profitable tool for managing time in a tokenized manner. We also offer an improved understanding of the concept and its potential applications. Whether viewed as a starting point for further development, or as an innovative solution in its own right, our hope is that our TIME token will spark new ideas, projects and creative solutions for the management and utilization of time in the Decentralized Finance (DeFi) space.

II. Review

To the best of our knowledge, our approach to time tokenization is unique in the current DeFi market. However, we have identified only two similar proposals that are worth mentioning.

The authors of [8] have developed a platform known as ChronoBank that connects freelancers and employers through blockchain technology. To enter the system, users must first purchase governance tokens (TIME) from a private crowdsale. Once inside the system, they can create and trade Labor Hour Tokens (LHT), which serve as the means of exchange for labor hours. While the proposal offers an innovative solution for the labor market, it restricts access to the system only to those who have acquired the governance tokens and limits its use case to just the exchange of labor hours.

In [9] the authors propose the creation of value from time tokenization using the Income Per Minute (IPM) token. The Timers application is designed to manage user interactions and system evolution. The total supply of IPM tokens gets started with a fixed value and capped at an initial crowdsale. The remaining tokens, representing time earnings, are created through the Token Verification Minting (TVM) system, which serves as proof of value creation. The TVM is divided into two stages: in the first stage, tokens are proportionally distributed to holders on a daily basis, similar to a staking system, but only minted when claimed based on the number of new users entering and setting up the Timers app. In the second stage, IPM tokens are minted based on user engagement on the platform, including social activities and similar. Despite the interesting economic model, it is still dependent on the initial crowdsale and the value of time to be created is initially shared based on the size of the initial IPM acquisition, which is not fair from the perspective of equal access to time for all. Additionally, it relies on social engagement from the application.

III. Proposed System

We propose an Ethereum Virtual Machine (EVM) based smart contract, simple, written in Solidity and compliant with the ERC-20 standard. It aims to tokenize time, expressed in terms of numbered blocks, and provide a community market for its exchange on the network. Each token unit represents a registered block, counted from a starting point by an enabled address, and can be traded freely within the contract by any interested party. Any address can be enabled as a block counter, provided that the necessary fees for the protocol are paid. Such fees provide a certain level of backing for the token, ensuring that it has liquidity and a residual market value.

This section is structured as follows: we first describe the tokenomics. Next, we present our open and decentralized alternative local community market, designed to facilitate the exchange of tokens and the functions that can be called by users and third party platforms. Finally, we demonstrate how the fees for token production are dynamically calculated, which we consider as an important part of the system.

A. TIME Token Features

The TIME token operates as follows: (*i*) to participate in the system, a user activates his Externally Owned Account (EOA) address or the address of a smart contract deployed for the same purpose to start producing or "mining" TIME units; (*ii*) once an address is activated, it has the ability to mint TIME for itself based on the number of registered blocks that have passed since activation or since the last time the mint function was called.

To enable an address to produce TIME, the user must pay a fee to the smart contract by calling either the `enableMining()` or `enableMiningWithTimeToken()` function. The first function requires payment with the underlying network's native cryptocurrency, while the second requires payment only with TIME token units. The exact fee amount can be determined in advance by querying the contract. The fees collected will be used as initial liquidity to establish the proposed market, which consists of the TIME token and the underlying network's native cryptocurrency (e.g., TIME/ETH, TIME/MATIC).

The activation fee for an address in the contract serves three crucial purposes: first, to prevent inflation of the total supply by deterring any potential abuse of the system through automated scripts that could generate an excessive amount of the token. By requiring a fee, the scarcity of the token is maintained, as only participants who are willing to pay the fee will be able to generate it; second, to provide initial liquidity for trading by using the fees collected to create a residual market for the token to be exchanged with; and third, to incentivize the community, once a portion of the fees is distributed proportionally among the entire community, based on the amount of tokens held in wallets, similar to a staking system, in which the people participates and profits from it.

Suppose someone wants to start producing TIME for an address they control. The first step is to call the `fee()` function from the desired address (`msg.sender`) to determine the cost of registering the `enableMining()` function. A similar process is used with the `enableMiningWithTimeToken()` function, where the `feeInTime()` function is called instead. It is important to note that fees paid only with TIME tokens are burned and do not re-enter the market, whereas fees paid with the native cryptocurrency are added to the internal pool.

Once the address has been enabled, the participant can call the `mining()` function to start producing TIME tokens. As an example, if the address was enabled at block number 11000 and the `mining()` function was called and registered at block number 12000 by the same address, the smart contract will mint 1000 TIME for that `msg.sender` address. This amount is calculated based on the difference of elapsed blocks between activation and call. The process is illustrated in Figure 1. Additionally, the same function also mints a supplementary amount of TIME, equivalent to 1% of the newly created tokens (10 TIME in this case), for the `block.coinbase` address, which is responsible for registering both the transaction and block. This incentivizes other participants to join the ecosystem and ensures its sustainability in the long term.

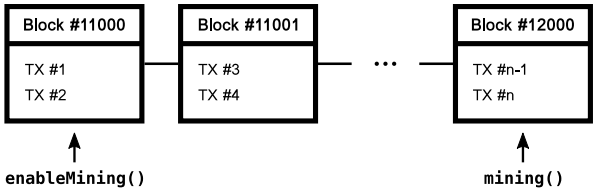

Fig. 1. Illustration of the TIME Mining Process across Registered Blocks.

After enabling an address, the participant can continuously mint TIME tokens at any block, with no call limitations, as the minted amount will always correspond to the number of blocks passed since the last `mining()` function call (tokenize time

action), neither more nor less. This means that an individual has the same "mining power" as an automated script with the same purpose. All participants must wait for a set number of blocks (some time) to be registered before they can produce a desired amount of TIME. It is important to note that the TIME smart contract does not take into account the timestamp information (from the `block.timestamp` global variable) as block miners can manipulate this information for their own benefit, potentially earning more tokens [10].

Finally, we emphasize that the block count system is exclusively assigned and maintained per address on the network. This means that each address operates independently with their own block count information, without any interference from other addresses. As a result, each participant with an enabled address essentially has their own personal time, which can be tokenized and used for various purposes. This allows for a fair and equal opportunity for all participants to generate TIME tokens and participate in the network.

B. Alternative Decentralized Community Market

The TIME token smart contract also offers basic functions of an Automatic Market Maker (AMM), acting as a simple Decentralized Exchange (DEX) for the TIME/ETH trading pair. If the smart contract is deployed on another blockchain, the trading pair would be TIME/native cryptocurrency of that network.

Investors seeking to purchase TIME can do so by sending the native cryptocurrency directly to the contract address or by calling the `saveTime(){value: ethAmount}` function and specifying the desired `ethAmount`. On the other hand, investors and users who already own TIME can exchange it for native cryptocurrency by calling the `spendTime(timeAmount)` function or by sending TIME tokens to the contract address and specifying the desired `timeAmount`. The exchange rate is automatically calculated using an adjusted version of the Constant Function Market Maker logic, which has been adopted by Uniswap V2: $x \cdot y = k$ [11].

Additionally, the current market rate can be easily obtained by calling either the `swapPriceNative(amountNative)` or `swapPriceTime(amountTime)` function. The former provides the rate in terms of the underlying network's native cryptocurrency, while the latter gives the rate in terms of TIME tokens.

The contract runs the AMM by featuring a 2% fee on each swap transaction that is split into four equal parts. The first part is added to the local Liquidity Pool (LP) to foment growth as more transactions occur, the second part goes to the development team's static address, the third part is transferred to the miner/validator responsible for registering the transaction, and the fourth part is distributed proportionally among all TIME token holders, fostering community engagement and incentivizing all participants. It is important to note that if the network does not provide a `block.coinbase` address, the third part of the fee will go to the development team. Token holders can claim their share of the fees by calling the `withdrawShare()` function (claim action). The fourth portion of fees is exclusively for TIME token holders in native cryptocurrency. TIME-paid fees for this portion are burned, not shared with the public.

Initially, the local AMM LP is established with TIME tokens and a fixed amount of native cryptocurrency from the fee paid when the first address is enabled. The goal of this internal LP is to provide liquidity for the contract from the start. To keep the local LP growing, we have also added a donation function, `donateEth(){value: ethAmount}`, where anyone can contribute by donating native cryptocurrency to the project.

C. Dynamic Fee Calculation

Our approach to onboarding new stakeholders is conservative. Entry into the system is contingent upon payment of a fee, which must be set at a value that balances the need to prevent rapid inflation of the economy and the desire to attract users. Our fee structure is as follows:

$$\bar{t}_i = \frac{T}{b_i - b_0} \tag{1}$$

b_0 is the block number of the first block registered when the TIME token smart contract was deployed. b_i is the block number at the i-th selected *timeframe* (current block), and T is the total number of TIME tokens mined. The average mining rate of TIME tokens, represented by $\bar{t}_i$, is calculated to determine the *speed* at which they are being produced (TIME per block).

As mentioned at the end of the section III-B, the system creates an internal LP with some initial given amount of TIME. We define T_{LP} as the number of TIME tokens exclusively belonging to the internal LP of the contract, and N_{LP} as the native cryptocurrency balance of the LP. These tokens and funds are used exclusively for the purpose of facilitating trades on the decentralized exchange within the smart contract.

Thus, our objective is to prevent the depletion of N_{LP}. To achieve this, we have established a metric that calculates the number of blocks b_{LP} required to exhaust N_{LP}, taking into account the current value of the average mining rate of TIME tokens, $\bar{t}_i$, and using the proper unit conversion factor, $c()$.

$$b_{\mathrm{LP}} = \frac{c(N_{\mathrm{LP}})}{\bar{t}_i} \tag{2}$$

With b_{LP} representing the estimated number of blocks required (*expected time*) to drain the LP, and m as the number of enabled addresses, we can determine a fair fee value. By setting a basic reference value for the initial fee, called F_{T} for TIME tokens and F_{N} for native cryptocurrency, we establish a waiting period for users to activate a new address. The fee functions, `fee()` f_{N} and `feeInTime()` f_{T} are calculated as follows:

$$f_{\mathrm{N}} = \frac{(F_{\mathrm{N}} \cdot F_{\mathrm{T}})}{m \cdot b_{\mathrm{LP}}} \tag{3}$$

$$f_{\mathrm{T}} = \frac{{F_{\mathrm{T}}}^2}{b_{\mathrm{LP}}} \tag{4}$$

We formulated the functions arbitrarily, based on preliminary tests to verify the economic feasibility of the system. We strongly believe that these functions will serve the purpose of maintaining the balance of the ecosystem over time.

As a result, the fees are dynamically linked to the speed of token production, meaning that if there is an increase in the number of addresses minting TIME tokens, it will become more costly to onboard new addresses (but not too much), and vice versa. Additionally, the fee values continue to evolve even if there is no token production.

IV. Use Cases

In this section, we outline the potential applications of the TIME token in the DeFi space. The following list is not exhaustive, but rather serves to highlight some of the key use cases:

- *Time as a financially significant metric:* the notion that "time is money" is more tangible than ever as people can now use time as a unit of measurement with real economic and financial impact.
- *Tokenized Time-based Markets:* the tokenization of time allows for its proper exchange and utilization as a valuable metric in a decentralized environment. This opens up new possibilities for time-based markets. We provide some examples next.
- *Labor Hour Markets:* the negotiation of terms between workers and employers can be based on labor hours calculated in TIME tokens. It is crucial to properly convert TIME into an understandable unit, considering it is measured in blocks, to accurately reflect the time spent working.
- *Streamlining of Receivables and Payment of Dues:* tokenized time presents an opportunity to revolutionize the way we approach receivables and payment of arrears. Whether you are eager to receive rewards from a staking contract or you have taken a loan with a deferred payment date, you can now advance or settle the agreement by utilizing a portion of your TIME tokens. This eliminates the need to wait for the predetermined conditions or assets to be released after the agreement has been signed. Tokenized time opens up new possibilities for managing and optimizing agreements, especially when it comes to the anticipation or settlement of receivables and payment of debts. By using TIME tokens, parties can expedite the release of assets or meet future conditions in advance, as they can be generated through waiting. This allows for greater flexibility and control in the fulfillment of contractual obligations, as opposed to simply waiting for conditions to be met after an agreement is signed.
- *Time-Backed Assets and Derivatives:* by leveraging the concept of tokenized time, DeFi platforms, both centralized and decentralized, have the potential to create stablecoins and derivatives collateralized by time, opening up new opportunities for growth and innovation in the financial sector.
- *Universal Basic Income (UBI) through Tokenized Time:* The idea that everyone has time could pave the way for a UBI based on tokenized time. With enough market demand and sufficient liquidity, it becomes possible to create a UBI through the mining of TIME tokens. This innovative approach to basic income could bring a new level of financial stability and security to individuals and communities.
- *Utility token:* even in a scenario of low market value, it can still be leveraged for a variety of utility purposes. From providing credit to serving as a currency for reward or loyalty programs, TIME tokens can have multiple applications across various platforms.

In order to provide real use cases soon, we plan to integrate the TIME token with new services and others we have already developed, as well as to call upon the community (investors, developers, etc.) to connect, engage and establish partnerships to add even more value to the asset, so that it can effectively transform the DeFi scenario. We really expect an organic growth, without marketing and advertising, but only users and enthusiasts sharing with each other a promising and potentially profitable idea.

Our proposal of tokenizing time presents a vast array of possibilities for implementation beyond the examples listed. With the emergence of a financially significant time metric, we envision new and innovative use cases that have yet to be explored. The potential of a time tokenization system is immense, and its widespread use in a digitized society holds exciting implications for the future.

V. Conclusion

In conclusion, our proposal for time tokenization can revolutionize the way we view and manage time as an asset in the market. With a wide range of use cases, from labor hour markets to universal basic income and beyond, tokenized time has the potential to greatly impact and improve many aspects of our increasingly digitized society. As a finite and irreplaceable resource, properly tokenizing time has the power to greatly increase its utility and value, providing new and exciting opportunities for individuals and organizations alike. With the growth and acceptance of decentralized finance, we believe that TIME token has the potential to play a significant role in shaping the financial future. By fully realizing the utility of tokenized time, we can unlock new levels of efficiency and effectiveness, transforming time from a mere commodity into a highly coveted asset.

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