Fractionalizing digital securities in the blockchain for increased transparency and security

Eduardo Pena Vina[1], Steven Blanc[2]

[1]CTO REClosure Ltd., Ireland

[2]CEO REClosure Ltd., Ireland

Abstract

In this paper, we introduce a method for the tokenization and fractionalization of digital securities, with a focus on facilitating their trading. The emphasis is placed on Real Estate, particularly within the domain of high-value commercial properties, which stands as the largest asset class globally. The trading of these tokens entails a legal conveyance of either partial or complete property rights, which includes the distribution of dividends, such as rental income. This process is executed on the blockchain through the use of bespoke smart contracts, building upon existing protocols like ERC-20. The preliminary application of this framework will be in the tokenization of social housing projects, with the objective of enhancing investment safety and promoting social welfare.

Keywords: Web 3.0, Real Estate, Tokenization, Digital Securities

I. Introduction

Overview

The global real estate market size was valued at USD 3.69 trillion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 5.2% from 2022 to 2030 [1]. In addition, the 2008 Housing crisis and now recently COVID-19 have highlighted to the general real estate industry that there is a need for a complete end-to-end digital sales process, and without such, their practice is at a disadvantage to those who have adopted technology to enhance their processes.

Real Estate-Backed Tokens

Real estate-backed tokens are a type of token that is backed by real estate. These tokens allow investors to participate in a diversified portfolio of assets while enjoying the benefits of cryptocurrency. There are several advantages associated with investing in real estate-backed cryptocurrency tokens. For one thing, they offer investors the potential for high returns. In addition, they are relatively safe from market volatility, making them a good option for those who are looking for a more stable investment option. Finally, real estate-backed cryptocurrency tokens can be easily purchased and sold using popular online exchanges, making them accessible to everyone.

Cryptocurrency Tokens

Cryptocurrency tokens are a form of digital currency that can be used to purchase goods and services on the internet. They are also referred to as altcoins, which are short for alternative coins. One of their most distinctive features is price volatility, which stems from various factors including market demand, investor sentiment, and regulatory news. This volatility, while attractive for speculative investments, can pose significant risks for both individual investors and businesses relying on these assets for operational purposes. The unpredictable nature of these tokens' value can lead to rapid financial gains but also substantial losses, making them an unreliable store of value or medium of exchange for consistent transactions.

Stablecoins

In response to the inherent volatility of cryptocurrency tokens, stablecoins have emerged as a significant development within the digital currency space. Stablecoins are a type of cryptocurrency designed to maintain a stable value relative to a specified asset or a basket of assets, such as fiat currencies (e.g., USD, EUR) or commodities (e.g., gold). This stability is achieved through various mechanisms, including collateralization (backing by other assets), algorithmic approaches to controlling supply, or through regulatory oversight. The primary advantage of stablecoins is their ability to combine the benefits of cryptocurrencies, such as fast and efficient transactions, with the reduced volatility typically associated with traditional fiat currencies. This makes them an appealing choice for daily transactions, remittances, and as a hedge against the volatility of other cryptocurrencies.

Asset-backed Tokens

Asset-backed tokens are digital claims on a physical asset and are backed by that asset. Gold, crude oil, real estate, equity, soybeans, or just about

any other real, physical asset can be tokenized and become an asset-backed token. Ownership of the token usually represents a right of ownership over the asset and, depending on the asset, may come with the expectation of future returns when the asset appreciates in value. As the asset itself appreciates in value, so does the token [2]. This type of token offers some advantages over other types of cryptocurrencies, such as stability and easy redeemability. Backing a token with a physical asset gives it intrinsic value and makes it more stable than a token that is not backed by anything. This makes asset-backed tokens a good vehicle for investment. They can also be redeemed for the underlying asset, which makes them more liquid than other types of tokens.

II. Tokenizing Real Estate

Real-Estate-Backed Tokens

Our objective is to develop a real estate platform that allows property owners to fractionalize and offer portions of their properties for sale. Investors can review property details and make purchases via the platform using fiat currency. The entire process of converting fiat to blockchain-based transactions is handled by us, enabling non-technical users to invest in real estate in a user-friendly way. Additionally, rental income is paid directly in fiat to investors' bank accounts, eliminating the need for direct cryptocurrency involvement in customer transactions. To implement this system:

- We secure registration of the security with the central bank.
- The SPV (Single Purpose Vehicle) owning the property is tokenized.
- An investment prospectus, approved by the central bank, is created.
- This prospectus is disseminated through real estate networks across the EU, targeting retail investors, self-administered pension funds, and innovative banks and exchanges, among others.
- Dividends, such as rental income, are automatically distributed to token holders in a time-weighted manner.

REClosure Digital Security Income Protocol

The popular ERC-20 [3] standard allows for the unrestricted trade of fungible tokens. Therefore, we built the Digital Security Income Protocol (DSIP), a modified version of this standard with the following additional features:

- The total supply of tokens is limited to 100,000 tokens (the issuer can mint tokens up to this limit, depending on the fraction of the property they wish to tokenize).
- Whitelisting: only pre-approved addresses are permitted to engage in trading with each other.
- Clawback Provision: the issuer is able to retract tokens from addresses under certain conditions. This feature is paramount in scenarios of regulatory or legal interventions, or in cases of identified fraudulent activities.
- Freezing Accounts: the issuer is able to halt transactions of specific accounts, for instance, in cases of suspicious activities or as part of legal proceedings.
- Fee in Stablecoin: Transactions involving DSIP tokens require a fee, payable in a designated stablecoin. This fee is processed through the token's transfer function.
- Fee Distribution: DSIP tokens feature a mechanism for splitting the transaction fee in predetermined ratios, needed in cases of e.g. colisting in 3rd party platforms.
- Rent Payment Functionality: The contract is designed to accept stablecoin funds for rent payments. A specific function to pay rent (or more generally, dividends) is incorporated for distributing these funds. The distribution is based on the duration of token holding, in such a way that current and past holders receive their due share according to the time they held the tokens.

Each property will have its own DSIP token.

Propto Payment & Utility Token

The Propto Payment & Utility Token, €PROPTO is the utility token inside and outside the REClosure Ecosystem. It will have an initial supply of 5bn tokens with an built-in inflation mechanism controlled by the DAO. It is a standard ERC20 token and thus it can be listed and publicly available to buy/sell across multiple exchanges. It can also be instantly converted into FIAT or stable coin.

€PROPTO, as a utility token within the REClosure Ecosystem, offers several benefits to its holders. For example, discounts on services, early access to property listings and access to exclusive real estate investment workshops and seminars. Additionally, it carries governance benefits, influencing the platform's future (see section about Governance). Finally,

since it's a ERC-20 token, it can be staked or provided as liquidity in DEXes.

User Onboarding

New users must be onboarded in the platform. This process ensures that we as a company comply with the AML regulations and that the customer is allowed by law to trade property under given conditions. This process has been streamlined in the Web 2.0 version of REClosure.

Once the documentation of the user has been analyzed, they are added to a whitelist, allowing them to trade the token with other whitelisted members.

Property Onboarding

Properties must be onboarded, exactly like users. And in the same vein, this is a streamlined, one-time process. Property owners need to upload documentation that, once validated, will be stored in our platform (with a signature in the blockchain to prove that it hasn't been tampered with). For data protection reasons, a redacted version will be published on our platform as part of the property's profile, while the full version will remain exclusive for investors. Finally, a DSIP token will be created for each property, as described previously.

III. The DSIP Smart Contract

Introduction

The Digital Security Income Protocol (DSIP) represents an advanced iteration of the Ethereum ERC-20 standard, incorporating augmented functionalities tailored for regulated digital asset trading. This smart contract has been developed in Solidity and targets all EVM-compatible blockchains, such as Ethereum and Polygon. The DSIP protocol introduces novel features, extending beyond the standard ERC-20 capabilities, to address specific requirements in digital securities management.

Design Philosophy and Architecture

DSIP's architecture amalgamates several custom modular extensions for each of its additional functionalities, such as KYC or rent distribution. On technical terms, the integrated OpenZeppelin's Ownable module in order

to centralized control by the issuer, a necessity in regulated environments. DSIP integrates three bespoke extensions: IdentityManager, FeeManager, and DividendManager, each addressing distinct protocol functions.

Identity Management

The IdentityManager extension enforces a whitelisting mechanism. This feature mandates pre-approval of addresses for trading participation, aligning with regulatory compliance needs. The contract owner exclusively manages this list, ensuring adherence to legal and regulatory frameworks.

Dividend and Rent Distribution

DividendManager contains the protocol's rent payment functionality. It administers stablecoin funds for rent or dividend distributions. The mechanism is designed to allocate payments proportionally, based on token holding duration, thus ensuring equitable distribution among current and past token holders.

Fee Management

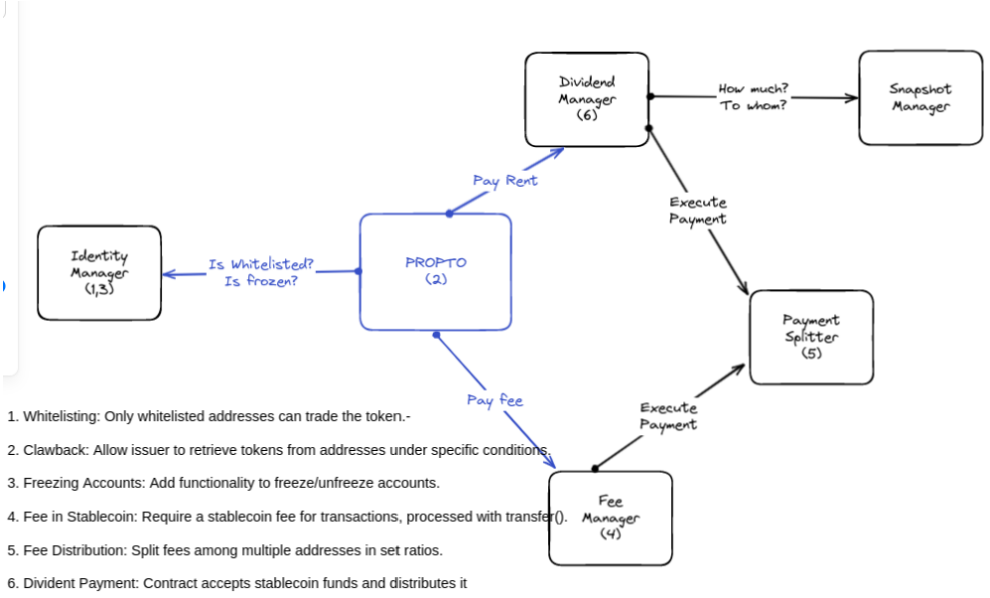
FeeManager contains the transaction fee dynamics. DSIP transactions (including the initial minting, or primary market) require a fee, payable in a pre-designated token (usually a stablecoin). This module facilitates the fee's collection and distribution, allowing transaction fee splitting in pre-defined ratios. This functionality is required in scenarios such as third-party platform colisting.

Token Supply and Minting

ERC20Capped limits the token's total supply limit at 100,000 units. The minting function, governed by the contract owner, allows token issuance up to this ceiling, in alignment with the property fraction intended for tokenization.

Operational Functions

The DSIP contract contains functions for adding or removing addresses from the whitelist, transferring tokens between whitelisted addresses, and setting parameters for dividend distribution and fee management. The transfer function embeds additional checks for whitelist compliance, guaranteeing that only approved addresses can engage in token exchange.



IV. Trading Tokens

The Decentralized Exchange

We conceived a Decentralized Exchange (DEX) that is deployed as a Smart Contract. That means that the whole process takes place on the blockchain. This approach has the following advantages:

- Automatic and secure execution environment.
- Compliant with the securities regulations.
- Transparency of the activities while being GDPR compliant.

We operate a constant product decentralized exchange (DEX), which utilizes a liquidity pool composed of two different tokens, maintaining the product of their quantities constant. This invariance is expressed as $x \cdot y=k$, where x and y represent the quantities of the two tokens in the pool, and k is a constant value. Trades are executed against this pool, with the trade amount determining the price based on the constant product formula. The price automatically adjusts due to the changes in token quantities, ensuring liquidity and limiting slippage within the constraints of the available pool size. This mechanism allows for decentralized, algorithmic price determination without the need for traditional order books.

The order book

Alternatively, we will also support an off-chain order book, where buyers and sellers have the option to either publish their offers or match with an existing one. In this scenario, we provide a platform for atomic swaps. Offers are published off-chain, accompanied by on-chain timestamping and certification to ensure accountability and traceability. The settlement of trades occurs transparently and atomically on the blockchain.

V. Onboarding a property

Option 1. Tokenization of shares

In the onboarding process for property, data is initially collected from the property owner and subjected to KYC protocols, ensuring regulatory compliance and validation of ownership. The shares of the SVP that owns the company are then tokenized. A property brochure is then developed and subjected to a validation process to confirm accuracy and regulatory adherence.

Post-onboarding, investor data collection follows a similar KYC procedure to verify identity and investment suitability. Investors select their investment property and amount, leading to the formal registration of the investment. Finally, the investment is materialized through the issuance of tokens to the investor's digital wallet, representing their stake in the property. Investors receive the dividends pertaining to their shareholding, proportional to their amount of tokens and the time those were held.

Option 2. Emission of a bond

Similarly to the previous case, but instead of tokenizing the shares of the SVP, it mints a bond, which is then tokenized.

It is important to note that in the both cases above, investors do not deal directly with the blockchain, therefore their tokens are kept in custody. It is possible, though, for tech-savvy users to receive their security tokens in their wallet.

VI. Practical Examples

Social Housing Project

Scenario

A social housing project, valued at €100 million, is being offered for sale by the current owner. The intent is to enable investors to purchase parts of this project. The number of potential investors is variable, ranging from a single investor to tens of thousands.

Our Solution

Upon onboarding the social housing project, we register its SVP as a security in the Central Bank and simultaneously create a new DSIP token, designated as €DSIP#SH01. Given the project's valuation and the decision to tokenize a specific portion, a predetermined number of tokens will be minted. For instance, if 20% of the project is to be tokenized, 20,000 units of €DSIP#SH01 will be created, with each unit representing an equal share of the 20% stake in the property. Investors can acquire these tokens either through our platform by using fiat, or in the secondary market.

Token holders receive their payments monthly in fiat, and have the possibility to trade these tokens in the secondary market. This adds a layer of liquidity to the investment, enhancing its attractiveness to potential investors by offering both a regular income stream and the option for capital mobility.

High-Value Shopping Center

Scenario

A high-value shopping center, with a valuation of €500 million and generating an annual yield of €60 million, is presented for investment. This scenario targets investors interested in high-yield, tangible assets. The current owner wants to liquidate a minority stake in it, e.g. 20%.

Our Solution

For this shopping center, we register a new SVP owning 20% of the asset, and split its shares in our dedicated DSIP token, designated as €DSIP#SC01. In line with the property's valuation and the decision to tokenize a portion of it, a specific number of tokens are minted. For example, tokenizing 20% of the center would lead to the creation of 20,000 units of €DSIP#SC01, each representing an equal share of that 20% stake. These tokens are minted and sold to investors initially in the primary market.

In order to distribute dividends, the property manager collects rent and deposits it into a virtual IBAN. Our system then converts this income into a stablecoin and deposits it in the address of €DSIP#SC01. This way the

yield is automatically distributed to token holders. Subsequently, the stablecoin is converted back to fiat to pay investors.

Additionally, token holders have the flexibility to trade their tokens in the secondary market, subject to KYC and AML compliance (whitelisting of both buyer and seller).

VII. Emergency protocols

Despite rigorous audits and penetration tests conducted prior to deployment of the DSIP token, unforeseen issues may still arise. In the event of a major vulnerability discovery, an emergency protocol is triggered to mitigate potential risks. In such scenarios, the protocol's functionality can be immediately stopped through the activation of the 'pause' feature, effectively freezing all transactions. Then, a patched version of the token is minted, mirroring the original token distribution among holders. These holders are then individually contacted with detailed instructions on transitioning to the new, secure token.

VIII. Potential future Applications

Real-Estate-Backed Loans

Token owners can *lock* their €DSIP tokens in a special smart contract that mints stablecoins like *dai*. The value of these stablecoins is pegged to fiat currency like the US Dollar. This way, real-estate-backed loans can be made in a decentralized, safe, and transparent way, thus increasing the liquidity of €DSIP.

Decentralized Mortgages

Investors can invest in particular properties and get back a monthly payment. The mortgage conditions are coded in the smart contract (therefore are fully transparent) and the transfer of ownership once fully paid back, penalties for late payments, and even liquidation of the asset in a public, decentralized auction.

IX. Conclusion:

This paper introduced a method for tokenizing and fractionalizing digital securities, particularly focusing on high-value commercial real estate. The process involves creating tokens that represent partial or complete property rights, including dividends like rental income. These tokens are

traded on the blockchain using bespoke smart contracts. The initial application of this method is in social housing projects, aiming to enhance investment safety and promote social welfare. The paper details the mechanisms of Real Estate-Backed Tokens, Cryptocurrency Tokens, Stablecoins, Asset-backed Tokens, and the specific Digital Security Income Protocol (DSIP) developed for this purpose. DSIP includes features like a limited total token supply, whitelisting of traders, clawback provisions, account freezing, stablecoin transaction fees, and rent payment functionality. The paper also discussed the Propto Payment & Utility Token (€PROPTO) within the REClosure Ecosystem, designed for transaction facilitation and community governance.

The onboarding process for users and properties is streamlined to comply with AML regulations and ensure secure and transparent trading. Two options for property onboarding are presented: tokenization of shares in the property's Single Purpose Vehicle (SPV) and emission of a bond by the SPV, then tokenizing it. Practical examples include a social housing project and a high-value shopping center, highlighting the process of token creation, dividend distribution, and secondary market trading. The paper concludes with potential future applications like real-estate-backed loans and decentralized mortgages, offering innovative solutions for increasing liquidity and transparency in real estate investments.

References

[1] Real estate market size & trends report, 2022-2030. Real Estate Market Size & Trends Report, 2022-2030. (n.d.). Retrieved November 15, 2022, from https://www.grandviewresearch.com/industry-analysis/real-estate-market

[2] CoinMarketCap. (2021, August 21). Asset-backed tokens: CoinMarketCap. CoinMarketCap Alexandria. Retrieved November 16, 2022, from https://coinmarketcap.com/alexandria/glossary/asset-backed-tokens

[3] *Erc20 White Paper*. ERC20 White Paper. (n.d.). Retrieved November 16, 2022, from https://erc20.tech/erc20token-whitepaper