

# WHITEPAPER

Version 2.0



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Paribus is a cross-chain decentralized finance protocol aiming to unlock underlying liquidity for a variety of conventional and unconventional digital assets.

## Abstract

If it can be verified, it can be sold. If it can be sold, there is intrinsic value. If there is intrinsic value, this value can be leveraged. Paribus is the protocol that offers DeFi holders and investors a platform to extend the reach of their digital assets and positions.

Unlike traditional finance, Decentralized Finance (DeFi) instruments have rapidly spawned virtual economies that are constantly evolving, refining, and innovating. This rapid evolution exposes both flaws and opportunities as the user base expands. These products exhibit a unique blend of flexibility and vulnerability, with a clear network effect driving more users towards the latest aggregators and compounders. Paribus, while forward-thinking, maintains a focus on existing applications across both non-fungible and fungible tokens. A key goal of Paribus is to delve into the realm of financial tools and products tailored specifically for NFTs.

The core objective is unlocking financial opportunities for NFTS, & RWA's Paribus introduces lending as the primary gateway tool, allowing access to liquidity and capital by collateralizing their assets.

The aim of Paribus is to provide a consolidated destination in which users can easily and freely participate in this financial revolution. To date, DEXs and lending platforms have led the charge while exotics are slowly gaining traction. For Paribus, we are building upon what has been built and continuing to iterate forward in the face of existing opportunities and in anticipation of demand. Non-fungible tokens, liquidity positions and RWA's deserve DeFi applications wherein holders have the opportunity to truly capitalize on their value.



# Introduction

The cryptocurrency market has burgeoned from its inception to over \$2.5 trillion in just 15 years since Bitcoin's introduction. Among the rapidly growing use cases, DeFi stands out, experiencing exponential growth since the "DeFi Summer" of 2020. However, this growth has exposed underserved markets and created pain points, particularly concerning unconventional crypto assets like NFTs.

Paribus addresses this gap by enabling users to harness the latent value of stagnant assets without the need for liquidation. In the dynamic world of DeFi, where assets hold varying values and interoperability remains a challenge, Paribus provides a solution by enhancing the liquidity, predictability, and reliability of non-conventional assets.

DeFi offers a plethora of opportunities for investors to earn passive income and engage with cryptocurrency markets. However, there are still barriers to overcome and liquidity to unlock. Recognizing this, Paribus focuses on enhancing liquidity across chains and asset classes, aiming to fill gaps in the market and catalyze overall market liquidity.



Chain agnostic lending/borrowing



RWA Collaterals



NFT collateral-based loans



LP Collaterals

Traditionally, the cryptocurrency realm revolved around a handful of “base assets” such as USDC, ETH, BTC. However, as the landscape evolves, there arises a pressing need to unlock liquidity across various untapped markets. In the forthcoming sections, we introduce a protocol designed with a singular objective:

To facilitate liquidity access for emerging markets. Our goal is to offer support for a curated selection of assets across multiple chains, empowering users to seamlessly access a diverse and expansive ecosystem of liquid opportunities.











# The Paribus Proposition

Paribus is a lending and borrowing platform that aims to unlock liquidity for both conventional and unconventional crypto assets. Our principle is simple: if it holds value, it can be utilized. We're committed to supporting a wide range of assets, from stablecoins like USDC to non-fungible tokens (NFTs) representing artwork or virtual lands and RWA's.

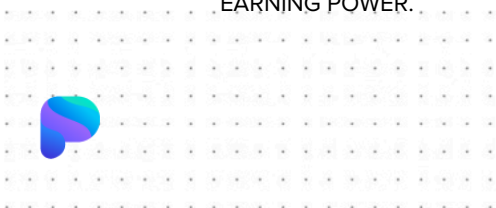
The concept of on-chain value is constantly evolving, and we're at the forefront of this transformation. To realize the full potential of these assets, they must be accessible across different platforms and chains. That's why our platform is designed to be interoperable, allowing users to engage with decentralized financial products seamlessly, regardless of the chain they're on. Paribus builds upon the foundation laid by previous DeFi projects, integrating innovative features like pools of assets and algorithmically derived interest rates. Inspired by successful protocols like Compound, we're expanding the scope beyond traditional coins and tokens, embracing the diverse range of assets in today's decentralized landscape.

As DeFi primitives come on-chain, it is revamping traditional investment as new utilities are being derived from principles that have remained unchanged for decades. Paribus has identified opportunities in the following areas:

 Liquidity Positions	 Structured as components of investment strategies
 Synthetic Assets	 Backed by on-chain collateral
 Digital art	 Virtual land
 Domain Names	 Real World Assets

For example tokenized real estate, metals and others - Crypto collectibles

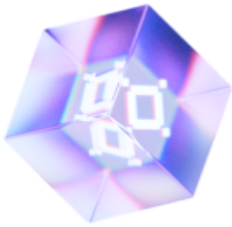
THE PARIBUS PROTOCOL BRINGS ALL OF THESE FORCES TOGETHER, OFFERING DEFI HOLDERS AND USERS A PLATFORM TO EXTEND THE REACH OF THEIR DIGITAL ASSETS AND POSITIONS TO REALIZE EARNING POWER.



# Paribus Pursuit

Paribus is committed to offering a comprehensive suite of features that enhance its value proposition as a pioneering DeFi protocol. Leveraging its interoperability across various blockchains, Paribus will extend its capabilities to unlock liquidity across a diverse spectrum of assets.

These assets include NFTs, LP's , RWA's, as well as more traditional assets such as BTC, USDC, ETH and many others. Our platform is designed to cater to the evolving needs of users, ensuring seamless access to liquidity across different chains and asset classes. expanding the scope of opportunities for users within the decentralized ecosystem.



**Non-fungible Tokens (NFTs)** have become extremely popular and demand for these digital assets are increasing exponentially while capturing mainstream media attention. Possibility to tokenize assets of value, regardless of their physical appearance and/or features, brings new opportunities as well as challenges. Paribus aims to solve one of these challenges and amplify the economic value of these tokens with enhanced liquidity and options to utilize this economic strength without having to sell the NFT outright. NFT owners will be able to unlock liquidity via collateralized loans against their NFT assets to finance additional ventures such as; trading, investing and more.



**Real World Assets (RWA):** In the rapidly evolving landscape of decentralized markets, the demand for Real World Assets (RWA) has been steadily growing. From state bonds to vaulted assets and tokenized real estate, decentralized platforms are increasingly offering a wide array of traditional assets in tokenized form. However, one of the significant challenges faced by these assets in the DeFi space is liquidity. Paribus recognizes this challenge and is committed to addressing it to unlock the full potential of RWA in decentralized finance. Paribus is at the forefront of solving the liquidity problem for Real World Assets (RWA) in DeFi. Through our innovative platform, we provide a solution that allows holders of RWA Assets to unlock liquidity without needing to liquidate their assets by allowing it to be used as collateral.



**LP Tokens:** At Paribus, we recognize the potential of LP Tokens to serve as collateral for borrowing and lending, offering sophisticated use cases that enable users to leverage their existing positions effectively. In the right market conditions, users holding LP Tokens can create what we call a "self-paying loan," where the returns generated from their LP positions cover the borrowed amount, effectively paying off the loan themselves. To cater to these advanced use cases, Paribus is developing a product line specifically tailored for borrowing and lending with LP Tokens. This initiative aims to empower users to maximize the value of their LP positions while accessing liquidity for their financial needs.



# Paribus Capture

Paribus is poised to dominate the DeFi market by upholding the gold standard of decentralization while prioritizing innovation and inclusivity. Through DAO governance, PBX token holders will drive decision-making, ensuring a trustless and permissionless environment ripe for innovation.

To capture market share, Paribus offers a diverse array of solutions:

- ✓ Standard Borrowing & Lending: supporting various stablecoins & alts
- ✓ NFT collateral-based loans: Unlock liquidity by borrowing against NFTs.
- ✓ LP collateral-based loans: Access liquidity by leveraging AMM liquidity positions.
- ✓ RWA markets: Flexible access to liquidity using Real World Assets.
- ✓ DAO: PBX token holders wield governance authority over every aspect of the protocol, ensuring a truly trustless and permissionless ecosystem.

Paribus' features and protocol are designed to evolve with new crypto asset classes, capturing the value stored in the emerging universe of interconnected blockchains

In alignment with the ethos of decentralization and DAO governance, Paribus is committed to transparency and community-driven decision making. Our protocol's source code will be publicly available under an open source license, ensuring accessibility and fostering collaboration within the DeFi community. However, beyond mere code accessibility, the true essence lies in the governance model facilitated by the Paribus DAO.



# NFTs & Synthetics:

## The Fungible and Non-Fungible

Tokens in the blockchain realm are digital assets managed and stored using cryptographic addresses and smart contract technologies. Among them, many fall under common standards like ERC-20, which facilitate their fungibility and seamless exchangeability. These tokens have played a pivotal role in shaping the crypto landscape, mirroring traditional money but with added benefits such as censorship resistance and non-inflationary supplies.

On the other hand, non-fungible tokens or NFTs have varying sets of properties and a uniqueness which makes them proverbially “one of a kind.” One cannot trade one-for-one while one Bitcoin is always one Bitcoin. Thus, NFTs can have associated values which only a marketplace can define. Some examples of these

- ✔ Smart contract insurance policies
- ✔ Digital art
- ✔ Virtual land
- ✔ Music
- ✔ Crypto collectibles
- ✔ Customizable Gaming Rewards/In-app use
- ✔ Domain names -- Ethereum Name Service-ENS

While speculators would be interested in naming a price and having a fluid exchange, the existing opportunities to do so are largely lacking. DEXs and automated market making solutions do not currently offer implementations for the exchange of these unique assets and have been relegated to static ownership until sold on a P2P marketplace.





## Paribus User

Paribus is made up of several different user types. The section clarifies the inherent characteristics of assets along with Paribus user types and their roles within the platform.

### Lenders

The lender is the key in any DeFi platform. Majority of the time these users are what are known as “HODL’ers” within the cryptocurrency space. They have no plans to outright sell their crypto assets. Paribus will be an additional outlet to this user group to earn a passive income while their underlying assets appreciate in value over time. Lenders can be thought of as liquidity providers within the ecosystem and are rewarded in return for doing so. The platform will provide Deposit APR(%) based on factors such as utilization rate. Lenders can at a rough level estimate their earnings based on the Deposit APR(%) for a given asset.

### Borrowers

Paribus will operate strictly as a collateralized loan platform. Meaning any borrower must deposit asset(s) in order to borrow against it. As a result borrowers are indirectly also liquidity providers to assure the platform is sustainable and self-sufficient. Every borrower is subject to paying a small one-time fixed platform fee as well as the interest accrued over the period of loan. The fee mechanism is detailed in the latter section of this paper.

### Liquidators

A liquidator in Paribus is in responsibility for preserving a check on undercollateralized positions in the





# Interest Rate Modeling

## Standard Asset Markets

Paribus operates autonomously based on variables and changes within its pools after each transaction. One of the key values that determines the borrow and deposit rates is Utilization Ratios,  $U$ . Utilization ratio is calculated per pool token, which can be seen below.

$$U_a = \text{Borrows}_a / (\text{Cash}_a + \text{Borrows}_a - \text{Reserves}_a)$$

Supply Rate is determined through the following formula.

$$\text{Supply Interest Rate}_a = \text{Borrowing Interest Rate}_a * U_a * (1 - \text{Reserve Factor}_a)$$

Breaking down the above formula, 'a' is the token/asset pool. Reserve Factor, is the percentage of interest paid by borrowers which the protocol can use to protect all liquidity suppliers from borrower defaults. Hence the name "reserve". This value is subject to change by the Paribus team initially depending on market conditions for a given asset. Going forward it will be adjusted via proposals through the Governance module using PBX tokens. The constant 1 is an arbitrarily hardcoded value which again is subject to change depending on market conditions for a given asset.

Supply Interest Rate, as per above formula requires a key value which is denoted under "Borrowing Interest Rate" for assets on Paribus. The calculation of borrowing interest rate is noted below.

$$\text{Borrow Interest Rate} = \text{Multiplier} * U + \text{Base Rate}$$

Breaking down the formula, Multiplier denotes the rate of increase in interest rate which is determined off our all-important Utilization Rate ( $U$ ). Lastly Base Rate represents the minimum borrowing rate per year. This value is hardcoded but subject to changes via Governance and PBX tokens.

Based on above formulas any asset that has a high utilization rate will in return provide a high deposit APR, thus better returns for those staking their assets in particular token markets. However, as LTV is limited, it may be difficult to maintain a high utilization rate for all tokens. As such, the overall utilization rate that we consider to be ideal is approximately 50%.



## Jump Rate Model

Certain assets utilize a model called “Jump Rate” which is derived from the famous jump-diffusion model introduced by Robert Cox Merton, an American economist. The idea behind jump models in general is to introduce rate hikes exponentially should certain market conditions be met i.e. utilization rate goes above a certain threshold. Such rises in interest rates in turn builds a positive feedback loop for liquidity for any given monetary policy.

**A jump rate has two standard parameters:**

- ✓ Base rate per year, the minimum borrowing rate
- ✓ Multiplier per year, the rate of increase in interest rate with respect to utilization

**However, it introduces two new parameters:**

- ✓ Kink, the point in the model in which the model follows the jump multiplier
- ✓ Jump Multiplier Per Year, the rate of increase in interest rate with respect to utilization after the "kink

The borrow rate is worked out differently under this model than the aforementioned standard interest rate model. See below for formula under Jump Rate model:

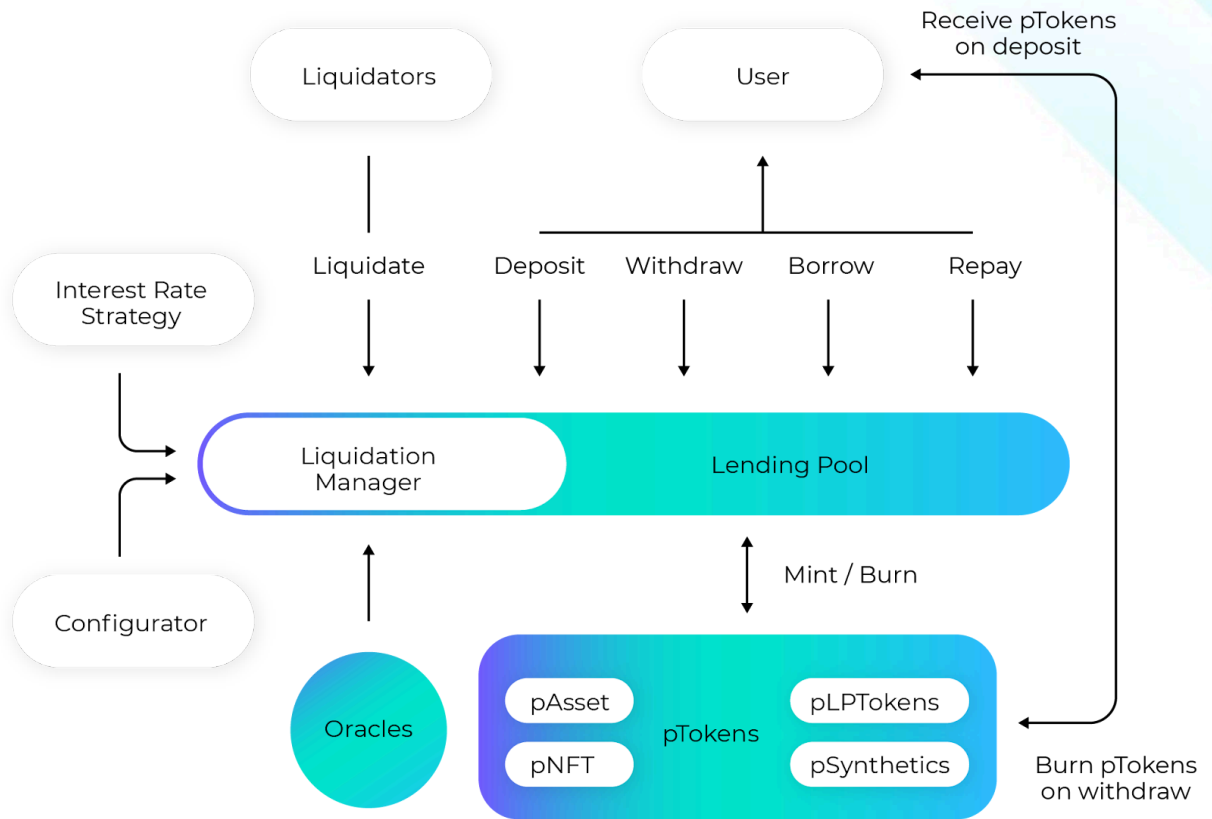
$$\text{Borrowing Interest Rate} = \text{Multiplier} * \min(U_a \text{ Kink}) + \text{Jump Multiplier} * \max(0, U_a - \text{Kink}) + \text{Base Rate}$$

## Polynomial and Index Models

The above formulas will be utilized within our MVP for conventional assets as mentioned. However, for unconventional assets such as NFTs, Virtual Lands and LP tokens we need more aggressive interest rate models such as “Polynomial” and/or “Index”. These models are currently being worked on by our team and will be plugged in to assure the system is reactive and sensitive against less liquid and riskier assets. Aforementioned models will increase interest rates aggressively to incentivize individuals to repay quickly thus enhancing and reassuring the sustainability and positive cash flow of the protocol



# Architecture



The Controller smart contract is used to establish the interactions between the other associated smart contracts and the protocol. The controller is used to whitelist different assets and enable their use in Paribus. The whitelisting process is needed to ensure that the market for an asset is liquid enough, that a valid oracle price feed and collateral factor is given.

Oracles are needed to provide the protocol with a reliable decentralized price feed.

Liquidators ensure that outstanding loans are liquidated if the value of the collateral deposited is no longer sufficient to cover the loan.

pTokens represent the user balance in the paribus ecosystem. They allow you to earn interest or serve as collateral based on the value of the underlying asset.

Interest Rate Strategy is a smart contract that implements the various interest rate strategies used in the protocol.



# Implementation

All SmartContracts that control and mutate data within Paribus will be open sources and verified on relevant scanner(s). Given our roadmap plans to become a DAO, we as the team behind Paribus, aim to make ourselves obsolete in the next 5 years and hand over control of the protocol into active PBX holders hands via Governance.

## Liquidations

Liquidations are in place to keep the system self-sufficient and sustainable. When a users borrowing balance exceeds their total collateral value due to underlying asset falling price and/or borrowed assets price increased in value then liquidations could be executed by machines, other dApps or humans through the liquidate function on “Liquidation Manager” contract. Calling this function will exchange the invoking party's assets for the borrower's collateral at a discounted rate in comparison to the general market.

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## Price Feeds

Paribus will utilize the most reliable and trustworthy price feeds from Oracles to assure asset exchange rates reflect their true value. Paribus will integrate oracles from leading projects to provide the best rates for our end users, be it borrowers or lenders.

Paribus will also offer its own price feeds for NFTs and RWAs by utilizing various off chain and on chain data including but not limited to floor price, trade history, liquidity, rarity and other data points. We also integrate external valuation providers and build an average valuation for the supported assets.

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## Fee Structure

Every borrow is subject to a borrow fee. This is hardcoded to 0.2% at the moment. The fee will be added to the total borrowed and reflected onto the users dashboard accordingly. These fees will be accumulated and added to protocol reserves. This fee is intended to serve as a “safeguard” to prevent abuse of short-term borrowers. The fee rate will be subject to change via Governance voting.

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## Risks

Given the nature of the interest rate model and its ability to dynamically adjust itself based on market conditions. It is crucial that both borrowers and lenders understand the model described above to avoid high interest rates and/or liquidations.



## Cross-Chain Compatibility

Cross chain capability plays a huge part in crypto markets and directly affects liquidity. As Paribus aims to unlock liquidity, cross-chain compatibility is one of the imperative features we are hard at work on. We have decided to utilize LayerZero and Everclear as the backbone of our cross-chain communication protocols which gives Paribus the flexibility to deploy onto many chains both EVM and non-EVM going forward.

We are partnering with various bridge providers to leverage their hard work and prevent “reinventing the wheel”, where appropriate. Below diagram provides a high level overview of networks that is on our roadmap to be integrated with.

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## Leveraging Interoperability Protocols

Paribus is poised to revolutionize borrowing and lending with its integration of interoperability protocols like LayerZero and Everclear. By leveraging robust interoperability capabilities, Paribus can seamlessly connect with all the relevant blockchains it's deployed on, allowing a frictionless experience for users to access liquidity from various chains while maintaining security and efficiency in their transactions.





## The PBX Token

From the recent inception in 2016 of the decentralized autonomous organization, or DAOs for short, there has been much interest in how these protocols can solve problems that pertain to economically efficient behavior. Creating a company or business model that allows for a decentralized structure of power can be a difficult task. DAOs are not companies or businesses and can help resolve many of these issues by distributing power to make protocol changes to the platform's users. Other benefits of a DAO come from its autonomous nature, once implemented there is no leeway for human error or not following through on an agreement. We believe in the power of decentralization and group collaboration.

With this in mind, we created the PBX utility token, for mainly platform governance purposes. In fact, the purpose of this token is to facilitate decentralization in a way that allows all active holders to participate in changes to the protocol.

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At Paribus, we firmly believe in the strength of decentralization and collective collaboration. Actively involved PBX token holders have the opportunity to propose and vote on various protocol improvements, fostering a feedback loop that incentivizes positive changes and strengthens the relationship between the protocol and its stakeholders. Moreover, community members who actively participate in governance will receive rewards from generated protocol fees for their contributions.

To participate in governance, users must lock (stake) a certain amount of PBX tokens for a designated period. Depending on the duration of the stake lock, users gain proportionate governance power (vePBX), enabling them to propose and vote on protocol changes.





## DAO Structure

The Paribus Decentralized Autonomous Organization (DAO) is the backbone of our governance framework, embodying principles of decentralization, transparency, and community-driven decision-making. Our DAO structure is designed to empower PBX token holders, enabling them to participate in protocol governance and shape the future direction of the Paribus ecosystem.



## Paribus Governance Workflow

The Paribus protocol employs a robust governance framework to enable token holders to propose, discuss, vote on, and enact changes to the protocol. This governance workflow ensures that the protocol remains adaptive, responsive, and aligned with the interests of its stakeholders.

| **Proposal Creation:** Any user holding vePBX tokens, the governance token of the Paribus protocol, can initiate a proposal. Proposals may encompass modifications to protocol parameters, introduction of new features, or amendments to existing functionalities.





| Discussion Phase: Following proposal creation, the community engages in open discourse regarding the proposal. Users participate in discussions, offering insights, feedback, and inquiries related to the proposal's implications and potential outcomes.

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| Voting Process: Subsequent to the discussion phase, the proposal progresses to the voting stage. COMP token holders exercise their voting rights to express support or dissent towards the proposal. Each COMP token represents one vote, with options for delegation available.

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| Voting Period: A defined time frame is allocated for voting. At the conclusion of this period, votes are tallied, and the outcome is determined based on the prevailing majority decision.

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| Execution Phase: Proposals garnering sufficient support proceed to the execution phase. The proposed changes are implemented into the protocol through the governance smart contracts. This implementation encompasses adjustments to protocol parameters, introduction of new functionalities, or other prescribed alterations.

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| Implementation: Upon execution, the changes become integral components of the protocol, influencing its operational dynamics. Users observe the impact of the changes and may provide further feedback for future proposals.

| Monitoring and Iteration: Post-implementation, the community diligently monitors the effects of the changes. Iterative proposals may be introduced to refine or revert changes based on observed outcomes, thus facilitating an adaptive governance process.

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Through this iterative governance mechanism, the Paribus community collectively governs the protocol, ensuring its ongoing adaptability, responsiveness, and alignment with the evolving needs of its users.



## vePBX Mechanism

At Paribus, we value active participation and engagement within our decentralized autonomous organization (DAO). To incentivize and reward this engagement, we have developed the vePBX mechanism, which grants voting rights and rewards based on merit and commitment, not just token ownership. This mechanism also serves as the basis for the distribution of protocol fees.

By rewarding commitment and participation, we ensure that decision-making within the DAO reflects the collective interests and dedication of our stakeholders. This is controlled by the staking period and their corresponding coefficient.

The calculation of the voting power is as follows

$$\text{Voting Power} = \text{Staked PBX} * \text{coefficient}$$

The coefficient is variable and depends on the lengths of the staking period. The staking period and the coefficient are the following:

- ✓ 13 weeks staking, coefficient of 0.1
- ✓ 26 weeks staking, coefficient of 0.21
- ✓ 52 weeks staking, coefficient of 0.45
- ✓ 104 weeks staking, coefficient of 1

Here is a simplified breakdown of how the vePBX works:

| User A stakes 1.000.000 PBX in the Paribus governance staking for a period of 26 weeks and receives a voting power of 210.000 vePBX.

| User B stakes 250.000 PBX in the Paribus governance staking for a period of 104 weeks and receives a voting power of 250.000 vePBX.

As we can see, while User B has a lower amount of PBX, his voting power is higher than User A due to the fact that he chose a higher staking period.



# Roadmap and future outlook

## Market-Driven Interest Rate

### Abstract

This proposal outlines the design of a novel decentralized finance (DeFi) lending platform that employs a market-driven interest rate algorithm. Unlike traditional DeFi platforms that primarily base interest rates on pool utilization rates, this platform integrates a wider array of both internal platform metrics and external market indicators. This approach aims to create a more responsive, dynamic, and economically sound system for determining lending and borrowing rates, thereby addressing current market inefficiencies and aligning more closely with real-world supply and demand forces.

### Problem Statement

Most existing DeFi lending protocols determine interest rates based primarily on the utilization rate of asset pools. While this method is straightforward, it has several limitations:

1. **Lack of Market Responsiveness:** Current models often fail to account for broader market trends and sentiments that can significantly impact supply and demand dynamics.
2. **Potential for Inefficiencies:** Relying solely on utilization rates can lead to interest rates that do not accurately reflect the true cost of borrowing or the fair return for lenders.
3. **Risk of Manipulation:** A singular focus on pool utilization can make the system more susceptible to manipulation and less stable in the face of market anomalies.

### Proposed Solution

The proposed solution involves the development of an interest rate algorithm that integrates both internal platform metrics and a range of external market indicators. This approach aims to achieve a more balanced, responsive, and market-aligned system.

### Key Data Points

The algorithm will consider the following data points:

1. **Platform-Specific Metrics:** Total liquidity available, total borrowed amount, and liquidity utilization rate.
2. **Market Indicators:** Open interest, funding rates on centralized exchanges, capital inflow and outflow, market volatility, and social media sentiment.



# Design

## Platform-Specific Metrics

- | Open Interest (OI): The total funds available for lending.
- | Total Borrowed (B): The total funds currently borrowed.
- | Utilization Rate (U):  $L/B$ , indicating the proportion of available funds being utilized.

## Market Indicators

- | Total Liquidity (L): Reflects the total number of outstanding derivative contracts.
- | Funding Rate (FR): Indicates the cost of holding positions in the derivatives market.
- | Capital Flow (CF): Measures the net inflow and outflow of funds in the crypto market.
- | Market Volatility (MV): A gauge of market uncertainty and price fluctuations.
- | Social Sentiment (SS): Represents the general sentiment in social media and news regarding specific cryptocurrencies.

## Interest Rate Calculation

1. Base Rate Calculation: Defined as a function of the utilization rate, e.g.

$$BR = \text{Base Rate Coefficient} \times U$$

2. Market Adjustment Calculation: A weighted sum of market indicators, e.g.

$$MA = W_1 \cdot OI + W_2 \cdot FR + W_3 \cdot CF + W_4 \cdot MV + W_5 \cdot SS$$

3. Final Interest Rate: The sum of the base rate and market adjustment, with caps to prevent extremes, e.g.

$$IR = \min(\max(BR + MA, \text{Min Rate}), \text{Max Rate})$$



## Additional Considerations

- | **Parameter Tuning:** Adjusting coefficients and weights based on empirical data and market analysis.
- | **Risk Management:** Implementing strategies to mitigate risks associated with market volatility and data manipulation.
- | **Regulatory Compliance:** Ensuring adherence to emerging regulations in the DeFi space.
- | **User Experience:** Maintaining a transparent and user-friendly interface for borrowers and lenders.

## Conclusion

The proposed market-driven interest rate algorithm aims to revolutionize DeFi lending by incorporating a broader spectrum of economic indicators. This approach not only promises to enhance the efficiency and stability of the lending market but also aligns it more closely with real-world economic dynamics, offering a more sophisticated and adaptive solution in the ever-evolving world of decentralized finance.

# zkML Price Oracle

## Abstract

This section describes the integration of a zero-knowledge machine learning price oracle (zkML) into the Paribus protocol. The price oracle is designed to improve privacy, security and scalability while providing accurate and verifiable price data for NFTs and RWAs. By utilizing zero-knowledge proofs and machine learning models, the proposed solution creates reliable oracles based on market data without compromising user privacy or system integrity.

## Problem Statement

Current price oracles in DeFi face several challenges:

1. **Data protection:** Traditional oracles often require raw data input, which can reveal sensitive information.
2. **Security vulnerabilities:** Traditional oracles are vulnerable to tampering and attacks, resulting in inaccurate price data.
3. **Scalability issues:** As the DeFi ecosystem grows, the demand for secure and efficient data feeds increases, straining the existing oracle infrastructure.
4. **Scoring complexity:** NFTs and RWAs have unique characteristics and complex scoring models that may not be adequately addressed by traditional oracles.



## Proposed Solution

The zkML price oracle combines the strengths of zero-knowledge proofs and machine learning to overcome the limitations of traditional price oracles. This approach ensures that pricing data is accurate, secure and scalable, while prioritizing data privacy and support for the highly complex models required to properly produce price valuations for NFTs and RWAs

## Key Components

1. **Zero-Knowledge Proofs (ZKPs):** This is a method of cryptography that allows different parties to prove the accuracy of a particular value without revealing the underlying information used to create that valuation. This will ensure that sensitive information remains confidential during the evidential process.
2. **Machine learning (ML) models:** Algorithms that are being trained based on historical market data to determine accurate prices of NFTs and RWAs.

## Design

### Zero-Knowledge Proofs

These are used to create proofs that can be easily verified without revealing the underlying data. This is particularly useful when working with sensitive information, such as when creating valuations for RWAs, which can often contain personal information in the dataset that is available off-chain. An example of this would be the creation of valuations for tokenized properties.

### Machine Learning Models

These are trained using historical market data such as trading history, price history, usage and others. These models are then able to convert any input data set into a price estimate. This is done by assigning each data point a normalized value with different weights, which is then converted into a final score at the end. The machine learning models are constantly improving the efficiency of price prediction based on real-time data and feedback they receive.



# Price Calculation

## Base Price for NFTs and RWAs

For NFTs, the base price is calculated using a combination of historical sales data, rarity ratings and demand indicators:

$$bpNFT = \alpha \times \text{Average Price} + \beta \times \text{Rarity Score} + \gamma \times \text{Demand Indicator}$$

In the case of RWAs, the base price includes the market value, the income and the condition of the investment itself:

$$bpRWA = \delta \times \text{Market Value} + \epsilon \times \text{Revenue Income} + \zeta \times \text{AssetConditionIndicator}$$

|  $\alpha, \beta, \gamma, \delta, \epsilon, \zeta$ : They are coefficients that are determined by giving each data point a different weight.

| Average Price: The average price at which other NFTs in this category are traded.

| Rarity Score: The uniqueness of the NFT and its features.

| Demand Indicator: Demand for this type of NFT. Can be the volume of trades.

| Market Value: The estimated value of the underlying real asset. For example, the valuation of a property in the land registry.

| Revenue Income: The income generated by the asset. For example, rental income in the case of tokenized real estate.

| Asset Condition: The valuation of the physical condition of the underlying asset.

## Market Adjustment

A weighted sum of market indicators specific to NFTs and RWAs:

$$MA = w1 \times \text{Market Sentiment} + w2 \times \text{Trading Volume} \\ + w3 \times \text{Liquidity} + w4 \times \text{Ownership Distribution} \\ + w5 \times \text{External Valuation}$$

|  $w1, w2, w3, w4, w5$ : The weight for each different indicator that is applied.





| **Market Sentiment:** The overall direction of the market and expectations.

| **Trading Volume:** Volume of trades for that asset category.

| **Liquidity:** The liquidity of the market. This includes open buy orders.

| **OwnershipDistribution:** How much of the NFTs or RWAs are within a specific group. Like the issuing company.

| **ExternalValuation:** Valuations for external providers. This could include third party price providers like Upshot.

## Final Price

The final price is the sum of the base price and market adjustment, with upper and lower limits to prevent extreme changes in the price. This upper and lower limits are based on previous evaluations:

$$FP = \min(\max(BP + MA, \text{Min Price}), \text{Max Price})$$

## Additional Considerations

| **Parameter Tuning:** Adjusting model parameters and proof generation settings constantly based on the change of the market.

| **Risk Management:** Implementing strategies to mitigate risks of data manipulation and ML model biases due to the lack of information or a bad training set.

## Conclusion

The zkML price oracle for NFTs and RWAs solves a major problem in the oracle space by combining zero-knowledge proofs with machine learning. This approach ensures accurate, secure and scalable price feeds that can be verified by all parties without the need to share sensitive data with the validators used to generate the price feed. zkML Price Oracle addresses the limitations of traditional price feeds and provides an adaptable solution in the evolving world of decentralized finance.



# Partial Liquidation System / Soft Liquidations

## Abstract

This section presents a partial liquidation system that is designed to improve stability and the user experience. Unlike conventional systems, where liquidation only occurs when a critical factor is reached, our platform allows users to set a soft limit. This feature enables partial liquidations before the hard limit is reached, thus reducing the risk of losing entire collateral positions in the event of a sharp market downturn.

## Problem Statement

In traditional credit protocols, liquidation occurs when a user's collateral factor falls below a predefined threshold (e.g. 80%). This model has several disadvantages:

1. Hard liquidations: As soon as the threshold is breached, users are forced to liquidate their collateral in full, which results in significant losses.
2. Risks of market fluctuations: In the event of sudden market movements, users can quickly lose all their collateral without being able to adjust their positions in time.
3. User experience: The potential loss of all collateral can deter users from participating in DeFi platforms.

## Proposed Solution

### Soft liquidation limits

Our platform plans to introduce a partial liquidation system in which users can set a soft limit (e.g. 60%) in addition to the hard limit (e.g. 80%). This system aims to reduce the risks of sudden market movements and to give users better control over their positions without risking the loss of all their collateral.

## Key Components

- | Soft limit (SL): A user-defined collateralization factor (e.g. 60%) at which partial liquidations begin.
- | Hard limit (HL): The maximum collateralization factor (e.g. 80%) at which full liquidations take place.



# Design

## Partial liquidation Process:

- | User limit: Users set a soft account limit at which early liquidations should begin. The hard limit remains set according to the platform standards.
- | Monitoring the collateral factor: The platform continuously calculates the collateral factor of each user's account.
- | Triggering partial liquidations: If the account collateral factor exceeds the soft limit, partial liquidations are initiated by the platform.
- | Adjustment of the loan: A portion of the user's collateral is sold to repay a portion of the outstanding loan. This action lowers the account collateral factor again, which means that other positions may be secured.

## Example scenario

- | Soft limit (SL): 60%
- | Hard limit (HL): 80%
- | When a user's account collateral factor reaches 65%, a partial liquidation is triggered by the platform. Some of the collateral is sold, which reduces the account collateral factor to, for example, 55%. This process is continued as needed to prevent the factor from reaching the platform's hard limit and triggering a complete liquidation.

# Design

The partial liquidation system offers a more user-friendly approach to collateral management. By allowing users to set soft limits, we can reduce the risk of total collateral loss. This reduces the default rate of loans in the event of market fluctuations and increases users' overall confidence in the platform. This approach is in line with real-world financial strategies and offers a more robust and adaptable solution in decentralized finance.

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# Peer-to-peer (P2P) NFT loans with a fixed term and rate

## Abstract

This section examines peer-to-peer (P2P) loans with non-fungible tokens (NFTs). Time-limited peer-to-peer NFT loans are a new product that allows holders to borrow money while not selling their NFTs.

NFTs have become a significant part of the blockchain world. They represent ownership of unique digital objects such as virtual real estate and art. However, the low liquidity of NFTs presents a challenge for its owners who do not want to sell their assets but still want to monetize them. Fixed P2P NFT loans solve this problem by giving owners the option to borrow crypto without having to sell their NFTs by using it as collateral.

## Problem Statement

1. Illiquid market: NFTs are generally less liquid than other digital assets, making it difficult for owners to access financial products without selling their NFTs.
2. Complex valuation: The valuation of NFTs can be difficult due to their uniqueness and the subjective factors that influence them, such as the traits that an NFT has.
3. Risk management: Both lenders and borrowers need to ensure that the right systems are in place to ensure the security and smooth running of transactions.

## Proposed Solution

### P2P fixed-term NFT loans

Fixed P2P NFT loans provide a solution to the problem of liquidity by allowing you to borrow money for a certain period of time without having to sell your NFTs by depositing them as collateral. The smart contract system is used to simplify and enforce the conditions attached to the loan and ensures transparency, security and trust between the parties.



## Key Components

### Loan agreement

1. Fixed term: A user-defined collateralization factor (e.g. 60%) at which partial liquidations begin.
2. Interest rate: The loan is subject to an interest rate agreed in advance.
3. Loan amount: The loan amount is determined on the basis of the estimated value of the NFT, which is usually a percentage of the value that includes the liquidity in the market.

### Smart contracts

1. Securing: The NFT is transferred to a smart contract that holds the asset until the loan is repaid. This ensures that the NFT cannot be transferred or sold during the term of the loan.
2. Repayment: The smart contract ensures that the repayment is processed. If the loan is repaid in full, the NFT is transferred back to the borrower, or if the loan is not repaid, it is transferred to the lender.

## Conclusion

P2P NFT loans with fixed terms offer a good solution for unlocking liquidity in NFTs without having to sell them. The use of smart contracts ensures transparency, security and flexibility. As the NFT market is constantly evolving, P2P NFT loans with fixed terms offer new opportunities for utilizing assets.

