Patronus

A DAO Managed Composable Decentralized Liquidity Protocol

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Abstract

Patronus is a composable DeFi liquidity protocol that aims to provide a set of products and services to safely and efficiently meet the increasing capital flow needs. The first application proposed by Patronus is a decentralized lending platform where users can lend and borrow assets seamlessly. Compared to existing lending applications, the Patronus lending platform applies a cutting-edge underlying framework with a better set of interest rate algorithms, position and liquidation management. Patronus takes advantage of the DeFi composability to support financial activities, including lending, perpetual swap, and aggregate liquidity mining, to meet users' liquidity demands.

1 Motivation

1.1 Build DeFi Lego

The development of Ethereum and smart contract have triggered the construction tide of decentralized finance (DeFi) applications. Many creative DeFi practices have emerged, and then greatly expanding the boundaries of the decentralized application layer. Furthermore, many have relatively mature business models, such as decentralized banks, exchanges, stablecoins, liquidity aggregators, perpetual swaps, asset management, insurance, etc.

Users can interact with DeFi applications by creating an on-chain address. This distinctive openness of blockchain technology is what you cannot see in the traditional financial industry. Anyone with any capital can make use of DeFi applications.

Openness is an essential precondition for composability, which is a distinctive feature of DeFi protocols and has been widely practised. For instance, a platform can recognise the voucher that one gets by providing liquidity to another platform. Thus, users can make the most out of their liquidity by, for example, earning LP rewards and lending against LP vouchers simultaneously. At the same time, both DeFi platforms also thrive.
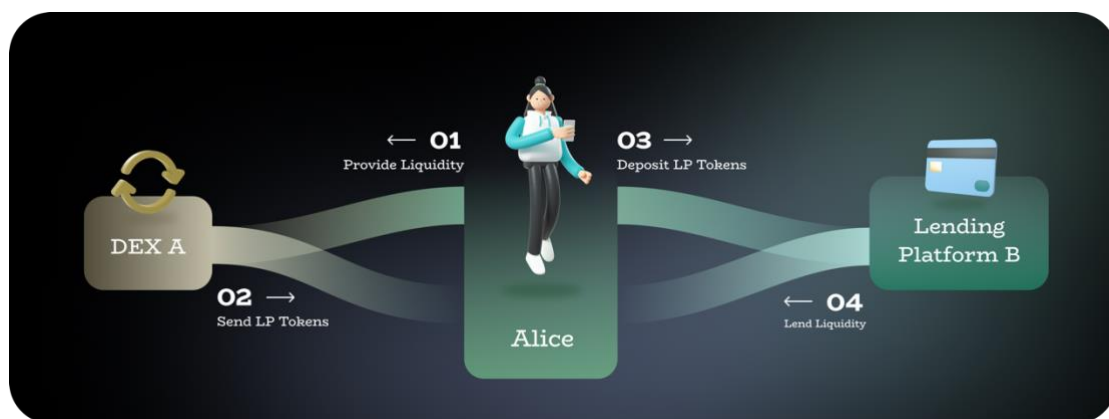

Figure 1: Example of DeFi combinability

There are increasing innovative combination practices. Patronus protocol is the advocator and defender of DeFi Lego and is committed to providing solutions to improve liquidity and capital efficiency through independent R&D and composability with other mature DeFi protocols.

1.2 Stick to DeFi Security

Crypto crimes, especially hacking incidents, have been increasingly rampant with the overall booming development of the blockchain industry. According to the statistics of SlowMist Hacked, as of June 30, 2022, there were 187 security incidents in the first half of 2022, with losses as high as about $2 billion.

Among these security incidents, about 77%, that is, 144 cases, are results of vulnerability exploits, losing $1.84 billion, accounting for 93% of the total loss of security incidents. Patronus believes security is essential for building an ecosystem. We code smart contracts prudently and responsibly.

We are advocates for open-source software, and Patronus has worked with various users and builders to build better and more secure DeFi applications. We work with trustable security experts and auditors to safeguard your assets. As a matter of fact, the inspiration for the name Patronus comes from our vision of creating a safe DeFi application. We will live up to our name.

2 Patronus Protocol

The decentralized lending platform is the first application that will be brought to you by the Patronus protocol. Through the smart contract deployed on the blockchain system, borrowers with capital needs can provide qualified collateral, thus obtaining liquidity support seamlessly. At the same time, the lender can receive interest.

2.1 Framework

2.1.1 Lending System

Patronus lending service is based on the Peer-to-Pool model. The lender deposits the assets in the corresponding public liquidity pool, while the borrower can lend the assets from the liquidity pool after depositing the qualified collateral. When the borrower repays the loaned assets with interest payable to the corresponding liquidity pool, the interest will be distributed to all the lenders according to their deposit proportion. Users can withdraw or repay at any time without paying attention to the loan term.

- Lending. The assets lent to the pools are represented by wCoin balance (such as "wAPT"). As the liquidity pool continues to generate and distribute the repaid interest, the unit wCoin could be progressively converted into an ever-growing amount of basic assets. In this way, earning interest is as simple as holding wCoin.

- Borrowing. Users can deposit wCoin as collateral to obtain a corresponding loanable quota and repay whenever they like. Similar to lending, the floating interest rate of each liquidity pool is determined by the market and defines the borrowing cost of each asset.

- Risk and Liquidation: When a borrower's outstanding loan exceeds the loanable quota as calculated by their collateral value, the system will put the user's collateral assets into the liquidation process in order to ensure the overall security of the liquidity pool. Liquidators can call the corresponding contract to buy the collateral assets with a specific discount ratio. Each asset may have a different collateral rate and liquidation penalty due to their difference in market size, liquidity, price volatility, etc.
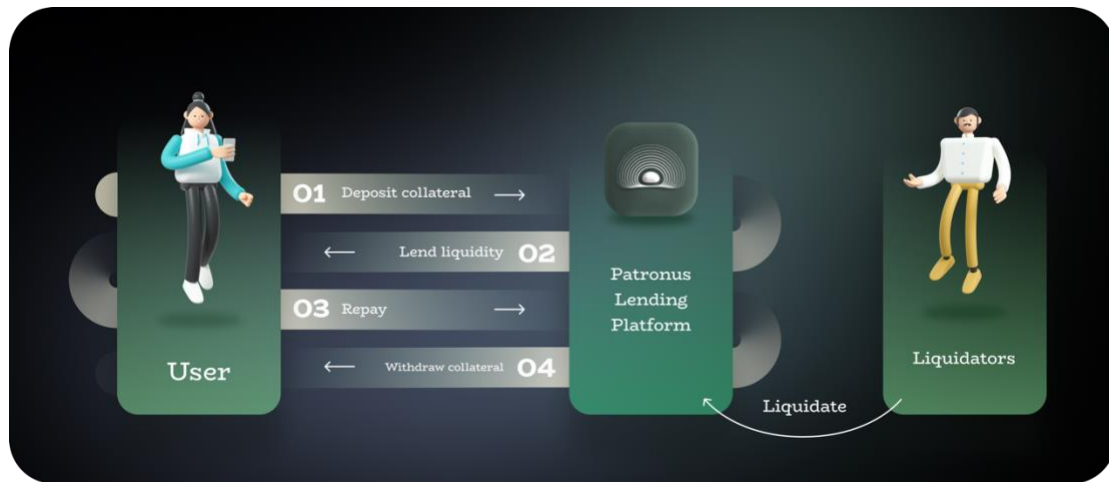
Figure 2: Patronus Lending Model

2.1.2 Reserves and service charges

The Patronus protocol is committed to providing liquidity solutions for crypto users around the world. During this process, Patronus needs cash flow to ensure system health and algorithms update until the system is mature.

Therefore, a small amount of the Borrow Fee will be charged for the lending service. The fee is based on the borrowing amount, multiplied by a fixed proportion (generally 0.05%~0.1%) and included in the borrower's debt. Meanwhile, a certain proportion (R) of the lending interest will be charged as a reserve, and the Reserve Factor R is adjustable (generally 5% ~ 25%). The reserve belongs to the treasury vault controlled by the DAO to support the corresponding protocol behaviors, such as funding innovative experiments or paying the relevant fees for cooperation with other protocols.

2.2 Interest

2.2.1 Interest Model

Patronus applied a set of interest rate models controlled by an algorithm. Based on the change in supply and demand, the model automatically adjusts the

interest rate, thus influencing the total value locked, capital supply and other dimensions. For all types of liquidity pools, the formula for the borrowing rate and the deposit rate is as follows:

$$\begin{cases} \beta_b = A * U + B \\ \beta_s = \beta_b * U * (1 - R) \end{cases}$$

where

A = Slope of the borrowing rate curve.

U = Utilization rate of the pool.

R = Reserve factor. $0 \leq s < 1$.

B = Intercept of the borrowing rate curve.

2.2.2 Interest Calculation

The annualized deposit interest rate and borrowing interest rate are converted into the interest rate per second, which are calculated based on continuous compound interest. Assuming that R is the annualized interest rate, the formula for calculating the interest rate per second(r) is:

$$r = \frac{R}{365 \times 24 \times 60 \times 60}$$

Then, the interest rate at time t:

$$r_t = r_{t-1} \times e^{r \times \delta t}$$

where δt refers to the time interval from time t-1 to time t.

If the borrowing amount is A_b , a borrowing time of t0 and repayment time of t1, the sum of principal and interest payable at maturity is:

$$A_b \times \frac{r_{t1}}{r_{t0}}$$

2.2.3 Real Compound Interest

Most lending platforms are using a discrete version of compound interest

model, which is, in reality, not very compound, as they accrue interest by the block and don't update the principal until something happens in the pool. This discrete interest accrual mechanism, along with the fact that block time isn't very constant and may be subject to change, makes the actual interest rate quite off from the advertised rate.

Patronus adopts a real compound interest calculation method, covering all the periods of time when users participate in liquidity activities, thus solving this problem. The following figure compares two interest accrual methods.
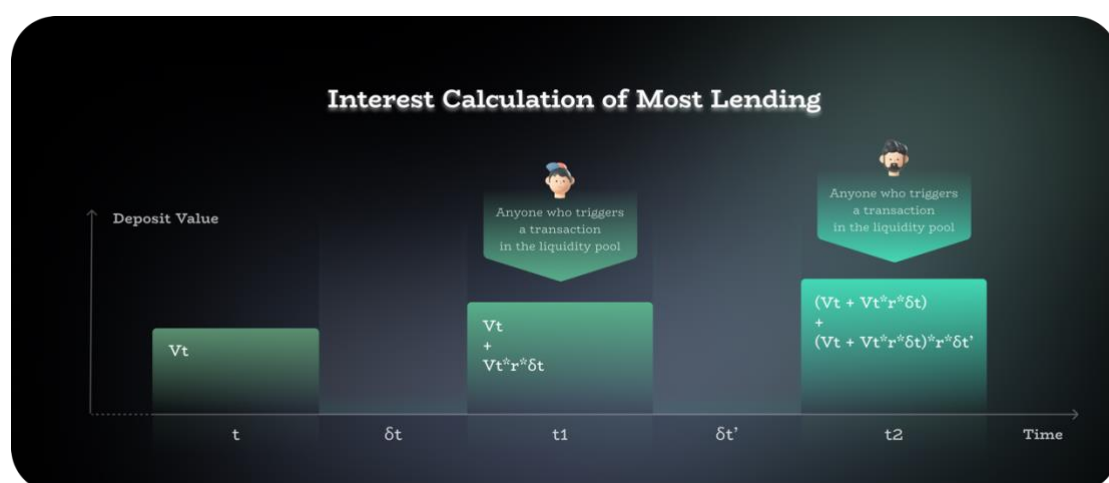

Figure 3: Interest Calculation of Most Lending

Suppose that Alice deposits a liquidity V_t to the liquidity pool at time t, and her account will only be refreshed when the contract is triggered by an additional transaction. That means time δ_t has already passed since Alice's deposit. Under this interest calculation algorithm, Alice's asset will be equal to the deposited principal plus its simple interest across the period $(V_t + V_t * r * \delta_t)$. The longer the time δ_t, the sharper the difference between simple and compound interest. This is far from the intention ad effect of compound interest.
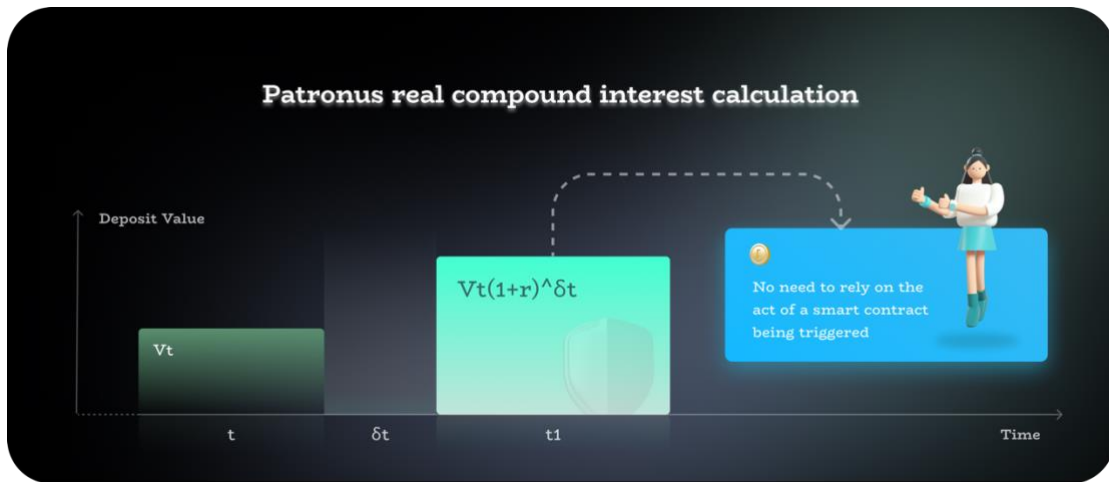
Figure 4: Patronus Real Compound Interest Calculation

Patronus converts deposit APY and borrowing APY into interest rate per second and adopts continuous compound interest calculation to ensure the perfect match between actual interest and borrowing period. Under this interest calculation method, the account update no longer depends on the trigger of the smart contract, and the accrued interest is no longer affected by other factors, ensuring the timeliness and predictability of the interest rate model.

2.3 Position Management

The borrower will obtain a corresponding loanable quota after depositing the collateral. Patronus adopts a set of rules to limit and evaluate the borrower's real-time borrowing capacity. When the value of the assets borrowed exceeds a certain proportion of the borrowing capacity, the collateral may face liquidation.
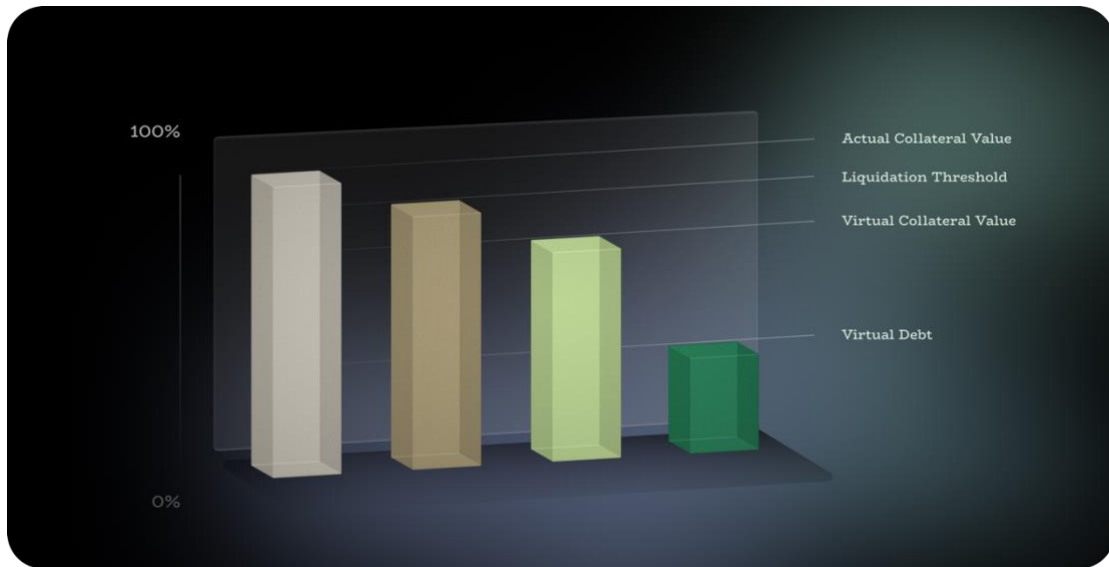
Figure 5: Example Position Status

Due to the value volatility of collateral and borrowed assets, the borrower needs to master the real-time information of its borrowing position.

The core settings related to borrowing positions are as follows.

- Collateral Factor. It represents the ratio of virtual collateral value to actual collateral value. For instance, if the real collateral value is 100 and Collateral Factor is 0.8, the virtual collateral value is 80. The sum of virtual collateral values determined by various Collateral Factors represents the maximum borrowing capacity.

- Debt factor. It represents the ratio of virtual debt value to actual debt value. For instance, if the real debt value is 100 and the Debt Factor is 1.25, the virtual debt value is 125. The total value of virtual debt cannot exceed the maximum borrowing capacity.

- Liquidation Threshold. It represents the maximum margin value of the collateral. For a specific collateral, the Liquidation Threshold is usually greater than the Collateral Factor. The liquidation mechanism will be triggered when the virtual debt's total value exceeds the collateral's

maximum margin value.

2.3.1 Borrowing Capacity

A user's borrowing limit is determined by the combination of the virtual value of the collateral deposited and the virtual value of the debts already borrowed. Assume that the maximum borrowing amount (in USD) of a user is V_{dm}, which is calculated by the following formula.

$$V_{dm} = \sum V_{di} \times DF_i - \sum V_{bj} \times BF_j$$

Where:

Vdi：USD value of deposit asset i

DFj：Deposit factor of asset i

Vbj：USD value of borrowed asset j

BFj：Borrow factor of asset j

Based on Patronus' risk control regulations (embodied in the Deposit factor and Borrow factor), the volatility risk of the pre-borrowed token needs to be considered when specifying the amount that can be borrowed in a particular token. Therefore, the formula for calculating V_x assuming that the user has a borrowable amount (in USD) in a particular token is as follows.

$$V_x = \frac{V_{dm}}{BF_x}$$

Where:

BFx: Borrow factor of asset x

2.3.2 Sub-account

Patronus provides a convenient tool to manage borrowing position risk - subaccounts. Users can manage multiple risk-isolated positions by holding one single address via Patronus.

When the user deposits for the first time, a Default account will be created. Then the user can directly establish sub-accounts without switching the address and then select and click the separate sub-account to access, operate, and manage the independent credit positions.

3   Patronus DeFi Lego

Patronus aims to provide a set of products and services to meet the increasing capital flow needs safely and efficiently. The following three aspects are essential to achieve the goal.

1. Support as comprehensive assets as possible.

2. Support asset transactions with a lower threshold.

3. Support reasonable leverage.

3.1 Other Use Cases

3.1.1 Perpetual Swap

The lending service framework set up by Patronus allows users to use mixed assets as a margin to borrow with certain leverage and then carry out perpetual contract transactions.

By virtue of DeFi Lego, Patronus ensures the contract transactions by integrating with the DEX with good liquidity and guarantees risk control by the liquidation mechanism.

3.1.2 Leverage Mining

Liquidity enables the steady development of the DeFi system and the expansion of the business scale. Various DeFi applications adopted different

liquidity incentives (known as "DeFi mining") to continuously attract liquidity to enter the systems. Patronus lending service framework enables the users to take the mixed assets as a margin to borrow with certain leverage and then invest assets in external liquidity incentive activities to earn multiple incentive returns with the Patronus aggregated mining algorithm.

4 Tokenomics

Patronus will issue the Tokenomics at the appropriate stage of development.