Qilin Protocol

A decentralized risk-optimizing protocol for derivatives trading.

Abstract

This whitepaper explains the mechanisms behind the Qilin protocol, a decentralized risk-optimizing protocol for asset derivatives trading on the Ethereum blockchain. This paper covers the protocol's core features, including a tranche-structured liquidity pool model, the Rebase Funding Rate mechanism, which reduces the risk of open positions for liquidity during market volatilities, the Dynamic Algorithmic Slippage mechanism, which incentivizes against position imbalance, and Leveraged L / S Position Token, a trading experience optimizing feature. This whitepaper also introduces the core application built on top of the Qilin protocol - perpetual futures trading, which allows traders to purchase long and short positions at leverage with guaranteed liquidity.

1 Problem Statement

AMM started the normalization of non-custodial crypto asset trading and enabled pooled liquidity for long-tail assets. However, the time value of these assets is still unable to be traded - that is, the high-leverage derivatives trading scene of these assets still has significant liquidity issues.

On the one hand, the predatory trading practices that exist on centralized order books create an exponential risk and cost curve for the liquidity side. This excludes order-book-based derivatives trading to low liquidity risk assets. For crypto-assets with higher risk profiles, the complex infrastructure of order books makes the risk profile unattractive to liquidity providers (usually professional market makers or the

exchange itself) as counterparties. This unattractive risk profile explains the use of aggressive liquidation practices employed by centralized exchanges.

On the other hand, the AMM-led P2Pool model only distributed the risk for liquidity providers but failed in systematic risk reduction. During market volatilities, liquidity providers either experience liquidity loss as counterparties or run the risk of the opportunity cost of missing out on the profit in the asset market. At the same time, capital efficiency issues exist in the DeFi market that further reduces the user experience for liquidity providers. Examples include having to provide liquidity on both sides of the trading pair, which adds a layer of exposure.

Overall, reducing liquidity risk is essential for the growth of decentralized derivatives trading. We introduce Qilin, a decentralized risk optimizer protocol for asset derivatives trading on the Ethereum blockchain.

2 Qilin Protocol's Terms & Parameters

General Terms

Term	Abbreviation & Symbol	Definition	Formula
Long		an on-chain position that gives the buyer the right to bet on the future price of an asset with the expectation that the asset will increase in value	
Short		an on-chain position that gives the buyer the right to bet on the future price of an asset with the expectation that the asset will decrease in value	
Initial Margin	a	the deposit a trader pays to open a long/short position; it also serves as backstop during liquidation when the position suffers a loss (for example, position liquidation would happen before a margin of $100 is depleted)	
Total Margin Value (Long/Short)	$\Sigma a^L / \Sigma a^S$	the total value of all the margin deposits from long/short positions	
Leverage	l		
Entry Price	p^0	the price of the asset at the time of purchase of the position	

Term	Abbreviation & Symbol	Definition	Formula
Liquidation Ratio	R_{margin}	a constant in the calculation of Liquidation Price	0.8
Liquidation Price	p^L	an algorithmically determined price threshold below which liquidation is initiated on a losing position before or after position bankruptcy or the price of the asset at the point of liquidation.	$\text{Short: } p^0 + \frac{a*R_{margin}}{A}$ $\text{Long: } p^0 - \frac{a*R_{margin}}{A}$
Position Value	A	the value of a long/short position.	$a * l$
Total Position Value	$\Sigma L / \Sigma S$	the total value of all long/short positions.	
Position Share	L^c / S^c	the share of the current Position Value in the Total Position Value.	$\Sigma L^c / \Sigma S^c * \frac{A}{\Sigma L / \Sigma S}$
Total Position Share	$\Sigma L^c / \Sigma S^c$	the amount of shares of the Total Position Value	
Net Profit		the profit of a position when liquidated	$\frac{\lvert p^f - p^0 \rvert}{p^f} * \frac{L^c / S^c}{\Sigma L^c / \Sigma S^c} * \Sigma L / \Sigma S$
Margin Loss		the loss taken on margin during liquidation	$A - \frac{L^c / S^c}{\Sigma L^c / \Sigma S^c} * \Sigma L / \Sigma S$

Terms for Tranche-Structured Liquidity Pool

Term	Abbreviation & Symbol	Definition	Formula
Liquidity Pool	LP	the pool of liquidity deposits which acts as the counterparty to traders	
Liquidity Providers	LPs	the supplier of liquidity in Liquidity Pools	
Tranche A	ALP	Tranche A is an uncapped tranche that provides reserve liquidity for the pool which shares 15% of the total LP profit	

Term	Abbreviation & Symbol	Definition	Formula
Tranche B	BLP	Tranche B is a capped tranche that is the counterparty liquidity for contract and shares 85% of the total LP profit	
Liquidators		actors which liquidate positions with margins depleted below a certain threshold in returns for liquidation rewards; accessible for Liquidity Providers with a certain amount of FS Token	
Constant Margin Ratio		a pre-determined constant (currently 0.2) used in determining if a liquidity pool will be open for new liquidity deposits.	
Initial Fundable Value		the initial total value of fundable liquidity of a liquidity pool	
Fundable Value		the value of newly fundable liquidity of a liquidity pool after initial funding, determined when an algorithmic threshold is met during high demand for liquidity	
Liquidity Pool Share		the share of an amount of liquidity deposit in the liquidity pool	
Liquidity Share Token	$\mathrm{LS\ Token}$	the share token representing the share of liquidity in the liquidity pool, redeemable for the corresponding asset and tradable as a crypto asset	

Terms for Rebase Funding Rate

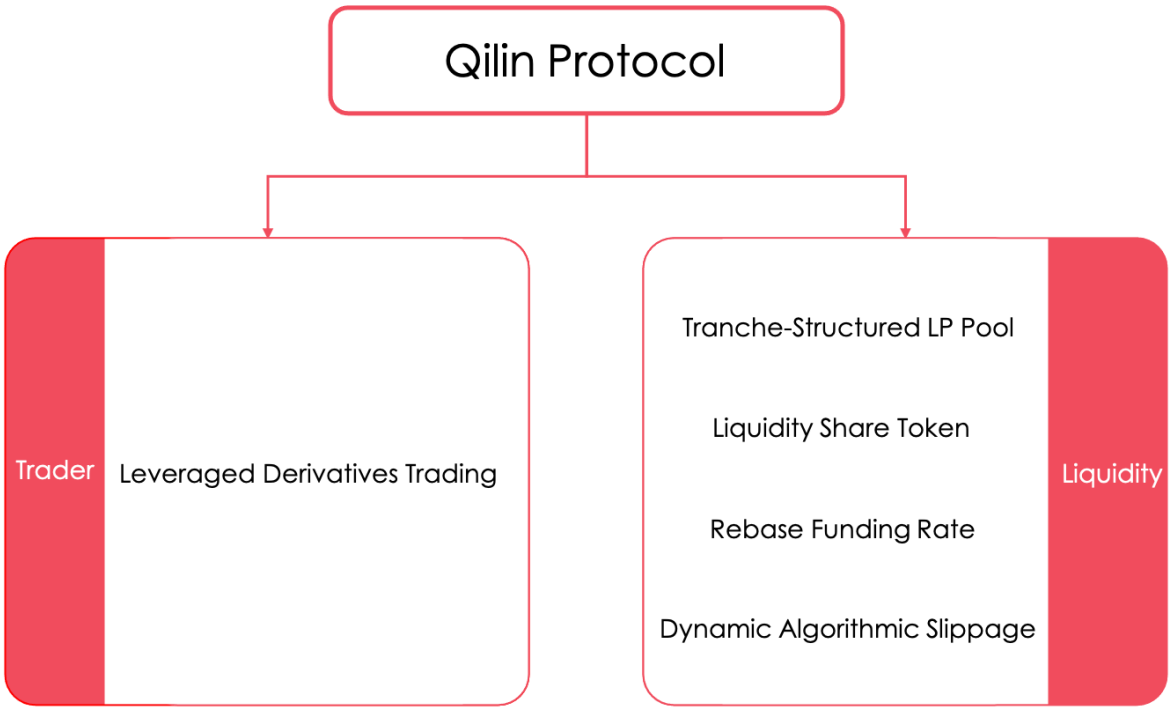
Term	Abbreviation & Symbol	Definition	Formula
Rebase Funding Rate	RFR		
Deviation Rate	D	the current rate of imbalance between long and short positions	$\frac{\lvert L-S\rvert * Price}{LP}$
Rebase Epoch	T	the period of rebalancing	
Rebase Interval	t	the interval between each Rebalance Epoch	
Rebase Frequency	n	the number of times of rebalancing	$\frac{T}{t}$

Term	Abbreviation & Symbol	Definition	Formula
Rebase Rate	r	the rate of rebalance in a single Rebalance Epoch	$\frac{D}{n} = \frac{\mathrm{tD}}{T}$
Imbalance Threshold	I	a pre-determined constant used to determine when the rebalance mechanism is initiated, set at 0.1	
Rebalance Funding Payment	B	the funding fee from a Rebalance Epoch	$r(\Sigma L) * Price$ $r(\Sigma S) * Price$
Post-Funding Deviation	D'	the deviation rate at the end of a Rebalance Epoch	$\frac{\lvert\Sigma L - \Sigma S\rvert * Price - B}{LP + B}$

Terms for Dynamic Algorithmic Slippage

Term	Abbreviation & Symbol	Definition	Formula
Slippage Sensitivity Index	$\mathfrak{P}$		$\frac{\mathrm{LP}}{\mathfrak{E}\lvert\Sigma L - \Sigma S\rvert * Price}$
Adjustment Constant	$\mathfrak{E}$	a pre-determined constant	
Standard Asset Amount	x		
Position Asset Amount	y		
Uniswap Constant Product	K'		$x * y$
Qilin Constant Product	K		$\mathfrak{P} * K$’

3 How Qilin Works (Graph)



4 Tranche-Structured LP Pool

Qilin's liquidity pools provide a single-side exposure to liquidity providers. The token pair of each liquidity pool is set as TokenA/TokenB, and LPs can purchase LS Tokens by depositing the pricing-side asset into the pool.

Similar to traditional tranche-structured finance, the liquidity pool for each asset pair is structured into two tranches - Tranche A and Tranche B - with different yield and risk profiles:

Tranche B:

Tranche B LP has a limited initial cap of 1 million USD for a certain trading pool. BLP enjoys higher returns while bears more risk from taking the opposite side against traders' positions. Tranche B shares 85% of the profit from the pool. The target audience for BLP is professional DeFi users and risk seekers.

Tranche A:

Tranche A LP shares 15% of the profit from the pool. ALP has no cap limit, and unused assets are deposited in DeFi yield platforms. ALP has an option to be converted into

BLP under high open interest of the trading pair. The target audience for ALP is normal DeFi users and risk-averse investors. ALP goes live at V2 launch.

With tranche B, the capped liquidity provisioning model aims to solve the problem of the lack of incentive for early-stage LPs in an infinitely open liquidity pool. With an initial supply of one million dollars of liquidity, tranche B provides the initial liquidity for contracts until further demand prompts additional liquidity from tranche A

Initial Liquidity Offering

Each pool has a pre-determined initial fundable value. For example, the initial fundable value for the BTC/USDC pool is initially capped at $1 million. Asset holders can purchase LS Token from the fundable pool until the cap is reached, at which point the pool is closed from further liquidity funding.

Tradable ETF-Type LS Token (Liquidity Share Token)

Qilin LP pool uses a single asset for settlement. Both BLP and ALP are tokenized to represent the value of the pool's liquidity shares. LS Tokens are tradable, integratable across DeFi protocols, and the underlying value is the USD value of the corresponding LP pool.

During the Initial Liquidity Offering and open periods, the price of the LS Token is determined as:

$$V_{LSToken} = \frac{V_{LiquidityPool}}{Supply_{CirculatingLSToken}}$$

As LS Tokens are tradable on the market as other ERC-20 tokens, its price is also determined by supply and demand.

Leveraged L / S Position Token

Similar to LS Tokens, trader's open positions can also be tokenized and become composable. Traders can buy or sell Position Tokens to quickly manage their positions.

5 Rebase Funding Rate

One issue that exists in on-chain derivatives trading and does not exist in asset swapping is the risk of open positions for liquidity providers. During market volatilities, the imbalance of long and short positions poses a risk to the liquidity pool which provides the risk backstop. Dynamic Rebalance Funding Rate is hence created to incentivize liquidity against the risk of open positions.

When the mechanism is initiated, an algorithmically determined amount of the margin balance is funded to the liquidity pool to incentivize against risk. A Deviation Rate (D) that measures the imbalance rate between long and short positions is calculated against the Imbalance Threshold (I):

$$D = \frac{|L - S| * \text{Price}}{LP}$$

$$I = 0.1$$

$$\text{If } D > I \text{ and } L > S$$

$$r = \frac{|L - S|}{n * L}$$

$$\text{Else if } D > I \text{ and } L < S$$

$$r = \frac{|L - S|}{n * S}$$

Where L is the long position, S is the short position, D is the offset range, n is the return period, and | L-S | is the naked position. In the new formula, the risk basis of Qilin is Pool, and the risk tolerance of Pool is taken as the risk basis to judge whether it is necessary to trigger Rebase Funding Rate. When Rebase Funding Rate is triggered, the proportion of naked position and unilateral position is used to determine the funding rate which can be recovered by rebasing.

6 Dynamic Algorithmic Slippage

Slippage refers to the difference between the signaled entry or exit price of a trade and the executed price of the trade. It results from a variety of market scenarios including price volatilities and non-optimal liquidity conditions and could incentivize against trading. However, the Dynamic Algorithmic Slippage mechanism utilizes the inherent slippage phenomenon of the market to incentivize against position imbalance.

As the size of unhedged positions increases, P gets smaller and, when applied in on Qilin’s AMM that is based on Uniswap's constant product formula, reduces liquidity

and therefore increases the slippage cost. Contracts that would reduce the L/S imbalance would reduce the slippage.

$$\frac{\mathrm{LP}}{\mathfrak{E}|\Sigma L - \Sigma S| * Price}$$

$$x * y = \mathrm{P} * K'$$

7 How Futures Trading Works on Qilin v1

Below is a simulated time lapse of position trades made on Qilin v1.

Note that the initial liquidity pool value is et at 10,000 USD:

Table 1: first two positions traded on Qilin v1 in simulation

Aa Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position A 100USD * 10 Long	**Position Value:** 1000 USD; **Position Share:** 1000; **Entry Price:** 10,000 USD; **Margin:** 100 USD;	100 USD	0 USD	10,000 USD	1,000 USD	0 USD	1,000	0
Position B 50 USD * 20 Short	**Position Value:** 1000 USD; **Position Share:** 1000; **Entry Price:** 10,000 USD; **Margin:** 50 USD;	100 USD	50 USD	10,000 USD	1,000 USD	1,000 USD	1,000	1,000

The liquidity pool has an initial funded value of 10,000 USD.

Position A has a margin of 100 USD and a leverage of 10x. This brings the Total position Value (Long) to 100 USD * 10 = 1,000 and the Total Trading Volume (Long) to

1,000 USD.

Position B has a margin of 50 USD and a leverage of 20x. This brings the Total position Value (Short) to 50 USD * 20 = 1,000 and the Total Trading Volume (Short) to 1,000 USD.

Table 2: a new position transaction triggers the Dynamic Rebalance Funding mechanism

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position C 50 USD * 10 Long	**Position Value:** 500U; **Position Share:** 500 **Entry Price:** 10,000 USD; **Margin:** 50 USD;	150 USD	50 USD	10,000 USD	1,500 USD	1,000 USD	1,500	1,000
RFR mechanism	**Epoch 1:** D = 0.2 > I; r = 0.01; Margin (Long) → 25 USD -> Liquidity Pool	125 USD	50 USD	10,025 USD	1,475 USD	1,000 USD	1,500	1,000

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
RFR mechanism	**Epoch 2:** D = 0.192 > I r = 0.0096 Margin (Long) → 25 USD -> Liquidity Pool	100 USD	50 USD	10,050 USD	1,450 USD	1,000	1,500	1,000

Position C has a margin of 50 USD and a leverage of 10x. This brings the Total position Value (Long) to 50 USD * 10 = 500 and the Total Trading Volume (Long) to 1,500 USD.

Rebase Funding mechanism is triggered when

D = |1500 - 1000| / (1500 + 1000) = 0.2, larger than the Imbalance Threshold I = 0.1

In Epoch 1,

r = D / n = 0.2 / 20 = 0.01

Value Rebalanced = (Total Volume Trading (Long) + Total Volume Traded (Short)) * r = 25 USD

from the Margin Balance (Long) is funded to the Liquidity Pool, which leaves the Total Margin Balance (Long) to 125 USD, the Total Trading Volume (Long) to 1,475 USD, and the Liquidity Pool Value up to 10,025 USD.

After Epoch 1, D is recalculated

D = |1475 - 1000| / (1475 + 1000) = 0.192, still larger than the Imbalance Threshold I = 0.1.

RFR mechanism continues.

In Epoch 2, 25 USD from Margin Balance (Long) is funded to the Liquidity Pool, Which leaves Total Margin Balance (Long) to 100 USD, the Total Trading Volume (Long) to 1,450 USD, and the Liquidity Pool Value up to 10,050 USD.

Table 3: a liquidation happens and a new epoch of RFR is not initiated due to changed trading volume

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position C liquidated	**Net Profit:** 0 USD **Margin Loss:** 17 USD; **Fee:** 1 USD; **Margin returned:** 32 USD	67 USD	50 USD	10,051 USD	967 USD	1,000 USD	1,000	1,000
RFR mechanism	D = 0.017 < I	67 USD	50 USD	10,051 USD	967 USD	1,000 USD	1,000	1,000

Position C is closed by the trader. Net Profit is

$$\frac{|LiquidationPrice - EntryPrice|}{EntryPrice} * \text{Position Share} * \frac{TotalTradingValue(Long/Short)}{TotalPositionShare(Long/Short)} = \frac{|10{,}000 - 10{,}000|}{10{,}000} * 500 * \frac{1{,}450}{1{,}500} = 0 \text{ USD}.$$

Margin Loss is

500 - 500 USD * 1450 USD/1500 = 17 USD.

With 1 USD as trading fee funded to the Liquidity Pool as LP reward, 32 USD is returned to the trader.

Total Margin Balance (Long) is now 67 USD, Total Volume Trading (Long) is now 967 USD.

Before Epoch 3 is initiated, D is recalculated

D = |967 - 1000| / (967 + 1000) = 0.017, smaller than the Imbalance Threshold I = 0.1.

RFR mechanism is currently switched off.

Table 4: a series of positions, RFR mechanism initiation, and liquidations

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Market Price Change 10,000 → 10,500 USD								
Position D 100 USD * 10 Short	**position Value:** 1,000 USD; **Position Share:** 1,000 **Entry Price:** 10,500 USD; **Margin:** 50 USD;	67 USD	150 USD	10,051 USD	967 USD	2,000 USD	1,000	2,000
Position E 100 USD * 10 Long	**position Value:** 1,000 USD; **Position Share:** 1,034 **Entry Price:** 10,500 USD; **Margin:** 100 USD;	167 USD	150 USD	10,051 USD	1,967 USD	2,000 USD	2,034	2,000

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position F 200 USD * 10 Short	**position Value:** 2,000 USD; **Position Share:** 2,000 **Entry Price:** 10,500 USD; **Margin:** 200 USD;	167 USD	350 USD	10,051 USD	1,967 USD	4,000 USD	2,034	4,000
RFR mechanism	**Epoch 1:** D = 0.34 > l; r = 0.017; Margin (Long) → 100 USD -> Liquidity Pool	167 USD	250 USD	10,151 USD	1,967 USD	3,900 USD	2,034	4,000
Market Price Change 10,000 → 10,500 USD								

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position D liquidated	**Net Profit:** 28 USD **Margin Loss:** 25 USD; **Fee:** 1 USD; **Margin returned:** 102 USD	167 USD	175 USD	10,124 USD	1,967 USD	2,925 USD	2,034	3,000
Position B liquidated	**Net Profit:** -20 USD **Margin Loss:** 25 USD; **Fee:** 1 USD; **Margin Returned:** 4 USD	167 USD	150 USD	10,145 USD	1,967 USD	1,950 USD	2,034	2,000
Position A liquidated	**Net Profit:** 20 USD **Margin Loss:** 33 USD; **Fee:** 1 USD; **Margin returned:** 86 USD	100 USD	150 USD	10,126 USD	1,000 USD	1,950 USD	1,034	2,000

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position F liquidated	**Net Profit:** 56 USD **Margin Loss:** 50 USD; **Fee:** 1 USD; **Margin Returned:** 205 USD	100 USD	0 USD	10,071 USD	1,000 USD	0 USD	1,034	0
Position E liquidated	**Net Profit:** -29 USD **Margin Loss:** 0 USD;**Fee:** 1 USD; **Margin returned:** 70 USD **Fee:** 1 USD; **Margin returned:** 70 USD	0 USD	0 USD	10,101 USD	0 USD	0 USD	0	0

8 Summary

- Qilin is a decentralized risk optimizer protocol for derivatives trading of Ethereum assets.
- Qilin introduces a tranche-structured liquidity pool model for asset pairs to maximize liquidity yield and provide different risk-reward profiles for different LP users.

- A Rebase Funding Rate is switched on during long/short imbalance and applied to the naked-side positions to mitigate risks for liquidity.
- A Dynamic Algorithmic Slippage is applied on naked-side positions to incentivize against risks of position imbalance.