Qlf: The Interstellar Liquidity Protocol

Amber Paper: Mechanisms, Technology, Tokenomics

Qlf Team

Abstract

Qlf is a protocol for capital deployment on Solana for the purposes of liquidity provision and yield farming, both with and without margin of up to 200x. The protocol introduces its own versions of an invariant-based Automated Market Maker protocol for exchange operations and a money market for short-term loans. The central contribution to the Solana ecosystem is a protocol for leveraged LP positions in AMM pools and yield farming protocols.

Qlf improves capital efficiency and facilitates more liquid markets by connecting low-risk, low-effort investors providing liquidity to lending protocols with risk-seeking, active management investors who focus on leveraged liquidity provision and yield farming positions.

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1 Executive Summary

One of the central innovations introduced by decentralized finance (DeFi) is fully automated money markets with low trust requirements, accessible by arbitrary parties. Capital deployment into collateralized debt products or automated non-custodial market making (AMM) is becoming streamlined, with lowest historical barriers for entry, both in the sense of compliance and minimal viable investment amounts. The established industry term for this group of mechanisms is liquidity provision (LP).

Second generation of DeFi brought forth two further innovations:

- Token incentives for liquidity provision ("yield farming"), and
- Margin trading and leveraged positions.

Qlf Protocolis a step towards third-generation DeFI, offering leverage for liquidity providers in AMMs on Solana blockchain. This paper describes the inner workings of the protocol and outlines its main contributions.

2 High-Level Overview

3 Introduction: Decentralized Liquidity Markets

3.1 Problem Statement

For a long while in early history of public blockchains, the primary means of exchange for on-chain assets were centralized platforms with custodial deposits. First attempts at noncustodial order book exchanges on Ethereum demonstrated limited success, but were severely held back by the resource constraints of the network. In particular, on-chain matching was outright impossible, while off-chain matching of on-chain orders showed limited viability, still incomparable to fully centralized exchanges in fees, latency, overall user experience, — and, consequently, trading volumes and liquidity depth as well.[1]

Despite the advantages of liquidity depth and user experience, centralized exchanges were highly problematic in their own right. The industry has seen hacks, scams, fraud, regulatory shutdowns, phishing, market manipulation, shady insider market makers, artificially inflated volumes, prohibitive costs of listing, etc. While certain preventative and mitigation measures have been established over the years, centralized platforms still retained their primal sins — centralized custody of funds, permissioned markets, and opaque trade execution.

The decentralized world offered three kinds of alternatives:

1. Scaling up the base layer[2] until it can support an order book exchange implemented as permissionless smart contracts.
2. Foregoing the notions of decentralization and permissionlessness, but banking hard on smart contract custody.
3. Changing the mechanisms that run the market.

[1] See [1] for further context on the historical development of DeFi.
[2] Without introducing meaningful centralization.

Scaling up without losing decentralization has been (and partially remains) a hard problem, but great advances have been made in recent years. This direction bore fruit, but while it helped improve the infrastructure, it did not add much to the conceptual development of the field. The same can be said about trusted noncustodial solutions.

It is the third option that revolutionized on-chain trading and gave rise to the industry of decentralized finance (DeFi), — starting with the practical introduction of automated market makers (AMMs).

3.2 Constant-Product AMMs

An automated market maker (in context of DeFi) is a smart contract -based solution implementing a set of liquidity pools and an invariant-preserving swap operation between them. Whenever a user wants to make a trade, she brings one of the assets to the AMM, and the AMM calculates the quote using a simple formula so that if the trade is made, the invariant is preserved. Since pool sizes and parameter constants are the only state that the AMM needs to keep, its potential throughput equals precisely that of the underlying layer, with no resources wasted.

In another key innovation offered by AMMs, a user can become a *liquidity provider* in the pool by committing liquidity to every side of the pool.[3] This action improves "liquidity depth" of the pool, and the liquidity provider is able to collect a portion of the trading fees pro rata to their contribution to the pool.

First-generation AMMs used constant-product as the invariant. Namely, if we denote the reserve of asset t as R_t, then for some given k, the following equation must hold under swap operations:

$$R_A \cdot R_B = k$$

If someone wants to swap some amount of asset A for asset B, the equation can be rewritten as follows:[4]

$$(R_A - \Delta_A) \cdot (R_B + \Delta_B) = k$$

The constant-product invariant is generic and does not rely on any external inputs.

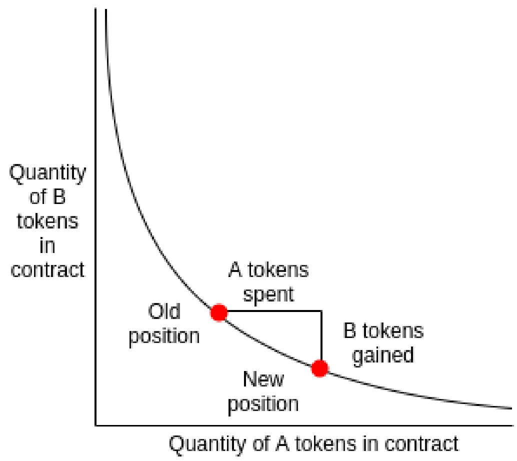

Figure 1: Constant-product price curve.

[3] In such a proportion that marginal quote price does not change with that liquidity insertion.
[4] Fee calculations are purposefully omitted for clarity.

3.3 Impermanent Loss

One subtle drawback of being a liquidity provider (LP) in an AMM is called impermanent loss. It stems from the fact that the LP in the AMM cannot choose their own inventory or affect its pricing: at the capital deployment event, the composition of deposited liquidity is determined by the current marginal quote price, and from then on the composition shifts as trades are made against the pool, at quote price.

One corollary of that is that whenever one asset appreciates against the other one on markets external to the AMM, the AMM keeps selling the more expensive assets for its quote price (which is lower than its market value, — unbeknownst to the AMM) until arbitrageurs make enough trades against the AMM to shift the price in the right direction. In this process, the LP loses value against the baseline scenario of just holding the initial inventory.

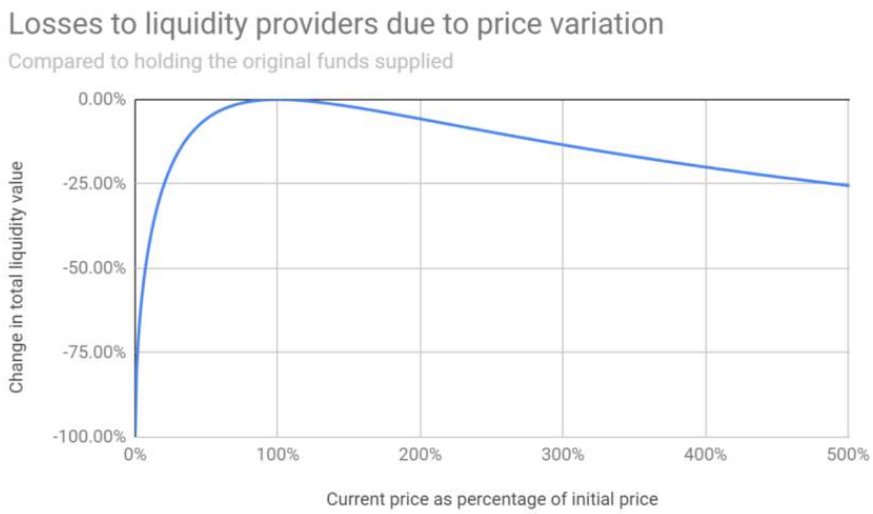

Figure 2: Impermanent loss from price variation.

If the prices shift back, the AMM will restock the LP's position to its initial composition, and the perceived loss will be unwinded, — hence the name.[5]

3.4 Leveraged Liquidity Provision

One of the steps in AMM development is providing leverage for LP positions. A product with that idea was pioneered in 2020 by Alpha Finance Labs under the name **Alpha Homora**. It operates on Ethereum network and allows to add leverage to positions on AMM exchanges such as Uniswap. Alpha Homora draws liquidity from other products (notably, Cream Finance) and offers it to traders in exchange for fees and protocol custody of their position (until it is deleveraged).

As was mentioned in the previous section, a liquidity provider in a constant-product AMM earns from fees (or trading volume), but loses from price variation (impermanent

[5] Impermanent loss has been extensively studied recently, and many great materials exist on it, from online calculators to academic articles. One such paper is [2]

loss). A leveraged AMM LP position is therefore a bet on trading volume against price volatility, — since if the price diverges too far from the initial value, the impermanent loss will outweigh trading fees, triggering a liquidation event that may consume the principal in order to repay the creditors.

Aside from that speculative component, leveraged LP is attractive in certain market conditions or for certain assets — for instance, for stablecoin vs. stablecoin pairs, since, unless one of the pegs is broken, the volatility is known to be low.

Leveraged liquidity provision can be seen as one of the instruments facilitating liquid automated markets and extending the range of possible trading strategies.

4 Qlf , The Interstellar Liquidity Protocol

Decentralized trading and management of digital assets are two rapidly evolving fields that strive to become the bedrock of the new financial world infrastructure. Introducing decentralization is hard on many levels[6], but also promises immense benefits for the world. A decentralized infrastructure is much more resilient, egalitarian, and transparent, and its corruptibility is limited since the power of any node is naturally finite.

That's just the tip of the iceberg. Recent history of the field demonstrates rapid advancements in distributed systems, mechanism design, mathematics (notably, zero-knowledge proofs), product innovation, and models of cooperation (decentralized autonomous organizations). The innovation continues and keeps accelerating.

Efficient and interoperable markets for digital assets are also vital and keep developing fast. One of the promising niches of the ecosystem is forming around Solana network, as it keeps hitting records for throughput of permissionless blockchain transactions and seed a competitive environment for innovation. In addition, Solana successfully runs an on-chain decentralized exchange (DEX) with an order book model and latency compared to its centralized counterparts. The scene for the next-gen DeFi is set.

Qlf aims to become the go-to place for blockchain liquidity, initially launching on Solana and then potentially expanding to other chains. Qlf is a family of protocols con -necting traders and investors of varying risk appetites to facilitate liquidity flows an d maximize capital efficiency for all stakeholders.

Figure 3: Conceptual breakdown of Qlf functionality.

At the core lies the protocol for leveraged liquidity provision into AMMs and yield farming. Complementary to that, Qlf offers two protocols for unleveraged liquidity man -agement: Qlf MM (a decentralized exchange service) and Qlf (an overcollateralized bor-rowing service).
The core purpose of both protocols is to provide entry points for traders and risk-averse investors, offering them a platform to trade and provide liquidity, all the while reining in an additional revenue from indirectly providing liquidity to the Leverage Protocol.

[6] Engineering, mechanism design, societal, regulatory, are just a few examples.

Stakeholder	Resource	Target	Strategy w/ Qlf
Risk-averse investors	Capital	Principal-protected yield (can be low)	Provide capital into the AMM pools
Risk-seeking investors	Capital	Maximize yield (by taking risks)	Provide liquidity into (external) AMMs with leverage borrowed from Qlf
Borrowers	Collateral in excess	Access to liquidity	Borrow from the lending pools
Solana traders (incl. on Serum exchange)	Working capital	Speculate	Don't know about Qlf
Arbitrageurs	Automation skills, short-term capital access	Earn by facilitating market efficiency	Perform liquidations
Protocol team	Development capability	Maximize TVL, monetize protocol usage	Develop the protocol

Table 1: Qlf Stakeholders

The relationship between the stakeholder groups is illustrated below:

Figure 4: Cross-protocol liquidity facilitation by Qlf .

4.1 Protocol Architecture

On the code level, Qlf consists of five key component

s: Qlf Leverage Protocol — the system that enables entering positions with leverage.

- Qlf MM — a protocol for unleveraged trading and liquidity provision on Serum with arbitrary price curves.
- Allotment Qlf — a protocol for lending and overcollateralized borrowing.
- Qlf Council (governance) — the decentralized autonomous organization (DAO) managing the protocol and its development.
- Qlf equity module - a module that enables purchase of various types of convertible derivatives for Qlf in exchange for liquidity, which becomes protocol owned.

Their relationship is outlined in the following sections.

4.2 Leverage Protocol

4.2.1 Overview

There are four principal concepts that make up the Leverage Protocol:

- The Treasury — the component that enables borrowing, tracks position health and keeps collateral in its custody. The treasury is the entry point for all interactions with the leverage protocol, since its the only part of the system that can borrow funds on behQlf of the users. It's important to note that the treasury does not contain any business logic for interacting with outside protocols and entering positions — it only manages position collateral and debt.
- Auction module — the system that runs liquidation auctions for unhealthy positions.
- Protocol connectors — modules that contain business logic for entering leveraged positions in various protocols. These modules are invoked by the treasury to actually manage user positions. Protocol connectors are defined very generally and can manipulate positions in any way, as long as the final position satisfies debt health requirements defined by the treasury. This means that users are able to instantiate their own connectors and use them with the leverage protocol, which enables the creation of custom products with leverage by the users. The Qlf team will provide a set of standard connectors for popular use cases on launch, such as leveraged yield farming or leveraged long/short positions on Raydium.
- Lockboxes — special NFTs holding a certain type(s) of assets, coupled with an oracle that allows determining their value. A lockbox is the main unit of collateral in the system. Simple examples of lockboxes are fungible and non-fungible SPL token lockbox, AMM farming position lockbox and interest-bearing token lockbox[7]. A single position can post one or more lockboxes as collateral. Since lockbox logic is directly responsible for correctly computing collateral value, new lockbox types (and, consequently, new oracles) can only be added by governance vote.

[7] These lockbox types will be provided by the team and pre-approved on launch

All of these concepts are implemented as Solana programs interacting with each other and external protocols.

The typicQlf ows of interactions when a user executes (manages their leveraged po -sition) and when an unhealthy position is liquidated are presented on Fig. 5 and Fig. 6,respectively.

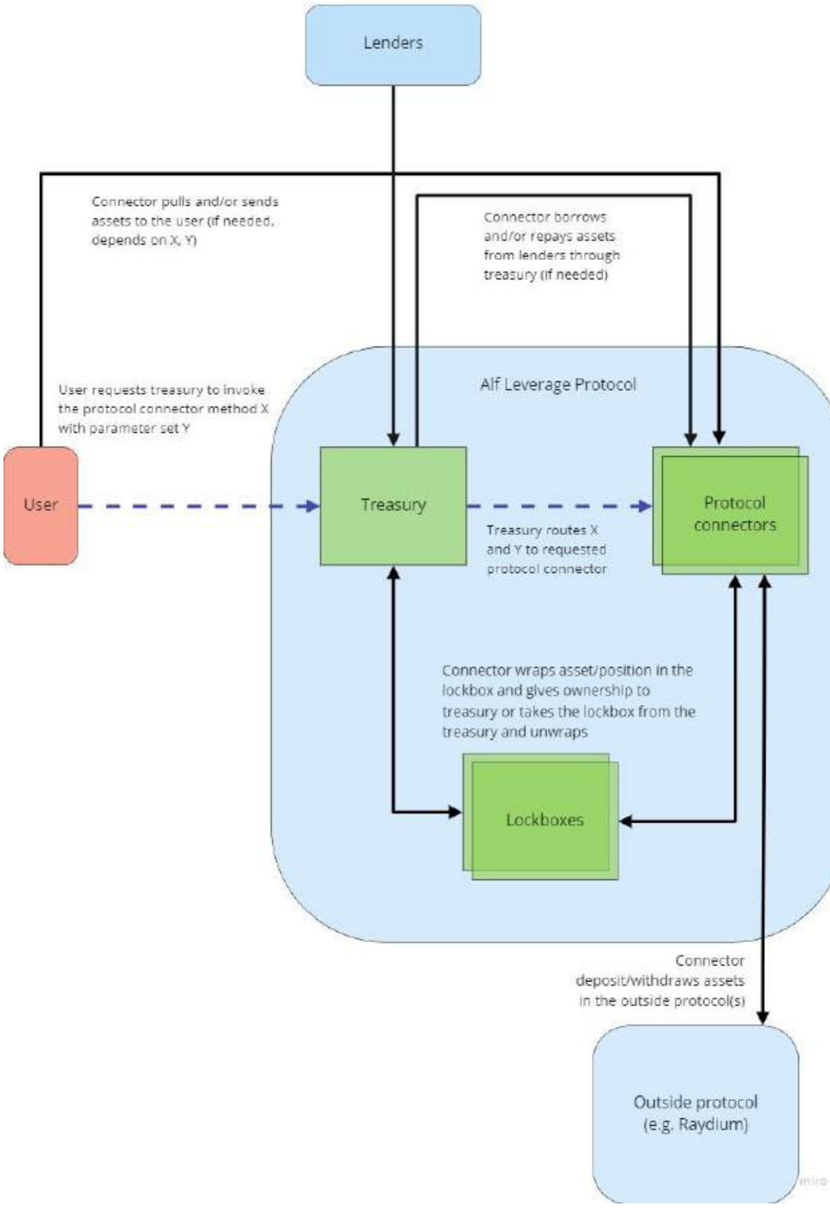

Figure 5: Qlf execution flow on each user request. Blue lines indicate messages and blac klines indicate assets/value flows.

4.2.2 Leveraged Position Lifecycle

Qlf
Leverage Protocol enables users to enter leveraged positions in various types ofassets . The two primary uses that the Qlf team envisions for the protocol initially are leveraged long/short positions and leveraged LP yield farming.

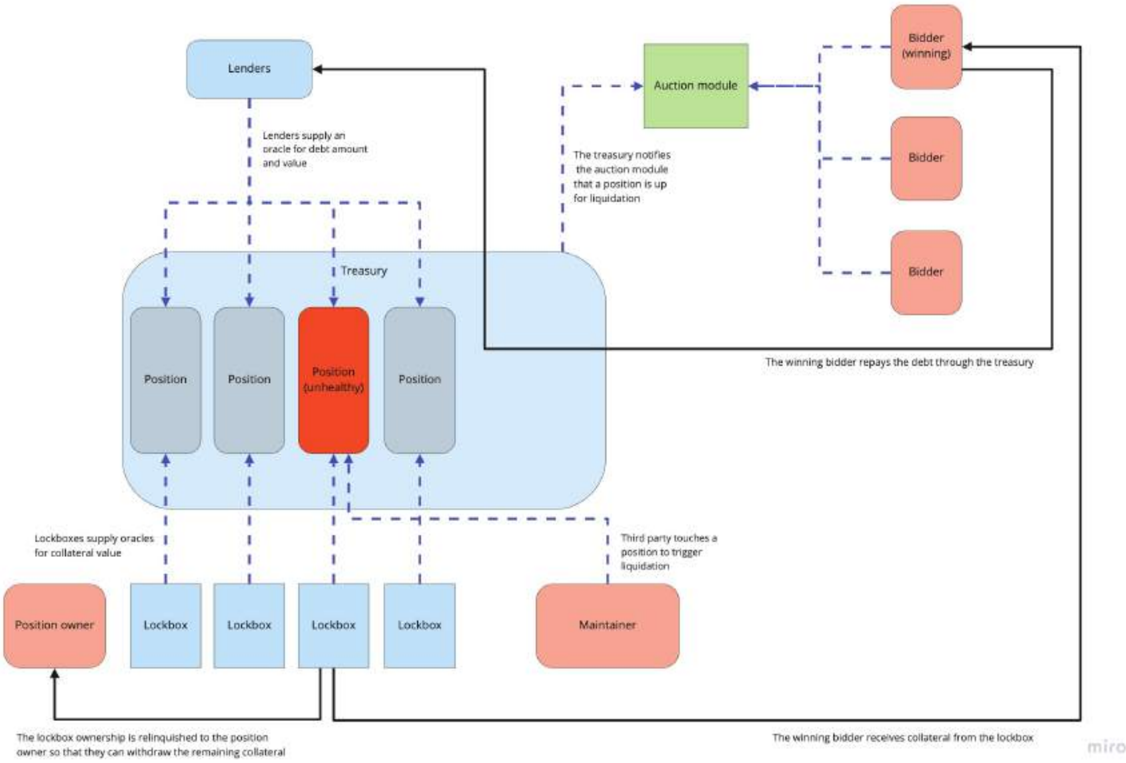

Figure 6: Qlf Leverage liquidation flow. Blue lines indicate messages and black line sindicate value flows.

As was mentioned in Section 4.1, all of the unallocated liquidity held by Qlf resides in the Treasury. Whenever the Leverage Protocol is queried to provide leverage for a position, it considers liquidity available in the Treasury and may borrow it — within a reserve limit — from Qlf -native or external liquidity protocols.
A portion of the fees taken
by the Leverage Protocol goes towards paying out the LPs in the protocols and pools that were used.

To allow for undercollateralized borrowing, the protocol does not relinquish borrowed funds (or target assets that these funds are transformed into), instead taking full custody of the position and treating borrowed funds or target asset as part of the collateral.

The following is an example of a typical user flow for a leveraged position:

1. The user wants to open a leveraged yield farming position on Raydium SOL/USDT pair. They bring 100 SOL and 15,000 USDT to Qlf and requests to open a position with 2x leverage;
2. Qlf chooses lenders (Qlf markets or outside lenders) with the current lowest rates for SOL and USDT and borrows 100 SOL and 15,000 USDT. Qlf combines initial and borrowed funds and sends them to a special module called Protocol Connector, which will execute the business logic required to open a Raydium position;
3. The Raydium protocol connector deposits assets into Raydium and then stakes the resulting LP tokens to farm RAY. The protocol connector wraps the staked position

into a special contract called a lockbox. The lockbox secures the staked LP position, while the ownership of the lockbox is given to the protocol treasury as collateral.

4. The treasury tracks the value of the lockbox (provided by a lockbox-specific oracle) and the value of the debt reported by it lenders. If the discounted (see below) value of the collaterQlf alls below borrowed value, the position will become eligible for liquidation.[8]

5. Suppose that the position is not liquidated, and in three months it has accrued 10% of debt, the value of LP tokens has increased 3% and the staked position yielded 20% in RAY. The user decides to close the position and sends a request to the protocol. The Raydium protocol connector takes the collaterQlf rom treasury, unstakes the LP tokens and transforms them into the initial underlying assets. It then repays the debt in underlying assets (making an additional swap if the exchange rate has moved) and sends the remainder, as well as farmed RAY, to the user. The user's final yie ld is $20\% * 2 + 3\% * 2 - 10\% = 36\%$.

While Qlf Leverage Protocol supports numerous use-cases, the lifecycle of a leveraged position closely follows the above outline, with only the assets, protocol connectors and lockboxes changing based on a particular use case.

4.2.3 Margin Limits And CollaterQlf actors

To track position health, Qlf tracks a so-called lockbox collaterQlf actor for each lock-box instance. The CF is a factor by which collateral value is discounted when comparing it to borrow value. By default, the collaterQlf actor is set to 1.5, which enables up to 3x leverage for any lockbox type: $\frac{OF+D}{D} = 1.5 \rightarrow D = 2 \cdot OF$, where OF is user's own funds and D is debt.

However, the community can vastly reduce the collaterQlf actor (therefore, increasing maximal leverage) for a lockbox type by adding a collaterQlf actor oracle. A collateral factor oracle is a special lockbox add-on that takes lockbox contents as input and outputs the current recommended collaterQlf actor.

CollaterQlf actors can have many behaviors, depending on a particular oracle chosen by a community. A few examples:

- Constant collaterQlf actor applied to all lockboxes of a particular type;
- A weighted-mean CF from individual CFs for lockbox assets, based on a fixed asset-to-CF table;
- A dynamic CF, computed based on recent lockbox value volatility;

CollaterQlf actor oracles enable fine tuning the margin limits for each particular typ e of collateral or position. E.g., for LP positions, which change slowly in value, leverag e limits as high as 50x or even 100x are possible, while for long/short positions in volatil e assets a dynamic limit can be imposed based on short-term volatility.

To prevent attacks, the absolute minimum CF is imposed system-wide. This parameter is chosen by governance.

[8] Note that steps 2–4 are not explicit from the user standpoint and are done by contracts in the backend. The user only brings funds and then sees a leveraged Raydium position in the interface.

4.2.4 Liquidations

Qlf

Leverage Protocol relies on arbitrageurs to ensure that unhealthy positions are liquidated timely. Third-party arbitrageurs can liquidate an underwater position by repaying the position's debt and receiving part of the collateral as a reward. A position is eligible for a liquidation when its CF-discounted collateral value falls below the borrow value. Liquidations take the form of an auction where liquidators bid on the amount of collateral they are willing to receive for repaying the position's debt. The right to liquidate is given to the bid claiming the least collateral.

4.2.5 Liquidation protection

In addition to market-driven liquidation (that protects liquidity providers), Qlf also offers protection for traders. Knowing the liquidation threshold, a trader can set a higher safety limit as an equivalent of a stop-loss order, and if the position gets close to liqui-dation, it will be closed by the protocol automatically, without incurring the liquidation penalty.

The tradeoff for using this mechanism is, naturally, that the safety limit chosen by the user reduces the price corridor in which the position remains active, potentially triggering an automated closure of a position that would recover on its own instead of getting liquidated.

4.2.6 Margin calls

For lockboxes where CF changes dynamically, a position can suddenly find itself underwater because of a CF update. To prevent this, the last known CFs for lockboxes are stored with the position and the collateral value for determining position health is derived from them. When a position is touched with a CF update that would put it underwater, it instead goes into a margin call state.

During a margin call, a position does not immediately update its CFs, and is instead given a grace period during which the position owner can restore its health with regard to the new CF — either by posting additional collateral or unwinding a part of the position.

Note that if the position goes underwater during the margin call based on the older CFs, it will be eligible for liquidation.

4.2.7 Risk Model: Safe leverage limits based on position volatility and liquidation speeds

Aside from available liquidity, the maximal leverage for particular asset types is largely determined by:

1. Volatility of the asset, which determines how much an asset can move within a time it takes the market to react and liquidate an unhealthy position;

2. Throughput of the underlying technology, which constraints the speed with which arbitrage can take place;

Here we provide an example of a rough calculation for determining a safe maximal leverage limit for a SOL/USDT yield farming position (i.e. a leveraged position in SOL/USDT LP).

Considering the low latency and high transaction throughput, we believe that 1 day is a very generous liquidation window for an unhealthy position. It remains to determine the maximal amount that the position value can diminish within 1 day.

Based on a GBM model and historical data of SOL/USDT pair, we have determined a 99.5-confidence interval of SOL price movement as $[-19.23\%, 23.81\%]$. This means that with 99.5% probability impermanent loss for the pair will not exceed 0.5% within a day. This means that the position value will fall at most 0.5% before the liquidation window end, which corresponds to a safe maximal leverage threshold of 200x.

Considering the confidence intervQlf or weekly price movement of [-40.7%, 68.8%] ,a trader that checks on a position once a week can set their initial leverage to 190x an dhave high confidence that it will not go into liquidation mode within a week.

4.2.8 Risk Model: Leverage Limits

Maximal possible leverage on a pair is a multiplier that determines how much liquidity is it safe for the protocol to lend to the investor so that the protocol can expect with a high degree of certainty to pay off its liquidity providers, regardless of market performance. It is determined primarily by two factors:

1. Availability of liquidity to lend out;
2. Market volatility on the chosen pair, measured against the protocol reaction times.

We will look at each of them below.

Availability of liquidity. 10x leverage requires 9x liquidity free-floating in the protocol. If Cindy wants to enter a SOL/USDC position on Raydium with 10x leverage with $1,000 worth of liquidity, Leverage Protocol needs to procure a further $9,000 worth of liquidity for her.

Since Cindy's position is for liquidity provision on an AMM, her returns function is trading fees vs impermanent loss, multiplied by leverage.

4.3 Qlf MM: Arbitrary Invariant Swap Markets

One of the notable achievements of Solana network is the possibility (and implementation) of an on-chain AMM DEX, Serum. Naturally, Serum shares the level of decentralization with the network itself, which is considered reasonable in the industry, —and thus Serum is the go-to exchange on Solana.

While having an orderbook and a matching engine works well for the non-crypto-native audiences, —including professional TradFi traders and market makers — it is not excessively convenient for liquidity providers coming from the DeFi world, or the wider investor audiences that do not have connections (or capital) to provide liquidity on an order book exchange efficiently.

Missing out on a group of potential liquidity providers reduces overall capital efficiency, since some of the liquidity that could add depth to Serum is not being used in that capacity. This is one of the reasons AMM protocols came to Solana: not as alternative markets to Serum, but mostly for the purposes of connecting this underserved market to Serum.

QIf
MM is an AMM protocol empowering its liquidity providers to dabble in both worlds, providing liquidity on Serum and also partially lending it out to QIf ’s leveraged LPs.

4.3.1 Order Routing

For an AMM complementing liquidity on Serum, there are three possible integration strategies:

1. **Full bidirectional integration.** Matching engine of Serum integrates the AMM and uses it to fill in the gaps between the orders placed in the book. Consider an example.

   Let's assume the book has order A_1 at price point 1.07 and A_2 at price point 1.11, and the current quote price of the AMM is 1.09. A large market buy order comes in. Serum fills the order A_1 first, then makes a trade on the AMM until its price point slips past 1.11, then fills the order A_2.

   This approach requires modification to the order book exchange, so its availability is not given — as it is a business decision and is not a matter of technology.

2. **Limit order orchestration by the AMM.** Alternatively to full integration, Serum is considered the go-to market for order execution, so AMM places small limit orders in the book, along the invariant curve. As a large market order comes in, AMM's orders and orders of other market makers get executed as usual. This approach allows the AMM maximal exposure to Serum's order flow (and therefore returns for the LPs even if the protocol is completely unknown on the market), but has to replace the orders every time liquidity is added or taken away from the AMM (since the invariant curve changes). Order orchestration is the approach currently taken by Raydium [4].

3. **AMM-side order execution.** This approach mimics a bidirectional integration, except it is the AMM that acts as the source for the order flow. If a user comes to the AMM to make a swap, the AMM breaks the operation down into small parts and uses the best price option (between the AMM and Serum) for each batch, therefore also acting as a DEX aggregator.

   If, on the other hand, the user comes to Serum directly, AMM is not queried and its liquidity is not utilized.

The optimal scenario for QIf
MM would be to achieve full bidirectional integration.However,
it requires upgrades to Serum's matching engine, and therefore it is not something the protocol team can count upon. Given that impossibility, AMM-side execution has important benefits over limit order orchestration. The two benefits QIf MM plans to capitalize on are fractional reserves and arbitrary curve markets.

4.3.2 Reserve Factor

For a classic example of an AMM,[9] capital efficiency is rather low. Conceptually, an LP providing liquidity on an invariant curve is equivalent to a high number of individual

[9]A great reference is Uniswap v1, [5].

limit orders with prices ranging from 0 to $+\infty$. Naturally, most of these orders never get filled, and the liquidity residing in them could be used elsewhere.

One way to utilize this liquidity better is to virtualize a portion of it and lend it out to another protocol or utility. For instance, if the current quote price for BTC is $55,000 (for instance, on a BTC/USDC pair), an AMM can pretend that it is ready to make trades within the price range of $20,000 to $120,000 and lend the remaining liquidity out.[10] Reserve factor is an important parameter that should be adjusted per market.

Since QIf MM executes orders on top of Serum in addition to its own liquidity pools, it is highly unlikely that the tail end of the price curve will ever be reached, since for that the trade has to deplete liquidity depth both on QIf MM and on Serum.
If that happens,however, QIf MM has two fallbacks:

1. The internal interest rate on the liquidity sent to the Treasury goes up, and the Treasury might reallocate its borrowing position from QIf MM to other sources (or trigger a soft margin call on the leveraged positions).

2. The AMM stops processing swap orders for the given market through the curve until the market recovers or liquidity is returned. Swap orders in the breached direction continue to be accepted but are routed to Serum directly.

Unlike a general-purpose AMM protocol, QIf MM is limited to the same range of mar-kets that is accepted in the Leverage Protocol , which are generally liquid markets ap-proved by governance, so fallback scenarios will likely never be reached.

4.3.3 Arbitrary Curve Markets

Section 3.2 described markets with constant-product invariant. While they generalize well and are unsophisticated, capital inefficiency (as described in the previous section) is always a factor. An alternative approach for increasing capital efficiency, notably pioneered and implemented by Curve, lies with usage of curves that allocate more liquidity towards the current reference price and less towards the price extremes [6].

Implementing arbitrary curves falls out of the scope of QIf MM during the initial rollout phases, but they remain an important possibility to further amplify the benefits for the protocol and therefore will be tested extensively during later development stages.

4.3.4 Bootstrapping liquidity

During the early stages (1 year after protocol launch), QIf will deploy additional in-centives to liquidity providers in QIf MM, up to the target pool saturation. The specifics of that process can be found in section 5.1.2.

4.3.5 Role of Governance

The protocol DAO impacts QIf MM in the following ways:

1. Curate the list of markets supported by the protocol.

2. Define the reserve factor per individual market.

[10] In case of QIf MM, the outstanding liquidity is captured into the Treasury and can be used by Leverage Protocol.

3. Adjust protocol fees. The initiQlf ee is 0.15% of the trade.

4. Decide to adopt or remove particular arbitrary curve markets.

4.4 Qlf : Lending & Borrowing

The second protocol in Qlf is a money markets solution: Allotment Qlf (Qlf).

It uti-lizes tokenized single-asset liquidity pools for lenders (liquidity providers) and overcollateralized debt positions for borrowers. Each asset supported by Qlf has a corresponding liquidity pool in AQlf , available for LPs and borrowers.

4.4.1 Liquidity pools

Each liquidity pool is dedicated to its own asset and is treated separately for the purposes of calculating pool utilization and interest rates. Whenever a liquidity provider enters a pool with a deposit, the protocol mints LP tokens representing the share of aggregate deposits. Fees captured by the pool (i.e. interest paid by the borrowers and by the Leverage Protocol users) are added to the pool of underlyings, without diluting share value. Whenever a liquidity provider wants to exit the pool, they burn their shares and receive the pro rata portion of the underlyings, which grew with each interest and fee payment in the meantinme.

4.4.2 Pool utilization and interest rates

At all times, each liquidity pool has an independent metric describing the utilization of its liquidity. It is calculated as $\frac{L_B}{L_D}$: a ratio between the aggregate deposits into that pool and aggregate debt drawn from this pool. The debt includes every type of borrowing positions, including liquidity taken out by the Leverage Protocol. To rephrase, utilization ratio always reports the amount of liquidity available on the spot, relative to the aggregated deposits.

At launch, the target utilization ratio is set to 85% for each asset, which the protocol incentivizes by dynamically adjusting interest rates for both lenders and borrowers linearly, depending on pool utilization (diagram below).

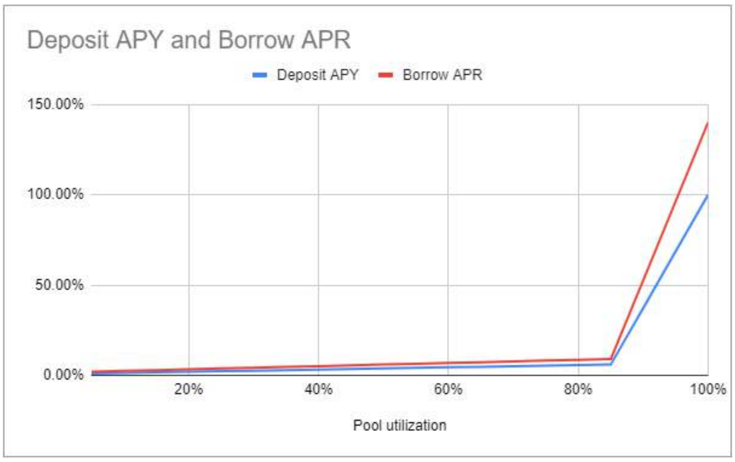

Figure 7: Qlf dynamnic interest rate

Target ratio and the slopes depend on multiple parameters and will be adjusted by QIf Council as trading data over the corresponding assets accumulates.

The model pursues three goals:

1. **Ensure protocol solvency at all times.** Underlying assets and liquidation markets are prone to price action and volatility. Despite that, the collateralization level invariant must be kept, enacting prompt liquidations between the time any particular position enters endangered state and the time when its collateral is worth less than the safety margin.

2. **Enable frictionless deposits and withdrawals.** Ideally, if a liquidity provider in AQIf closes her position, she should be able to withdraw her entire deposit on the spot, even if it is considerable in size. For a lending pool, this means that reasonably sized inventory should be kept on hand by the protocol, and once a withdrawal happens, the added incentives (shifting interest rates) should motivate other stakeholders to promptly adjust the utilization ratio to its target value, eitehr providing additional liquidity, or closing some of the loan positions.

3. **Maintain high capital efficiency.** As long as the first two properties are maintained, the protocol should minimize the amount of idle liquidity, i.e. liquidity that does not generate a yield. Idle liquidity reduces return rates for all liquidity providers, so it should be kept as low as possible, insofar as it does not threaten the solvency of the protocol.

4.4.3 Borrowing limits and liquidations

While deposits and utilization are tracked individually on pool-per-pool basis, borrowing limits are aggregated across all of the available pools.

Example. If a user deposits $10,000 USDT and $10,000 USDC into the corresponding pools, her total collateral will be listed as $20,000.

The maintenance margin for borrowing positions is measured against total collateral and equals 115% before liquidations. If the user's outstanding debt (including unpaid interest) reaches or exceeds $\frac{1}{1.15} \approx 0.87$ of the collateral, a liquidation can be triggered by any market agent, selling off a part of the user's collateral to repay part of the debt and bring the total collateralization level to the safety margin of 130%. The choice of assets to liquidate is up to the liquidator. Liquidation reward is 10% of the value liquidated.

Example. Alice deposits $10,000 USDT and $10,000 USDC and borrowed $16,000 worth of SOL. Her collateralization ratio is now $\frac{\$20,000}{\$16,000} = 125\%$. For the sake of simplicity, let's assume that the interest rate is 0%.

A day later, SOL price goes up 15%, bringing Alice's outstanding debt to $\$16,000 \cdot 1.15 = \$18,400$. Her collateralization ratio is now $\frac{\$20,000}{\$18,400} \approx 108.7\%$, which is under the allowed maintenance margin.

A liquidator steps in and chooses to sell off SOL to bring the debt up to the 130% collateralization limit. The calculation he performs is as follows. Let's denote the amount to liquidate as v. Then

$$\frac{\$20,000}{\$18,400 \cdot (1 - 1.1v)} = 1.3 \Leftrightarrow 1.1v = 1 - \frac{\$20,000}{\$18,400} \cdot \frac{1}{1.3} \Leftrightarrow v \approx 0.149$$

Therefore the liquidator needs to sell $0.149 \cdot \$18,400 \approx \$2,741$ worth of SOL (and claim an additional $274 worth of SOL as reward), to bring the position to 130% safety margin. Failing to react to a changing market situation, Alice loses $\approx \$3,015$, but AQlf stays solvent and is able to repay its liquidity providers with interest.

4.4.4 Bootstrapping liquidity

During the early stages (1 year after protocol launch), Qlf will deploy additional in -centives to liquidity providers in AQlf , up to the target pool saturation. The specific s of that process can be found in section 5.1.2.

4.4.5 Role of governance

The Qlf Council performs four functions in relation to AQlf :

1. Curate the list of supported assets and oracle feeds reporting the market prices for these assets.
2. Adjust the interest rate curves as necessary, based on the prolonged observation over pool performance and research advancements in the field of single-asset lending pools.
3. If necessary, adjust risk parameters of individual asset pools, regarding their collateralization ratio.
4. Set the allowance rate regulating how much debt can be taken on by the Leverage Protocol.

4.5 Qlf Equity Module

Aside from other means of attracting liquidity, Qlf uses a special mechanism for producing liquidity owned by the protocol (as opposed to liquidity temporarily provided by the users). The mechanism enables purchase of various types of convertible derivatives for Qlf in exchange for liquidity, which becomes protocol owned.

Qlf equity module is a system that will be enabled some time after launch and will sell part of the LP rewards Qlf allocation in a form of various convertible notes in exchange for liquidity, which becomes protocol-owned.

Protocol-owned liquidity (POL) has a number of distinct advantages over liquidity provided by mercenary LPs:

- POL does not have high requirements in terms of yield in order to entice LPs to bring their capital. As such, POL can be lent out to users for much smaller borrowing rates, which boosts their returns and attracts more borrowers to the protocol.
- POL can be put on the balance sheet of the protocol as an asset. As such, the posession of POL by the protocol will provide a lower bound to the value of the governance token.
- Idle POL can be allocated to various DeFi instruments, generating yield for Qlf owners.

- Governance token buyers will have more skin in the game, since they actually relinquish liquidity assets. This means that actors with long-term interest in the protocol will be attracted, rather than mercenaries which will extract farming rewards and leave.

The types of convertible notes sold by the protocol will be determined at a later date. However, we can provide some examples of what can be expected:

- An option-like contract which requires the buyer to post the amount of liquidity equal to $(strike\_price + premium) * \text{Qlf}\ \_amount$. When the contract expires, the buyer can either exercise, in which case the protcol pays them the entire $\text{Qlf}\ \_amount$ and retains posted liquidity; or decides not to exercise, in which case the protocol only retains $premium * \text{Qlf}\ \_amount$.

- A futures-like contract which allows the buyer to purchase Qlf at a discount to market, but only unlocks the purchased Qlf amount at a later date, to prevent immediate arbitrage.

4.6 Governance Chambers And the Qlf Councli

4.6.1 Design Goals

The goal of Qlf is to provide the best possible access to liquidity and LP opportunities.Naturally, it has to be permissionless and noncustodial, with no central party able to interfere with its function or with service provision to any of the users. In addition, as the DeFi space is constantly evolving, so must the go-to liquidity protocol in order to stay relevant. Therefore Qlf needs a robust governance structure with sufficient decentralization to be resilient, but also efficient self-regulatory and crisis management mechanisms.

This is the role of the protocol DAO, the Qlf Council .At high level, Qlf Council has four key functions:

1. Ensure the long-term adequacy of the protocol by steering the development direction and making key strategic decisions.
2. Using the DAO Fund to fund or co-fund vital project initiatives.
3. Onboard and offboard modules of the protocol, granting/ revoking access to Qlf Treasury, enabling or disabling protocol connectors used by the Leverage Protocol.
4. Adjust parameters in the protocols that Qlf comprises: fees, leverage, maintenance margins, etc. An important part of this role is adjustment of the inflationary rates of Qlf and specific yield farming rewards and events.

To that effect, the DAO consists of several modules with a clear separation of concerns between them, and is able to form special-purpose subcommittees to perform particular roles in a faster cadence.

4.6.2 Design Rationale

Design of decentralized governance structures has seen considerable evolution that accelerated with inception of DeFi. There are several issues common to many existing governance structures in the industry.

Voter participation. Direct democracy, especially in a constantly shifting environment, takes a toll on its voters. The amount of attention a particular governance stakeholder is prepared to pay to the protocol is generally low, and governance decisions often involve opining on complex problems in many-dimensional parameter spaces. As a result, voter turnout is chipped away by less important decisions, and often does not recover.

Governance structures with a high degree of centralization (i.e. with few voters having a majority share of the voting power) are usually better at keeping track and defining a meaningful agenda, but centralization is harmful in the longer term.

Reaction latency. Some actions have to be made quickly. The most typical example is disabling an integration with an external protocol that got compromised, or reacting to direct attacks on the core protocol itself. Sometimes offboarding a particular asset — e.g. an algorithmic stablecoin that flash crashed and does not seem likely to recover — is a matter of retaining solvency of the protocol.

On the other end of the spectrum there are divisive decisions that have high impact on the future of the protocol, such as a considerable change in interest rate curves. For these actions, a long community discussion is absolutely necessary, so the window between a proposal being introduced and a decision made could span weeks.

Good governance models keep a balance between the two types of decisions and the mechanisms that are used to process them.

Special interest groups. As many parameter adjustments have unclear consequences for most voters, participation on them is not often of high priority for an average stakeholder. Meanwhile, — and this is especially true for protocol families (as opposed to one-trick protocols) — if a particular group runs a business model highly dependent on a particular parameter, their incentive to modify that parameter is high and can be calculated by its direct economic benefit.

This can be a good property and a bad property, depending on the overarching architecture of the protocol and unique circumstances. Preferably, no special interest group should have a combination of high incentive and high voting power in relation to a parameter able to adjust protocol externalities.[11]

Economic attacks on governance. Since reputation systems are still generally considered an unsolved problem [3], DAO governance relies on some form of voter staking or voter representation based on token ownership. The alienable nature of governance tokens and their free exchange on the open market open up vectors for economic attacks. An attacker can try and pass a governance vote in their favour by acquiring governance tokens and using them to try and flip or ramrod a decision. As long as the decision can bring in more benefit than the cost of capital paid by the attacker, the vector is viable.

DeFi instruments such as flash loans, lending solutions, and leveraged short positions only amplify this problem: the number of ways to reduce the cost of capital or to increase the potential gains of an attack is large, and keeps growing.

[11] As an example, if a special interest group running leveraged LP into rare algorithmic stablecoins would be able to single-handedly increase maximum capital allocation from the Treasury into their strategy, then, aside from getting high revenues for themselves as their leverage grows, they could also destroy the Treasury, should said stablecoins flash crash and take down the borrowed tokens with them.

In this case the parameter is the reserve ratio of the Treasury allocated to this particular connector in Leverage Protocol, while the negative externality is insolvency of the Treasury.

A good governance system should use a combination of methods to shift the potential attack surfaces in a way that increase attack costs as much as possible, and make sure the community has time to react to any vote that can have an immediate economic impact on the protocol.

4.6.3 Architecture

The Qlf Council connects the concepts of direct and representative democracies through the concept of subcommittees.

Figure 8: Qlf Council structure and roles

Governance staking. Governance participation requires time-locking Qlf with the protocol to acquire the non-transferable voting token, vQlf .

Each participant can choose a vQlf staking allocation between the Stellar Referendum and one of the subcommittees, with at least 30% allocated to the Stellar Referendum. There is a one-week delay for weight reallocation.

Staking rewards. All vQlf holders receive the governance inflationary reward (initially set as 10% annual). In addition, protocol fees going towards the DAO are split equally between the DAO Fund and the Subcommittee Dividend Fund, earning a revenue to the vQlf holders that stake in the given subcommittee.

Voting procedure. All decisions falling under the purview of the Stellar Referendum are subject to at least one-week discussion and pre-commit period and at least one more week for voting.[12] All decisions within the power of a subcommittee only receive votes from the vQIf stakers in that subcommittee. It is up to the proposer to decide whether the proposal will have a 7-day or a 14-day window, therefore affecting the possibilities for stake reallocation.

Veto rights. Every decision passed by any subcommittee is subject to a mandatory 3-day diligence period before it is enacted. During that time any participant in the Stellar Referendum can launch a Stellar-level vote to overturn the decision. The proposer of a veto must commit QIf tokens worth $500 to their proposal. These tokens are burned if the veto vote is not passed.

4.6.4 Operational parameters

To be passed, a proposal needs to go through several steps, gated by governance constants adjustable by the DAO module. The diagram below illustrates a typical workflow for a proposal that passes.

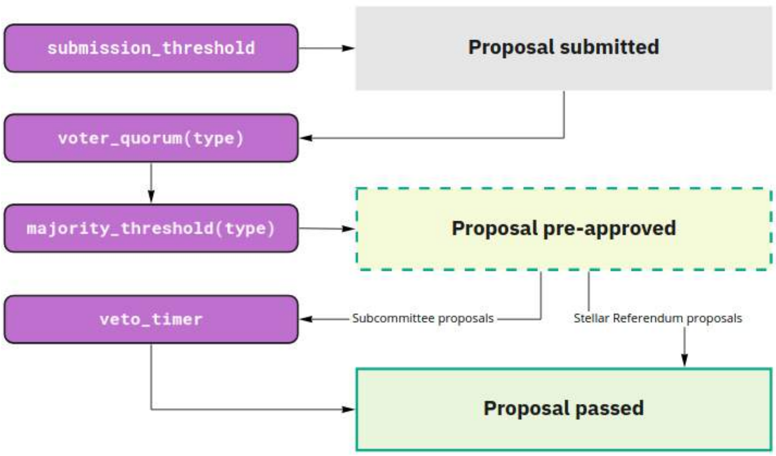

Figure 9: Life cycle of a passed proposal. Purple boxes are parameters.

At launch, the parameters are defined as follows:

Item	**Quorum**, % of floating supply	**Threshold**
Monetary policy	10%	supermajority (2/3)
Payment from the DAO fund	10%	simple majority (50%)
Treasury parameters	15%	supermajority (2/3)
Veto a subcommittee decision	5%	simple majority (50%)
Grant or revoke a special role	6%	simple majority (50%)

[12]Therefore it is entirely possible to reallocate stake from a subcommittee to increase one's weight in a Stellar-level decision.

5 Token Mechanisms

5.1 GenerQlf unctionality

The core value loop in Qlf Protocolconnects low-risk and high-risk investors,enabling an intra-protocol money market for short-term leveraged LP positions. Two major contributors to Qlf 's efficiency are its accumulated liquidity pool and the governance stru c-ture, vetting yield protocol integrations and adjusting the system parameters to optim a l values.

These interactions are captured and incentivized with the protocol token, Qlf . It is a utility and governance token, serving four key functions in the protocol ecosystem :

1. Staking in the DAO module to decide on:
   - DAO Treasury utilization (funding development, incentive programs, grants, buyback & burn events).
   - Managing Qlf inflation for various participants.
   - Parameter adjustment (fees, lockboxes, system-wide CF limits, etc).
   - Adding new lenders for the treasury.
2. Yield farming rewards for:
   - Incentivized pools in Qlf lending market.
   - Qlf Leverage Protocol users.
   - Incentives for prospective lender protocols.
   - Partnership farming programs.
   - Qlf convertible note buyers.
3. Loyalty tiers: staking a large amount of Qlf

enables higher leverage and other bonuses.

5.1.1 DAO and vQlf staking

Governance votes are weighted with the users' relative balances in vQlf - a special non-transferable token that is acquired by time-locking Qlf. The exact vQlf balance is calculated as:

$$b_{vQlf} = s_{Qlf} * \frac{t}{t_{max}}, \quad (1)$$

where s_{Qlf} is the staked amount, t is the time-lock period chosen by the user and t_{max} is the maximal time-lock period.

After staking into vQlf, users can participate in governance votes and are eligible for additional bonuses and incentives (see below).

Time-locked Qlf is also automatically staked in the Leverage Protocol Safety Module. The Safety Module bails out "platform debt", i.e. uses locked funds to repay positions that cannot be liquidated due to their debt value falling below collateral value.

5.1.2 Qlf incentives

Users of the protocol can receive Qlf rewards for various activities:

- **Lender incentives.** Native AQlf and Qlf MM pools that Qlf Leverage Protocol will initially borrow from receive Qlf rewards for providing leverage liquidity. Qlf rewards are allocated to different assets based on pool allowance utilization ratios[13]- since pools with higher utilization ratio indicate higher demand for the asset, the protocol will increase Qlf rewards to attract additional supply. The actual reward allocated to a pool is computed as $A_p = A \cdot \frac{U_p}{\sum_{t \in P} U_t}$, where A is the total allocation to lenders (there are two separate allocations for AQlf and Qlf MM), U_p is the pool utilization ratio and P is the set of all pools in the particular protocol.
- **POL acquisition**. Part of the LP reward issuance at some time after launch will be sold to buyers in exchange for liquidity, in order for the protocol to have its own permanent liquidity reserve.
- **Borrower incentives.** Borrowers in the Qlf Leverage Protocol also receive rewards based on their borrowed value over time. For each asset, the protocol tracks the total borrowed amount and rewards each position with Qlf based on its share in the debt for that asset. The distribution of Qlf rewards between assets is initially equal, but can be adjusted by governance.
- **Infrastructure lender incentives.** The governance can vote to allocate a part of lender Qlf rewards to large scale liquidity providers, such as third-party pools and lending protocols.
- **Partnership programs.** The governance can vote to allocate additional rewards to users that use the Qlf Leverage Protocol to participate in partner protocols.

[13] Pool allowance utilization ratio is the proportion of the funds borrowed by the Treasury to the maximal Treasury borrowing limit, defined by the Reserve factor of each pool.

5.1.3 vQlf loyalty tiers and rewards

Users that stake a large amount of vQlf are eligible to special tier bonuses:

Tier	vQlf locked	Bonus
Asteroid Tier	0–100,000	No additional rewards
Planet Tier	100,000–240,000	CF decreased by 5%
Star Tier	240,000–1,280,000	CF decreased by 10%
Galaxy Tier	1,280,000–4,960,000	CF decreased by 20%
Universe Tier	4,960,000+	CF decreased by 20% and delayed liquidations.[14]

5.2 Token Allocation

Qlf is a fungible SPL token used by Qlf Protocol. The initial supply is 10,000,000,000 Qlf tokens that will be distributed at launch. The token is deflationary, no future mintin g will be possible.

Tokens are allocated and will be vested as follows:

Group	%	Tokens	Price	Valuation	Raise USDT	Vesting
Angel	1%	100*m*	$0.0020	20*m*	200, 000	23 months
Seed	2%	200m	$0.0035	35*m*	700, 000	19 months
Private	2%	200m	$0.0040	40*m*	800, 000	16 months
Pre-ido	1%	100m	$0.0040	40m	400, 000	16 months
Public	2%	200*m*	$0.0070	70m	1,400,000	5 months
Liquidity	35%	3, 500*m*				28 months
Staking	15%	1, 500*m*				25 months
Treasury	15%	1, 000*m*				25 months
Marketing	14%	1, 000*m*				25 months
Team	11%	1, 100*m*				22 months
Advisors	2%	200*m*				22 months
Total	**100%**	**10B**			**3,500,000**	

[14]For Universe Tier members, underwater positions will not be liquidated immediately, instead going into a margin call state, similar to margin calls on CF updates.

Appendices

Appendix A Comparison

A.1 Qlf competitive advantages

Functionality	Qlf Protocol	Francium	Apricot	Tulip
Chain	Solana	Solana	Solana	Solana
Leverage	**Up to 200x**	up to 3x	up to 3x	up to 3x
Protocol liquidity	Farming **and** protocol-owned	Farming	*Undefined*	Farming
AMM	**Yes**	No	No	No
Lending	Yes	Yes	Yes	Yes
Liquidation Threshold	**Up to 90%**	83%	80–90%	85%
Liquidation Fee	**As low as 3%**	5%	4%	5%
Borrowing Fee	**7.5%**	10%	20%	10%
Performance Fee	**2%**	4%	20%	1.5%

A.2 Lending

Initially, 7.5% (later adjusted by DAO participants) of all lending interests paid by borrowers are gathered as protocol fees, and the remaining 92.5% are distributed to lenders.

A.3 Farming

Qlf charges one of Solana's ecosystem'

s lowest performance fee on the earning from LP token farming of 2% (later adjusted by DAO participants). Do note that the earnings displayed on Qlf Dashboard will have the performance fee deducted,
so the amount
shown in the Dashboard tab is the total amount the leveraged trader is entitled to.

A.4 Liquidation Bot

Initially, a liquidation bot will be run by the team to embrace an orderly market and to ensure that positions are liquidated without protocol experiencing loss. Liquidation bot code will be open-sourced for future public development.

At launch, all profit made from the team's liquidation bot will go to Treasury to backstop black swan events. Later all unused funds will be redistributed to Qlf Protocolstak -ers.

Appendix B FAQ

B.1 Qlf explained

Qlf is a Solana native automated market maker, decentralized lending, and liquidity providing protocol where users can participate as lenders or borrowers in isolated lending pools. The Qlf Protocolfacilitates a new kind of leveraged yield farming experience for borrowers, with enhanced leverage and farming rewards, while enabling lenders to earn a significantly higher yield on supplied tokens without the risk of impermanent loss.

B.2 Liquidity provider explained

Liquidity providers are entities that supply(lend) tokens to decentralized exchanges (DEXs) and other DeFi protocols.

B.3 LP tokens explained

When you supply liquidity to a DEX, you receive LP tokens as proof of contribution. For example, if you provide SOL and RAY to a DEX, you will receive SOL-RAY LP tokens in return. These LP tokens signify your proportional share of the total liquidity pool in the DEX for the token pair.

A small trading fee is accrued to the liquidity pool as a reward for liquidity providers whenever anyone swaps or trades on the DEX between your supplied token pair. Hence your compensation from the trading fee is acquired.

B.4 Earning yield on DEX as a liquidity provider explained

Liquidity providers on AMMs DEXs such as Saber and Raydium earn yield from transaction fees and staking rewards. Qlf enables risk-seeking and risk-averse investors to significantly increase (or decrease) the risk (and rewards) of this yie ld accordingly.

B.5 Farming / staking rewards explained

Decentralized exchanges usually offer farms or staking pools enabling liquidity providers to stake their LP tokens and gain reward tokens. These farms provide an extra incentive to liquidity providers and aid in reducing the risk of impermanent loss.

B.6 Impermanent loss explained

Impermanent loss is one of the key risks related to being a liquidity provider. The value of an LP token is normally backed 50-50 by the chosen tokens in the token pair. Due to the operating structure of automated market makers or constant-product market makers, a significant percentage price divergence of the chosen tokens relative to each other can result in a capital reduction to liquidity providers compared to simply holding the tokens if the liquidity is removed from the pool at that moment. (The loss is called “impermanent” because it is experienced only if liquidity is withdrawn from the pool.)

B.7 Leveraged yield farming explained

Leveraged yield farming is a product of Qlf that enables liquidity providers to use their LP or any other supported tokens to borrow and obtain more LP tokens, with the intention of supplying more liquidity to the decentralized exchanges and earning extra yield and farming rewards, which should exceed the borrowing cost. Qlf 's unique LP token collateralization model and liquidation auction mechanics enable the highest leveraged yield farming positions in Solana's ecosystem. However, the risk of impermanent loss is also magnified with leveraged yield farming.

B.8 Indirect liquidity providing explained

Lenders in Qlf have the ability to provide liquidity indirectly by making their tokens available to borrowers for leveraged yield farming through Qlf MM or AQlf Protocols. In addition, lenders do not risk impermanent loss with their tokens lent since the risk of impermanent loss is taken care of on behQlf of borrowers in the Qlf leverage protocol.

B.9 TVL explained

Total value locked (TVL) is an insightful metric of DeFi protocols. Total value locked depicts what number of tokens multiplied with their current price are locked in a protocol at a given time. Qlf TVL calculations consist of the following elements:

Total assets lent to Qlf Protocol (assets that are lent plus those which are borrowed and lent again) Total liquidity supplied to Qlf MM protocol (liquidity pooled in Qlf MM pools) Total liquidity supplied to outside protocol through Qlf leverage module (excluding liquidity gathered from AQlf and Qlf MM and including initial collateral with outside lenders liquidity)

B.10 Price oracle explained

A price oracle is any smart contract that provides on-chain access to price information for a token, usually measured in terms of another token or an off-chain unit of account. Normally every decentralized lending solution is functional only with accurate and timely on-chain prices to account for the value of collateralized debts, as well as to stop borrowers from withdrawing more than the value of their collateral at every time.

Appendix C Launch parameters

C.1 Pairs with high leverage at launch

Based on three Raydium pairs and their LP rates, — SOL-USDC (12.79%, 65.00%), RAY-SOL (3.73%, 38.72%), RAY-ETH (2.60%, 62.33%), — at launch Qlf will focus highest leverage opportunities on them, targeting acquisition of SOL, RAY, and ETH with the liquidity farming program.

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