

Bolgin

Introduction

Bolgin is a decentralized protocol that allows for crypto borrowing without crypto collateral.

A core limitation of current crypto lending protocols is that they require overcollateralization with crypto, which prevents the vast majority of borrowers in the world from participating. By incorporating the principle of “trust through consensus”, the Bolgin protocol creates a way for borrowers to show creditworthiness based on the collective assessment of other participants rather than based on their crypto assets.

The protocol can then use this collective assessment as a signal for automatically allocating capital. By removing the need for crypto collateral and providing a means for passive yield, the protocol dramatically expands both the potential borrowers who can access crypto and the potential capital providers who can gain exposure.

Bolgin Overview

The Bolgin protocol has four core participants: Borrowers, Backers, Liquidity Providers, and Auditors.

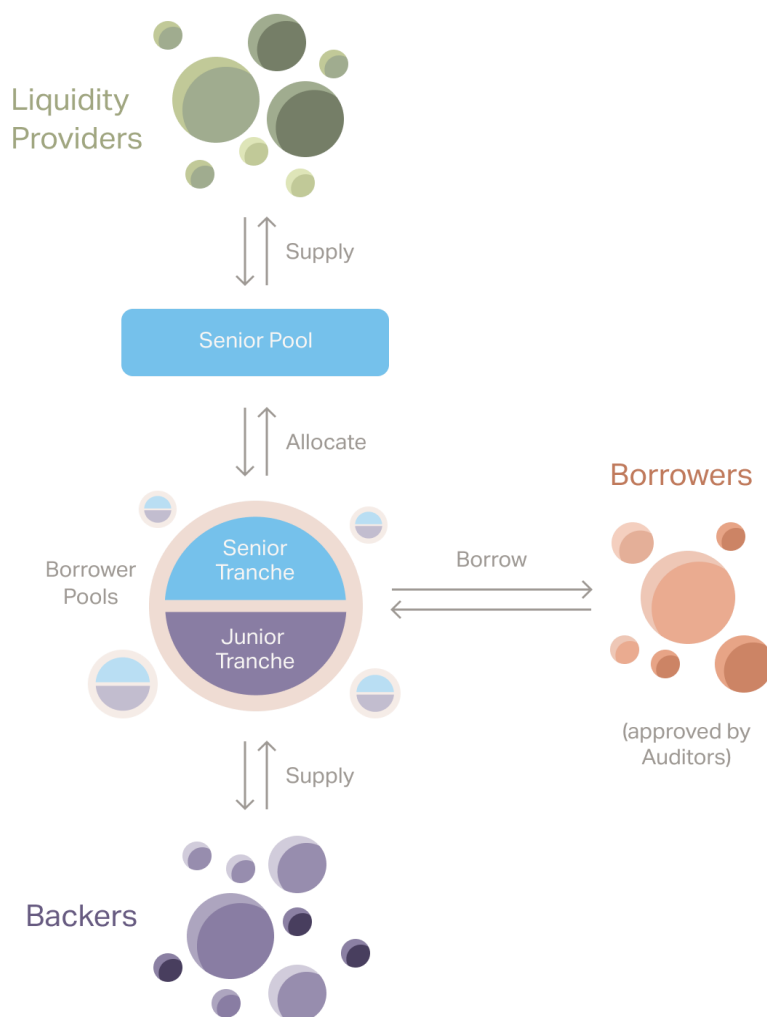
Borrowers are participants who seek financing, and they propose Borrower Pools for the Backers to assess. Borrower Pools contain the terms a Borrower seeks, like the interest rate and repayment schedule.

Backers assess the Borrower Pools and decide whether to supply first-loss capital. After Backers supply capital, Borrowers can borrow and repay through the Borrower Pool.

Liquidity Providers supply capital to the Senior Pool in order to earn passive yield. The Senior Pool uses the Leverage Model to automatically allocate capital to the Borrower Pools, based on how many Backers are participating in them. When the Senior Pool allocates capital, a portion of its interest is reallocated to the Backers. This increases the Backers’ effective yield, which incentivizes them to both provide the higher-risk first-loss capital and do the work of assessing Borrower Pools.

Lastly, Auditors vote to approve Borrowers, which is required before they can borrow. Auditors are randomly selected by the protocol, and they provide a human-level check to guard against fraudulent activity.

Architecture Diagram



Glossary of Core Components

- **Auditors** — Participants who receive GFI rewards for securing the protocol with a human eye.
- **Backers** — Participants who supply junior tranche (first-loss) capital to individual Borrower Pools.
- **Borrowers** — Participants who raise capital from the protocol via Borrower Pools.

- **Borrower Pool** — Smart contract that encodes a set of financing terms for a Borrower, including the interest rate and repayment schedule, and through which the Borrower can borrow capital and repay it with those terms.
- **GFI** — Token used for Governance votes, Auditor staking, Auditor vote rewards, staking on Backers, early Backer rewards, and other potential rewards for all protocol participants.
- **Governance** — Smart contract that is managed by the community DAO and has the ability to update the protocol via decentralized governance votes.
- **Leverage Model** — A formula by which the Senior Pool automatically determines how much capital to allocate to each Borrower Pool.
- **Liquidity Providers** — Participants who supply capital to the Senior Pool.
- **Senior Pool** — Smart contract that accepts capital from Liquidity Providers and automatically allocates capital to the senior tranche of Borrower Pools according to the Leverage Model.

Borrowers

Borrowers are participants who seek financing from the protocol. They propose terms to Backers to supply capital to their Borrower Pools.

Borrower Pool Creation

A Borrower Pool is the smart contract through which Borrowers borrow and repay capital. Any Borrower can create a Borrower Pool and define the terms they want:

- *Interest Rate*: Fixed interest rate APR, e.g. 15%.
- *Limit*: Total capital that can be borrowed, e.g. \$1M.
- *Payment Period*: Frequency of interest payments, e.g. every 30 days.
- *Term*: When the full principal is due, e.g. 365 days.
- *Late Fee*: Additional interest owed when payments are late, e.g. 5%.

Creating a Borrower Pool is like proposing a “term sheet” to Backers. It does not guarantee the terms will be accepted, since Borrowers then need to convince Backers to supply junior tranche (first-loss) capital. The amount Borrowers can borrow is based

on how much Backers supply, combined with the amount the Senior Pool allocates based on the Leverage Model.

Notably, Borrowers need to set a limit for their Borrower Pools, a self-imposed cap on how much capital they can borrow. While Borrowers might ideally want an infinite limit, Backers want to know that they are staking first-loss capital only towards a total potential amount that the Borrowers can safely deploy. Borrowers therefore have an incentive to set the limit only as high as they can convince Backers they can safely use.

In order to create a Borrower Pool, the Borrower must also stake an amount of GFI equal to double the cost of an Auditor approval, which is a fixed rate set by the protocol. This helps guard against spam, signal to Backers that the Borrower is serious, and provide GFI to pay for the first Auditor approval. The first half of the staked GFI is used for the first Auditor approval. The Borrower can redeem their remaining staked GFI when they have fully repaid their borrowed balance.

Borrowing and Repaying

Borrowers can borrow capital through the Borrower Pool at any time. The total amount they can borrow is the minimum of:

- A. The calculated limit based on the capital that Backers have supplied and the additional Senior Pool leverage amount.
- B. The combined total capital that Backers have supplied in that Borrower Pool plus the remaining capital in the Senior Pool.
- C. The Borrower Pool's limit.

After borrowing, Borrowers make repayments to the Borrower Pool according to its interest rate and payment period. When they pay more than the interest owed, the remainder is applied to the principal balance.

Junior and Senior Tranches

Borrower Pools have both a junior and senior tranche. Backers supply capital to the junior tranche, and the Senior Pool supplies capital to the senior tranche. When a borrower makes repayments, the Borrower Pool applies the amount first toward any interest and principal owed to the senior tranche at that time, and then toward any interest and principal owed to the junior tranche at that time.

To track the different amounts that different participants supply, both the Backers and the Senior Pool receive an NFT when they supply capital. The NFT tracks the amount

that was supplied and how much of it has been redeemed. At any time, a Backer or the Senior Pool can use their NFT to redeem their specific portion of the available repayments in the pool.

The Borrower Pools use NFTs rather than fungible tokens because it allows the protocol to ensure that no one redeems more than their proportional share of the total repayments as they come in. For example, let's say two Backers have each supplied \$500 for a total of \$1,000 borrowed, and that so far the Borrower has made repayments totaling \$300. In this scenario, the NFTs ensure each Backer can only redeem up to \$150, which is their portion of the repayments so far, rather than each one racing to redeem the full \$300 for themselves.

Origination Fee

There may be certain participants who work with Borrowers to establish terms and bring them to the protocol. To compensate them for these efforts, Borrower Pools support an origination fee that is paid to the pool's originator. The origination fee is defined as a percentage of the interest. For example, for a \$1M Borrower Pool with 15% interest paid monthly and a 10% origination fee, the Borrower would pay monthly interest of \$12.5K and the originator would receive a monthly fee of \$1.25K. To align incentives with capital providers, the originator fee is treated as the most junior tranche, so every payment first goes toward what is owed to the senior pool and backers before it goes toward the originator fee.

Summary of Borrower Incentives

A key question is what incentives Borrowers have to pay back what they borrow.

The first incentive is that Borrowers likely want to continue borrowing from Bolgfin . The moment they are late on a payment, Borrowers are unable to borrow further from any Borrower Pool. Also, Backers will likely stop supplying more capital if a Borrower is continually late on repayments. It is up to Backers to determine that Borrowers do in fact want to continue borrowing from the protocol in the future.

The second incentive is that because Borrowers need to publicize their address when proposing pools to Backers, their on-chain history becomes public to future creditors, even those off-chain.

Lastly, while not explicitly supported by the protocol, Backers may form off-chain legal agreements with Borrowers. Backers may require such an agreement to be in effect, either with them directly or with another Backer, in order to be willing to supply

capital. In these cases, the legal agreement and potential recourse are another important incentive for Borrowers.

Backers

Backers evaluate Borrowers and supply first-loss capital on their Borrower Pools. Backers can achieve higher returns when the Senior Pool leverages them with additional senior tranche capital.

Supplying to Borrower Pools

Backers look at Borrower Pools as investment opportunities. They evaluate the information Borrowers provide and decide if they want to supply capital to the junior tranche of a Borrower Pool.

The Senior Pool provides additional senior tranche capital to the Borrower Pool according to the Leverage Model. To account for the lower risk of the senior tranche, 20% of the senior tranche's nominal interest is reallocated to the junior tranche. In addition, the protocol retains 10% of all interest payments as reserves, which are managed by the decentralized Governance.

As a result, the Senior Pool earns an effective interest rate equal to 70% of the nominal interest rate. Or, in terms of the nominal interest rate, i_n , protocol reserve allocation, p , and junior reallocation percent, j :

$$i_{senior} = i_n * (1 - p - j)$$

Accordingly, based on these same inputs and the leverage ratio, r , Backers receive an effective interest rate of:

$$i_{junior} = i_n * (1 - p + r * j)$$

For example, consider a Borrower Pool with a 15% interest rate and 4.0X leverage ratio. If the Backers supply \$200K, the Senior Pool will allocate another \$800K. Assuming the Borrower borrows the full \$1M for one year, they will pay \$1M * 15% = \$150K in interest. Of that, the Senior Pool receives $0.15 * (1 - 0.1 - 0.2) = 10.5\%$ interest, or $\$800K * 0.105 = \$84K$. The Backers receive $0.15 * (1 - 0.1 + 4 * 0.2) = 25.5\%$ interest, or $\$200K * 0.255 = \$51K$. The remaining \$15K is the 10% protocol reserve allocation.

Early Backer Rewards

It is easier to feel confident supplying to a Borrower Pool when a lot of other Backers are already supplying to it and the Senior Pool is already adding leverage. It is riskier to be the first one in a Borrower Pool. To incentivize Backers to supply early on, the protocol provides an additional GFI reward to all Backers who contribute early on, with the reward amount decreasing for later Backers as the Borrower Pool reaches its limit.

The protocol assigns the reward when a Backer supplies, but the reward is not immediately claimable. The percent of the reward that is claimable is proportional to the percentage of the full expected repayment of principal plus interest that the Borrower successfully repays. This ensures the Backer only receives the early Backer reward after the Borrower Pool proves valuable to the protocol.

Staking on Backers

In addition to evaluating individual Borrower Pools, Backers may also evaluate other Backers in order to give them leverage. Backers can do this by staking GFI directly on another Backer.

Based on the amount of GFI staked on a given Backer, the Senior Pool uses the Leverage Model to calculate a leverage ratio and allocate capital whenever that Backer supplies to Borrower Pools. For example, if a Backer has a leverage ratio of 4.0X based on who has staked GFI on them, then anytime they supply to a Borrower Pool, the Senior Pool will allocate 4.0X of that amount.

The Senior Pool provides this leverage up to a maximum total that is calculated as the leverage ratio multiplied by the total value of GFI staked on that Backer. For example, if the Backer has \$1M worth of GFI staked on them with a 4.0X leverage ratio, the Senior Pool will allocate up to \$4M total leverage.

When GFI is staked on a Backer, that GFI serves as collateral against potential defaults for that Backer's positions in Borrower Pools. When a Borrower defaults, the GFI staked on all the Backers in that pool are reallocated to the senior tranche until the senior tranche is made whole on their expected payments. This incentivizes Backers to stake on other Backers who supply to safe Borrower Pools.

To reward Backers for staking GFI on other Backers, the protocol distributes GFI to them on a regular basis. The protocol allocates the distributions in proportion to the interest their leveraged GFI earns. This incentivizes Backers to stake on other Backers who supply to high-yielding Borrower Pools.

Summary of Backer Incentives

Backers have an incentive to provide first-loss capital to Borrower Pools because they can receive both early Backer rewards and higher effective yields based on the Senior Pool leverage. They also have an incentive to stake GFI on other Backers because they can earn additional rewards when that Backer supplies to Borrower Pools.

Auditors

Auditors perform human-level checks on Borrowers to confirm they are legitimate, helping to secure the protocol against fraud. Borrowers need the approval of Auditors to borrow from Borrower Pools.

Approval Votes

Borrowers need an approval vote from Auditors in order to borrow. Auditors stake GFI in order to be selected for votes, and they earn GFI rewards when they vote with the majority of other Auditors, according to the rules described below.

Anyone can be an Auditor by staking a minimum amount of GFI and passing the Unique Entity Check. When a vote is requested, the protocol selects 9 Auditors on a random basis weighted by the amount of GFI they have staked.

When selected for a vote, Auditors evaluate whether Borrowers appear to be legitimate. In this vote, the Auditors are not evaluating the Borrower's creditworthiness — rather, they are providing a confirmation that the Borrower does what they claim to do and that they do not appear to be colluding with any other participants.

Auditors can do whatever they like to decide how to vote. In practice, they may review off-chain documents provided by Borrowers and communicate with Borrowers directly through channels such as forums, email, and video calls. This can all occur off-chain on a variety of platforms. The protocol only needs the final vote and is agnostic to how Auditors arrive at their vote.

Approval Vote Requests

Borrowers can request an approval vote once their first Borrower Pool has reached at least 20% of its limit and they have staked enough GFI to reward Auditors for the vote. If more than 2 Auditors vote “No”, their full GFI staked amount is slashed.

In addition to the Borrower making their first approval request, anyone can use GFI to pay for an approval request at any time. This is helpful if someone believes a prior approval vote had an incorrect result, or if someone believes the Borrower has started to act fraudulently and should lose their approval.

Approval Vote Outcomes

Once selected, auditors have 48 hours to provide a “Yes”, “Unsure”, or “No” vote. Their GFI is slashed if they a) don’t vote within the 48 hour window, b) vote “Yes” when the majority vote “No”, or c) vote “No” when the majority vote “Yes”. If they vote “Unsure”, there is no penalty but also no reward.

Based on the way Auditors vote, there are three potential outcomes:

1. **Full Approval:** This occurs when there are at least 6 “Yes” votes and no more than 1 “No” vote. The Borrower is approved to access capital, and the Senior Pool allocates capital to their Borrower Pools.
2. **Backer-Only Approval:** This occurs when there are at least 6 “Yes” or “Unsure” votes, and no more than 1 “No” vote. The Borrower is approved to access capital, but the Senior Pool does not allocate capital to their Borrower Pools.
3. **No Approval:** This occurs when there is more than 1 “No” vote, or when there are not enough votes to meet the above approval thresholds. The Borrower is not approved to access any capital.

Summary of Auditor Incentives

Auditors are incentivized to participate and vote correctly in order to earn GFI rewards. Also, by staking GFI, they are both incentivized to avoid having their stake slashed and are naturally aligned with the long term success of the protocol.

Liquidity Providers

Liquidity Providers supply capital to the Senior Pool in order to earn passive yield. The Senior Pool automatically allocates their capital to the senior tranches of Borrower Pools.

Supplying to the Senior Pool

Liquidity Providers supply capital to the Senior Pool in order to earn passive yield. The Senior Pool then automatically allocates that capital across the senior tranches of Borrower Pools according to the Leverage Model. The Senior Pool thereby provides both diversification across Borrower Pools and seniority to the first-loss capital of Backers. Supplying capital to the Senior Pool is also fully permissionless.

To compensate Backers for both evaluating Borrowers Pools and providing first-loss capital, 20% of the Senior Pool's nominal interest is reallocated to Backers.

FIDU

When Liquidity Providers supply to the Senior Pool, they receive an equivalent amount of FIDU. FIDU is an ERC20 token. At any time, Liquidity Providers can withdraw by redeeming their FIDU for USDC at an exchange rate based on the net asset value of the Senior Pool, minus a 0.5% withdrawal fee. This exchange rate for FIDU increases over time as interest payments are made back to the Senior Pool.

It is possible that when a Liquidity Provider wants to withdraw, the Senior Pool may not have sufficient USDC because it has been borrowed by Borrowers. In this event, the Liquidity Provider may return when new capital enters the Senior Pool through Borrower repayments or new Liquidity Providers.

Summary of Investor Incentives

Investors are incentivized to supply to the Senior Pool in order to earn passive yield.

Leverage Model

The Leverage Model determines how much capital the Senior Pool allocates toward each Borrower Pool, based on how much it "trusts" each Borrower Pool.

Trust Through Consensus

In order to determine how to allocate capital from the Senior Pool, the protocol uses a principle of "trust through consensus." This means that while the protocol doesn't trust any individual Backer or Auditor, it does trust the collective actions of many of them. At a high level: when more Backers supply to a given Borrower Pool, the Senior Pool increases the ratio with which it adds leverage.

Because this approach relies on counting individual Backers, the protocol must ensure they are in fact represented by different people. Therefore, all Backers, Borrowers, and Auditors require a "unique entity check" to participate (see the Unique Entity Check section).

Leverage Model Formula

The leverage amount, A , that the Senior Pool allocates is determined by the formula $A = S * D * L$, where:

- S is the total capital supplied by Backers.
- D is the distribution adjustment on a scale of 0 to 1, which accounts for how evenly distributed the Backers are. D is closer to 0 when the distribution is skewed and closer to 1 when the Backers are more equally distributed. This ensures no single Backer has an outsized influence. The formula for D uses the percent supplied by each Backer, s_n , and is based on the Herfindahl-Hirschman Index:

$$D = 1 - \sum_{i=1}^n s_n^2$$

- L is the leverage ratio on a scale of 0 to the maximum potential leverage ratio. Based on the number of Backers, b , the leverage ratio increases linearly from B_{min} , the minimum number of Backers necessary for leverage, to B_{max} , the maximum number of Backers necessary to achieve the maximum potential leverage, L_{max} :

$$L = L_{max} * \frac{\max(0, b - B_{min})}{B_{max} - B_{min}}$$

Unique Entity Check

Since the Leverage Model relies on "trust through consensus", it is critical to avoid sybil attacks by having confidence that each Borrower, Backer, and Auditor is a unique entity. Therefore, they must each be verified with a "Unique Entity Check" before they can participate.

Governance approves the protocol's Unique Entity Check providers. This will start with oracles that perform off-chain checks to validate that the wallet addresses are unique entities. However, this design does not require oracles. If and when on-chain

decentralized IDs mature, Governance can vote to migrate the protocol to these new providers.

Governance

Governance is managed by a community DAO and has the ability to perform maintenance functions and parameter adjustments via decentralized governance votes, including:

- Upgrading contracts
- Changing protocol configurations and parameters
- Selecting Unique Entity Check providers
- Setting the rewards and distribution of GFI
- Pausing protocol activity in the event of an emergency

Discussion of Fraud Resistance

Because the protocol does not require crypto overcollateralization, this opens up new potential vectors for fraud. It is worth discussing each one in depth, and how the protocol builds resistance against it. Note that these scenarios focus on malicious or dishonest activity, not poor performance of well-intentioned borrowing.

Fraudulent Borrower, Honest Backers

A fraudulent Borrower could attempt to fool both Auditors and Backers into thinking they are legitimate, and then borrow capital without repaying it. The first guard against this are the Auditors, who must approve Borrowers before borrowing. Because Auditors are randomly selected, it is difficult to collude with them. The second guard are the Backers, who are highly incentivized to analyze their investments closely, since they supply higher-risk junior capital. It is likely that Backers will want to do extra research on Borrowers and potentially communicate with them directly. Lastly, Backers may sign off-chain legal contracts with Borrowers, which opens Borrowers to legal recourse.

Borrower Collusion with Backers

A Borrower could collude with people they know to act as Backers and supply to their Borrower Pool. This would artificially increase the leverage ratio and fool the Senior

Pool into allocating additional capital. The first guard against this are the Auditors, who must approve Borrowers before borrowing. Because Auditors are randomly selected, it is difficult to collude with them. The second guard is that it requires many individually verified Backers to supply significant amounts of upfront capital in order for the Senior Pool to provide leverage, which makes such collusion difficult and expensive. Lastly, the Unique Entity Check adds sybil resistance by making it difficult to programmatically create fake Backers.

Borrower Collusion with Auditors

A Borrower could collude with Auditors to obtain approval for creating Borrower Pools when they are not legitimate. The first guard is that the Unique Entity Check prevents a sybil attack where fake Auditors are programmatically created. The second guard is that Auditors must stake GFI, which is slashed if they vote differently than the majority of Auditors. The third guard is that Auditors are randomly selected, weighted by their staked GFI, so it would require staking a significant amount of upfront capital to be chosen enough to skew the votes. The fourth guard is that anyone can request an approval at any time, so it would require colluding for all potential future votes rather than just one. Lastly, even if a fraudulent borrower successfully colludes with Auditors, they must also convince many Backers to risk their own capital.

Fraudulent Backers, Honest Borrowers

An individual or group of Backers might supply to a particular Borrower Pool even when they don't view it as a good risk. This would artificially increase the leverage ratio and fool the Senior Pool into allocating additional capital, boosting the Backers' returns. The first guard against this is that the Unique Entity Check requires each Backer to be verified, preventing a sybil attack and requiring the coordination of many people. The second guard against this is that it requires the Backers to take real risk by supplying first-loss capital. The Backers only achieve higher returns if the Borrower does in fact pay back what they borrow, in which case it is beneficial to all participants in the protocol, including the Senior Pool.