# Bucket Protocol: Decentralized Borrowing Protocol

White Paper V2

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## Abstract

Bucket Protocol is a decentralized protocol enabling digital asset holders to optimize their capital efficiency without incurring unpredictable interest payments by leveraging their collateral. Users deposit digital assets into a smart contract as collateral and establish a personal position, termed a "Bottle," to instantaneously access liquidity by minting a USD-pegged stablecoin, BUCK. Each Bottle is required to maintain a minimum collateralized ratio of 110%. BUCK holders can redeem their stablecoins for collateral at any time. Furthermore, the redemption mechanism and algorithmically adjusted fees ensure that BUCK remains firmly pegged to the value of $1.

Bucket Protocol employs an instant liquidation mechanism that hinges on incentivized stability deposits and a redistribution cycle between high-risk and low-risk Bottles. This achieves a lower collateralized ratio requirement than existing systems, ensuring overall system stability. The Protocol's stability is primarily sustained through economically driven user interactions and arbitrage activities, as opposed to relying on active governance or monetary interventions.

We introduced the white paper version 2, including all existing and new features. Following the launch of the Bucket Protocol on June 28, 2023, nearly eight months of market feedback have resulted in continuous improvements to fundamental aspects like the interest rate, PSM (Peg Stability Module), flash minting, and the use of LP (Liquidity Provider) tokens as collateral. These updates ensure the system's sustainability, composability, and flexibility.

# Contents

# 1 Introduction

Cryptocurrencies, including BTC, ETH, and SUI, exhibit significantly higher price volatility compared to traditional asset classes, such as stocks or bonds. Nevertheless, numerous individuals employ tokens for investment, making payments, trading, or purely for speculation.

Fiat-backed stablecoins, such as Tether, USDC, Paxos, TrueUSD, and USDY, have emerged as stable, centralized alternatives to volatile tokens. Additionally, crypto-backed stablecoins are gaining popularity, serving as a primary driving force for attracting users to the Decentralized Finance (DeFi) movement. MakerDAO, a collateralized debt platform, enables users to lock up volatile tokens in exchange for newly minted stablecoins, DAI. This approach allows token holders to access a portion of their token's economic value while maintaining a fully invested position. Token holders can then leverage the obtained liquidity to secure additional collateral, achieving greater liquidity and capitalizing on the leverage effect.

Crypto-backed stablecoins generally cannot be redeemed at the face value of the collateral and cannot guarantee a hard price peg due to the absence of direct arbitrage opportunities. There is no issuance or redemption mechanism enabling arbitrageurs to purchase newly minted stablecoins or sell them back to the protocol for guaranteed profits when the price deviates from the peg. Instead, these systems rely on a less efficient soft peg mechanism that adjusts fees to alter loan attractiveness, stabilizing the exchange rate. Consequently, crypto-backed stablecoins typically exhibit higher price volatility than fiat-backed stablecoins, resulting in lower capital efficiency and limited liquidity.

Some protocols using collateralized debt platforms can mint stablecoins independently, eliminating the need to rely on lenders for liquidity. These systems can generate liquidity without incurring real-time refinancing fees. However, most platforms still charge recurring fees on loans (with annual rates as high as 20.5%), which accumulate over time. Variable fees (stability fees) aim to regulate token supply and maintain the peg of issued stablecoins, similar to interest rates in traditional banking. Interest rates only indirectly impact token supply for both new and existing loans, and their short-term effects are limited. While existing borrowers may struggle to repay loans promptly in response to rising interest rates, short-term speculators and those seeking leverage may not be significantly affected initially.

Governance token holders typically manage their system's economic parameters, such as setting fee rates to benefit the protocol. In practice, on-chain governance has proven controversial and challenging due to low voter turnout, potential incentive mechanism issues, and power concentration in the hands of a few.

In addition to charging stability fees, existing platforms often require borrowers to substantially over-collateralize their positions. As borrowers frequently maintain collateralized ratios significantly higher than the minimum requirement, this results in lower capital efficiency. Existing platforms necessitate over-collateralization because they employ liquidation mechanisms for under-collateralized positions. Both collateral auctions and fixed-price sell-offs are inherently inefficient and require improvement.

In summary, current collateralized debt platforms face considerable drawbacks that limit their effectiveness and utility for users. These challenges include high and unpredictable interest fees imposed on borrowers, making borrowing costly and challenging for users to plan capital costs. Moreover, problematic governance mechanisms often hinder these platforms' efficiency and stability. The demand for high collateralized ratios, driven mainly by inefficient liquidation processes, impacts the platform's overall performance. Finally, the lack of a direct redemption mechanism contributes to price instability, further compromising the platform's reliability and user experience. Consequently, there is an urgent need for a more advanced, efficient system to address these limitations and enhance user experience in the collateralized debt platform domain.

In this paper, we introduce a decentralized borrowing protocol that enables digital asset holders to

optimize capital utilization with competitive low interest. By leveraging their collateral through an innovative mechanism, users can access instant liquidity by minting a USD-pegged stablecoin, BUCK. This protocol not only ensures system stability with a low collateralized ratio but also provides a hard price floor and a governance-free algorithmic monetary policy. Bucket Protocol improves upon the traditional borrowing model, offering a suite of advantages such as low interest rate liquidity, censorship resistance, and growth incentives. By implementing economically driven user interactions and arbitrage activities, Bucket Protocol delivers a more efficient and reliable solution for digital asset holders seeking to maximize their capital utilization in the decentralized finance space.

The remainder of the paper is organized as follows: Section 2 introduces the key benefits of the Bucket Protocol. Section 3 provides an in-depth explanation of the system, encompassing both the system overview and architecture. Section 4 discusses the system's functionalities. Section 5 presents the innovative bottle liquidation mechanism. Section 6 elaborates on the details of the recovery mode. Finally, a brief conclusion is presented in Section 7.

# 2 Key benefits of the Bucket Protocol

Bucket Protocol enhances the existing model by offering the following key advantages:

- Low interest rate liquidity
- Low collateralized ratio (110%)
- Peg Stability Module (PSM)
- Robust Price Floor and Ceiling
- Flash Loan and Flash Mint service
- Governance-free algorithmic monetary policy
- Censorship resistance
- Growth and early adopter incentives
- Multiple Collateral Types

## 2.1 Low interest rate liquidity

Bucket Protocol provides liquidity with low interest rates on borrowers. SUI holders can access liquidity against their collateral. Moreover, to maintain the USD peg, the Protocol charges a one-time Borrowing Fee for newly drawn liquidity, serving as an algorithmically controlled monetary instrument. This allows users to employ their BUCK stablecoins across the DeFi ecosystem.

Notably, when Bucket Protocol launched in June 2023, there were no interest rates. However, we identified that a revenue model reliant solely on liquidation could not sustain coin value. Initially relying only on a Borrowing Fee and Redemption Fee, the one-off income was insufficient to maintain value, leading to token sustainability issues. Consequently, we introduced an interest rate.

## 2.2 Low collateralized ratio (110%)

When an individual position's collateralized ratio falls below a specific threshold, the lending system must implement special measures to ensure that the stablecoin supply remains fully backed. In existing systems, this is typically achieved through an interactive process of liquidating the position and selling the collateral to compensate for the shortfall. However, this fixed-price collateral selling method is inherently inefficient, as it necessitates a significant discount to the current collateral price to guarantee quick sales during challenging situations. Auction mechanisms for selling collateral offer a fair economic alternative to discounts but can be lengthy and susceptible to errors. The longer it takes to sell the collateral, the higher the risk that its value might decrease further. Consequently, auction-based systems must set their liquidation ratio high enough to provide extra margin for potential price drops during liquidation.

Bucket Protocol employs a novel two-layer liquidation mechanism that can instantly liquidate under-collateralized positions. Since liquidators are predetermined, there is no need to find a collateral buyer when a position enters undercollateralized mode. This advantage allows for a significant reduction in the collateralized ratio while maintaining high stability.

## 2.3 Peg Stability Module (PSM)

To maintain a robust peg for BUCK, Bucket has implemented a peg stability module (PSM). The PSM is a special vault with an MCR of 100%, fee rate of 0.1%, and an interest rate of 0.0% that allows for 1:1 conversion between BUCK and supported stablecoins such as USDC, USDT, USDCbnb,

and USDCpol. Bucket Protocol aims to unify different versions of stable-coin and provide an effective method for creating BUCK, marking an important step toward addressing liquidity dispersion within the Sui Network. PSM strategy simplifies the experience for users who have transferred assets across various blockchains and helps to maintain the robust price floor ceiling of BUCK.

## 2.4 Robust Price Floor and Ceiling

Bucket Protocol incorporates multiple mechanisms to ensure BUCK remains firmly pegged to 1 USD. We will skip the issuance fee and redemption fee for now to provide a high-level explanation of the price floor and price ceiling.

Price Floor: Bucket Protocol enables anyone holding BUCK to redeem the collateral, even if it was not initially their collateral. This feature establishes a price floor for BUCK. For instance, when BUCK is valued at 0.99 USD in a DEX, arbitrageurs can use 99 USD to buy 100 BUCK, then use 100 BUCK to redeem collateral with a face value of 100, and sell it immediately, gaining a 1 USD profit.

Price Ceiling: Whenever BUCK price is over 1.001 USD on the market, arbitrageurs can obtain BUCK using PSM with a 0.1% fee. Which makes the price ceiling at 1.001 USD.

## 2.5 Flash Loan and Flash Mint service

Bucket Protocol offers a flash loan and flash mint service, providing arbitrageurs with a more convenient arbitrage experience. These combined mechanisms ensure the healthy operation of the Bucket Protocol, offering robust support for the entire financial market.

Users can borrow collateral (e.g., Sui) from Bottle and Buck through the Tank during Flash Loan.

Moreover, users can opt for the newly introduced flash mint service, which is similar to flash loans but with unlimited borrowing amounts. Bucket Protocol can flash mint new Bucks for the borrower and burn them before the transaction ends.

## 2.6 Governance-free algorithmic monetary policy

Bucket Protocol is a platform that does not rely on governance mechanisms to vote on monetary interventions, such as interest rate changes. All Protocol parameters are either preset and immutable or algorithmically controlled by the Protocol itself, rendering governance unnecessary and allowing for more autonomous and efficient operation.

Bucket uses the current fraction of redeemed BUCK as an indicator of peg deviation to autonomously set a base rate that determines both the Redemption Fee and the Borrowing Fee. As the number of redeemed coins increases, the base rate also rises and tends to decay to 0.5% again when there are no redemptions occurring. Furthermore, Bucket controls the attractiveness of new loans and throttles the generation of fresh BUCK by implementing the Borrowing Fee, preventing adverse market effects from fluctuating interest rates.

Additionally, Bucket Protocol reduces the current stablecoin supply by allowing BUCK redemption for SUI, motivating low-collateral borrowers to repay their loans and further controlling the price volatility of BUCK, thereby stabilizing its value.

Overall, Bucket Protocol employs a series of autonomous control measures to stabilize BUCK's value, enhancing market reliability and stability. By eliminating the need for governance mechanisms, Bucket Protocol achieves more autonomous and efficient operation.

## 2.7 Censorship resistance

Bucket Protocol is an innovative solution, distinct from traditional platforms. As a decentralized system, it operates without a centralized authority or administrator with special privileges, ensuring that no single individual or entity has the power to interfere with, modify, or halt the protocol's operation.

Functioning as a protocol instead of a platform, Bucket Protocol offers a more secure and transparent environment for its users. This decentralized approach maintains system integrity, preventing tampering or unauthorized access, and creates a robust network by leveraging blockchain technology, which is less susceptible to single points of failure.

In summary, Bucket Protocol, designed as a protocol rather than a platform, provides an innovative solution emphasizing security, transparency, and reliability. The absence of a central administrator with special privileges reduces the risk of interference or manipulation, fostering a more stable and trustworthy system for all users.

## 2.8 Multiple Collateral Types

The Bucket Protocol offers a variety of digital asset types for users to select as collateral. These assets encompass SUI, along with tokens that have undergone staking, like afSUI, vSUI, and haSUI. Additionally, it supports liquidity provider (LP) tokens acquired by contributing liquidity, such as afSUI/SUI.

This wide range of collateral choices makes the Bucket Protocol highly useful and adaptable for Defi users. Accepted digital asset types could grow over time thanks to the dynamic field and generic features of Sui Move smart contract.

# 3 System Overview

The following diagram summarizes the token flows between the Protocol and its users:

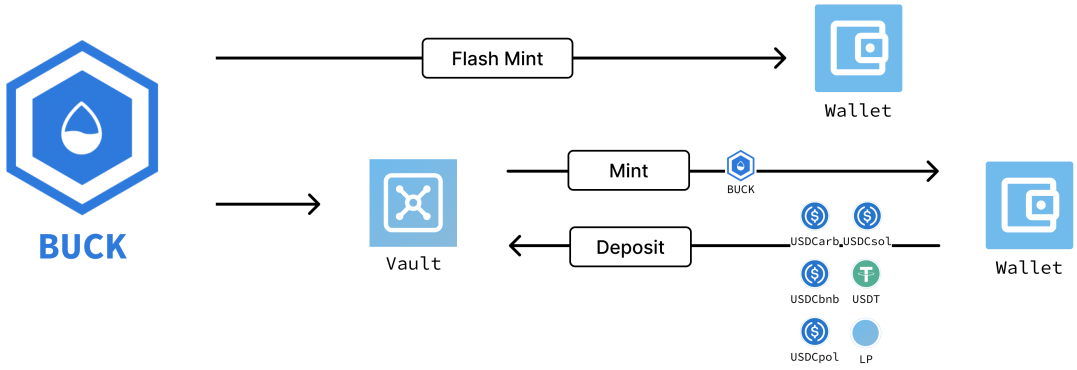



Figure 1: Vault Overview for the BUCK stablecoin

## 3.1 The BUCK Stablecoin

BUCK is a USD-pegged stablecoin designed for ease of use. Users can mint BUCK by depositing collateral assets into Bucket, facilitating BUCK's entry into circulation while simultaneously providing users with liquidity. Moreover, users can repay their BUCK debt to retrieve their original underlying collateral whenever desired.

Compatible with the Sui blockchain, BUCK can be securely stored in various cryptocurrency wallets or on multiple platforms. Once acquired, BUCK operates like any other cryptocurrency, enabling users to send it to others, make payments for goods and services, or deposit it in the Tank within the Bucket Protocol to earn a share of the Protocol's revenue.

Every BUCK in circulation is directly backed by collateral, guaranteeing that the value of the collateral surpasses the BUCK debt. Transparency is maintained as all BUCK transactions are publicly accessible on the Sui blockchain.

The BUCK stablecoin is backed by multiple types of over-collateralized digital assets, including BTC, ETH, SUI, with plans to incorporate additional assets in the future.

## 3.2 Bottle & Bucket

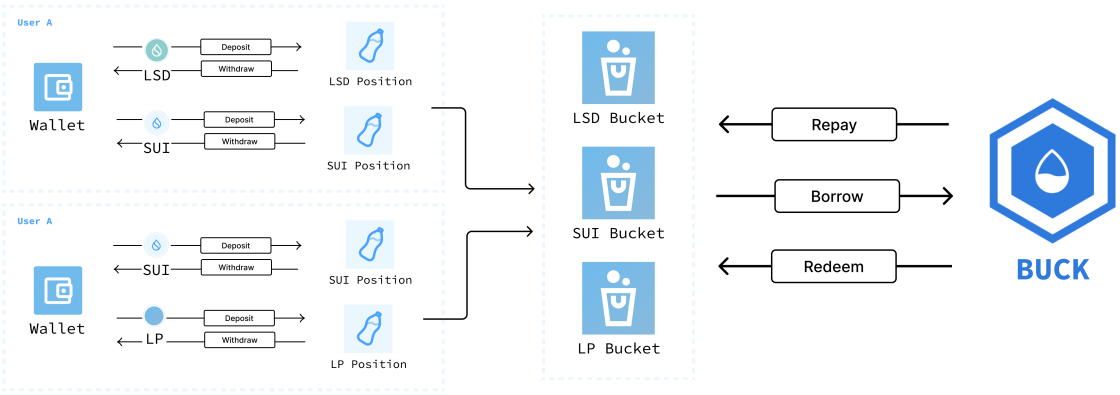



Figure 2: How position work.

The Bucket Protocol features a pool known as the Bucket that aggregates individual collateral (bottle) from all participating users. Within this system, a Bottle is where you take out and maintain your loan. Depending on the types of collateral accepted by the Protocol, multiple Bottles can be associated with a single address, such as one for SUI and another for ETH. Plus, the protocol segregates different collateral types into distinct Buckets, thereby insulating against potential risks associated with individual collateral units. These Bottles share similarities with Collateralized Debt Positions (CDPs) found on other platforms in terms of their core concept.

Within each Bottle, two distinct balances are maintained: the collateral asset (e.g., SUI) and the debt, denominated in the stablecoin BUCK. Users can adjust these balances by adding more collateral or repaying portions of their debt. As these modifications occur, the Bottle's collateralized ratio adjusts accordingly to reflect the updated balance. For added convenience, users can close their Bottles at any point by simply paying for their BUCK debt in full.

## 3.3 Tank

The Tank is the first line of defense in maintaining system solvency. It achieves that by acting as the source of capital to liquidate the bottle whenever its Collateralization Ratio falls below 110% (Minimum Collateralization Ratio), ensuring that the total BUCK supply is always backed. When any Bottle is liquidated, an amount of BUCK corresponding to the remaining debt of the Bottle is burned from the Tank's balance to repay its debt. In exchange, all collateral from the bottle is transferred to the tank and shared with contributors.

Users can become Tank Contributors by depositing BUCK into a specific collateral type of Tank. This framework helps the end-user discern the particular class of collateral they wish to acquire via liquidation, thereby fostering improved asset type management. This capability not only augments strategic portfolio diversification but also enhances risk mitigation efforts, aligning with the advanced financial practices typically seen in sophisticated financial institutions.

As time progresses, these Tank Contributors experience a pro-rata reduction in their BUCK deposits while simultaneously acquiring a pro-rata share of liquidated collateral. Given that Bottles are liquidated at collateralized ratios slightly below 110%, it is anticipated that Tank Contributors will receive a higher dollar value of collateral than the debt they settle. This makes the Tank a vital component in maintaining the stability and solvency of the Bucket Protocol.

# 4 System functionality

## 4.1 Borrower Operations

The Bucket system allows any user to acquire liquidity in a completely permissionless manner by depositing collateral into a Bottle. Once deposited, the collateral is securely locked in the Bottle, enabling the user to withdraw up to 90.91% of its current dollar value in BUCK stablecoins. In simpler terms, the Bottle must always maintain a Minimum collateralized ratio (MCR) of 110%, which is the ratio of the current dollar value of the collateral to the withdrawn liquidity (BUCK).

Borrowers can repay or borrow additional liquidity within the limits of the MCR at their convenience. They can also retrieve their collateral within the same limit, offering them full control over their assets. Additionally, a Bottle can be topped up with more collateral as needed, providing extra versatility.

### 4.1.1 Borrowing Fee

The Bucket Protocol charges a one-time Borrowing Fee for BUCK issuance, which is applied to the liquidity borrowed by users. This fee is calculated by combining a base rate with an additional 0.5% (refer to section 4.3 "Redemption Mechanism: Redemption Fee and Base Rate") and then multiplying the sum by the amount of liquidity drawn by the borrower. This structure ensures that fees are proportional to the liquidity utilized, creating a fair and equitable system for all participants. The minimum Borrowing Fee is set at 0.5%, while the maximum fee is capped at 5%. This range balances fee assessment, encouraging users to borrow liquidity while maintaining the Protocol's sustainability and operational costs. By charging a one-time fixed fee for borrowed liquidity, the Bucket Protocol offers a transparent and straightforward fee structure, allowing users to better manage their cost of capital.

**Example**: Given that the current base rate is 0.5%, the borrowing fee would be 1% (base rate + 0.5%). A borrower opens a new Bottle by depositing 2 SUI to mint 2,000 BUCK. The borrower is subject to a 1% borrowing fee on the 2,000 BUCK, which means they will receive 2,000 BUCK while incurring a debt of 2,020 BUCK (2,000 + 20). In order to close the Bottle and fully retrieve the 2 SUI collateral, the borrower must repay the 2,020 BUCK, at which point all the Liquidation Reserve will be refunded.

### 4.1.2 Interest Rate

In February 2024, a new feature was introduced to the Bucket Protocol, which applies a competitive low compound interest rate when borrowing Buck. This can help keep the system sustainable. Whenever someone interacts with the protocol, it automatically updates the interest. Below is a breakdown of how it works:

**Interest Accumulation Formula:**

Each bottle will record a **BottleInterestIndex** when opening. The interest accumulation for a specific time is calculated using the formula:

$$\text{ActiveInterestIndex}(n) = \text{ActiveInterestIndex}(n-1) \times (1 + \text{rate} \times \text{period}) \tag{1}$$

In the formula, **rate** is the interest rate for every millisecond. While **period** is the time that has passed since the last update, in milliseconds.

**Example**: Suppose the current interest rate of Sui Bottle is 4%, then the rate per millisecond will be $\frac{4}{31536000000} = 0.000000000126839167935058 3$. Suppose a borrower deposits 20000 Sui and borrows

10000 Bucks at time 0. Then, another user interacts with the protocol at time 10000. The borrower's underlying debt at time 10000 will be:

$$\begin{aligned} \text{debt}_{10000} &= 10000 + 0.000000000126839167935058 3 \times 10000 \\ &= 10000.000001268392\ldots \end{aligned} \tag{2}$$

Moreover, the interest calculation for the borrower after time 10000 will be based on the new debt at time 10000, that is, based on 10000.000001268392.

#### 4.1.3 Restrictions due to Recovery Mode

Borrower operations within the Bucket Protocol are subject to certain restrictions when the Protocol is in Recovery Mode or on the verge of entering it (please refer to section 6, "Recovery Mode").

To safeguard against potential liquidation due to fluctuations in the SUI price, borrowers should maintain a margin between their collateralized ratio (CR) and Minimum collateralized ratio (MCR). It is important to note that during Recovery Mode, liquidations may impact Bottles with higher CR, up to a maximum of 150%. Consequently, risk-averse borrowers should ensure their Bottles are sufficiently collateralized to avoid being near the bottom tiers of collateralization compared to other Bottles, especially when the system is approaching Recovery Mode.

By maintaining a relatively high CR, borrowers not only reduce the likelihood of facing liquidation but also decrease the risk of being affected by a redemption (refer to section 4.3)

### 4.2 Tank Operations

The Tank serves as the foremost line of defense in preserving the solvency and stability of the Bucket system. It functions by utilizing deposits to absorb and nullify the debt from defaulted Bottles. In return for contributing to this essential safety mechanism, Tank Contributors (i.e., Tank participants) are rewarded with the acquisition of collateral from liquidated positions at a discounted rate. BUCK holders can become Tank Contributors by depositing BUCK into the Tank. Generally, the deposited BUCK can be withdrawn from the pool at any time, provided they have not been used to absorb defaulted Bottles. However, withdrawal of deposits is temporarily disabled when there are under-collateralized Bottles in the system that can be liquidated.

During the liquidation process, a specific amount of BUCK in the Tank, corresponding to the debt of the liquidated Bottle, is burned. In exchange, the Tank receives all of the collateral from the liquidated Bottle. Since liquidations occur just below the 110% threshold, this results in a collateral gain for participants at the time of liquidation. The share of collateral received by a Tank Contributor from the liquidation is determined by the proportion of their current deposit relative to the total BUCK in the pool.

Tank Contributors have the flexibility to withdraw all or part of their remaining BUCK deposit. However, it is crucial to note that the system always pays out the entire collateral gain made by the depositor. Tank Contributors who are also borrowers can choose to transfer the collateral gain to their Bottles, rather than paying it out to their Sui address. In other words, the system allows them to use the accumulated collateral gain to top up their own collateral in their Bottles.

This dynamic process fosters a thriving ecosystem that encourages active participation and ensures that the system remains solvent and stable. Tank Contributors benefit from their involvement, while the Tank effectively manages defaulted Bottles and mitigates risks associated with undercollateralized positions.

In conclusion, the Tank plays a vital role in the Bucket Protocol system, offering a safety net for managing undercollateralized Bottles and preserving the system's overall stability. By providing incentives to Tank Contributors, the Bucket Protocol encourages active participation and cultivates a robust, sustainable ecosystem that benefits all users.

## 4.3 Redemption Mechanism

The Bucket Protocol's stablecoin, BUCK, operates as a fully redeemable stablecoin, offering users a dependable and stable store of value. At any given time, holders can redeem their BUCK for any type of collateral based on the face value of the redeemed coins, with the current exchange rate. This redemption mechanism establishes a price floor for BUCK, enabling direct arbitrage opportunities whenever the stablecoin trades for less than $1. This feature ensures that the value of BUCK remains closely pegged to the US Dollar.

During the redemption process, as illustrated in Figure 3, the system uses the BUCK to repay the riskiest Bottle(s) with the lowest collateralized ratio, transferring the corresponding amount of collateral from the affected positions to the redeemer. The amount taken from each borrower is limited by their respective debt, allowing them to retain any collateral surpluses. In essence, borrowers lose the same nominal amount of debt (in BUCK) as they lose collateral (in USD), ensuring that they do not experience a net loss from redemptions. This mechanism maintains a fair and balanced environment for all users.

Redemptions positively impact the overall collateralization of the Bucket Protocol, enhancing its robustness and price stability. As Bottles with the lowest CR are repaid, the robustness of the system improves, and users can have greater confidence in the platform's stability and long-term viability.

When a Bottle is fully redeemed and its debt reaches zero, it is automatically closed by the system. At this point, the borrower can reclaim any remaining collateral surplus, ensuring that they regain full control over their assets once their outstanding debt has been settled.

BUCK's redeemable nature and the Bucket Protocol system's meticulously designed redemption mechanism play a pivotal role in maintaining the platform's stability and value proposition. By facilitating direct arbitrage, repaying lowest CR Bottles, and preserving fairness for borrowers, the Bucket Protocol promotes a strong and enduring ecosystem advantageous to all participants.

### 4.3.1 Redemption Fee and base rate

The Bucket Protocol calculates the redemption fee based on the previous base rate and the quantity of BUCK redeemed as a proportion of the total stablecoin supply. At system initiation, the base rate is set to 0%. For each redemption, the base rate increases in proportion to the redeemed BUCK and is then applied to the current redemption as follows:

$$BaseRate_t = BaseRate_{t-1} + \alpha \times \frac{m}{n} \tag{3}$$

where $m$ denotes the amount of redeemed BUCK, $n$ signifies the current supply of BUCK, and $\alpha$ is a constant parameter with a value of 0.5.

Over time, the base rate experiences decay due to a decay factor applied with every BUCK redemption and issuance, prior to calculating the resulting fee. The decay takes the form:

$$BaseRate_t = BaseRate_{t-1} \times \delta^{\Delta t} \tag{4}$$

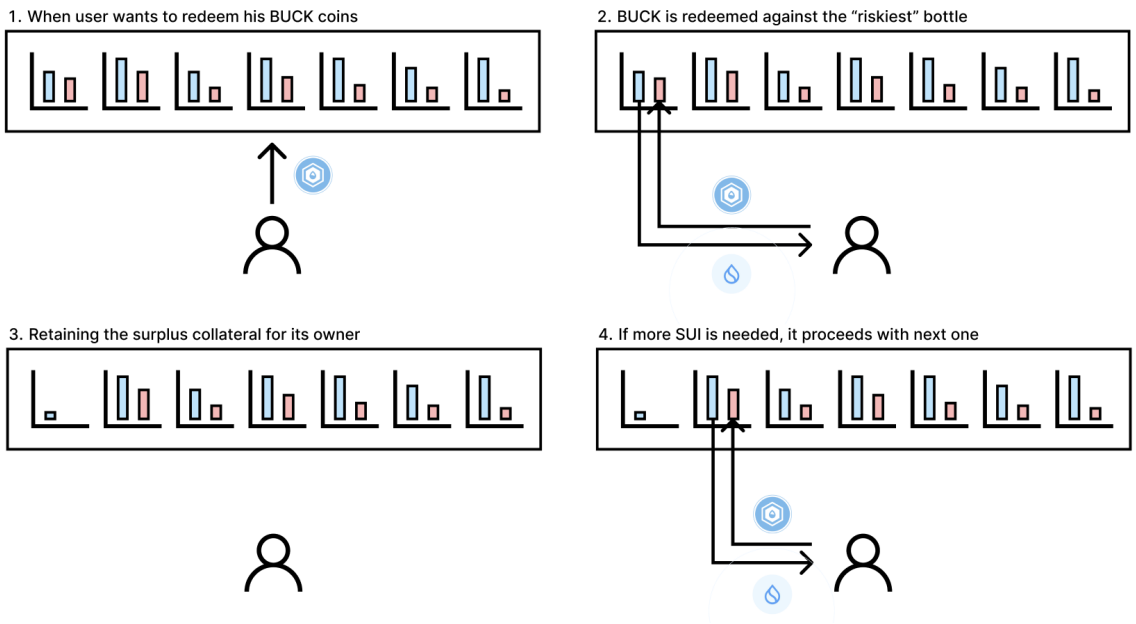



Figure 3: Redemption mechanism of Bucket Protocol

Where $\delta$ represents an hourly decay factor (0.944 in our case), and $\Delta t$ denotes the time elapsed in hours since the last redemption or loan issuance, the decay factor $\delta$ is selected to ensure a 12-hour half-life for the base rate.

Redemptions are subject to a redemption fee, calculated as the redemption fee rate multiplied by the nominal redeemed amount of BUCK. The minimum redemption fee rate is set at 0.5%. This fee is deducted from the redeemed BUCK, consequently reducing the SUI received by the redeemer in exchange.

$$RedemptionFee = BaseRate + 0.5\% \tag{5}$$

**Example**

BUCK is currently trading at \$0.95, with a previous base rate of 1.4%. An arbitrageur redeems 150,000 BUCK, while the total BUCK supply stands at 10 million. The most recent redemption occurred 2 hours ago, and no liquidity has been issued in the interim. The hourly decay factor is set at 0.944. Initially, the system applies the decay rate to the current base rate:

$$BaseRate_t = BaseRate_{t-1} \times \delta^{\Delta t} = 1.4\% \times 0.944^2 = 1.2476\% \tag{6}$$

Subsequently, the base rate is adjusted in proportion to the fraction of total supply redeemed, with a coefficient of 0.5 ($\alpha = 0.5$):

$$BaseRate_t = BaseRate_{t-1} + 0.5 \times \frac{m}{n} = 1.2476\% \ + 0.5 \times \frac{150,000}{10,000,000} = 1.9976\% \tag{7}$$

As a consequence, the redeemer obtains \$147,004 $(150,000 \times (1 - 1.9976\%))$ worth of SUI. Given that the exchanged BUCK holds a current value of only \$142,500 $(150,000 \times 0.95)$, the redeemer realizes an arbitrage profit of \$4,504.

## 4.4 Peg Stability Module

Through Peg Stability Module (PSM), users can exchange stablecoins, such as USDC, to Buck on a 1:1 basis with a competitive conversion fee. The PSM is a special vault with an MCR of 100%, a fee rate of 0.1%, and an interest rate of 0.0% that allows for 1:1 conversion between BUCK and supported stablecoins. This vault is shared within the same asset type, meaning all users who interact with an asset's PSM interact with the same vault. Each supported PSM asset will have its own vault with unique parameters, such as conversion fees.

## 4.5 Flash Loan and Flash Mint Service

The Bucket Protocol comprises three kinds of flash loan sources: Flash Mint, the Bucket, and the Tank. Arbitrageurs can utilize these sources for flash loans, enabling them to generate profits.

Starting in March 2024, Bucket Protocol introduced a Flash Mint service, which allows for the Flash Minting of any amount of Bucks during Flash Loan. These flash-minted Bucks are then burned at the end of the Flash Loan process. This feature enhances the flexibility of Bucket Protocol's Flash Loan service.

Moreover, A user can borrow assets from the Bucket and Tank. Each Bucket holds a type of collateral deposited by all users, while the Tank stores Bucks deposited by Tank Contributors. For example, if the BUCK price declines by 5% compared to its peg on any decentralized exchange (DEX), a user can borrow SUI from the SUI Bucket, purchase BUCK at the specific DEX at a discounted rate, and then redeem the BUCK into SUI to repay the original SUI debt with an additional amount of SUI. This additional amount is possible because the protocol uses an oracle-based redemption ratio. All these steps can be completed within a single transaction, eliminating the need for users to provide collateral and resulting in a Flash Loan.

Flash Loan services contribute additional liquidity to both the Bucket Protocol and the broader Sui ecosystem. Although Flash Loans are not free, Protocol offer a ridiculously low-cost option, charging users a modest fee of 0.05%. As a useful reminder, it is essential to ensure that the potential profit exceeds the 0.05% fee when employing Flash Loans for arbitrage opportunities.

# 5 Forced Liquidation Mechanism

In order to ensure that the entire supply of stablecoins remains fully backed by collateral, Bottle's collateralized ratio (CR) falling below the minimum collateralized ratio (MCR) triggers the forced liquidation process for undercollateralized Bottles.

The liquidation process is as follows:

- The system identifies undercollateralized Bottles.
- Anyone can initiate liquidation by pressing a button, which allows for the simultaneous liquidation of multiple Bottles in a single batch. This can be achieved either by specifying a particular group of Bottles or by following an ascending order, starting from the Bottle with the lowest collateralized ratio.
- Funds from the Tank are used to close the position of debts (BUCK) and collateral (e.g., SUI) of undercollateralized Bottles.
- The user who triggers the liquidation initially receives 0.25% of the collateral as a reward, while there is the other 0.25% of the collateral would distribute into the Well.

If the Tank is empty, the system uses a secondary liquidation mechanism called redistribution. In such a case, the system redistributes the debt and collateral from liquidated Bottles to all other existing Bottles.

- The redistribution of debt and collateral is done in proportion to the recipient Bottle's collateral amount.

In most instances, Tank Contributors have a financial incentive to initiate liquidations as quickly as possible. To offset the gas expenses associated with a liquidation, particularly during periods of elevated gas prices, Bucket compensates the liquidator with 0.1% of the Bottle's collateral (SUI). This ensures that liquidators are fairly rewarded for their efforts, maintaining the stability of the system.

## 5.1 Forced Liquidation Against the Tank

As previously mentioned, the Tank is financed by Tank Contributors who deposit BUCK tokens into the smart contract. Its primary function is to serve as a "shock absorber": deposited tokens absorb liquidated BUCK debts, and contributors are rewarded for their participation.

When a Bottle becomes undercollateralized (less than 110%) due to a decline in the SUI price, the debt (in BUCK) can be instantly offset against an equivalent amount of pooled BUCK tokens, which are then burned by the system. In exchange, the system transfers 99.5% of the collateral (in SUI) from the liquidated Bottle to the Tank, while allocating the remaining 0.5% to the party responsible for initiating the liquidation process.

Over time, the BUCK in the Tank is gradually replaced by collateral. Generally, each liquidation contributes a collateral surplus gain to the pool, as the collateral is almost always worth more (in USD) than the burned BUCK tokens. This is because the liquidation is triggered below a collateralized ratio of 110%, but with a high likelihood significantly above 100% (unless the collateral price drops by more than 9.09% between two price feed updates).

A Tank Contributor receives a portion of the liquidations that take place during the tenure of their BUCK deposit. Upon acquiring the collateral, the combined value of the remaining BUCK deposit and the collateral gain will most likely surpass the initial value of the deposit. Consequently, Tank Contributors are incentivized by the anticipated positive returns.

An individual's share of the surplus gains is determined by the ratio of their remaining BUCK deposit (reduced by previous liquidations) to the total amount of BUCK in the pool. If no new deposits are made, all individual shares will remain constant throughout the liquidation process. As new deposits are introduced, early depositors are encouraged to increase their contributions in order to maintain their share of future rewards.

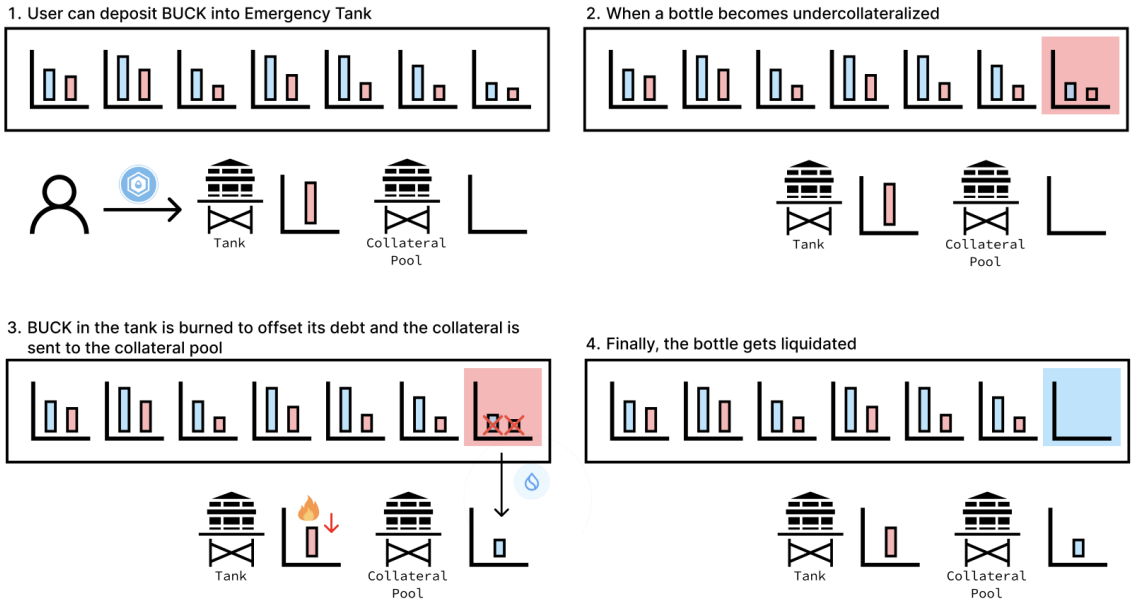



Figure 4: Offset undercollateralized Bottles against the Tank

## 5.2 Redistributing Undercollateralized Bottles to Other Bottles

There may be instances where the BUCK tokens in the Tank are insufficient to offset all undercollateralized Bottles, or when a Bottle's debt can only be partially absorbed as the Tank depletes its BUCK reserves during a liquidation. In such scenarios, the system redistributes the remaining debt and collateral from the partially liquidated Bottle, as well as the remaining undercollateralized Bottles, to all existing Bottle positions.

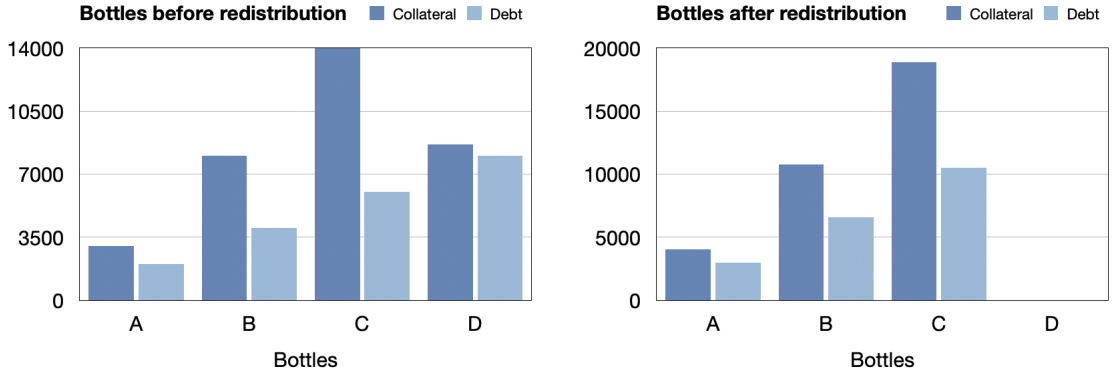
The redistribution of collateral and debt is executed in proportion to the recipient Bottle's collateral amount. This implies that Bottles with higher CR will receive a larger share of debt and collateral from liquidated positions compared to those with lower CR, thereby preventing cascading liquidations within the system.

**Example**

The two diagrams below depict Bottles A, B, C, and D along with their respective debt and collateral amounts. Bottle D has become undercollateralized and is subsequently redistributed to Bottles A, B, and C.

Receiving shares of collateral and debt generally results in a net gain for borrowers; however, it simultaneously reduces their collateralized ratios. The risk of being drawn down and becoming undercollateralized as a recipient is minimal, affecting only Bottles that are already very close to the Minimum collateralized ratio (e.g., 111%).

| Bottle | Debt | Coll. SUI | CR | Debt increase | Coll. increase | New debt | New coll. SUI | New CR | Net gain USD |
|---|---|---|---|---|---|---|---|---|---|
| A | 2000 | 3000 | 150% | 960.77 | 1037.63 | 2960.77 | 4037.63 | 136% | 76 |
| B | 4000 | 8000 | 200% | 2562.05 | 2767.01 | 6562.05 | 10767.01 | 164% | 204 |
| C | 6000 | 13980 | 233% | 4477.18 | 4835.35 | 10477.18 | 18815.35 | 180% | 358 |
| D | 8000 | 8640 | 108% | -8000.00 | -8640 | 0.00 | 0.00 | n/a | -640 |
| Total | 20000 | 33620 | 168% | 0.00 | 0.00 | 20000.00 | 33620 | 168% | 0.00 |




# 6 Recovery Mode

System solvency depends on the amount of BUCK tokens in the Tank and, ultimately, on the Total collateralized ratio (TCR) across all Bottles, calculated by dividing the total collateral (in USD) by the total debt (in BUCK).

To maintain sufficient collateralization within the system even during times of crisis, the Protocol includes a Recovery Mode, activated as a last resort when the TCR falls below the critical threshold of 150%. In this unique mode of operation, Bottles with a collateralized ratio between 110% and the current TCR become subject to liquidation as well. Such additional liquidations are only possible against the Tank (i.e., they are exempt from redistribution), and necessitate that the entire debt be liquidated at once.

To safeguard borrowers from excessive losses, the collateral offset against the Tank is limited to 110% of the liquidated debt. Borrowers can reclaim any remaining collateral above 110% at any time following the liquidation.

During Recovery Mode, the liquidation mechanism is governed by the following rules:

These changes incentivize Tank Contributors to increase their deposits during Recovery Mode, subsequently improving the system's TCR.

The existence of Recovery Mode helps prevent the system from falling below the critical threshold: the threat of additional liquidations motivates risky borrowers to enhance their collateralized ratios and encourages Tank Contributors to augment their deposits well before the system reaches the threshold ratio of 150%. On the other hand, risk-averse borrowers are advised to maintain a collateralized ratio above 150% at all times.

*Restrictions on Bottle operations.* All Bottle operations that would worsen the TCR are temporarily disabled if the system is in Recovery Mode. In Recovery Mode, ONLY the following operations are

| **Bottle's collateralized ratio** | **Liquidation Procedure** |
|---|---|
| $< 100\%$ | The Bottle is liquidated by directly redistributing its entire debt and collateral to other Bottles, without any prior Tank offset. |
| between 100% and 110% | As under normal operation, the Bottle is liquidated by first offsetting its debt and collateral against the Tank and redistributing any remaining amounts to other Bottles. |
| between 110% and TCR | The Bottle is liquidated by offsetting its debt against the Tank, provided that the entire debt can be liquidated. The liquidated collateral is capped at 110% of the debt, and the remaining amount above 110% is reclaimable by the borrower. |
| TCR | No liquidation possible. |

permitted:

- topping up collateral
- repaying debt

Additionally, new Bottles can only be opened during Recovery Mode if their collateralized ratio exceeds 150%. This precaution prevents users from inadvertently creating Bottles that may immediately become subject to liquidation.

# 7 Conclusion

We introduce the Bucket Protocol, a collateralized debt protocol featuring innovative liquidation and redemption mechanisms that push the boundaries of capital efficiency and liquidity costs. It issues a stablecoin with a hard price floor against the underlying fiat currency. Additionally, the Bucket Protocol paves new paths to incentivize decentralization and growth from the outset by tokenizing and redistributing a significant portion of its protocol revenue to users.