Cashmere Protocol: Single Side AMM for StableSwap

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Abstract

This paper discusses the technical aspects of the Cashmere exchange. That's why this article focuses on four main topics: The following topics are covered: (1) Introduction; (2) Swap System; (3) CashmereDao and Liquidity Mining System; and (4) Crosschain Aggregator. In summary, users will be able to stake stable coins as a single stableswap using single side AMM, cross-network asset transfers with the LayerZero interoperability messaging system, have a say in the system with CashmereDao, and receive a share of the revenues. In this article, we will explain all the technical details of the Cashmere system and all the necessary implications and approaches.

1 Introduction

We are just at the beginning of the road for De-Fi. Just think about it: TVL in the De-Fi corresponds to 1/35 of JPMorgan's assets. The market has had an incredible growth rate for the last 2 years. Every day, a new player joins the market, and the competition grows stronger. As the number of conscious users increases, the technology and quality offered by the projects become more important. Users no longer have to transact on a single network but instead have various assets on various networks to make investments. It's thought that one of the most important processes for De-Fi in the future is Layer2, and the Crosschain mechanism will be the gamechanger, which means it's going to be the mainstream itself. The Cashmere Labs offer solutions to these problems users face.

1.1 Terminology

1. **Compensation Ratio:** The ratio showing the relationship between assets and liabilities in the related pool.
2. **Base Pool:** A deposit receives CSM tokens in an amount that is proportional to its share of the total contribution from the Base Pool.
3. **Boosted Pool:** By staking CSM tokens, depositors can get additional CSM tokens from the Boosting Pool.
4. **veCSM**: Voting escrow token obtained by locking CSM holders
5. **CashmereDao:** Consists of a collection of veCSM holders, the entity that determines emissions from peak pools and votes for new pools.
6. **Price Oracle:** A specialized oracle, a decentralized network, or a trusted party that sends data from the outside world to a blockchain.
7. **Gauge Controller:** A autonomous treasury controller, Cashmere Dao members using that gauge for distribution of emission
8. **Crosschain Aggregator:** Swap cross assets across the 7 EVM chain using Layer Zero Labs messaging interoperability technology.
9. **Single Side AMM:** A swap mechanism using that single variant function.

2 System of Stableswap

2.1 Compensation Ratio

The compensation rate is one of the most considered variables in the system of Stableswap. The compensation ratio shows us the relationship between the system's asset value and liability. It functions like a kind of ledger. Liquidity provided to the protocol would become a liability. A higher compensation ratio indicates a lower default risk. The compensation ratio is an important parameter in our protocol since it needs to be maintained above a certain level to avoid default.

The protocol's liquidity would become a liability. A reduced default risk is indicated by a larger compensation ratio. The compensation ratio is a critical element in our protocol since it must be kept over a particular threshold to avoid default.

The token is under-compensated if the compensation ratio is less than one. And if the compensation ratio is greater than one, the area is overcompensated. When a swap occurs in Cashmere, the swap-from token's liquidity (in the system pool) increases, while the swap-to token's liquidity (in the system pool) falls.

Cashmere supports convergence toward equilibrium while penalizing deviation from it. As a result, price slippage has been defined as a function of the compensation ratio.

$$Compensation\ Ratio = \frac{Asset}{Liability}$$

2.2 Swapping

Cashmere Protocol uses single side AMM unlike other AMM's. AMM's like Uniswap and Curve uses invariant functions. But this causes some problems. One of them is impermanent loss. Due to the impermanent loss, it creates a liquidity shortage, the main reason for this is that the annual return of the user cannot meet the impermanent loss. Cashmere Labs uses Single-Side AMM for stableswap. Single-side AMM allows stablecoins to be swapped with very low slippages. The system uses the Compensation Ratio system for this, LP logic not the case for that. Additionally, with the assistance of the Cashmere Labs, stableswap transactions can be carried out with the least amount of slippage and without the need of any bridge across networks. This accelerates and simplifies the user's movement between Layer2 networks. Very high-volume transactions can be made with Single-Side AMM. You can receive positive slippage if you switch from a pool with a low compensation ratio to a pool with a high compensation ratio. In this way, financial players had earned an arbitrage opportunity and it helps to secure the spot of equilibrium. We will now examine the swap mechanism in detail.

2.2.1 Price Oracle

First, Cashmere tracks the exchange rate of each token via Chainlink. If there is a stablecoin unpeg of more than +2% (maximum price deviation), all swaps will be stopped. Stablecoins must be pegged for swap transactions. Define the exchange rate y_i to be the price of the token i in terms of USD. For a swap from token i to token j, the price of token i in terms of token j is defined:

$$y_{i \to j} = \frac{y_i}{y_j}$$

2.2.2 Solvency Risk

The liquidity provided by Cashmere Labs would become a liability to the protocol. The value is the L_i for token i account. A_i for token i account that the protocol currently holds. The compensation ratio c_i is defined to be $\frac{A_i}{L_i}$, which is a ratio of default risk of token i account. A higher compensation ratio means a lower risk of default. $c_i = 1$ is the optimal value for the protocol. The protocol uses several systems to balance this compensation ratio, such as the positive arbitrage and interest rate model. If any kind of default risk occurs, it gives users the opportunity to exit from different assets.

2.2.3 Terminal exchange rate

Cashmere does not use the slippage system. For this reason, it aims to penalize large amount of transactions made in a single transaction. Cashmere does not use the slippage system. For this reason, it aims to penalize large amounts of transactions made in a single transaction. In these transactions, the exchange rate used in the transfer is rearranged. It can be defined as:

$$y^*_{i\to j} = y_{i\to j}\,(1 - S_{i\to j})(1-\tau)$$

$y_{i\to j}$ is the external price oracles, $S_{i\to j}$ is the average slippage and τ is the trading fee.

After a swap δ_i token i to token j, $A'_i = A_i + \delta_i$ and $A'_j = A_j - y^*_{i\to j}\delta_i$. Then we have two compensation ratios:

$$c'_i = \frac{A_i + \delta_i}{L_i} > \frac{A_i}{L_i} = c_i$$

$$c'_j = \frac{A_j - y^*_{i\to j}\delta_i}{L_j} < \frac{A_i}{L_j} = c_j$$

2.3 Account Slippage

Cashmere uses the single variant slippage function instead of invariant curves. Define account slippage function to be $g : \mathbb{R}^+ \to [0,1]$ that maps compensation ratio of a token account to slippage value between 0 and 1. The g function must have some properties.

1. g is the continuously differentiable
2. $g' \leq 0$ if g' exists
3. g is weakly convex function

g' will be called as "marginal slippage" on this context. g is the decreasing function to prevent reduce compensation ratio. When any asset compensation ratio is recovered, the function can provide users with less slippage. g is the weakly convex function because if c_i is low, the cost of reducing compensation ratio would increase.

We could generate an account slippage function by Riemann integrating the function g' according to Lebesgeu's Theorem. The marginal slippage function defined to be:

$$g'(c) = \begin{cases} -1, & for \ -\frac{xz}{c^{z+1}} < -1, \\ -\frac{xz}{c^{z+1}}, & for \ -\frac{xz}{c^{z+1}} \in [-1,0] \end{cases}$$

$$g(c) = \int g'(c)dc = \begin{cases} -c + T_1, & for \ -\frac{xz}{c^{z+1}} < -1, \\ \frac{x}{c^z} + T_2, & for \ -\frac{xz}{c^{z+1}} \in [-1,0] \end{cases}$$

x and z are fixed parameters to be specified. $x = 0.00002$ and $z = 7$ could be competent choice of parameters.

The slippage function g is the reference point for slippage. In any swap, that account for token i involved, there will be an initial compensation ratio c_i and final compensation ratio c_i'. For token i, the account slippage is defined by definite integral along the swap path S.

$$S_i := \frac{\int_S g'(c)dc}{c_i' - c_i} = \frac{g(c_i') - g(c_i)}{c_i' - c_i}$$

2.4 Swap Slippage

The account slippage is not the final slippage $S_{i\to j}$ that users would encounter when swapping token i to token j. The swap path should at least involve two tokens. Account slippage on token i is indemnity for the user, while account slippage on token j is a penalty for the user since $c_i' > c_i$ and $c_j' < c_j$. As a result, we define the swap slippage $S_{i\to j}$ to be

$$S_{i\to j} = S_i + (-S_j) = S_i - S_j$$

2.5 Incentives for Compensation Ratio Convergence

Cashmere enables users' positive arbitrage to balance compensation ratio. The swap slippage defined above can make the compensation ratios close to each other. Also, it can encourage users to positive slippage. Mathematically, for any swap from token i to token j, If $c_i', c_j' \in (c_i\,, c_{j,})$, we have $S_{i\to j} < 0$.

If $c_i', c_j' \notin (c_i\,, c_{j,})$, we have $S_{i\to j} > 0$

2.6 Trading Fee

Cashmere collects trading fee τ from any swap. Trading fee distributed to Cashmere Dao Members and treasury. This amount varies on the swap action carried out by users. Mathematically:

$$\tau = \begin{cases} \tau_1, \ if \ \ S_{i\to j} > 0 \\ \tau_2, \ if \ \ S_{i\to j} \le 0 \end{cases} \quad and\, \tau_1 \ge \tau_2 > 0$$

For stableswap, we may use $\tau_1 = \tau_2 = 0.04\%$

2.7 Withdrawable Arbitrage

Withdrawable arbitrage is necessary for the cashmere single side amm. Withdrawal fee to prevent such an attack.

Consider the account for token i, assume $c_i < 1$ and user deposited or going to deposit a certain amount d_i into token i account.

User might swap θ token j to $\bar{\theta}$ token i. The new compensation ratio for token i would be $c_i' = \frac{A_i - \bar{\theta}}{L_i}$. User pays the slippage for lowering c_i

User withdraws d_i from token i account. The new compensation ratio decreases further to

$$c_i'' = \frac{A_i - \bar{\theta} - d_i}{L_i - d_i}$$

User reverses swap in first step, to gain the slippage of pushing c_i to a higher level. User purposes to restore the compensation ratio of token j account. With changed compensation ratio, c_i'', the required amount of reversal swap θ' tends to be different from the initial amount θ.

The final compensation ratio is defined to be:

$$c_i^* = \frac{A_i - d_i - (\bar{\theta} - \theta')}{L_i - d_i}$$

2.8 Withdrawal Fee

Withdrawable arbitrage can cause withdrawals from the pool and is harmful to cashmere's pool health. The system takes withdraw fee to prevent sudden money outflows. This very small fee prevents the withdrawal arbitrage in the system from being used in a harmful way. Profit function is defined to be:

$$\pi(\theta, A_i, L_i, d_i) = d_i\big(g(c_i^*) - g(c_i'')\big) - L_i(g(c_i') - g(c_i) + g(c_i^*) - g(c_i''))$$

It's desired to find the maximum profit. From that c_i' and c_i'', are known. Note that, $c_i^* = \frac{c_i L_i - d_i}{L_i - d_i}$ which is function of c_i . We than consider the derivative of π with the respect of c_i

$$\frac{\partial \pi}{\partial c_i} = L_i\,(g'(c_i) - g'(c_i^*))$$

Also note that:

$$c_i < 1$$

$$\Rightarrow c_i^* < c_i$$

$$\Rightarrow g'(c_i^*) < g'(c_i), by\ convexity\ of\ g$$

From that we have:

$$\frac{\partial \pi}{\partial c_i} = L_i\,(g'(c_i) - g'(c_i^*)) \begin{cases} > 0, & if\ c_i < 1 \\ < 0, & if c_i > 1 \\ = 0, & if c_i = 1 \end{cases}$$

This amount to be paid if and only if $c_i' < 1$

Assume the withdrawal amount is equal to 1% of the pool and withdraw cost is w_c:

$$c_i \geq 1 \xRightarrow{withdraw} w_c = -0.0000\%$$

$$c_i = 0.9 \xRightarrow{withdraw} w_c = -0.0011\%$$

$$c_i = 0.7 \xRightarrow{withdraw} w_c = -0.0518\%$$

$$c_i = 0.6 \xRightarrow{withdraw} w_c = -0.2731\%$$

3 System of Liquidity Mining and CashmereDAO

First of all, it will be explained as 4 main topics in order while reviewing Cashmere's liquidity pool system. veCSM, gauge controller, base pool, and boosted pool.

Cashmere's single-side AMM and single-side liquidity are interconnected. There are a number of reasons for this. Most stable exchanges are like USDC-DAI, USDC-USDT, USDC-MIM, etc., based on coin pairs with different liquidity pools. USDC is available in the three-coin pairs mentioned above. However, USDC is not shared between liquidity pools. This lies behind the decrease in swap efficiency. Additionally, users may have a shortage of liquidity in the LP system and will experience a certain amount of slippage when creating an LP, like the Curve 3 pool. That's why Cashmere Labs encourages its users to single-side yield farming. With that, shortage of liquidity will be eliminated, and users will not incur any loss while providing liquidity.

Cashmere has a system that allows you to stake single-side stablecoins. You can stake your native stablecoins as singles in their networks and earn a certain amount of CSM rewards. There are different factors that determine this reward, such as the amount of money you deposit, the amount owned "veCSM" by the user, the gauge and compensation ratio the pool has. We will explain each one technically in turn.

Cashmere Dao owns the revenues generated by Cashmere Labs. In addition, DAO has the right to interfere and organize the distribution of income and the decisions of the labs. To make this income distribution, a set of mechanisms are used along the way. Cashmere Labs generates revenue from stableswap transactions, cross-chain aggregator transactions, and a few other processes. It also provides emission rewards for incentives to liquidity providers and voting right holders for governance. In that way, users play an active role both in determining the emissions of the pools and in the distribution of trading fees.

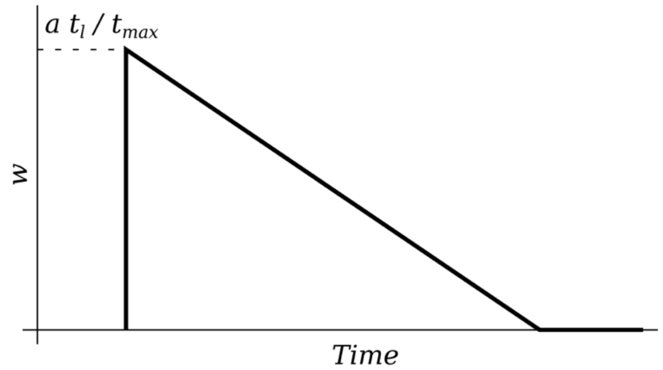
3.1 Time-weighted voting. Vote-locked tokens in VotingEscrow

Unlike voting with token amount a, CashmereDAO tokens are lockable in a $VotingEscrow$ for a selectable lock time t_1, where $t_1 < t_{max}$ and t_{max}= 4 years. After locking, the time left to unlock is $t \leq t_1$. The voting weight is equal to:

$$w = a\frac{t}{t_{\max}}$$

In other words, voting is weighted by both quantity and time, where the time that counts is how long the tokens will not be able to be moved in the future.

Voting escrow CSM (veCSM), inspired by voting escrow CRV (veCRV), and adopted by Curve Finance. veCSM is not transferable or tradable.
Return the time-weighted voting weight w and the sum of all of those weights $W = \sum w_i$ respectively. This is typical governance token.

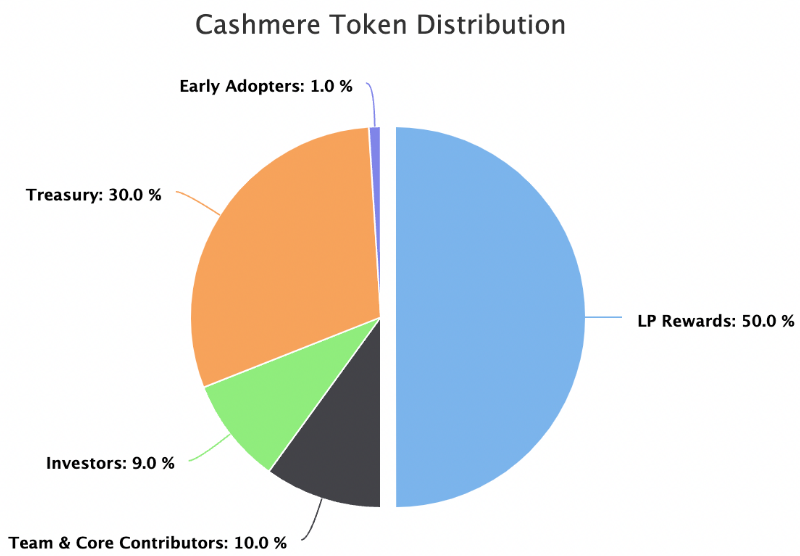


Users may lock CSM tokens and also extend the time with increased lock function or increased amount. Withdrawal can remove tokens from the escrow when the lock has expired.

User voting power w_i is linearly decreasing until lock time expires. The total voting power is W. For the optimization, system abstain periodic check-ins, every time the user movement are recorded and checked such as deposits, withdrawals, or changes lock time. This way, the total voting power changes with each check-in, with feedback from each user. However, system limit the end of user locks to times rounded by whole weeks.

3.2 Tokenomics and Inflation system.

The maximum CSM token supply is 100,000,000 (100 million). The token distribution is as below:



The team and core contributor tokens are locked for the first 12 months, and subsequent linear vesting for the 36 months. The Treasury is unlocked at %100. This is used for launching liquidity and other community-driven activities. For LP rewards, Cashmere delivers its native token CSM through two different pools: (1) base pool and (2) boosted pool, which respectively account for %40 and %60 of the aggregate allocation.

Token ERC20CSM is an ERC20 token which allows a piecewise batch inflation schedule. CSM using cliff system for batch inflation. $cliff_{max}$ is the maximum cliff amount. $cliff_r$ is remaning cliff amount. $cliff_{current}$, is the current cliff number, CSM_{rate} is the determines the instantaneous cliff's emission rate. Mathematically;

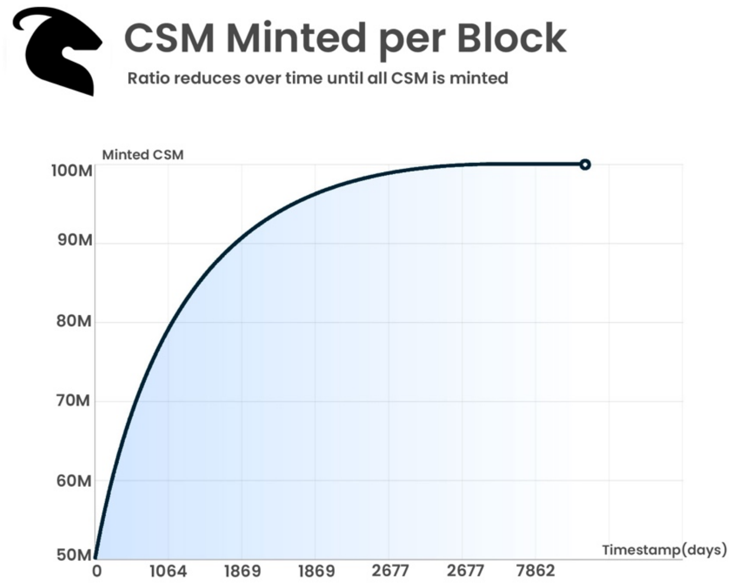
$$cliff_{max} = 1000$$

$$cliff_r : \mathbb{Z}^+ \rightarrow \{0,1000\}$$

$$cliff_r = cliff_{max} - cliff_{current}$$

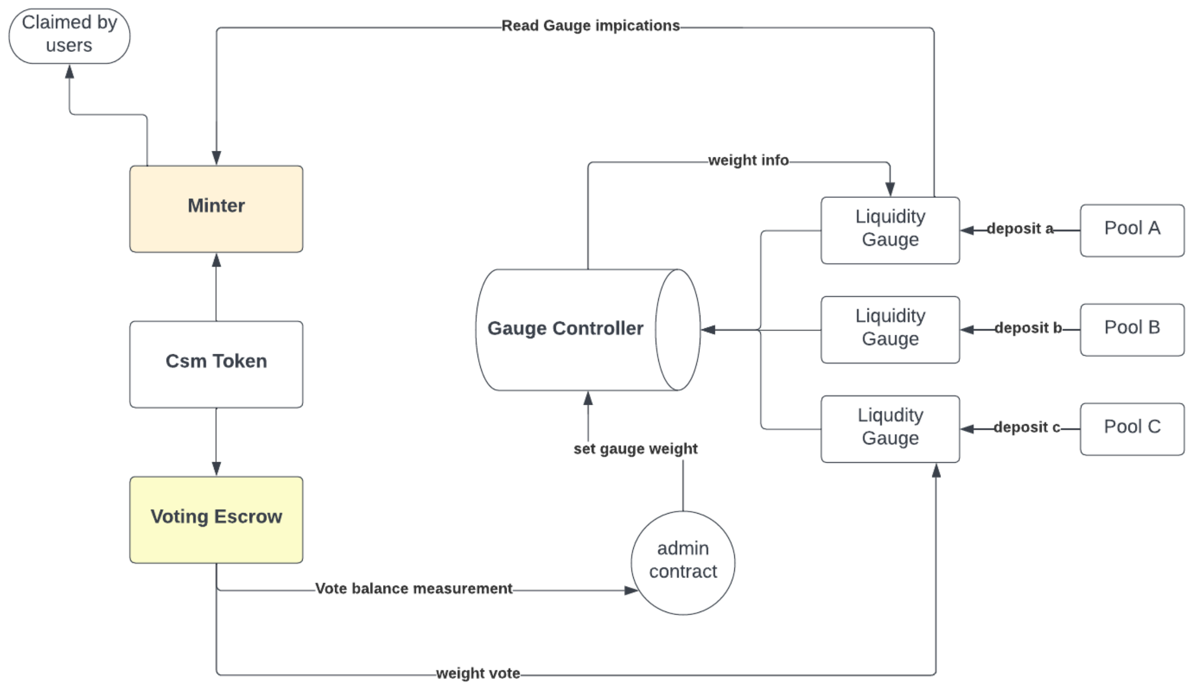
$$CSM_{rate} = \frac{cliff_r}{cliff_{max}}$$

Therefore, first 500 batch is opened with launch because are minted. First emission rate equals to $\frac{cliff_r}{cliff_{max}} = \frac{500}{1000} \rightarrow 0.5\ csm/block$. The first batch takes about 2.14 days to complete. This time increases with each batch. The most recent CSM minting takes about 21 years.



3.2 Gauge controller and Liquidity Gauge

In Cashmere, users also have the right to change the liquidity reward weight of the pools. When a user applies a new weight vote, it gets applied only at the beginning of the next whole week. For optimization, users cannot change their votes in the pool for 10 days. The gauge controller must be controlled by Cashmere DAO members. When the user changes his preference, this decision is not transferred directly to the contract. It counts towards the next gauge selection. This is due to contract optimization. It will be more understandable if we describe the gauge system schematically.



Each gauge has a weight depending on votes. Those weights represent how much of the daily CSM inflation will be received by the liquidity gauge.

E.g.

20% of veCSM holders voted USDT Gauge Pool
15% of veCSM holders voted DAI Gauge Pool
10% of veCSM holders voted USDC Gauge Pool
20% of veCSM holders voted FRAX Gauge Pool
35% of veCSM holders voted TUSD Gauge Pool

In this case if total daily CSM emission is = 43,200 CSM/daily
USDT Gauge Pool will get 20% of 43,200 CSM Token emission = 8,640 CSM/daily
DAI Gauge Pool will get 15% of 43,200 CSM Token emission = 6,480 CSM/daily
USDC Gauge Pool will get 10% of 43,200 CSM Token emission = 4,320 CSM/daily
FRAX Gauge Pool will get 20% of 43,200 CSM Token emission = 8,640 CSM/daily
TUSD Gauge Pool will get 35% of 43,200 CSM Token emission = 15,120 CSM/daily

3.3 Base Pool

The Base Pool delivers emissions to a stablecoin deposit at an amount that is positively proportional to its share of the aggregate deposits. It delivers the following monthly emission Rd_x for a deposit x of stablecoin i:

$$Rd_x = E_b . W_i . \frac{L_x}{\sum_{t=1}^{N} L_t}$$

E_b: monthly emission allocated to the Base Pool
L_x: amount of deposit x in stablecoin account i
$\sum_{t=1}^{N} L_t$: aggregate deposits (i.e.: liability) of stablecoin account i
W_i: emission weighting assigned to stablecoin account i

As we mentioned above, w_g is the gauge weight of stablecoin account i and the emission weight of stablecoin account i is determined by the gauge controller and its formula is:

$$W_i = CSM_{rate} . \ w_g$$

Adding the price of CSM token C_p, we can derive the the annual percentage rate (APR) delivered by this pool for deposit x:

$$APR_x = 12 \ . \ \frac{Rd_x . C_p}{L_x} = 12 \ . \frac{E_b \ . W_i \ . C_p}{\sum_{t=1}^{N} L_t}$$

In this pool, APRs are identical across all deposits, irrespective of their sizes.
Some implementations:

(1) As the user keeps other deposits constant, the absolute token emission in a single deposit increases in direct proportion to the size of the deposit. The remaining deposits have lower emissions.

(2) If a depositor divides his capital into different deposits or deposits it in different wallets, the amount of emissions he will receive does not change.

(3) Holding other deposits constant, an increase in the size of a single deposit lowers the APR of all deposits, including its own APR.

3.4 Boosting Pool

The Boosting Pool differs from the Base Pool in that its liquidity emission is subject to staking of CSM tokens. The pool is related to the veCSM amount.

- To encourage the purchase of CSM tokens.
- Long-term staking should be encouraged.
- To link the farming of TVL to the staked token.
- To lock CSMs and decrease selling pressure.
- To decrease CSM's circulating supply.

The Boosting Pool delivers emissions to a stablecoin deposit x according to a specific weight function Wc_x that depends on both the amount of stablecoin deposit L_x and veCSM amount $veCSM_x$:

$$Wc_x = \sqrt{L_x \,.\, veCSM_x}$$

If the depositor has not locked any CSM and is not a veCSM holder, the depositor cannot benefit from the boosting pool.

Each deposit x has an allocative share A_x of the emission that is based on its weight share:

$$A_x = \frac{Wc_x}{\sum_{t=1}^{N} Wc_t}$$

$\sum_{t=1}^{N} Wc_t$: aggregate of all deposits weight

Accordingly, the Boosting Pool delivers the following monthly emission Rc_x for a deposit x of stablecoin i:

$$Rc_x = E_c \,.\, W_i \,.\, A_x$$

E_c: monthly emission allocated to the Boosting Pool
W_i : emission weighting assigned to stablecoin account I

There are APRs delivered by the Boosting Pool. If we only consider stablecoin deposits as the principal, then:

$$APRc_x = \frac{12 \,.\, Rc_x \,.\, C_p}{L_x}$$

If we consider both stablecoin deposits and staked CSM the principal, then

$$APRc_x = \frac{12 \,.\, Rc_x \,.\, C_p}{L_x + CSM_x \,.\, C_p}$$

(1) Holding other deposits and their locked CSM constant, the absolute emission delivered by the Boosting Pool to a single deposit always increases with its locked CSM and/or deposit amount. Meanwhile, the remaining deposits receive lower emissions.

(2) If a depositor divides his capital into different deposits or deposits it in different wallets, the amount of emissions he will receive does not change.

(3) If the deposit amounts or locked CSM of all deposits change by the same proportion, then the allocative share of each deposit and hence the emission remain unchanged.

3.5 Total Return

This section summarizes the total return that a depositor can earn from providing stablecoin liquidity and locking CSM tokens onto the Cashmere.

A deposit can simultaneously earn emissions from both the Base Pool and the Boosting Pool. The total monthly emission R_x for a deposit x thus amounts to the summation of pools.

$$R_x = Rd_x + Rc_x = W_i \,.\, (E_d \cdot \frac{L_x}{\sum_{t=1}^{N} L_t} + E_c \cdot \frac{Wc_x}{\sum_{t=1}^{N} Wc_t})$$

And the corresponding APR for the total return is also identical the summation of the APPs of the two pools.

a. If all Deposits and the locked CSM amount change at the same rate, the allocation share of each deposit, i.e., the amount of emission, remains the same.
b. While APR decreases with the amount of deposits deposited, it also increases with the amount of locked CSM (veCSM). This relationship may not be correct if the user includes both the CSM and the deposit in the principal account.
c. If a depositor divides his capital into different deposits or deposits it in different wallets, the amount of emissions he will receive does not change.

3.6 Cashmere DAO

CSM holders can vote to lock their CSM into the Cashmere DAO to receive veCSM. The longer they lock for, the more veCSM they receive. Vote locking allows you to vote in governance, boost your CSM rewards and receive trading fees.

Users who stake CSM can claim government trading fees as often as they'd like, but fees will only be converted into stablecoin, which has the highest compensation ratio for the health of the system. Every time a trade takes place on Cashmere, 50% of the trading fee is collected by the users who have vote locked their CSM. Fees from the previous week are distributed every week.

Also, users who reach a voting power of 2500 veCSM can also create new proposals. There is no minimum voting power required to vote.

Cashmere DAO members also maintain emission control. Users can vote on emission rates on a weekly basis, increasing their own income and having a greater say in the governance of the Cashmere treasury. The existence of Cashmere's DAO gauge and lock system assures to provide a completely decentralized and fair reward distribution.

On the strength of this power, Cashmere Dao increases the demand for its own token and can satisfy its users despite its issuance surplus. The token system is utilized for as many users as possible to participate in the lab management and the incentives to liquidity providers increase. In this way, the system makes itself sustainable.

	Liq in Pool & Gauge No veCRV	Liq in Pool & Gauge Has veCRV	No Liq No veCRV	No Liq Has veCRV
Base LP APRs	YES	YES	NO	NO
Boosted LP APRs	NO	YES	NO	NO
Can vote DAO proposals	NO	YES	NO	YES
Can vote gauge weights	NO	YES	NO	YES
Can get Liquidity Bribes	YES	YES	NO	NO
Can get Proposal Bribes	NO	YES	NO	YES
Can get GOV Fees	NO	YES	NO	YES

3.7 Interest Rate Model

Interest rate is one of the important adjustment mechanisms of Cashmere. Economically, rational users tend to switch from a low APR to a high APR. Therefore, if we increase the APR of pools with a high compensation ratio, users will swap products with a low compensation ratio for those with higher compensation. As a result, the liability of the product at a low compensation ratio will decrease. In this way, we will use the situation of users to maximize their own profits for the health of the system.

To mitigate the imbalances of the coverage ratios among different stablecoin accounts, Platypus adds an adjustment factor a_i to each stablecoin account's base weighting W_i. Base weight, as we mentioned above, is determined by the gauge controller determined by CashmereDao. As the adjustment factor impacts the final weighting Wf_i of each stablecoin account, the emissions from both the Base Pool and the Boosting Pool adjust accordingly.

The following is the final weighting Wf_i applied to each account's emissions:

$$Wf_i = \frac{W_i \, . a_i}{\sum_{j=1} W_j \, . a_j} \; where \; a_i = \frac{1}{\frac{1}{r} + \frac{1}{c_i^3}}$$

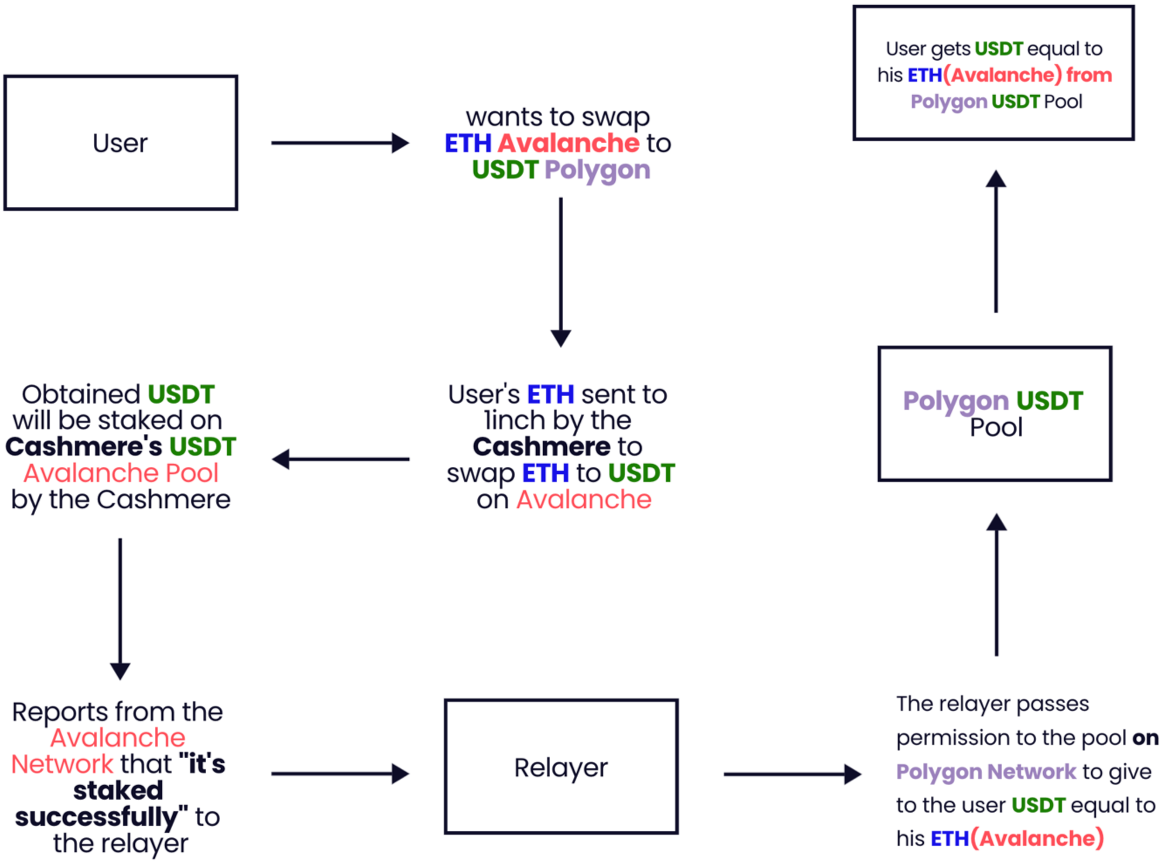
c_i : the coverage ratio of stablecoin account i

$\sum_{j=1} W_j \, . a_j$: aggregate weights of all stablecoin accounts j

(1) High compensation ratio means high adjustment factor. High adjustment factor makes the pool gain more weight. More emissions encourage users to swap to the product in that pool.
(2) The adjustment factor is bounded from above by σ It is obvious that, for any stablecoin account i , $a_i \to \sigma$ as $c_i \to \infty$. More specifically, as a coverage ratio continues to increase, the final weighting increases at a decreasing rate and the impact exerted by a further increase in the coverage ratio eventually dwindles to zero.

4 Crosschain Aggregator

The Cashmere Labs also allow the exchange of non-pegged assets. It does not use a bridge when switching non-pegged assets like BTC, ETH, and AVAX between L2s and L1. The Omnichain Interoperability Labs are being used by the router. The single side additionally makes use of its own stable pools while using this technique. When the user swaps the X product that is in Chain (a) to the Y product that is in Chain (b), the labs use the 1-inch aggregator and pass over the liquidity of the cashmere labs. Due to this, before making a bridge, the user acquires a Y native asset that is in Chain (b). The exchange of assets will take place separately for each chain. Users will only be given information on the amount of withdraw-able assets from the stable LP between chains. As a result, MEV bots cannot attack between chains during the messaging period. In fact, the Cashmere Labs, with this solution, provide a solution to early liquidity starvation, particularly in L2s.



4.1 Crosschain Swap System

Cashmere 7 provides services to the network. To achieve this, LayerZero uses messaging interoperability. Users can stake stablecoins on all 7 networks. Cashmere makes cross-asset transfers of users between networks without using a bridge. To do this, it uses stablecoin liquidity from these 7 existing networks.

S_c is swap path of cross-chain aggregator. n_a and n_b are network type like Avalanche or Ethereum, i and j are stablecoin account. f_i means that i stablecoin account on n_a network.

$$S_c: (n_a, f_i) \rightarrow (n_b, f_j)$$

If user swap Δ_x on n_a to Δ_y on n_b that using cashmere cross chain aggregator, the swap path is defined to be:

$$f_i' = \Delta_x \overset{1-inch\ swap}{\Longleftrightarrow} \Delta_{f_i}$$

$$f_j' = \Delta_{f_j} \overset{1-inch\ swap}{\Longleftrightarrow} \Delta_y$$

$$S_c^*: (n_a, f_i - \Delta_{f_i}) \rightarrow (n_b, f_j + \Delta_{f_j})$$

$$\Delta_{f_j} \cong \Delta_{f_i}$$

$x\ and\ y$: any cross-asset of their network

(1) The system reflects the best price to the user by using the 1-inch aggregator, considering the compensation ratios.
(2) There is no bridge transfer between networks. The messaging interoperability provided by Layer Zero is used. The inter-relayer messaging system is used. The entire system is fully decentralized.
(3) There will be no change in the asset-liability ratio in the system. Because the inner amount and outer amount are equal.

$$Total_c = \frac{A_{total} + (\Delta_{f_i} - \Delta_{f_j})}{L_{total} + (\Delta_{f_j} - \Delta_{f_i})} \cong \frac{A_{total}}{L_{total}}$$

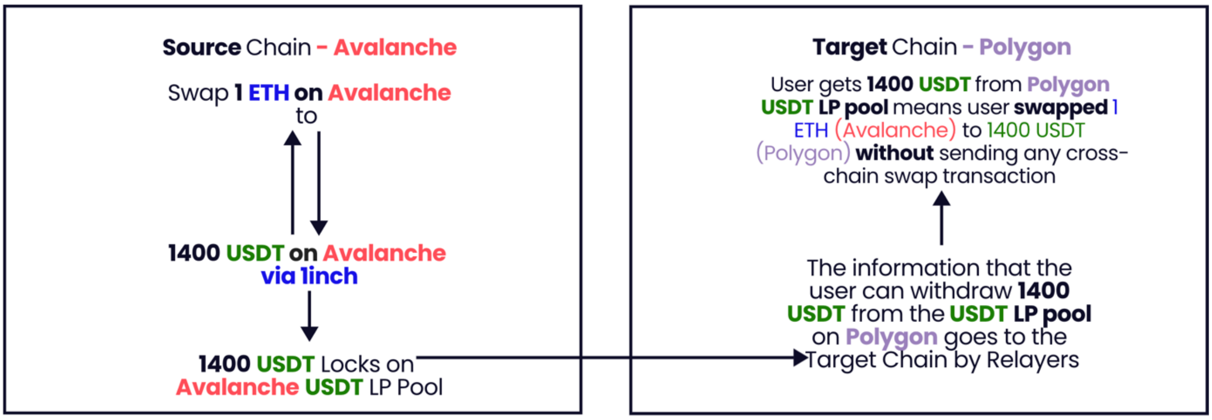
(4) It includes compensation ratio changes between networks and the amount owned by the network as an incentive for arbitrage bots. Arbitrage bots can dispose of excess in a network based on the principle of Positive slippage. (2.5 section)

If $c_i', c_j' \in (c_i, c_{j,})$, we have $S_{i \rightarrow j} < 0$.

If $c_i', c_j' \notin (c_i, c_{j,})$, we have $S_{i \rightarrow j} > 0$

4.2 MEV Resistant

Users won't be able to send a swap transaction between the chains. The asset swap will take place in each chain separately. Only the information about the amount of the asset that will be granted to users' withdrawal from the stable LP pool will be delivered between the chains. Therefore, MEV bots won't be able to attack during the cross-chain messaging period. This system does not completely eliminate the risk of MEV. But it will provide the slippage amounts as a regular decentralized swap operation in a native network. The cross-chain operation does not create an additional MEV attack risk.



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