Kommodo: concentrated liquidity lending protocol

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Abstract. A permissionless fully collateralized lending protocol allows financial parties to lend and borrow assets without the trust of a central party. Blockchains provide part of the solution, but the main benefits are lost if a trusted third party is still required to determine the price between assets. We propose a solution to the pricing problem by requiring concentrated liquidity positions for liquidity and collateral. The use of concentrated liquidity positions can guarantee that the value of the collateral position will be higher or equal to the borrowed position for the lifetime of the loan, removing the need for trusted third parties or liquidations.

1. Introduction

Lending and borrowing is part of the trust based financial system. Within the decentralized finance space there is active research to integrate lending and borrowing without requiring trusted third parties. The current decentralized finance based lending protocol implementations require trust in an oracle provider. Recently there have been made developments that do not require trusting an oracle provider, however these systems use liquidation games, are complex and require active participation to avoid liquidation. In this paper Kommodo is presented, a novel lending protocol that allows lending and borrowing between any token pair with minimal complexity and without the trust of oracles or liquidations.

2. Lending protocols

Lending protocols allow depositing funds and receiving a yield in return. In addition a lending protocol allows to borrow these deposited funds against collateral funds while paying interest for these borrow activities. Pooled lending protocols aggregate deposited funds in a pool to borrow from. Peer to peer lending protocols match single lenders and borrowers. Pooling the funds allows for efficient matching between lenders and borrowers.

Permissionless lending protocols have no knowledge of the borrower or option to retrieve the borrowed funds and therefore require full collateralization of the loan. To determine the collateral needed between two assets the permissionless lending protocol requires knowledge of the asset prices.

A change in price can require an increase in collateral. Current implementations of blockchain based lending protocols use oracles to input the price and liquidation games to guarantee sufficient collateral on changing prices. There are lending protocols that do not require trusting an oracle for price input, these protocol determine the price algorithmically based on the total lending pool conditions. These protocols are complex and require liquidation games to guarantee sufficient collateral on changing prices.

3. Automated market makers

Trading is the mechanism for price discovery of an asset. The decentralized finance space implemented automated market makers (AMMs) for efficient blockchain based trading, allowing price discovery between assets referred to as tokens. AMMs are agents that pool liquidity and make it available to traders according to an algorithm [1]. AMMs allow for permissionless trading efficiently matching trades.

Initial iterations of AMMs inefficiently distributed liquidity uniformly along a single curve. Concentrated liquidity positions (CLPs) are AMMs liquidity positions (LPs) with the ability to concentrate the liquidity by “bounding" it within an arbitrary price range [2]. This improves the pool’s capital efficiency and allows LPs to approximate their preferred reserves curve, while still being efficiently aggregated with the rest of the pool. For AMMs with two assets (A and B) the CLPs will return A at a price above the bound price range, B below the bound price range and a mix of A and B within the bound price range.

4. Concentrated liquidity lending

For permissionless lending protocols the collateral value is required to be higher than the borrow value at all times. To comply with this requirement the collateral has to increase when price changes increase the collateral needed. In the case that the collateral asset deposited is the same as the borrowed asset there is no active price change, the price is always equal to 1. On initial requirement of full collateralization this guarantees that the deposited collateral value is always higher than the borrowed value, no future increases in collateral are ever required. However borrowing and lending between the same asset has minimal use cases.

We propose a protocol for lending and borrowing CLPs as the asset. The use op CLPs allows a combination of trading between two assets while having the value guarantee of using one asset. The only requirement for borrowing a CLP is that the value of the borrow CLP is equal or less than the collateral amount.

P = assetA / assetB
V = CLP value

To simplify the proof we assume that P > 1. We first determine the collateral amount:

$$collateral = amountA$$

We then calculate the assetB amount for the borrow CLP based on the collateral amount and the CLP price:

$$amountB = \frac{collateral}{Pborrow}$$

The current borrow CLP value can be determined based on the current price:

$$Vborrow = \begin{cases} Pborrow \leq Pcurrent, & amountA \\ Pborrow > Pcurrent, & amountB \end{cases}$$

This gives the following guarantee over the total lifetime of the loan:

$$collateral \geq Vborrow$$

The guarantee can be deducted from the fact that value borrow is equal to amountA or is divided by a price greater than one. Value borrow therefore must always be smaller than value collateral. For prices smaller than one the formulas need to be adjusted to multiplication. Since it then is a multiplication of a number smaller than one the guarantee also holds. The use of CLPs for lending allows to mathematically guarantee the requirement of a permissionless lending protocols. This beautifully simple guarantee allows for the protocol to be permissionless and require no oracle, governance or liquidation games.

The single asset collateral in the example can be replaced by a CLP while maintaining the value guarantee. Because the loans are guaranteed fully collateralized, closing of the loan will only happen when the borrower closes it or by anyone when no interest is available. Interest is therefore a significant part of the design. Under chapter *5. Interest* we propose the use of an interest curve proportional to the borrowers risk to calculate the interest payment. This design requires the collateral to be a CLP instead of a single asset. We therefore propose the use of a collateral CLP together with a borrow CLP.

5. Interest

The funds of the lender are locked for the duration of the loans, in exchange the lenders are payed interest by the borrowers. Different designs for interest calculation are possible. A single fixed interest rate is simplest in design. The single fixed rate however has multiple flaws. Most importantly higher risk loans (for the lender) where the borrow CLP price is closer to the current price will receive the same interest as lower risk loans where the borrow CLP price is far from the current price. This would incentivize lenders to only provide funds far from the current price, minimizing the amount that can be borrowed. An interest rate based on the ratio of supply vs borrow also has this flaw. To incentivize lenders to deposit CLPs closer to the current price they have to receive more interest than lenders farther from the current price.

We propose the use of a risk proportional interest rate. With single token collateral the current price has to be used as a base to calculate the proportional interest between the current price and the borrow CLP price. This is not acceptable because the current price can be manipulated, allowing borrowers to manipulate the interest payed. The use of a CLP as collateral allows for the interest to be set proportional to the difference between the borrow CLP price and the collateral CLP price. This allows the interest to be set proportional to the risk of the lender and borrower without manipulation, incentivizing lenders to deposit CLPs closer to the current price.

6. Conclusion

We proposed a protocol for lending and borrowing without relying on a trusted third party. The protocol requires no external price input and no liquidations. This is achieved by using CLPs as assets to provide the guarantee that the amount of collateral is always equal to or more than the amount borrowed. The interest is made proportional to the difference between price borrow and price collateral to allow borrowers to borrow at its own risk/reward ratio. Because of the value guarantee closing a loan can only be done when interest is no longer payed or by the borrower during the lifetime of the loan, removing the need for liquidations.

References

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