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 when a borrower can default on a loan or a trusted third party is still required to determine the price between assets. We propose a solution to the solvency and pricing problem by requiring concentrated liquidity positions for liquidity and collateral. The use of concentrated liquidity positions can guarantee solvency for the lifetime of the loan, removing the need for trusted third parties, price oracles 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. Most decentralized finance based lending protocols 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 we present Kommodo 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 do not know the borrowers identity missing the option to forcefully retrieve the borrowed funds requiring full collateralization of the loan. To determine the collateral needed between two assets the permissionless lending protocol requires the asset prices. A change in price can result in a required 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 (assetA and assetB) the CLPs will return assetA at a price above the bound price range, assetB below the bound price range and a mix of assetA and assetB 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, in other words a solvency guarantee. However borrowing and lending between the same asset at first glance seems to have 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 solvency guarantee of lending and borrowing one asset. The only requirement for borrowing a CLP is that the value of the borrow CLP is equal or less than the collateral value on opening.

P = assetA / assetB
V = CLP assetA value

To prove the solvency guarantee we first determine the collateral amount:

$$collateral = amountA$$

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

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

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

$$Vborrow = \begin{cases} Pcurrent < Pborrow & amountB \times Pcurrent \\ Pcurrent \geq Pborrow, & amountA, \end{cases}$$

This gives the following solvency guarantee for the total lifetime of the loan:

$$collateral \geq Vborrow$$

The solvency guarantee can be deduced from the fact that the value borrowed is equal to amountA or the amountA value is the amountB borrowed multiplied by a price smaller than the borrow price. The value borrowed therefore must always be less than the value of the collateral. The use of CLPs for lending allows to mathematically guarantee the solvency requirement needed for a permissionless lending protocols. This beautifully simple guarantee therefore allows for the protocol to be permissionless without the need for an oracle, governance or liquidation games.

For simplicity the proof used a single asset as collateral. The single asset can be replaced by a CLP while maintaining the solvency 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 an important part of the design. Under chapter *5. Interest* we propose the use of an interest curve proportional to the collateral and borrowed CLP price ratio. 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 receive interest from the borrowers. Different designs for interest calculation are possible. Below we examine the main design options:

1. A single fixed interest rate is simplest in design. The single fixed rate however does not allow the protocol to change interest rates to attract liquidity in a changing environment, like other yield protocols offering higher returns.
2. An interest rate curve based on the ratio between total supplied vs borrowed assets would allow the protocol to attract liquidity in a changing environment. However there is no ratio to be calculated because the borrowed assets are CLPs instead of single assets and to determine the borrowed assets value the current AMM price is required. The current AMM price can be manipulated. This would allow borrowers to manipulate the interest rate payed.
3. An interest rate curve based on the ratio between collateral and borrowed CLP. For 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, as noted before, because the current AMM price can be manipulated. The use of a CLP as collateral and borrow position allows for the interest to be set proportional to the difference between the borrow CLP price and the collateral CLP price. The CLP price ratio method allows both the lender and borrower to influence the interest rate for the loan.

We propose the use of the CLP price ratio interest curve. Allowing borrowers to select an interest rate within their risk margins by depositing CLP collateral at their preferred price influencing the interest rate on the loan. While also allowing lenders to influence the minimal interest for their loan by depositing a CLP at their preferred price. A higher CLP price by the lender would mean that the borrower is required to haven an increased distance between the borrow CLP and the collateral CLP. In changing environments, for example the scenario of other higher yield protocols, lenders redeposit a CLP at a higher price to increase the interest rate.

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 or more than the amount borrowed. The interest rate is made proportional to the difference between price borrow CLP and price collateral CLP to allow borrowers and lenders to influence the interest rate based on their risk/reward ratio. Because of the solvency guarantee closing a loan can only be done when interest is no longer available or by the borrower during the lifetime of the loan, removing the need for liquidations.

References

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