Hey Chain: A Liquidity Optimizing Mechanism On Lightning Network

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Abstract

As less liquid crypto assets rise in popularity, liquidity provision will become a major hurdle for crypto exchanges. I propose a novel liquidity provision mechanism that incentives the maintenance of lightning channels bewteen sellers, buyers and exchanges to maximize the opportunity for secure, instant exchange of less liquid tokens.

1 Introdution

As the crypto space evolves, there has been a constant paradigmatic shift toward the adoption of less liquid tokens. The rise of ICOs has led to an explosion of ERC-20 tokens, and the rise of Crypto Kitties similarly triggered an explosion of ERC-721 tokens.

Even though token issurance has become ubiquitous, the lack of liquidity for many of these tokens means that token issuers have to pay a significant sum to access liquidity, i.e., getting listed on one of the largest centralized exchanges. It is estimated that Binance on average charges $ 4 million per listing, and Huobi $ 2 million per listing.

Non-fungible tokens represent an extreme example of non-liquid asset, since a double coincidence of wants is much more rare given the large repertoir of items available. Therefore, to make non-fungible tokens tradable, we need to drastically increase the efficiency of our existing way of conducting token exchange.

The Lightning Network offers one of such alternatives. Transactions on the Lightning Network are secure, fast and interoperable. It promises the potential of enabling a global network of payment channels.

Nonetheless, the current design of the Lightning Network fails to properly account for the network externality of maintain lightning channels. When two nodes A and B open up a lightning channel, they not only enable direct transactions between themselves, but also enable other parties to route transactions

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through them. This positive externality, however, is not captured by either party.

Since the cost of opening and closing a channel and the cost of locking up sufficient funds in the channel can be quite significant, this means that most lightning nodes will try to minimize the number of lightning channels as long as it can access all the other nodes. This has caused the lightning network to become relatively centralized around several major hubs. The consequence is decreased liquidity and increased centralization.

Hey Chain introduces a mechanism that incentives nodes to maintain lightning channels to provide liquidity. It calculates a rebate to pay for each lightning channel out of the dynamic shadow price of liquidity for each trade that utilizes the channel.

2 Problem Statement And Solution

Let us consider a collection of interoperable cross-chain networks of n nodes for m assets, $\{A_{ij}\}$ where $i, j = 1, 2, ..., m$, each represented by an $n \times n$ matrix. Each entry a_{st} in each matrix A_{ij} represent how much it costs in network asset i at node s to exchange for 1 unit of an network asset j at node t, and the diagonal of the matrix just represents the case of trading pairs within a centralized exchange. Importantly, the prices represent net prices after accounting for factors such as trading fees and slippage. Where there is no trading pairs available due to lack of listings on an exchange of lack of communications channel, we assume the cost to be arbitrarily large.

We consider the best price available when a node r places an order to exchange asset p for asset q, and represent it as $P_{rpq,min}$. For each communication channel $a_{st} \in A_{ij}$, this price must be weakly lower when the channel is open than when it is closed. The difference between the two best prices,

$$\Delta P_{rpq,min|a_{st} \in A_{ij}} = P_{rpq,min|a_{st} \in A_{ij}=g} - P_{rpq,min|a_{st} \in A_{ij}=\infty}$$

is the shadow price for this communication channel to be open for this particular order. Note that the shadow price is in fact dynamic, as it depends on whether other communication channels are open or not. We provide a rebate of the shadow price to the two sides of the channel at the rate of $\delta_{a_{st} \in A_{ij}}$, where $\delta_{a_{st} \in A_{ij}} < \frac{1}{2}$.

Suppose that the cost of maintaining a communication channel is c per minute. Further suppose that the order flowing through the channel follows a Poisson distribution with mean arrival rate λ. Then it is economically efficient to maintain the channel when

$$\frac{1}{2} \lambda E[\Delta P_{rpq,min|a_{st} \in A_{ij}}] \geq c$$

On the other hand, a node will maintain a channel when

$$\delta_{a_{st} \in A_{ij}} \lambda E[\Delta P_{rpq,min|a_{st} \in A_{ij}}] \geq c$$

Therefore, in order to incentivize the maintanence of a node, we just need to calibrate $\delta_{a_{st} \in A_{ij}}$ so that the above inequality holds.