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PH 360

Project Proposal

Derivatives are complex financial instruments created between two institutions that offer specialized exposure and payoff functions for isolating and hedging risk. They were invented for commodity based businesses like farmers and merchants whose livelihood depends on the price of their good. These businesses typically are paired in contract with speculators who are willing to take on risk in order for future profit. Creating networks that allow institutions to safely engage and execute either side of these contracts is a nontrivial problem in consensus, because left to their own devices institutions will usually not be able to agree on the value of a contract, how much debt is to be exchange, and how to centralize payments such that the number of payments a single institution has to make is minimized when thousands of contracts exist. Blockchain is an ideal technology to solve a problem which is currently solved by centralized counterparty institutions, which take an enormous amount of fees to essentially create consensus and execute contracts. If derivatives are successfully settled on the blockchain, Goldman Sachs estimates that $10 billion in transactional fees can be saved every year.

The concept of settling derivatives on the blockchain is not unique to our application. The concept was discussed in an extensive, mostly legal document published by Fordham Law that details what a solution would like look, how traders would use it, how risk management personnel would evaluate it, what legislation would need to adjust to accommodate it and how the blockchain would need to function in order to work in this space. It also details what features the solution would need to fully subvert the current central counterparty establishment.

The Depository Trust and Clearing Corporation (DTCC) is a traditional accounting and clearinghouse company that is developing a blockchain derivative settlement scheme for the largest dealers in this space. DTCC's solution uses Solidity to settle debts through smart contracts. According to

blockchain related press, DTCC was able to put most of the “business logic”, which is to say the valuation of contracts and trading infrastructure, on the blockchain.

A multi-agent systems application embedded in this project has to do with the minimization in number of transactions that parties in a system need to perform. Each major broker-dealer, like JP Morgan or Citibank or Goldman Sachs, may have hundreds or thousands of derivative contracts in existence at any time with numerous other organizations. Having to pay each contracts debt separately would incur hefty fees in the current transactional system, as most derivative settlement projects have accepted that actual payment for assets happens off the chain in more traditional electronic communications. Instead, we can work to make the list shorter with respect to number of transactions and consolidate debt into larger, singular transaction. Take this example debt network:

$$\begin{aligned} \text{Alice} &\xrightarrow{10} \text{Bob} \\ \text{Alice} &\xrightarrow{20} \text{Dick} \\ \text{Carol} &\xrightarrow{30} \text{Bob} \\ \text{Carol} &\xrightarrow{40} \text{Dick} \end{aligned}$$

If each debt was paid separately, there would be 4 payments. A more optimal network (in terms of number of transactions) is:

$$\begin{aligned} \text{Bob} &\xrightarrow{30} \text{Alice} \\ \text{Bob} &\xrightarrow{10} \text{Carol} \\ \text{Dick} &\xrightarrow{60} \text{Carol} \end{aligned}$$

By saving one transaction, we have saved some transactional costs in this network. This action of reduction is called “netting”. Centralized counterparties that currently settle derivatives net in a centralized manner. A decentralized solution like ours will need to do this as well.

Our proposed solution follows the standard daily workflow of a clearinghouse. At the start of the trading day, contracts that have expired or have otherwise become invalid are removed from the pool of active contracts in what is known as “pruning” contracts. Once this is done, orders can be accepted and logged over the course of the trading day. An order is a request from a market participant to buy or sell a

particular derivatives contract, defined by the type of contract (option, future, etc.) as well as the underlying commodity. The order will also specify time until expiry, the price of the contract and underlying, and the notional amount in USD that the contract is worth. At the end of the trading day, matching orders between buyers and sellers are paired to create contracts. These contracts as well as already existing contracts are then re-evaluated based on the changed time until expiry and any changes in the spot price of the underlying. This procedure is known as “marking” contracts. Based on any changes in the value of each contract, there will be updated debts between the buyers and sellers in each contract. This debt network can become very complex given that one trader may be a participant in multiple contracts, but nevertheless reducible to smaller set of payments. This reduced debt network is the result of the final step of the clearinghouse’s daily obligations which is known as netting.

Our solution will be built on top of the IBM Hyperledger infrastructure. Hyperledger simplifies the blockchain network into a series of participants, transactions and assets. In our implementation the participants in the network are traders and a single admin, whose responsibility is to initiate the state transitions from Start Of Day (SOD) to End Of Day (EOD). The assets in this network consist of orders and contracts. The transactions types are specific to the different types of participants. Traders will have access only to the CreateOrder transaction, which takes user defined order information and publishes to the network. The admin can submit transactions which progress the network through it’s different states. The SOD transaction from the admin will prune orders and begin accepting orders. The EOD transaction will stop accepting orders, mark contracts based on end of day spot prices and determine net settlements.

An important demonstration to show that our application works will be a successful trading day demonstrated for the entire class. In this, we will have three accounts on the chain: one for the administrator and two for traders. The users will interact on the same network by using a secure shell connection into a central server and logging into different accounts on the Hyperledger interface. The entire workflow described above will be followed, displaying each functionality.

The above workflow is the “low hanging fruit” for this project, but there are several additions that can be made to improve upon and make the MVP closer to reality. For example, monitoring margin accounts and having traders verify in some manner that the appropriate payments for that trading day’s

debt have been made external to the chain will bring this system closer to what the current central counterparties are able to handle on their own infrastructure.

CCP's also retain the ability to provide an insurance fund to the network, composed of small amounts of margin from every traders account that can be used to pay out creditors when debtors cannot meet margin calls. They can lockout institutions that haven't paid from trading further with the network. Once the margin monitoring addition is created, this further modification can be added on top.

The final and biggest modification that can be made is full exchange functionality. The assumption to this point is that traders agree on contracts using some direct connection between trading floors and then the contracts are added to chain. If the blockchain application can handle all modifications to this point, there is no reason why a full decentralized exchange for derivatives contracts can be created with the same infrastructure, with the entire trading workflow from marketplace to settlement to margining. If the base functionality can be finished by April 27th, these modifications can take shape.

References:

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