Deposits Protocol - decentralized lending and borrowing of crypto assets

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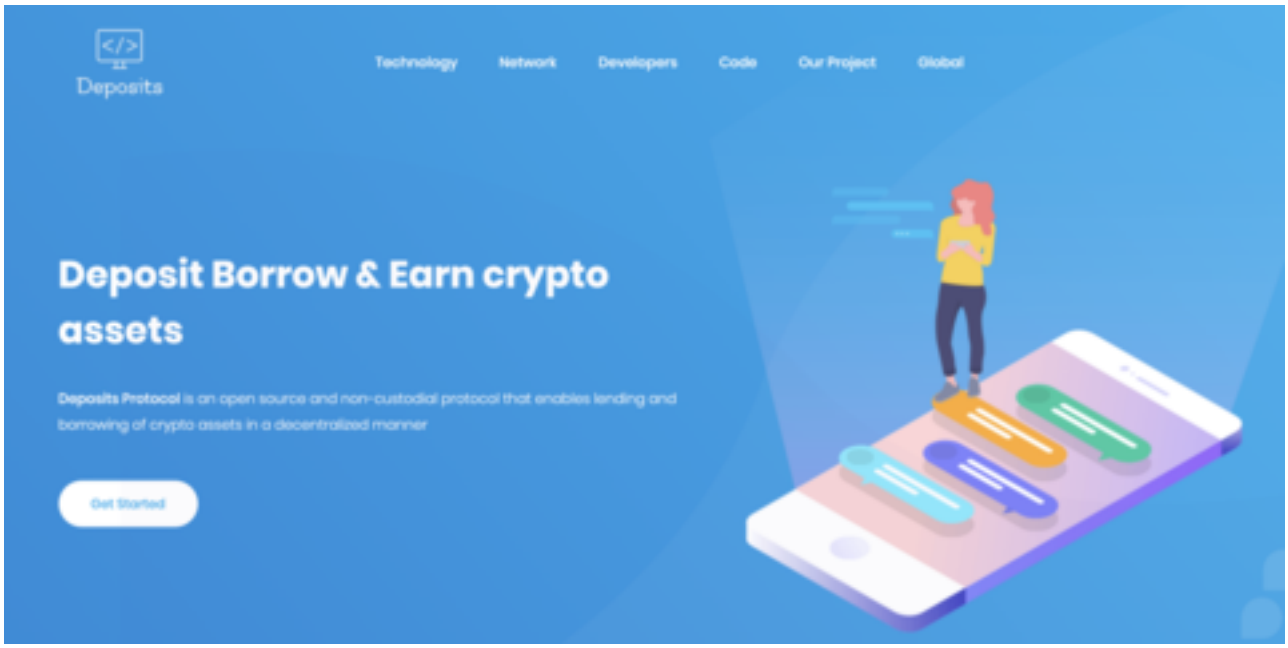
Abstract

Deposits Protocol is an open source and non-custodial protocol that enables lending and borrowing of crypto assets in a decentralized manner. Deposits Protocol utilizes deposit token (dToken), asset lending pool, and algorithmic interest rate mechanism to provide distributed lending and borrowing service on the blockchain. Deposits Protocol intends to expand to include non-fungible tokens (NFT) in addition to ERC-20 crypto assets in future iterations of services.



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1 Introduction

Cryptocurrencies and blockchain assets have become widely adopted and traded since the advent of the first cryptocurrency, Bitcoin, in January 2009. Generally speaking, there are two groups of owners of cryptocurrencies, the holders and the traders. Cryptocurreny holders believe in holding cryptocurrencies for the long term, while traders would like to take advantage of price fluctuations for shorter term gains.

Crypto assets owned by holders can be considered idle or surplus assets that are under utilized and do not generate any interest. There are also significant storage costs associated with holding idle crypto assets. Crypto currency traders, on the other hand, would like to leverage their trading positions by getting more crypto currencies than they actually own, akin to margin trading in stocks. Therefore, there exists a need for a market of lending and borrowing crypto assets.

Blockchain based crypto assets are suitable for automated lending and borrowing mechanisms. There have been attempts to make direct peer to peer lending possible. It involves a holder of crypto assets directly lending to a specific borrower. In direct peer to peer lending models, the lender is responsible for initiating, collateralizing, and managing loan offers and fulfillment. This process incurs significant cost on participants.

In this paper, we propose a blockchain based crypto asset market system, **Deposits Protocol**, that allows efficient and effective borrowing and lending of Ethereum based tokens. In essence, Deposits Protocol is a money-market mechanism that enables crypto asset holders to generate positive returns on crypto holdings.

2 The Deposits Protocol

Deposits Protocol is a system of blockchain smart contracts that establish lending markets of crypto assets directly on blockchain. The Deposits Protocol creates and administrates crypto asset lending pools, allows depositing and borrowing of crypto assets without third party intermediaries, and establishes adjustable interest rate and loan resolution mechanisms.

Users of the Deposits Protocol deposit and borrow crypto assets from asset pools by interacting directly with Ethereum smart contracts in a transparent manner. The Ethereum blockchain preserves and stores all transactions and interest rate data regarding the Deposit Protocol. Interest on borrowed crypto assets are determined by smart contract algorithms based on the demand and supply of the crypto assets. Any Ethereum based crypto asset, such as Ether and ERC20 tokens, can be used within the Deposit Protocol system.

Each crypto asset constitutes a distinct lending pool. Lending terms, such as collateral, interest rate, maturity, are determined by smart contracts of the lending pool. Crypto asset pools greatly simplifies the blockchain based lending and borrowing of crypto assets, and furthermore reduces risks of individual loans.

2.1 Depositing Assets and dTokens

The Deposits Protocol aggregates various crypto assets from depositors or lenders and pools the deposits together into lending pools. Lending pools are identified by the underlying type of crypto asset. Lending pools are fungible, i.e. the depositor does not lend to a specific borrower. The concept of lending pool offers several benefits. Firstly, lending pool offers more liquidity than direct peer to peer lending. Secondly, depositors can withdraw their asset without having to wait for a specific loan to mature.

When a user deposits in a specific crypto asset into the lending pool, the depositor receives a corresponding amount of Deposit Tokens, dTokens. dTokens have a 1:1 relationship to the amount of crypto asset deposited, and accrue interests of the deposited assets. dTokens are minted upon deposit. The interest paid to depositors are in the form of value increase of the dTokens they hold. The value of dTokens held by depositors increases until they are redeemed or liquidated. Upon loan redemption or liquidation, dTokens are burned.

2.2 Borrowing Assets

Users can borrow from lending pools after locking up a crypto asset of a greater value as collateral. Crypto assets of high liquidity and low risk can be configured as suitable forms of collateral. Every lending pool has a Loan-to-Value ratio, which determines how much of the lending pool is available for borrowing.

In order to borrow from the lending pool, a borrower needs to lock up a crypto asset of a greater value than their intended borrowing amount to back their borrow position. In case of price fluctuation, a borrow position may be liquidated. Liquidation of a borrow position happens when the value of the collateral drops below a threshold. Reaching this liquidation ratio puts the collateral on sale at a discounted price, which incentivized liquidators to purchase the collateral and close out the borrow position. The discounted value of the collateral should be lower than the collateral fair market value, but still be above the loan value in order to both incentivize liquidators and keep the solvency of the lending pool.

2.3 Interest Rate

The interest rate on borrowing positions is based on several factors, namely:

- M-r the average market lending rate.

- R-slope1 the interest rate slope below U-optimal, increases the rate as U increases.

- R-slope2 the interest rate slope beyond U-optimal, increases as the difference between U and U-optimal increases.

- U is the utilization rate.

Interest Rate formula:

Interest Rate = M-r + (U/U-optimal)*R-slope1, if U is less than U-optimal

Interest Rate = M-r + R-slope1 + ((U - U-optimal)/(1-U-optimal))* R-slope2, if U is equal to or greater than U-optimal

3 Architecture and Technical Implementation

Technically speaking, the Deposits Protocol is a set of Ethereum smart contracts. The major component of the Deposits Protocol is the concept of Crypto Asset Lending Pool (CALP). The Deposits Protocol smart contracts allow users to deposit and lend, borrow, accrue and redeem interest earnings, repay or liquidate loans on the Ethereum blockchain without any intervention of third parties. All Deposits Protocol transactions are public and stored on the Ethereum blockchain in a verifiable and transparent manner.

3.1 Deposit Token Contract - dToken

The Deposits Protocol utilizes an ERC20 token to represent deposits of crypto assets into the lending pool. Upon deposit, the depositor receives a corresponding amount of representative tokens, Deposits Tokens (dToken), which map to the underlying assets at 1:1 ratio. The balance of dTokens of the depositor grows with the perpetual accrual of interest on deposits. Deposits Tokens (dTokens) are ERC20 compliant. Interest earnings in the form of dTokens can be sent to any address designated by the depositor as interest on deposits accrue.

3.2 Crypto Asset Lending Pool - CALP

Crypto Asset Lending Pool (CALP) is the core component of the Deposits Protocol. CALP holds various crypto assets in different reserves. Only highly liquid and low risk crypto assets should be approved to held in reserves. Depositors may deposit crypto asset into the reserves. Users may borrow against the reserves provided they post collateral of a certain greater value.

Each reserve (crypto asset) has a Loan To Value ratio, which limits the amount of borrowing from that specific reserve. The LTV ratio is calculated as the weighted average of collateral posted by borrowers expressed in ETH.

Loans can be made to borrowers on the basis of a fixed or variable rate. Loans have indefinite term, and can be repaid in part or in full anytime.

As the price of posted collateral fluctuates, a loan position may be liquidated. A liquidation happens when the price of the collateral drops below a certain threshold, LQ. Reaching this ratio creates a liquidation bonus, which incentivizes liquidators to buy the collateral at a discounted price. As with LTV, each reserve or crypto asset has a different Liquidation Threshold.

3.3 Depositing

Users deposit crypto assets by sending the asset to the Crypto Asset Lending Pool (CALP) smart contract. The CALP contract performs the following operations upon receiving the deposit:

updates the borrow/liquidity indexes

increases total liquidity

update interest rates

mint equivalent dTokens

transfers underlying asset to reserve

3.4 Redeeming

The redeem action allows users to exchange an amount of dTokens for the underlying asset. The actual amount to redeem is calculated using the dToken/underlying exchange rate Ei.

3.5 Borrowing

The borrow action transfers to the user a specific amount of underlying asset, in exchange of a collateral that remains locked.

3.6 Repaying

The repay action allows the user to repay completely or partially the borrowed amount plus the origination fee and the accrued interest.

3.7 Liquidating

The liquidationcall contract allows any external actor to purchase part of a collateral at a discounted price. In case of a liquidation event, a maximum of 50 percent of the loan can be liquidated, which will bring the health factor back above 1.

3.8 Instant Block Loan

Instant Block Loan allows users to borrow from the reserves and return liquidity and fee back to the reserve within one block.

Instant Block Loans temporarily transfer the funds to a smart contract that respects the IFlashLoanEnabledContract.sol interface. The address of the contract is a parameter of the action. After the funds are transferred, the method executeOperation() is executed on the external contract. The contract can do whatever action is needed with the borrowed funds. After the method executeOperation() is completed, a check is performed to verify that the funds plus fee have been returned to the LendingPool contract. The fee is then accrued to the reserve, and the state of the reserve is updated. If less funds than what was borrowed have been returned to the reserve, the transaction is reverted.

3.9 Interest Rate Mechanism

Setting Interest Rate The interest rate on borrowing positions is based on several factors, namely:

- M-r the average market lending rate.

- R-slope1 the interest rate slope below U-optimal, increases the rate as U increases.

- R-slope2 the interest rate slope beyond U-optimal, increases as the difference between U and U-optimal increases.

- U is the utilization rate.

Interest Rate formula:

Interest Rate = M-r + (U/U-optimal)*R-slope1, if U is less than U-optimal

Interest Rate = M-r + R-slope1 + ((U - U-optimal)/(1-U-optimal))* R-slope2, if U is equal to or greater than U-optimal

Interest Rate Oracle Lending Rate Oracle, which will provide information to the contracts on the actual market rates that other lending platforms, both centralized and decentralized, are providing. The information provided by the Lending Rate Oracle is used to set the interest rate for our platform.

Interest Rate Adjustment The LendingPool contract exposes a function rebalanceStableBorrowRate(address reserve, address user) which allows to rebalance the stable rate interest of a specific user. Anybody can call this function: however, there isn't any direct incentive for the caller to rebalance the rate of a specific user. For this reason, Deposits Protocol will provide an agent that will periodically monitor all the stable rates positions and rebalance the ones that will be deemed necessary. The rebalance strategy will be decided offchain by the agent, this means that users that satisfy the rebalance conditions may not be rebalanced immediately. Since those conditions depend on the liquidity available and the state of market, there might be some transitory situations in which an immediate rebalance is not needed. This does not add any element of centralization to the protocol. Even if the agent stops working, anybody can call the rebalance function of the LendingPool contract. Although there isn't any direct incentive in doing it, there is an indirect incentive for the ecosystem. In fact, even if the agent should cease to exist, depositors might still want to trigger a rebalance up of the lowest borrow rate positions, to increase the liquidity rate and/or force borrowers to close up their positions, increasing the available liquidity. In case of a rescale down, instead, borrowers have a direct incentive in performing a rebalance of their positions to lower the interest rate. The following flowchart explains the sequence of actions of the function rebalanceStableBorrowRate(). The compounded balance that is accumulated until the instant at which the rebalance happens, is not affected by the rebalance.

3.10 Governance

The rights of the protocol are controlled by the DEPS token. Initially, the Deposits Protocol will be launched with a decentralized on-chain governance based on the DAOStack framework which will evolve to a fully autonomous protocol. On-chain implies all votes are binding: actions that follow a vote are hard-coded and must be executed. To understand the scope of the governance it's important to make the distinction:

The Deposits Protocol is bound to evolve and will allow the creation of multiple lending pools with

segregated liquidity, parameters, permissions, and type of assets.

The Deposits Lending Pool is the first pool of the Deposits Protocol until the Pool Factory Update is released and anyone can create their own pool.

Within the Deposits Protocol, the governance will take place at two level :

1. The Protocol's Governance voting is weighted by DEPS for decisions related to protocol parameters and upgrades of the smart contract. It can be compared to MakerDAO's governance where stakeholders vote on current and future parameters of the protocol.

2. The Pool's Governance where your vote is weighted based on your share of pool liquidity expressed in dTokens. The votes cover pool specific parameters such as assets used as collateral or to be borrowed. Each Pool will have its own governance, under the umbrella of the Protocol's Governance. More details on the Governance will be published in a Governance Proposal to the community.

4 Conclusion

The Deposits Protocol relies on a lending pool model to offer high liquidity. Loans are backed by collateral and represented by dTokens, derivative tokens which accrue the interests. The parameters such as interest rate and Loan-To-Value are token specific. Deposits Protocol improves Decentralized Finance's current offering, bringing two key innovations to the lending ecosystem:

Stable Rates to help borrowers' financial planning;

Instant Block Loans to borrow without collateral during a single transaction.

Following the launch of the mainnet, Deposits Protocol will uphold its commitment to decentralization through additional features. The Pool Factory will allow anyone to launch their own lending pool based on our smart-contracts. Governance will be on-chain with rights represented by:

The DEPS token at Protocol level for updates of the smart contract;

dTokens at Pool level for pool specific parameters.

4.1 Future Work

We plan to include non-fungible tokens into Deposits Protocol in order to increase the available asset that can be posted as collateral.

4.2 Acknowledgements

Deposits Protocol is based on AAVE Protocol (http://aave.com) with modification and extension to include non-fungible tokenized (NFT) assets.

We would like to acknowledge several industry veterans for advising our project.

4.3 Versions and Revisions to this position paper

- v. 1.0 – February 2020 v. 1.1 – May 2020