Flash Loans

Flash Loans are special transactions that allow the borrowing of an asset, as long as the borrowed amount (and a fee) is returned before the end of the transaction (also called One Block Borrows). These transactions do not require a user to supply collateral prior to engaging in the transaction. There is no real world analogy to Flash Loans, so it requires some basic understanding of how state is managed within blocks in blockchains.

Flash Loans are an advanced concept aimed at developers. Youmust have a good understanding of EVM, programming, and smart contracts to be able to use this feature.

Overview

Flash-loan allows users to access liquidity of the pool (only for reserves for which borrow is enabled) for one transaction as long as the amount taken plus fee is returned or (if allowed) debt position is opened by the end of the transaction.

Aave V3 offers two options for flash loans:

- flashLoan
- : Allows borrower to access liquidity ofmultiple reserves
- in singleflashLoan
- transaction. The borrower also has an option to open stable or variabled rate debt position backed by supplied collateral or credit delegation in this case.
- NOTE:flash loan fee
- is waived for approvedflashBorrowers
- (managed byACLManager
-)
- flashLoanSimple
- : Allows borrower to access liquidity ofsingle reserve
- for the transaction. In this case flash loan fee is not waived nor can borrower open any debt position at the end of the transaction. This method is gas efficient for those trying take advantage of simple flash loan with single reserve asset.
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Execution Flow

For developers, a helpful mental model to consider when developing your solution:

1. Your contract calls thePool
2. contract, requesting a Flash Loan of a certainamount(s)
3. ofreserve(s)
4. usingflashLoanSimple()
5. orflashLoan()
6. .
7. After some sanity checks, thePool
8. transfers the requestedamounts
9. of thereserves
10. to your contract, then callsexecuteOperation()
11. onreceiver
12. contract .
13. Your contract, now holding the flash loanedamount(s)
14. , executes any arbitrary operation in its code.
15.
    - If you are performing aflashLoanSimple
16.
    - , then when your code has finished, you approve Pool for flash loaned amount + fee.
17.
    - If you are performingflashLoan,
18.
    - then for all the reserves either depending oninterestRateMode
19.
    - passed for the asset, either the Pool must be approved for flash loaned amount + fee or must or sufficient collateral or credit delegation should be available to open debt position.
20.
    - If the amount owing is not available (due to a lack of balance or approval or insufficient collateral for debt), then the transaction is reverted.
21. *
22. All of the above happens in 1 transaction (hence in a single ethereum block).
23.

Applications of Flash Loans

Aave Flash Loans are already used with Aave V3 for liquidity swap feature. Other examples in the wild include:

- Arbitrage between assets, without needing to have the principal amount to execute the arbitrage.
- Liquidating borrow positions, without having to repay the debt of the positions and using discounted collateral claimed to payoff flashLoan amount + fee.
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Flash loan fee

The flash loan fee is initialized at deployment to 0.05% and can be updated via Governance Vote. UseFLASHLOAN_PREMIUM_TOTAL to get current value.

Flashloan fee can be shared by the LPs (liquidity providers) and the protocol treasury. TheFLASHLOAN_PREMIUM_TOTAL represents the total fee paid by the borrowers of which:

- Fee to LP:FLASHLOAN_PREMIUM_TOTAL - FLASHLOAN_PREMIUM_TO_PROTOCOL
- Fee to Protocol:FLASHLOAN_PREMIUM_TO_PROTOCOL
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At initialization,FLASHLOAN_PREMIUM_TO_PROTOCOL is set to 0.

Step by step

1. Setting Up

Your contract that receives the flash loaned amountsmust conform to theIFlashLoanSimpleReceiver.sol orIFlashLoanReceiver.sol interface by implementing the relevantexecuteOperation() function.

Also note that since the owed amounts will bepulled from your contract, your contract must give allowance to thePool to pull those funds to pay back the flash loan amount + premiums.

1. Calling flashLoan() or flashLoanSimple()

To call either of the two flash loan methods on the Pool, we need to pass in the relevant parameters. There are 3 ways you can do this.

1. From an EOA ('normal' ethereum account)
2. To use an EOA, send a transaction to the relevantPool
3. calling theflashLoan()
4. orflashLoanSimple()
5. function. SeePool api docs
6. for parameter details, ensuring you use your contract address fromstep 1
7. for thereceiverAddress
8. .\
9. From a different contract
10. Similar to sending a transaction from an EOA as above, ensure thereceiverAddress
11. is your contract address fromstep 1
12. .\
13. From the
14. same
15. contract
16. If you want to use the same contract as in step 1, useaddress(this)
17. for thereceiverAddress
18. parameter in the flash loan method.
19.

Never keep funds permanently on yourFlashLoanReceiverBase contract as they could be exposed to a'griefing' attack , where the stored funds are used by an attacker.

Completing the flash loan

Once you have performed your logic with the flash loaned assets (in yourexecuteOperation() function), you will need to pay back the flash loaned amounts if you usedflashLoanSimple() or interestRateMode=0 inflashLoan() for any of the assets inmodes parameter.

- Paying back a flash loaned asset
- Ensure your contract has the relevant amount + premium to payback the borrowed asset. You can calculate this by taking the sum of the relevant entry in theamounts
- andpremiums

- array passed into theexecuteOperation()
- function.\
- Youdo not
- need to transfer the owed amount back to thePool
- . The funds will be automaticallypulled
- at the conclusion of your operation.
- Incurring a debt (i.e. not immediately paying back)
- If you initially used amode=1
- ormode=2
- for any of the assets in themodes
- parameter, then the address passed in foronBehalfOf
- will incur the debtif
- theonBehalfOf
- address has previously approved themsg.sender
- to incur debts on their behalf.
- This means that you can have some assets that are paid back immediately, while other assets incur a debt.
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