Quantstamp Security Assessment Certificate

DRAFT

June 22nd 2022

June 22nd 2022 — Quantstamp Verified

KLAP

This audit report was prepared by Quantstamp, the leader in blockchain security.

Executive Summary

Type	Ethereum
Auditors	Ed Zulkoski, Senior Security Engineer Bohan Zhang, Auditing Engineer Andy Lin, Senior Auditing Engineer
Timeline	2022-06-13 through 2022-06-21
EVM	Arrow Glacier
Languages	Solidity
Methods	Architecture Review, Unit Testing, Functional Testing, Computer-Aided Verification, Manual Review
Specification	None
Documentation Quality	Medium
Test Quality	Low
Diff/Fork information	This code was based on the Geist protocol which is a fork from the Aave V2 repository at commit 61c2273.

Source Code

Repository	Commit
lending-contracts	603b93a

Total Issues	**8** (0 Resolved)
High Risk Issues	0 (0 Resolved)
Medium Risk Issues	**1** (0 Resolved)
Low Risk Issues	**5** (0 Resolved)
Informational Risk Issues	**2** (0 Resolved)
Undetermined Risk Issues	0 (0 Resolved)

8 Unresolved
0 Acknowledged
0 Resolved

⌃ High Risk	The issue puts a large number of users' sensitive information at risk, or is reasonably likely to lead to catastrophic impact for client's reputation or serious financial implications for client and users.
⌃ Medium Risk	The issue puts a subset of users' sensitive information at risk, would be detrimental for the client's reputation if exploited, or is reasonably likely to lead to moderate financial impact.
⌄ Low Risk	The risk is relatively small and could not be exploited on a recurring basis, or is a risk that the client has indicated is low-impact in view of the client's business circumstances.
◌ Informational	The issue does not post an immediate risk, but is relevant to security best practices or Defence in Depth.
? Undetermined	The impact of the issue is uncertain.

◌ Unresolved	Acknowledged the existence of the risk, and decided to accept it without engaging in special efforts to control it.
◌ Acknowledged	The issue remains in the code but is a result of an intentional business or design decision. As such, it is supposed to be addressed outside the programmatic means, such as: 1) comments, documentation, README, FAQ; 2) business processes; 3) analyses showing that the issue shall have no negative consequences in practice (e.g., gas analysis, deployment settings).
◌ Fixed	Adjusted program implementation, requirements or constraints to eliminate the risk.
◌ Mitigated	Implemented actions to minimize the impact or likelihood of the risk.

Summary of Findings

During the audit, we have reviewed changes to the core protocol when compared to related Aave V2 and Geist implementations. In total, 9 primary issues have been noted ranging from Medium to Informational severity. These primarily relate to changes from the existing codebase that are either inconsistent or incomplete (i.e., additional modifications may be necessary). We recommend addressing all issues before deploying the code in production. Additionally, the test scripts corresponding to the existing test suite (i.e., for directories others than `staking` and `venomics`) have not been updated. We strongly recommend ensuring that existing tests pass and the code changes do not break existing functionality.

ID	Description	Severity	Status
QSP-1	Inconsistent parameter semantics in `handleAction()`	^ Medium	Unresolved
QSP-2	Incorrect pool used	⌄ Low	Unresolved
QSP-3	Unmodified events	⌄ Low	Unresolved
QSP-4	Not Handling All Token Types in `UiIncentiveDataProviderV2`	⌄ Low	Unresolved
QSP-5	Missing or Hardcoding Incentive Value in `UiIncentiveDataProviderV2`	⌄ Low	Unresolved
QSP-6	Outdated Dependency Interface and Functions	⌄ Low	Unresolved
QSP-7	Clone-and-Own	○ Informational	Unresolved
QSP-8	Undocumented Interface	○ Informational	Unresolved

Quantstamp Audit Breakdown

Quantstamp's objective was to evaluate the repository for security-related issues, code quality, and adherence to specification and best practices.

DISCLAIMER:
This report pertains to the diff from Aave V2 61c2273, but does not consider the `staking/*`, `venomics/*`, `PriceFeed.sol`, and `Timelock.sol`.

Possible issues we looked for included (but are not limited to):

- Transaction-ordering dependence
- Timestamp dependence
- Mishandled exceptions and call stack limits
- Unsafe external calls
- Integer overflow / underflow
- Number rounding errors
- Reentrancy and cross-function vulnerabilities
- Denial of service / logical oversights
- Access control
- Centralization of power
- Business logic contradicting the specification
- Code clones, functionality duplication
- Gas usage
- Arbitrary token minting

Methodology

The Quantstamp auditing process follows a routine series of steps:

1. Code review that includes the following
   i. Review of the specifications, sources, and instructions provided to Quantstamp to make sure we understand the size, scope, and functionality of the smart contract.
   ii. Manual review of code, which is the process of reading source code line-by-line in an attempt to identify potential vulnerabilities.
   iii. Comparison to specification, which is the process of checking whether the code does what the specifications, sources, and instructions provided to Quantstamp describe.

2. Testing and automated analysis that includes the following:
   i. Test coverage analysis, which is the process of determining whether the test cases are actually covering the code and how much code is exercised when we run those test cases.
   ii. Symbolic execution, which is analyzing a program to determine what inputs cause each part of a program to execute.

3. Best practices review, which is a review of the smart contracts to improve efficiency, effectiveness, clarify, maintainability, security, and control based on the established industry and academic practices, recommendations, and research.

4. Specific, itemized, and actionable recommendations to help you take steps to secure your smart contracts.

Toolset

The notes below outline the setup and steps performed in the process of this audit.

Setup

Tool Setup:

- Slither v0.8.3

Steps taken to run the tools:

1. Install the Slither tool: `pip3 install slither-analyzer`

2. Run Slither from the project directory: `slither .`

Findings

QSP-1 Inconsistent parameter semantics in `handleAction()`

Severity: *Medium Risk*

Status: Unresolved

File(s) affected: `IncentivizedERC20.sol`, `IChefIncentivesController.sol`, `IAaveIncentivesController.sol`

Description: In `IncentivizedERC20._transfer()`, we have the following call to `handleAction()`: `_getIncentivesController().handleAction(sender, senderBalance, currentTotalSupply)`.
This differs from the original implementation in several ways:

1. The order of arguments `senderBalance, currentTotalSupply` are reversed (however this now correctly aligns with the order of parameters in `IChefIncentivesController.sol`).

2. `senderBalance` is now used instead of `oldSenderBalance` (which corresponded to the balance before the transfer occurred).

The other `IncentivizedERC20` functions `_mint()` and `_burn()` are updated similarly.
However, `StableDebtToken` implements its own version of the functions `_mint()` and `_burn()` that has calls to `handleAction()` of the form: `_incentivesController.handleAction(account, oldAccountBalance, oldTotalSupply)`. This swaps the order of arguments as noted above in point 1, but it still uses the old balance values in contrast to point 2.
It is not clear which approach aligns with the new `ChefIncentivesController`.

Recommendation: Add documentation `IChefIncentivesController.handleAction()` clarifying if `userBalance` should be calculated before or after the transfer (similarly for other actions such as `mint`). Ensure that `ChefIncentivesController` aligns with the new semantics.

QSP-2 Incorrect pool used

Severity: *Low Risk*

Status: Unresolved

File(s) affected: `protocol/lendingpool/LendingPoolConfigurator.sol`

Description: In `_initReserve()` on L89 and L124, the `pool` variable is used instead of `_pool`. This does not align with the other `_initTokenWithProxy()`, as in on L72.

QSP-3 Unmodified events

Severity: *Low Risk*

Status: Unresolved

File(s) affected: `protocol/tokenization/AToken.sol`

Description: Although the `mintToTreasury()` function has been updated to mint tokens for both the `treasury` and `treasury.dev()` address, the `Transfer` and `Mint` events on L191-192 have not been updated.

Recommendation: Update the function to account for both mint and transfer operations.

QSP-4 Not Handling All Token Types in `UiIncentiveDataProviderV2`

Severity: *Low Risk*

Status: Unresolved

File(s) affected: `misc/UiIncentiveDataProviderV2.sol`

Description: The function `getReserveIncentiveData()` sets the `IncentiveData` for `aIncentiveData` and `sIncentiveData` but misses the `vIncentiveData`. On the other hand, the function `_getReservesIncentivesData` sets the `IncentiveData` for `aIncentiveData` and `vIncentiveData` but comments out the code for `sIncentiveData`.

Exploit Scenario: The off-chain component will fail to read the incentive data correctly.

Recommendation: Please fixes the code to handle the incentive for all token types. However, from the code in `LendingPoolConfigurator.sol:_initReserve`, only "A Token" and "V Token" is used for the incentive. The team can remove incentive data regarding "S Token" if no longer used.
Also, please remove the commented code in `L154-180` and `L204-244` if not needed.

QSP-5 Missing or Hardcoding Incentive Value in `UiIncentiveDataProviderV2`

Severity: *Low Risk*

Status: Unresolved

File(s) affected: `misc/UiIncentiveDataProviderV2.sol`, `misc/interfaces/IUiIncentiveDataProviderV2.sol`

Description: The struct of `IUiIncentiveDataProviderV2.sol:IncentiveData` includes 9 fields. However, the implementation in `UiIncentiveDataProviderV2.sol` hardcodes `emissionEndTimestamp` to 11111 and `precision` to 18. Also, `tokenincentivesUserIndex` is not being set for the struct `IUiIncentiveDataProviderV2.sol:UserIncentiveData`. Following are the places that might have issues in the file `UiIncentiveDataProviderV2.sol`:

- `getReserveIncentiveData`: in `L68` and `L95`, the `emissionEndTimestamp` field is hardcoded as `11111`. Also, `L73` and `L100` hardcodes the `precision` to 18.

- `_getReservesIncentivesData`: in `L140` and `L196`, the `emissionEndTimestamp` field is hardcoded as `11111`. Also, `L145` and `L201` hardcodes the `precision` to `18`.

- `getUserReservesIncentivesDataSingle`: `L288-291`, `L312-315`, and `L336-339` comment out the part setting `tokenincentivesUserIndex` to the `UserIncentiveData` struct

- `_getUserReservesIncentivesData`: `L381-384`, `L408-411`, and `L435-438` comment out the part setting `tokenincentivesUserIndex` to the `UserIncentiveData` struct

Exploit Scenario: The off-chain component will fail to read the incentive data correctly.

Recommendation: Please clarify if those fields are needed. If the new incentive controller no longer uses or provides the data for the fields, we recommend removing those fields from the struct to keep the code clean. Otherwise, please fill in the correct value for the fields.

QSP-6 Outdated Dependency Interface and Functions

Severity: *Low Risk*

Status: Unresolved

File(s) affected: `misc/AaveOracle.sol`

Description: The interface `IChainlinkAggregator` is outdated. Chainlink documentation (link) recommends using `AggregatorV3Interface`. Also, the function of the interface `latestAnswer` is deprecated (link).

Recommendation: Use the new interface and the recommended function.

QSP-7 Clone-and-Own

Severity: *Informational*

Status: Unresolved

File(s) affected: `dependencies/*/*.sol`

Description: The clone-and-own approach involves copying and adjusting open source code at one's own discretion. From the development perspective, it is initially beneficial as it reduces the amount of effort. However, from the security perspective, it involves some risks as the code may not follow the best practices, may contain a security vulnerability, or may include intentionally or unintentionally modified upstream libraries.

Recommendation: Rather than the clone-and-own approach, a good industry practice is to use a package manager (e.g., npm) for handling library dependencies. This eliminates the clone-and-own risks yet allows for following best practices, such as, using libraries. If the file is cloned anyway, a comment including the repository, commit hash of the version cloned, and the summary of modifications (if any) should be added. This helps to improve traceability of the file.

QSP-8 Undocumented Interface

Severity: *Informational*

Status: Unresolved

File(s) affected: `IChefIncentivesController.sol`, `LendingPoolConfigurator.sol`

Description: The interface `IChefIncentivesController` has several function signatures that are not documented, making the usage in `LendingPoolConfigurator` unclear. For example, the function `addPool(address _token, uint256 i)` is called several times in `LendingPoolConfigurator._initReserve()` with `i = 1`. It is unclear if this is correct.

Recommendation: Add documentation to `IChefIncentivesController.sol`. Note that this issue exists for all new interfaces including `IMasterChef.sol`, `IPriceFeed.sol`, `IVe.sol`, etc.

Automated Analyses

Slither

Issues reported by slither have been identified as either false positives, or have been included as part of other issues noted above.

Adherence to Specification

No documentation was provided aside from AAVE ones.

Code Documentation

1. In `protocol/lendingpool/LendingPoolConfigurator.sol:L99`: consider renaming the comment `// GEIST does not...` -> `// Klap does not...`.

2. In `ILendingPoolConfigurator.sol`, the struct `InitReserveInput` has a new field `allocPoint`. It is not clear what this field is intended for as there is no inline documentation.

3. In `PriceOracle.sol`, the function `updateAssetPrice()` should not be called "update", since it is a view function.

Adherence to Best Practices

1. In `protocols/libraries/math/MathUtils.sol`, `sqrt()` does not use SafeMath. Consider using SafeMath for operations as in L21 if numbers that could potentially overflow will be used.

2. Add unit tests for the `protocol/libraries/math/MathUtils.sol:sqrt`.

3. Use 2 spaces for the space indentation in `protocol/libraries/math/MathUtils.sol:sqrt` to make it consistent with the other part of the code.

4. Consider removing the `IAaveIncentivesController` as the team is migrating it to `IChefIncentivesController`. However, there are still two places (listed in the following) referencing the `IAaveIncentivesController` interface. Please clarify whether they are still needed and either remove the not-used contracts or migrate them to use `IChefIncentivesController`:

   - `misc/UiPoolDataProvider.sol`

   - `misc/interface/IUiPoolDataProvider.sol`

5. Remove the non-referenced clone-and-own dependencies:

   - `dependencies/openzeppelin/upgradeability/AddressUpgradeable.sol`: note that this is an empty file.

   - `dependencies/openzeppelin/upgradeability/ContextUpgradeable.sol`: this is only referenced in the `dependencies/openzeppelin/upgradeability/OwnableUpgradeable.sol`; but the `OwnableUpgradeable.sol` is not referenced in other places.

   - `dependencies/openzeppelin/upgradeability/OwnableUpgradeable.sol`: some code uses `OwnableUpgradeable.sol` from the `@openzeppelin` package instead of this clone-and-own folder.

   - `dependencies/openzeppelin/upgradeability/ReentrancyGuardUpgradeable.sol`: some code uses `ReentrancyGuardUpgradeable` from the from the `@openzeppelin` package instead of this clone-and-own folder.

6. Consider removing non-using contracts and interfaces:

   - `misc/Timelock.sol`

   - `misc/interfaces/IUiIncentiveDataProviderV3.sol`

   - `interfaces/IBondDepository.sol`: aside from not being used, should the naming be `IBand...` instead?

   - `interfaces/IUniswapExchange.sol`

7. Change the visibility of `misc/Timelock.sol:getBlockTimestamp` function from `internal` to `private`.

8. Remove unused local variable `prevChainlinkResponse` in `misc/PriceFeed.sol:L97`.

9. Remove the visibility statement of the `constructor`. Solidity 0.7 removes the need for explicit statement ([doc](#)):

   - `adapters/FlashLiquidationAdapter.sol`

   - `adapters/ParaSwapLiquiditySwapAdapter.sol`

   - `adapters/UniswapLiquiditySwapAdapter.sol`

   - `adapters/UniswapRepayAdapter.sol`

   - `misc/AaveOracle.sol`

   - `misc/UiPoolDataProviderV2.sol`

   - `misc/UiPoolDataProviderV2V3.sol`

10. Make the `protocol/lendingpool/LendingPoolStorage.sol` an `abstract` contract as it will not be used as a standalone contract.

11. Could replace the following code in `mintToTreasury()` from

```
contracts/protocol/tokenization/StableDebtToken.sol`
    _mint(
    treasury,
    amount
      .percentMul(PercentageMath.PERCENTAGE_FACTOR.sub(ITreasury(treasury).devPercent()))
      .rayDiv(index)
    );
    _mint(
    ITreasury(treasury).dev(),
    amount.percentMul(ITreasury(treasury).devPercent()).rayDiv(index)
    );
```

by

```
    uint256 rayDivRes = amount.rayDiv(index);
    uint256 shareForTreasury = rayDivRes.percentMul(PercentageMath.PERCENTAGE_FACTOR.sub(ITreasury(treasury).devPercent()));
    uint256 shareForDev = rayDivRes.sub(shareForTreasury)
    _mint(
    treasury,
    shareForTreasury
    );
    _mint(
    ITreasury(treasury).dev(),
    shareForDev
    );
```

to reduce operations and hence save gas.

Test Results

Test Suite Results

The test scripts corresponding to the old code suite (i.e., not `staking/*` and `venomics/*`) have not been updated, however new tests have been added for the `staking/*` and `venomics/*` directories which are out-of-scope for this engagement. We recommend updating the existing test scripts to ensure that the changed code still behaves as expected.

Appendix

File Signatures

The following are the SHA-256 hashes of the reviewed files. A file with a different SHA-256 hash has been modified, intentionally or otherwise, after the security review. You are cautioned that a different SHA-256 hash could be (but is not necessarily) an indication of a changed condition or potential vulnerability that was not within the scope of the review.

Contracts

```
4291aec1fc792f3b39dd733203a4ca6f3febcc3cebe789895892249d0ba0eddd  ./contracts/deployments/StableAndVariableTokensHelper.sol

51348fb315081ca194a1dedbb58b2ee1c0c03a9d3e28788844d659174ea6b3be  ./contracts/deployments/ATokensAndRatesHelper.sol

0270d3968c75da8b83530dbe9c06b7ad39c37df50b57856999cf5e9074590974  ./contracts/interfaces/IInitializableAToken.sol

aaac616d95de21ffbcfb6ade3eeb7ffd8bd5bce6524ab74602db83fa466c5e18  ./contracts/interfaces/IExchangeAdapter.sol

585535dbe569fdcf5ed6726d213434f888dae2ec23a4219bd76a19be67ae4e3a  ./contracts/interfaces/ITreasury.sol

2be687f2ded5cf1ea4a18122637b063531319640b8a4c6e758f76b324bbffc69  ./contracts/interfaces/ICreditDelegationToken.sol

af15748e44f6a521317592a7e7b831b8b63d6fb775f1942a77792d9ec6e5b8a5  ./contracts/interfaces/IERC20WithPermit.sol

07ea8ec6c949dbb64d46704f6c9c96c9348b3a630a822041bf8530e174f2d042  ./contracts/interfaces/IUniswapLPToken.sol

8c5c498a06d711a5eb317283e4a406e9d420f44f10227b421f76fc8763403b12  ./contracts/interfaces/IOnwardIncentivesController.sol

12f23e962eb42af30d07be31853b42a0846d2712ae6132558f84c94b8996ba52  ./contracts/interfaces/IUniswapV2Router02.sol

74094dec0346ecdcd8f098d9fab8b471d1fa1477be8716d8d69bbdc9c3e1fac1  ./contracts/interfaces/IPriceOracle.sol

9887af5264d8f64392fdf5f82da51d3d03911b3659eb305f2fc8a8a5c9db1be3  ./contracts/interfaces/ITokenLocker.sol

3b7e87f1bb80fb0c41cf68ead8ae81bd569e1f480f1c8edd21829151b0c14741  ./contracts/interfaces/IAaveIncentivesController.sol

b8ef496ef5245629ae667d8231a4d663f9863ed6d58220766ea65a3a95dbbb49  ./contracts/interfaces/IVariableDebtToken.sol

13fba376c7381e052c5d30b35904f096008e64c69dde33e70c97958bf397de4a  ./contracts/interfaces/IRewarder.sol

256210d70e4d66fae19d7fca7671b62c885c59cd798e1c87ed53bc9254020348  ./contracts/interfaces/IScaledBalanceToken.sol

716d51d2b75b35a866ad197ac158f559b95b82e67737f4cf8e3ffe3f5cb287aa  ./contracts/interfaces/IReserveInterestRateStrategy.sol

7dbdc05c8276a1134869e3ff3abe4f13dde194da7ee3269daa3a018d2c153755  ./contracts/interfaces/IUniswapExchange.sol

a175f2107ba3da02bd2da72e480bd4c249aab76d0d766176bde5d56af83312dc  ./contracts/interfaces/IInitializableDebtToken.sol

fcf656313502f0cfd14018dccfa9a6f740eb2ce9127eebf4e073be2d8d8a4a1f  ./contracts/interfaces/IMasterChef.sol

28838219409994c7fa930e982c0523a336c45b59ad57887d00c64aa0e4683db6  ./contracts/interfaces/ILendingPool.sol

99abd289fea69bdae66d3855c37ebed619f0a09c58bdcf7b93ff55f516d6169e  ./contracts/interfaces/ILendingPoolAddressesProvider.sol

0eafa9ad5bc32d77100f87eeddc9cf7b04891b5de58f30ed3e750577e29ef01d  ./contracts/interfaces/IParaSwapAugustusRegistry.sol

41952b8fa7118d106767ed882a8a776f40f844dd73d8deda78026aece17157eb  ./contracts/interfaces/IMultiFeeDistribution.sol

57a3d5427237e9f30084bef48ff2662109a5a92d88a0fbed16fd4b2ff499858f  ./contracts/interfaces/IVe.sol

8dfe4768e57ef1b57c47c6f2f2b8a64d520e45c105056faeadc875e032e5bafe  ./contracts/interfaces/IAToken.sol

32f1b007d120dd0bf097147446bb3af5fcf38fadbe5bfe53214c7a2da02c20f1  ./contracts/interfaces/IChainlinkAggregator.sol

5414c9c9f9ce71d9d63670b324df57b999ae66c2aaa67352c8327685b904c3e4  ./contracts/interfaces/IPriceFeed.sol

dbeb10d6af59f8631ee79d72551bdbd369ac5b9dec5a5baa312905f49ef1af5b  ./contracts/interfaces/IChefIncentivesController.sol

238e12f248d588c2a8fc3310917325149c9500e4230259150c3c5376d4c82f77  ./contracts/interfaces/IParaSwapAugustus.sol

13ce2408d0e6f424ba7f4b5efdac8d88df1fadfd4fae473ab11bd65ab59d9527  ./contracts/interfaces/IERC20Metadata.sol

58d0667c6f132a6a03f608b59b2bd48a56b58a625474853a289a2ef740154396  ./contracts/interfaces/ILendingPoolConfigurator.sol

21e4f887515c9326b3f321687c6831f5948a6ed6da644351cff78072b570ff37  ./contracts/interfaces/ISwapRouter.sol

e5297804d96284623d60df6fdd56c0a3d71d6c2bbe01d3126af5b8b85b811f5a  ./contracts/interfaces/IBondDepository.sol

dbecd8f3926442be2ce18b9ba71790818a7fb1e61d473ac22ad8d5c2b037f09b  ./contracts/interfaces/ILendingPoolAddressesProviderRegistry.sol

fd8ab2e568830942a06be1b3ece1e9731cd9a03c0d2e27bf470a290a44c86f92  ./contracts/interfaces/IChefIncentivesLite.sol

0ed3a386fddf5f975b55d96bf4592fffce6ba2805420d62722850f5f128c6055  ./contracts/interfaces/ILendingPoolCollateralManager.sol

8cb0cfa737aa664378902e264b02ec70da8d102b9508dfa5448cc5f7530609b3  ./contracts/interfaces/ILendingRateOracle.sol

51211e71a4a899b2a0dd46660e3859f089fba999aaec3046db00e37c73171530  ./contracts/interfaces/IStableDebtToken.sol

33c3a765cd546adc614ece0c4bab0e60f36f6e21352fc382a8c8a50c61b8c2c4  ./contracts/interfaces/IDelegationToken.sol

786d62873cefabd5893844d96fa6b04115830aa2b5ca1bebaa1409ee97527865  ./contracts/interfaces/IBandStdReference.sol

34539b5e928283f95c8018b87f0dd163b0ab39b73a20d23abd8fd482e452ea67  ./contracts/interfaces/IPriceOracleGetter.sol

acad598e0ba81d322d3571b5b267bd15b681c642e3cfd94c825bf9964153513d  ./contracts/venomics/MockFairAssetReserves.sol

88203fd245ad668a44e57709041e8fa0312cacad58cfe9ebd5b17f6d49634213  ./contracts/venomics/FairAssetReserves.sol

df485d650701834f9ca2ad0534a179a3e2ba0b5dcff063489ba07e9e478ae8ed  ./contracts/venomics/VeInterfaces.sol

c691ee772f6b6c1d95f8f1d42178663cbaade5cac9e9f16c6d8838a7f644899e  ./contracts/venomics/ve.sol

3051db65d63e9fe2bec5cf600b414e0f5bdc2da1b13ca4f516966ee89b71cf81  ./contracts/staking/GeistToken.sol

9470b9f2148ae0d8bdb6b114bbbf8d31eada22c00207a70e3fa86c20c4b93c04  ./contracts/staking/MasterChef.sol

984b45dba1cfae8e3602910dee9139305bb96d035b15bef95578f8563e87a50a  ./contracts/staking/MultiFeeDistribution.sol

b956eae29bdcac94098c530b5f77655d26d1d3f7a7abb53a81b0b763ea5f3cfd  ./contracts/staking/MultiRewarder.sol

65026bf11b2c6e1853ba31d70badc92bf86e46235dc2df0dd958a65f4a58b6af  ./contracts/staking/ChefIncentivesController.sol

64c8fd5747a586e7a0a4607cf501614a9ece824a3e556cd6b2c79f7336005849  ./contracts/staking/Treasury.sol

5dc780de64834af865770ba1ad28585f865f3f3bb9e7cacfc77704daf44fe5c5  ./contracts/adapters/BaseParaSwapSellAdapter.sol

93f84af5a5bb8ec9fa73cde87762b02edb1bd83b8cefc382cc5f65c393f4805d  ./contracts/adapters/UniswapLiquiditySwapAdapter.sol

8238c91a802e4166cfdfd2cdf3b3ba6f70f1f1ed366591691b37ae756948c8ed  ./contracts/adapters/UniswapRepayAdapter.sol

5323c494bb4b0a21ef9205b09ac141da37cbeb2f1d95ab3edc5032cfff4b04d7  ./contracts/adapters/BaseParaSwapAdapter.sol

34f15555dcb4252279d36fbf9a6f5626c2020565a9bdd2e044ea70390252fbf2  ./contracts/adapters/ParaSwapLiquiditySwapAdapter.sol
```

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7b70c9d09d17be2c1d96af072d2fed36e02985d0c1a0484820c4095ee9f9b959  ./contracts/adapters/FlashLiquidationAdapter.sol

53bab4b6857961eccabd668c3d56efa8e744fa006dd658bfbe9c6ae4d0c710fc  ./contracts/adapters/BaseUniswapAdapter.sol

ce5b8fe01823c38db631857e4caf4ca995c2f553a3c4b4b349dfa872063df7be  ./contracts/adapters/interfaces/IBaseUniswapAdapter.sol

94b4d002950e785bf0d82bc543b34f26ba204ce978b83f9ab59e9535fb9fd4d0  ./contracts/protocol/lendingpool/LendingPool.sol

6d15b8dc8211c4d84f1395d49a461af080b51c8e730e037ceee525a41362968e  ./contracts/protocol/lendingpool/LendingPoolCollateralManager.sol

899352574ccf34e1d6fa19e85beacb96bf11b244042e9e22ca04e27aeb558b83  ./contracts/protocol/lendingpool/LendingPoolStorage.sol

e0697b1bd6204bb09ccc4b219dea92e71c883c14f17bd82b3b879c8d6ae9ddf2  ./contracts/protocol/lendingpool/LendingPoolConfigurator.sol

432e3020a2dd3d5c3f3d4e89e224349e810ea405df6f894b464fc1155c53abb7  ./contracts/protocol/lendingpool/DefaultReserveInterestRateStrategy.sol

48bfbae2216bbef02d3d83abf6c5eb0557208c613b0dfd05e10b07c0fb9cf7a0  ./contracts/protocol/tokenization/DelegationAwareAToken.sol

261c4681de0d1484b1887e395ca2ef7915c2f02234802dc261b40ff51841549b  ./contracts/protocol/tokenization/AToken.sol

06d45dd31c76efb8f689cefd3434c89edf6da99d0450450384fb249b66118e1d  ./contracts/protocol/tokenization/IncentivizedERC20.sol

a221d64f5510107e01ce0d56930a7c475e86af96b45e53bf4cf4b071d9a86183  ./contracts/protocol/tokenization/VariableDebtToken.sol

704065f2398284f22591ca14310a136374563c8637812843d1a1bc49ae870a6a  ./contracts/protocol/tokenization/StableDebtToken.sol

63aedbe5021003fa49d3d197040e31be3f0eeeb14e5a9b335b65fd65eb1a8622  ./contracts/protocol/tokenization/base/DebtTokenBase.sol

2bf4f3d2ced61030a733b79ff59a395c955c12027984622d8cb46335a44cb35d  ./contracts/protocol/libraries/helpers/Errors.sol

a7adf5bb834ffaac4498e3ca286c015261d3bdc3bc7006cdd0d9455815b98166  ./contracts/protocol/libraries/helpers/Helpers.sol

9ba965dc647851e0e55234fa9219ad596c1d9fcd059ccb7f2d0328f76cc9ce3e  ./contracts/protocol/libraries/aave-
upgradeability/InitializableImmutableAdminUpgradeabilityProxy.sol

6e86821829148d9976280406085d8313f1b8e76d5a88aa4a99d98d985d0a43fd  ./contracts/protocol/libraries/aave-
upgradeability/BaseImmutableAdminUpgradeabilityProxy.sol

d70209f46ccf7c5c7585e2e87a485ccb5a064773a58552f0663e3d91539a62a6  ./contracts/protocol/libraries/aave-upgradeability/VersionedInitializable.sol

f0b34dd12e471a02b44d47f8a6a58143a1db82c2db52163b1dd655c8a807df5b  ./contracts/protocol/libraries/math/MathUtils.sol

2fe3ec973fef9f04fed3c98afa2024672e6b60c737c12aaf515db3468e04dcb1  ./contracts/protocol/libraries/math/PercentageMath.sol

9c498eef948352a986ab3e6d6bd1d59a60715b10270196359b427a1d718766ba  ./contracts/protocol/libraries/math/WadRayMath.sol

b0e311d1e1a73982fa5307c7e5673260ca477e035dce345f40e498042ae5b2b5  ./contracts/protocol/libraries/logic/GenericLogic.sol

e96a8d4224545c31d73444c945f5f40ecd1b958fb58b7143575ece77756c0662  ./contracts/protocol/libraries/logic/ReserveLogic.sol

efaa60145d1e1ae8364c3be90c98a84582c944902d560ef1501d6b45ee8a141a  ./contracts/protocol/libraries/logic/ValidationLogic.sol

5760e4f4ca198bf5eab4f86fc0cca7a131efb440e2a5df5dbaab7fe2fa7e6ca0  ./contracts/protocol/libraries/types/DataTypes.sol

d8bcef1243017d485f3ceb46c4398710514c7a63a1d964ef735ac58652f324b3  ./contracts/protocol/libraries/configuration/UserConfiguration.sol

1abde3333ab21bec95e28bd3e6fa8084c0d5add73f1a0a8bbb1dc0bfe5e63248  ./contracts/protocol/libraries/configuration/ReserveConfiguration.sol

1fd9c9962c0f6a076e564962a8555d356af72bec68abc109bb1dacdf66bbd6ba  ./contracts/protocol/configuration/LendingPoolAddressesProvider.sol

b5abe37c8f4dc1110aa01c5ec2c2d02abf1c01a7c2a160db6b846af86688e2a5  ./contracts/protocol/configuration/LendingPoolAddressesProviderRegistry.sol

bc7d3e5500479bfd78fb41eed328950f7dacce2eb0aa5f82954d650a7179c834  ./contracts/dependencies/openzeppelin/upgradeability/Initializable.sol

105f6a255daa6f58206a0edc059a0a98242c0b6005734bf1338df3c2f4608e6e
./contracts/dependencies/openzeppelin/upgradeability/AdminUpgradeabilityProxy.sol

b5101d45e812f203e085c02858d05b3d0b3424b0b09b4e8f90fb4f4707288983
./contracts/dependencies/openzeppelin/upgradeability/BaseUpgradeabilityProxy.sol

4bc95401a914e842c5c49c6b2712139f95ae7f869725a67fbee19c2854c9b5f8
./contracts/dependencies/openzeppelin/upgradeability/BaseAdminUpgradeabilityProxy.sol

72cb510dc3db34857f96501105d6f0cd4f5ca607e61ade1431fbfd473b32296a  ./contracts/dependencies/openzeppelin/upgradeability/OwnableUpgradeable.sol

3e51d53e8c2e3432104c5564f64bbf0082fc095b243c216df96951cd5b5f4e42  ./contracts/dependencies/openzeppelin/upgradeability/ContextUpgradeable.sol

37242abc82f858163447e0d24d943d78b001978d5d0dbe91c8d33f0f91951b82
./contracts/dependencies/openzeppelin/upgradeability/ReentrancyGuardUpgradeable.sol

c441e0018fcf6b65d6f2933a355ab89ca3c89b668d6395335b920f7deb32c422
./contracts/dependencies/openzeppelin/upgradeability/InitializableUpgradeabilityProxy.sol

b31d4fa53013d5c31d0f432729936138e64d2901aca394687761374c2237cd2f  ./contracts/dependencies/openzeppelin/upgradeability/Proxy.sol

18eeab548d45071515e2f33dd67af3aaa16066501b82fe647e55bb2ce02de78c
./contracts/dependencies/openzeppelin/upgradeability/InitializableAdminUpgradeabilityProxy.sol

7f8cadecc6cba6a9c674b454242485807e6da686f2bb223d557cc80c5d8d1edd  ./contracts/dependencies/openzeppelin/upgradeability/UpgradeabilityProxy.sol

e3b0c44298fc1c149afbf4c8996fb92427ae41e4649b934ca495991b7852b855  ./contracts/dependencies/openzeppelin/upgradeability/AddressUpgradeable.sol

248cbc51cc48877fc32ed83151d43bf2860c20e68ed9533b19415df68e86affd  ./contracts/dependencies/openzeppelin/contracts/IERC20.sol

fd5ccdf61a85dd267a70105f9f9afb0787b78856ec47b09d62f47d256b10b85d  ./contracts/dependencies/openzeppelin/contracts/ReentrancyGuard.sol

35724cd559c9eabf3541413585354b6b075adef58cffb69b1961965b5bc7ad42  ./contracts/dependencies/openzeppelin/contracts/ERC20.sol

0b545c1e1200226b5c80e8a8831386238e188ca6f4cb68cd0dd05cd73653dbd1  ./contracts/dependencies/openzeppelin/contracts/Ownable.sol

5e51b222d3056887a3f250a9fef9330468de25d0f25e6ed20cd890ef44641d0b  ./contracts/dependencies/openzeppelin/contracts/SafeERC20.sol

95caa72e3c6cf6570c730dd7f8ec18aea0d8a44b58ce43b5744178b4309c87b9  ./contracts/dependencies/openzeppelin/contracts/SafeMath.sol

5c8a13a6345b3c9b30de09e5c47991577814e94db0c37dbd3e7d333fe2b4965e  ./contracts/dependencies/openzeppelin/contracts/Address.sol

eb771cc53fe99b30f9d0c2f4f8055799f5e04807fd506be36072298cd6582f4e  ./contracts/dependencies/openzeppelin/contracts/IERC20Detailed.sol

5630b534e40b2c87db528022b3bcaa3ed7e6ef3e735e5628f5ec166d6c5f016c  ./contracts/dependencies/openzeppelin/contracts/Context.sol

f8f2dd727e9d3020bec02afdc9755fa31d14d15d9e9c451050596dd2ed937e8d  ./contracts/flashloan/interfaces/IFlashLoanReceiver.sol

6be9e9803bceec3a4290fb4253e53e0f53068bbbada0e14f94a4b48d9cbcd070  ./contracts/flashloan/base/FlashLoanReceiverBase.sol
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661075412b8b52c1ef1f63a2a0d9677ace34cce609c85c673bc6124e47737314  ./contracts/misc/AaveProtocolDataProvider.sol

b4c2170c4e9a083c22e60576195f140e4cee015fa5090ef17c60bb39088deaf0  ./contracts/misc/WETHGateway.sol

362b5c7477510901fcffa0cb03788efd54e7a7bb7ecdde67351313cc3c990c3f  ./contracts/misc/Timelock.sol

ca464c25203fed7dfb93e03c015e3173a3d137f445d993372cb5a0249d7ce384  ./contracts/misc/AaveOracle.sol

ef70fc45391fb74bf3d0eb951c7dcdc19b42908d633cd9e1e78acf308cf51a6a  ./contracts/misc/WalletBalanceProvider.sol

179586a43987a3067d2165367522892621ace7812f42b006358d92ed31d98f53  ./contracts/misc/UiPoolDataProviderV2V3.sol

20fd05938eb84e6ca7a4403c1c88a0b4b1a3e58d419282e8e0c1ae4d80bc676f  ./contracts/misc/UiPoolDataProviderV2.sol

f49a4212461b1d7f827c974f4575b9015199a1dbd47fec3668647a74ccdaa408  ./contracts/misc/UiPoolDataProvider.sol

193ceae810701da72e83efe8d8cff5e6fbc58f2184f6bcc1eece67b7a7123037  ./contracts/misc/UiIncentiveDataProviderV2.sol

c71c8ce01e22065cca815127532953ae5dbe37b892d13c0c0563534488982b62  ./contracts/misc/PriceFeed.sol

7d8c340dbeeb8bdb300ad4f7970e94582caec92174dd2d891643108c5903055f  ./contracts/misc/interfaces/IUniswapV2Router01.sol

6b598571d006d2c13983c4b20dfa04fea21428e9b132f6b4f16c5c89fa19f008  ./contracts/misc/interfaces/IUniswapV2Router02.sol

27a8d71550e224a0637a5e0e2ddc331f1721c0dbac881babc3036f9935b7db72  ./contracts/misc/interfaces/IWETHGateway.sol

8fc285d7735a675c2c3758c309e6c8149598ac686f73cfa5f29ba0d9f430eb80  ./contracts/misc/interfaces/IUiPoolDataProvider.sol

ec88eb23a79b17c0620a3230e95a66286fe0028ad80b8500ba47dfaf6a41b8d1  ./contracts/misc/interfaces/IWETH.sol

8573f67fdf0c7a1d58fa68566bf49bd59e37b1bdbe2f88bbca846b707574dbd1  ./contracts/misc/interfaces/IUiIncentiveDataProviderV3.sol

0b160956649fb6e9f3a89ae05da166cefb6e7e22dea4e35e0f22c641ae8d9671  ./contracts/misc/interfaces/IUiIncentiveDataProviderV2.sol

c9ce3ab81c384a7707fc451468ce6e1f1ef3441065f6e320013be24374b23373  ./contracts/misc/interfaces/IUiPoolDataProviderV2.sol

f1928a9519f8df4e4e95d20a273a18a9abc4b060223de92cdc6d16967b45422d  ./contracts/misc/interfaces/IUiPoolDataProviderV3.sol

dd9b626cee56e09140f18eb5d3739e4d95aa9ce3ee610ec2840f0733eed4d56a  ./contracts/misc/interfaces/IERC20DetailedBytes.sol

d3cb22c2df3dfbf0f726088e3ae8fab2cd766c0684ed69b244f379fb308eb7b4  ./contracts/misc/interfaces/IAaveOracle.sol

c48e79fb7b26c516328c30ccdd50720a8b980f073d7fb9a252488e8afca2384c  ./contracts/mocks/upgradeability/MockStableDebtToken.sol

4c71acc6b538da526a7302fabbea32ed14f8b82e1a28b415b468a66739dfcbc4  ./contracts/mocks/upgradeability/MockAToken.sol

4bbfe59b2d65042c8f22423703dab65b837a8158993d6f1e54529e3f1bf88434  ./contracts/mocks/upgradeability/MockVariableDebtToken.sol

13d3daef9131eb3473679d768e81ff6482972f51a46536411bc5fd60cbabfb18  ./contracts/mocks/attacks/SefldestructTransfer.sol

957f6e61a33c166db8b4bd65dba8c25a44b85b306ce60f41b6f43d82dd463a5d  ./contracts/mocks/tokens/WETH9Mocked.sol

2f1764620771fd7b3aceec5e7cb9f1b6f58a5f4aeee7b05aebd2f2f3d59df2eb  ./contracts/mocks/tokens/LPERC20.sol

446002120ed9e1d0913dfe8c4befa0c782cae6e2259ad6243f64ecad58360e38  ./contracts/mocks/tokens/MintableDelegationERC20.sol

e39983ea911c79ab140f9757db8fa20fadc16ae8fbb13ca9f5444a3486f7b92d  ./contracts/mocks/tokens/MintableERC20.sol

866db3a8e8cef72ca3b7769359fdf96291adacce7226b67db47f707d8cf0e969  ./contracts/mocks/dependencies/weth/WETH9.sol

8afdd8f49b9bf48639a326dd1a35ca29b44539a4621b8dd965b6c9ead7ba44fe  ./contracts/mocks/flashloan/MockFlashLoanReceiver.sol

c73f1938f827070b5a63abdd664c17cabe81beb7e5b8b3391630dbda55370738  ./contracts/mocks/swap/MockParaSwapTokenTransferProxy.sol

598bb1b42f6b012ce315ed9b02b53fc10a8790d343228b05cad9d57e98b9e5f3  ./contracts/mocks/swap/MockParaSwapAugustus.sol

b2e4518ee16b0f4e3dfd7b9211ef0f9dcfadf97b5aed6803bc5d47d5fd16b54c  ./contracts/mocks/swap/MockParaSwapAugustusRegistry.sol

ebf9c22089d29664c5f07b2363396b85ac6a6c2d7e2b459162f82d5df8855d6d  ./contracts/mocks/swap/MockUniswapV2Router02.sol

127d8bd38909d75725688e42754858c2fef6f5de56fcf06f8e5c10eea4441e3b  ./contracts/mocks/oracle/PriceOracle.sol

48bb05fb090f5b05575a27a0ad1473e1165d6f54cd697061a4568378b4f56d1d  ./contracts/mocks/oracle/LendingRateOracle.sol

f3d1771d523317850ee5f22df74171dbb20d44433dcef7b45ca9db891a3c0e6a  ./contracts/mocks/oracle/CLAggregators/MockAggregator.sol
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Tests

```
18f91358a7a75eddcf4e3ae1a40f16f3e9bb8e12645129404554cee9c17d2f7c  ./test-suites/test-treasury/treasury.spec.ts

f8572d067a08029c2fdbadf18baffef178497f5d2c017d60980fc46d8a380f52  ./test-suites/test-treasury/__setup.spec.ts

f44c57cfe163cb67b1ef2b5ed70bc98aaa2920ce05829ac66bf6baf8bea485ce  ./test-suites/test-ve/exact_numbers.spec.ts

4d784d5701e02879898ea34b009ccd81c6fe197043165b38b2f1a147e3cacec1  ./test-suites/test-ve/withdrawal_tests.spec.ts

95209343a73e289165a0cabf8030c98b51a4fc1f47e9a8cab4503b8ae20d5ade  ./test-suites/test-ve/various_amounts.spec.ts

472b2c220bf67f6863d8117936763cf07cdd5e3e4d3f52dc16e0c023ffaa8928  ./test-suites/test-ve/venomics.spec.ts

7f9561753abea355dba8354c7435b21942866003eb947057ca09c505793ce24e  ./test-suites/test-ve/geist.spec.ts

b26bb492f8521d1441f3517921b951e35fc87a63fe1936313d99e662075c85f5  ./test-suites/test-ve/ve_additional_funcs.spec.ts

8f8ea025ef42bc9f33c9b78578e626394ff822223c8d99e34f84283f8b5f215d  ./test-suites/test-ve/__setup.spec.ts

fb60f3bc544f11d65312095161c79d6a87ee14b9f44361c63e7c5ea1a0bc8521  ./test-suites/test-ve/multi_rewarder.spec.ts

d672752e11d777e20e116207ded8ded80a1415bb16ee15920fec3865c600e753  ./test-suites/test-ve/upgrades.spec.ts

828d10f35ef1915be7d7bf1b37f92f15beff5c8cdc22601d45990400e8c0f89d  ./test-suites/test-ve/lp_rewards.spec.ts

7514f014cf2226c0e674db57a172c47ec720f33ea273788ec43bc73f65c21d0f  ./test-suites/test-ve/permissions.spec.ts

b3b518a2a3b375add8a5cf1cd17d74a70933cf15002535c56166609895f812a3  ./test-suites/test-ve/helpers/utils.ts

a443518dcae6e3d2edea799296328cadd5fe643fd835945f3483911ad2d09405  ./test-suites/test-amm/atoken-transfer.spec.ts

994d83c7218072c2189fe8ef8582771e67a18ecdfcc944bb9ffbe770626f3410  ./test-suites/test-amm/uniswapAdapters.base.spec.ts

b513b175fe7aec1f290bb173421a509a5f4c8335175f0c570ceaf995bf5f15ae  ./test-suites/test-amm/delegation-aware-atoken.spec.ts
```

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d6a719afa693745368f7fc191332f885563869a3e051ba1fe7962d3e7fbad23f  ./test-suites/test-aave/atoken-transfer.spec.ts
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374ae27e4af4417bb4753c1875ab6dc85f6a2ed39a236e68a180d2056b3b6d7a  ./test-suites/test-aave/liquidation-atoken.spec.ts
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c6958f1364ed53f920f8b3dd4c3cff4667e2b09f31ad981ed3dc4f3801354847  ./test-suites/test-aave/subgraph-scenarios.spec.ts
6f5017715931333ab9b0bcb8925dba68c13c1a1cc9ce5b66048f19d6a79a9446  ./test-suites/test-aave/helpers/almost-equal.ts
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f1cf4a5c5780428a054b148f0cd29d177c41e4417ed4e84a3c86b5ede9793934  ./test-suites/test-aave/helpers/utils/helpers.ts

65dca8b3a5c4edf170780fc0fcb019e55eb1bdd46671090b3420e4e359e48e14  ./test-suites/test-aave/helpers/utils/math.ts

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Changelog

- 2022-06-22 – Initial report

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Quantstamp is a Y Combinator-backed company that helps to secure blockchain platforms at scale using computer-aided reasoning tools, with a mission to help boost the adoption of this exponentially growing technology.

With over 1000 Google scholar citations and numerous published papers, Quantstamp's team has decades of combined experience in formal verification, static analysis, and software verification. Quantstamp has also developed a protocol to help smart contract developers and projects worldwide to perform cost-effective smart contract security scans.

To date, Quantstamp has protected $5B in digital asset risk from hackers and assisted dozens of blockchain projects globally through its white glove security assessment services. As an evangelist of the blockchain ecosystem, Quantstamp assists core infrastructure projects and leading community initiatives such as the Ethereum Community Fund to expedite the adoption of blockchain technology.

Quantstamp's collaborations with leading academic institutions such as the National University of Singapore and MIT (Massachusetts Institute of Technology) reflect our commitment to research, development, and enabling world-class blockchain security.

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