Planet Finance

Smart Contract Security Audit

Prepared by: **Halborn**

Date of Engagement: **November 18, 2021 - January 14th, 2022**

Visit: **Halborn.com**

DOCUMENT REVISION HISTORY

VERSION	MODIFICATION	DATE	AUTHOR
0.1	Document Creation	11/24/2021	Alessandro Cara
0.2	Document Amended	11/25/2021	Juned Ansari
0.3	Document Updates	12/03/2021	Juned Ansari
0.4	Document Updates	12/16/2021	Juned Ansari
0.5	Draft Review	01/14/2022	Gabi Urrutia
1.0	Remediation Plan	01/27/2022	Juned Ansari
1.1	Remediation Plan Review	01/27/2022	Gabi Urrutia
1.2	Remediation Plan Update	02/09/2022	Juned Ansari
1.3	Remediation Plan Update Review	02/09/2022	Gabi Urrutia

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EXECUTIVE OVERVIEW

1.1 INTRODUCTION

Planet Finance engaged Halborn to conduct a security assessment on their Green protocol smart contracts beginning on 18th November, 2021 and ending 14th January, 2022. This security assessment was scoped to the smart contracts code in Solidity for the Green protocol.

Although Halborn was able to identify several security risks, these were not considered posing a high risk to Planet Finance and its users.

1.2 AUDIT SUMMARY

The team at Halborn was provided ten weeks for the engagement and assigned two full-time security engineers to audit the security of the smart contract. The security engineers are a blockchain and smart-contract security experts with advanced penetration testing, smart-contract hacking, and deep knowledge of multiple blockchain protocols.

The purpose of this audit was to achieve the following:

- Ensure that all Contract functions are intended
- Identify potential security issues with the assets in scope

In summary, Halborn identified some security risks that were addressed and accepted by the Planet Finance team.

1.3 TEST APPROACH & METHODOLOGY

Halborn performed a combination of manual and automated security testing to balance efficiency, timeliness, practicality, and accuracy regarding the scope of this audit. While manual testing is recommended to uncover flaws in logic, process, and implementation; automated testing techniques help enhance coverage of the Planet Finance contract solidity code and

can quickly identify items that do not follow security best practices. The following phases and associated tools were used throughout the term of the audit:

- Research into architecture and purpose.
- Smart contract manual code review and walkthrough.
- Graphing out functionality and contract logic/connectivity/functions (solgraph)
- Manual assessment of use and safety for the critical Solidity variables and functions in scope to identify any arithmetic related vulnerability classes.
- Manual testing by custom scripts.
- Scanning of solidity files for vulnerabilities, security hotspots or bugs. (MythX)
- Static Analysis of security for scoped contract, and imported functions. (Slither)
- Testnet deployment (Remix IDE)

RISK METHODOLOGY:

Vulnerabilities or issues observed by Halborn are ranked based on the risk assessment methodology by measuring the **LIKELIHOOD** of a security incident and the **IMPACT** should an incident occur. This framework works for communicating the characteristics and impacts of technology vulnerabilities. The quantitative model ensures repeatable and accurate measurement while enabling users to see the underlying vulnerability characteristics that were used to generate the Risk scores. For every vulnerability, a risk level will be calculated on a scale of 5 to 1 with 5 being the highest likelihood or impact.

RISK SCALE - LIKELIHOOD

5 - Almost certain an incident will occur.
4 - High probability of an incident occurring.
3 - Potential of a security incident in the long term.
2 - Low probability of an incident occurring.
1 - Very unlikely issue will cause an incident.

RISK SCALE - IMPACT

5 - May cause devastating and unrecoverable impact or loss.
4 - May cause a significant level of impact or loss.
3 - May cause a partial impact or loss to many.
2 - May cause temporary impact or loss.
1 - May cause minimal or un-noticeable impact.

The risk level is then calculated using a sum of these two values, creating a value of 10 to 1 with 10 being the highest level of security risk.

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL

10 - CRITICAL
9 - 8 - HIGH
7 - 6 - MEDIUM
5 - 4 - LOW
3 - 1 - VERY LOW AND INFORMATIONAL

1.4 SCOPE

IN-SCOPE : Planet Finance Green protocol

The security assessment was scoped to the following smart contracts:

Listing 1

```
1 BNB_INTEREST_RATE_MODEL.sol
2 PlanetDiscountStorage.sol
3 compoundAnchored.sol
4 gGAMMA_Delegate.sol
5 GAMMA.sol
6 Reservoir.sol
7 gGAMMA_Delegator.sol
8 Gammatroller.sol
9 UniswapAnchoredView.sol
10  gToken_Delegate.sol
11 Maximillion.sol
12 UniswapConfig.sol
13 gToken_Delegator.sol
14 Ownable.sol
15 UniswapLib.sol
16 gAQUA_Delegate.sol
17 PlanetDiscountDelegate.sol
18 Unitroller.sol
19 gAQUA_Delegator.sol
20 interestRateModel.sol
21 PlanetDiscountDelegator.sol
22 changesInContracts
23 gBNB.sol
```

COMMIT-ID : 3306216998712f894e19addefca1bb21ceb613e2
OUT-OF-SCOPE : External libraries and economics attacks
Fixed-Commit-Id : feec7832689c7cf81db9a123f97f8d79e48f05d3, f309e1a19180b02177a514c686c8a377a42f0a65

2. ASSESSMENT SUMMARY & FINDINGS OVERVIEW

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL
0	0	2	8	12

LIKELIHOOD

IMPACT

(HAL-03)	(HAL-02)			
(HAL-04) (HAL-05)		(HAL-01)		
(HAL-11) (HAL-12) (HAL-13) (HAL-14) (HAL-15)	(HAL-06) (HAL-07) (HAL-08) (HAL-09) (HAL-10)			
(HAL-16) (HAL-17) (HAL-18) (HAL-19) (HAL-20) (HAL-21) (HAL-22)				

EXECUTIVE OVERVIEW

SECURITY ANALYSIS	RISK LEVEL	REMEDIATION DATE
MISUSE OF AN ORACLE	Medium	SOLVED - 01/20/2021
UNCHECKED TRANSFER	Medium	SOLVED - 01/20/2021
COMPTROLLER ERC777 LEADS TO RE-ENTRANCY	Low	RISK ACCEPTED
INCOMPATIBILITY WITH NON-STANDARD ERC20 TOKENS	Low	RISK ACCEPTED
EXTERNAL FUNCTION CALLS WITHIN LOOP	Low	RISK ACCEPTED
MISSING ZERO ADDRESS CHECK	Low	RISK ACCEPTED
EXPERIMENTAL FEATURES ENABLED	Low	RISK ACCEPTED
PRAGMA VERSION DEPRECATED	Low	RISK ACCEPTED
MULTIPLE PRAGMA DEFINITION	Low	RISK ACCEPTED
FLOATING PRAGMA	Low	RISK ACCEPTED
IGNORE RETURN VALUES	Informational	ACKNOWLEDGED
MISUSE OF A BOOLEAN CONSTANT	Informational	ACKNOWLEDGED
MISSING ZERO VALUE CHECK MIGHT LEADS TO UNNECESSARY GAS CONSUMPTION	Informational	ACKNOWLEDGED
USE OF BLOCK.TIMESTAMP	Informational	ACKNOWLEDGED
MISSING EVENTS EMITTING	Informational	ACKNOWLEDGED
LACK OF TEST COVERAGE AND DOCUMENTATION	Informational	ACKNOWLEDGED
UNIMPLEMENTED FUNCTIONS	Informational	ACKNOWLEDGED
REDUNDANT BOOLEAN COMPARISON	Informational	ACKNOWLEDGED
UNUSED REDUNDANT CODE	Informational	ACKNOWLEDGED

USE OF INLINE ASSEMBLY	Informational	ACKNOWLEDGED
WRONG CODE NOMENCLATURE	Informational	ACKNOWLEDGED
POSSIBLE MISUSE OF PUBLIC FUNCTIONS	Informational	ACKNOWLEDGED

FINDINGS & TECH DETAILS

3.1 (HAL-01) MISUSE OF AN ORACLE - MEDIUM

Description:

The UniswapAnchoredView contract is calling latestAnswer to get the last asset price. This method will return the last value, but it will not allow checking if the data is fresh. On the other hand, calling the method latestRoundData allows running additional validation.

Code Location:

Listing 2

```
1  function validate(address gToken) external returns (Error,bool
       valid) {
2
3
4          //Anyone can call validate if the market is calling it
               fetch the config using the Gtoken market address
               otherwise fetch the config using the gToken address
               given
5          // NOTE: We don't do any access control on msg.sender here
               . The access control is done in
               getTokenConfigByReporter,
6          // which will REVERT if an unauthorized address is passed.
7          TokenConfig memory config = getTokenConfigByGToken(msg.
               sender);
8
9          config = config.gToken == msg.sender ? config :
               getTokenConfigByGToken(gToken);
10
11         int256 currentAnswer = (AggregatorValidatorInterface(
               config.reporter).latestAnswer());
12         (Error error2,uint256 reportedPrice) =
               convertReportedPrice(config, currentAnswer);
13
14         if(error2 != Error.NO_ERROR){
15             emit Fail(error2);
16             return(error2,false);
```

```
17          }
18
19          [Redacted for brevity]
20      }
```

Risk Level:

Likelihood - 3
Impact - 3

Recommendation:

It is recommended to use the latestRoundData function to retrieve an asset's price instead. Checks on the return data should be introduced with proper revert messages if the price is stale or the round is **incomplete**.

Remediation Plan:

SOLVED: The Planet Finance team fixed this issue in the commit **f309e1a19180b02177a514c686c8a377a42f0a65** (Refer:UniswapAnchoredView.sol). As a result, now, code uses latestRoundData function to retrieve an asset's price.

3.2 (HAL-02) UNCHECKED TRANSFER - MEDIUM

Description:

In the contracts Reservoir and Gammatroller , the return values of the external transfer calls are not checked. It should be noted that token does not revert in case of failure and return false. If one of these tokens is used, a deposit would not revert if the transfer fails, and an attacker could deposit tokens for free.

Code Location:

Reservoir.sol Lines #396-398

Listing 3: Reservoir.sol (Lines 396,397,398)

```
396     token_.transfer(gammaTroller, deltaDripGammaTroller_);
397     token_.transfer(foundation, deltaDripFoundation_);
398     token_.transfer(treasury, deltaDripTreasury_);
```

Reservoir.sol Lines #410

Listing 4: Reservoir.sol (Line 410)

```
406   function dripOnFarm(uint _amount) external onlyFarm {
407
408     farmDripped += _amount;
409
410     token.transfer(farmAddress, _amount);
411
412     emit FarmDripped(farmDripped, block.timestamp);
413
414   }
```

Gammatroller.sol Lines #4590

Listing 5: Gammatroller.sol (Line 4590)

```
4586     function grantGammaInternal(address user, uint amount)
             internal returns (uint) {
4587         Gamma gamma= Gamma(getGammaAddress());
4588         uint gammaRemaining = gamma.balanceOf(address(this));
4589         if (amount > 0 && amount <= gammaRemaining) {
4590             gamma.transfer(user, amount);
4591             return 0;
4592         }
4593         return amount;
4594     }
```

Risk Level:

Likelihood - 2
Impact - 4

Recommendation:

It is recommended to use SafeERC20, or ensure that the transfer return value is checked. It is recommended to check after transfer balance.

Remediation Plan:

SOLVED: The Planet Finance team fixed this issue in the commit **feec7832689c7cf81db9a123f97f8d79e48f05d3**. As a result, now code using the SafeERC20 implementation and add the safetransfer function to the Reservoir.sol contract code. However, the team added that the team does not use the grantGammaInternal function in the gammatroller contract.

3.3 (HAL-03) COMPTROLLER ERC777 LEADS TO RE-ENTRANCY - LOW

Description:

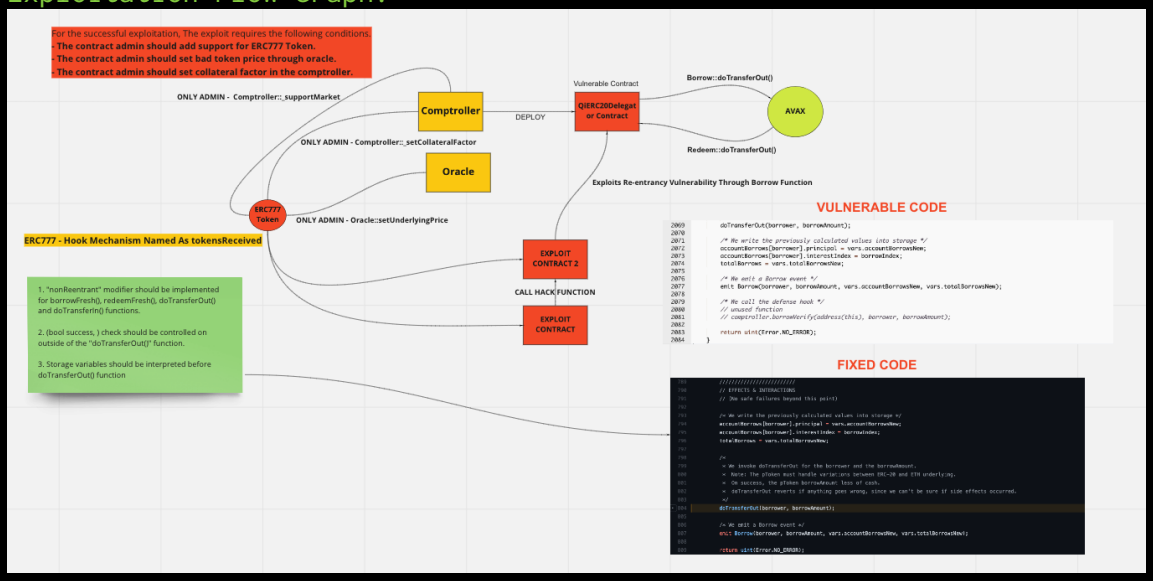
It is noted that forked comptroller contract Unitroller.sol uses ERC777 that have functions vulnerable to Re-enterancy Vulnerability. It should be noted that all compound forks are vulnerable, unless nonReentrant modifier is used.

Exploitation Scenario:

For the successful exploitation, the exploit requires the following conditions

- The contract admin should add support for ERC777 Token.
- The contract admin should set the bad token price through oracle.
- The contract admin should set collateral factor in the comptroller.

Exploitation Flow-Graph:



Code Location:

Listing 6: Unitroller.sol (Line 1801)

```
1794         /*
1795          * We invoke doTransferOut for the borrower and the
                  borrowAmount.
1796          *  Note: The gToken must handle variations between ERC-20
                   and ETH underlying.
1797          *  On success, the gToken borrowAmount less of cash.
1798          *  If doTransferOut fails despite the fact we checked pre
                  -conditions,
1799          *   we revert because we can't be sure if side effects
                  occurred.
1800          */
1801         vars.err = doTransferOut(borrower, borrowAmount);
1802         require(vars.err == Error.NO_ERROR, "borrow transfer out
                failed");
1803
1804         /* We write the previously calculated values into storage
                */
1805         accountBorrows[borrower].principal = vars.
                accountBorrowsNew;
1806         accountBorrows[borrower].interestIndex = borrowIndex;
1807         totalBorrows = vars.totalBorrowsNew;
1808
1809         /* We emit a Borrow event */
1810         emit Borrow(borrower, borrowAmount, vars.accountBorrowsNew
                , vars.totalBorrowsNew);
1811
1812         /* We call the defense hook */
1813         gammatroller.borrowVerify(address(this), borrower,
                borrowAmount);
1814
1815         return uint(Error.NO_ERROR);
1816     }
```

Recommendation:

It is recommended to implement the below controls
- “nonReentrant” modifier should be implemented for borrowFresh(), redeemFresh(), doTransferIn() and doTransferOut()

- (bool, success) check should be controlled on the outside of the “doTransferOut()” functionality
- Storage variables should be intercepted before doTransferOut() function

Below is the fix to the vulnerable code.

Listing 7

```
        /* We write the previously calculated values into storage */
        accountBorrows[borrower].principal = vars.accountBorrowsNew;
        accountBorrows[borrower].interestIndex = borrowIndex;
        totalBorrows = vars.totalBorrowsNew;

                /*
         * We invoke doTransferOut for the borrower and the borrowAmount.
         *  Note: The gToken must handle variations between ERC-20 and ETH underlying.
         *  On success, the gToken borrowAmount less of cash.
         *  If doTransferOut fails despite the fact we checked pre-conditions,
         *   we revert because we can't be sure if side effects occurred.
         */
        vars.err = doTransferOut(borrower, borrowAmount);
        require(vars.err == Error.NO_ERROR, "borrow transfer out failed");

        /* We emit a Borrow event */
        emit Borrow(borrower, borrowAmount, vars.accountBorrowsNew, vars.totalBorrowsNew);

        /* We call the defense hook */
        gammatroller.borrowVerify(address(this), borrower, borrowAmount);

        return uint(Error.NO_ERROR);
    }
```

Remediation Plan:

RISK ACCEPTED: The Planet Finance team acknowledged this issue. The team confirmed that the deployed contracts are not implemented with ERC-777, and the ERC777 standard will not be used in the future.

3.4 (HAL-04) INCOMPATIBILITY WITH NON-STANDARD ERC20 TOKENS - LOW

Description:

Some tokens (like USDT) don't correctly implement the EIP20 standard and their transfer/transferFrom functions return void, instead of a success boolean. Calling these functions with the correct EIP20 function signatures will always revert.

In the contract Gammatroller.sol, gAQUA_Delegate.sol, gAQUA_Delegator.sol gBNB.sol, gGAMMA_Delegate.sol, gGAMMA_Delegator.sol, gToken_Delegate.sol, gToken_Delegator.sol, Maximillion.sol, and Unitroller.sol their transfer or transferFrom does not return a boolean for ERC20 functions if implemented. A contract compiled with solidity version greater than 0.4.22 interacting with these functions will fail to execute them, as the return value is missing. Tokens that don't correctly implement the latest EIP20 spec, like USDT, will be unusable in the smart contract as they revert the transaction because of the missing return value.

We recommend using OpenZeppelin's SafeERC20 versions with the safeTransfer and safeTransferFrom functions that handle the return value check as well as non-standard-compliant tokens.

Code Location:

Following contracts transfer or transferFrom does not return a boolean.

Listing 8

```
1 (Gammatroller.sol#1379-1441):EIP20NonStandardInterface.transfer(
      address,uint256)
2 (Gammatroller.sol#1379-1441):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
3 (gAQUA_Delegate.sol#906-968):EIP20NonStandardInterface.transfer(
      address,uint256)
4 (gAQUA_Delegate.sol#906-968):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
```

```
5 (gAQUA_Delegator.sol#728-790):EIP20NonStandardInterface.transfer(
      address,uint256)
6 (gAQUA_Delegator.sol#728-790):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
7 (gBNB.sol#687-749):EIP20NonStandardInterface.transfer(address,
      uint256)
8 (gBNB.sol#687-749):EIP20NonStandardInterface.transferFrom(address,
      address,uint256)
9 (gGAMMA_Delegate.sol#766-828):EIP20NonStandardInterface.transfer(
      address,uint256)
10 (gGAMMA_Delegate.sol#766-828):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
11 (gGAMMA_Delegator.sol#14-76):EIP20NonStandardInterface.transfer(
      address,uint256)
12 (gGAMMA_Delegator.sol#14-76):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
13 (gToken_Delegate.sol#906-968):EIP20NonStandardInterface.transfer(
      address,uint256)
14 (gToken_Delegate.sol#906-968):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
15 (gToken_Delegator.sol#728-790):EIP20NonStandardInterface.transfer(
      address,uint256)
16 (gToken_Delegator.sol#728-790):EIP20NonStandardInterface.
      transferFrom(address,address,uint256)
17 (Maximillion.sol#672-734):EIP20NonStandardInterface.transfer(
      address,uint256)
18 (Maximillion.sol#672-734):EIP20NonStandardInterface.transferFrom(
      address,address,uint256)
19 (Unitroller.sol#670-732):EIP20NonStandardInterface.transfer(
      address,uint256)
20 (Unitroller.sol#670-732):EIP20NonStandardInterface.transferFrom(
      address,address,uint256)
```

Risk Level:

Likelihood - 1
Impact - 3

Recommendation:

It is recommended to use SafeERC20: safeTransfer and safeTransferFrom.

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue, as the team confirmed that Planet Finance does not use any non-standard tokens in the
protocol.

3.5 (HAL-05) EXTERNAL FUNCTION CALLS WITHIN LOOP - LOW

Description:

Calls inside a loop increase Gas usage or might lead to a denial-of-service attack. In some functions discovered there is a for loop on variable `i` that iterates up to the `gTokens.length`, `assets.length`, `usersWhoHaveBorrow.length`, and `usersWhoHaveSupply.length` array length. If this integer is evaluated at large numbers, this can cause a DoS.

Code Location:

Listing 9: Gammatroller.sol (Line 4561)

```
4556     function claimGamma(address[] memory holders, GToken[] memory
             gTokens, bool borrowers, bool suppliers) public {
4557         for (uint i = 0; i < gTokens.length; i++) {
4558             GToken gToken = gTokens[i];
4559             require(markets[address(gToken)].isListed, "market
                 must be listed");
4560             if (borrowers == true) {
4561                 Exp memory borrowIndex = Exp({mantissa: gToken.
                     borrowIndex()});
4562                 updateGammaBorrowIndex(address(gToken),
                     borrowIndex);
4563                 for (uint j = 0; j < holders.length; j++) {
4564                     distributeBorrowerGamma(address(gToken),
                         holders[j], borrowIndex);
4565                 }
4566             }
4567             if (suppliers == true) {
4568                 updateGammaSupplyIndex(address(gToken));
4569                 for (uint j = 0; j < holders.length; j++) {
4570                     distributeSupplierGamma(address(gToken),
                         holders[j]);
4571                 }
4572             }
4573         }
4574         for (uint j = 0; j < holders.length; j++) {
```

```
4575            gammaAccrued[holders[j]] = grantGammaInternal(holders[
                    j], gammaAccrued[holders[j]]);
4576        }
4577    }
```

Listing 10: Gammatroller.sol (Lines 4050,4058)

```
4035    function getHypotheticalAccountLiquidityInternal(
4036        address account,
4037        GToken gTokenModify,
4038        uint redeemTokens,
4039        uint borrowAmount) internal view returns (Error, uint,
                uint) {
4040
4041        AccountLiquidityLocalVars memory vars; // Holds all our
                calculation results
4042        uint oErr;
4043
4044        // For each asset the account is in
4045        GToken[] memory assets = accountAssets[account];
4046        for (uint i = 0; i < assets.length; i++) {
4047            GToken asset = assets[i];
4048
4049            // Read the balances and exchange rate from the gToken
4050            (oErr, vars.gTokenBalance, vars.borrowBalance, vars.
                    exchangeRateMantissa) = asset.getAccountSnapshot(
                    account);
4051            if (oErr != 0) { // semi-opaque error code, we assume
                    NO_ERROR == 0 is invariant between upgrades
4052                return (Error.SNAPSHOT_ERROR, 0, 0);
4053            }
4054            vars.collateralFactor = Exp({mantissa: markets[address
                    (asset)].collateralFactorMantissa});
4055            vars.exchangeRate = Exp({mantissa: vars.
                    exchangeRateMantissa});
4056
4057            // Get the normalized price of the asset
4058            vars.oraclePriceMantissa = oracle.getUnderlyingPrice(
                    asset);
4059            if (vars.oraclePriceMantissa == 0) {
4060                return (Error.PRICE_ERROR, 0, 0);
4061            }
4062            vars.oraclePrice = Exp({mantissa: vars.
                    oraclePriceMantissa});
```

```
4063
4064            // Pre-compute a conversion factor from tokens ->
                    ether (normalized price value)
4065            vars.tokensToDenom = mul_(mul_(vars.collateralFactor,
                    vars.exchangeRate), vars.oraclePrice);
4066
4067            // sumCollateral += tokensToDenom * gTokenBalance
4068            vars.sumCollateral = mul_ScalarTruncateAddUInt(vars.
                    tokensToDenom, vars.gTokenBalance, vars.
                    sumCollateral);
4069
4070            // sumBorrowPlusEffects += oraclePrice * borrowBalance
4071            vars.sumBorrowPlusEffects = mul_ScalarTruncateAddUInt(
                    vars.oraclePrice, vars.borrowBalance, vars.
                    sumBorrowPlusEffects);
4072
4073            // Calculate effects of interacting with gTokenModify
4074            if (asset == gTokenModify) {
4075                // redeem effect
4076                // sumBorrowPlusEffects += tokensToDenom *
                        redeemTokens
4077                vars.sumBorrowPlusEffects =
                        mul_ScalarTruncateAddUInt(vars.tokensToDenom,
                        redeemTokens, vars.sumBorrowPlusEffects);
4078
4079                // borrow effect
4080                // sumBorrowPlusEffects += oraclePrice *
                        borrowAmount
4081                vars.sumBorrowPlusEffects =
                        mul_ScalarTruncateAddUInt(vars.oraclePrice,
                        borrowAmount, vars.sumBorrowPlusEffects);
4082            }
4083        }
4084
4085        // These are safe, as the underflow condition is checked
                first
4086        if (vars.sumCollateral > vars.sumBorrowPlusEffects) {
4087            return (Error.NO_ERROR, vars.sumCollateral - vars.
                    sumBorrowPlusEffects, 0);
4088        } else {
4089            return (Error.NO_ERROR, 0, vars.sumBorrowPlusEffects -
                    vars.sumCollateral);
4090        }
4091    }
```

Listing 11: gBNB.sol (Lines 2660,2667)

```
2653     function updateDiscountForAll() external {
2654
2655         address[] memory usersWhoHaveBorrow = PlanetDiscount(
             discountLevel).returnBorrowUserArr(address(this));
2656         address[] memory usersWhoHaveSupply = PlanetDiscount(
             discountLevel).returnSupplyUserArr(address(this));
2657
2658
2659         for(uint i = 0 ; i < usersWhoHaveBorrow.length ; i++){
2660             (bool exist,,,,) = PlanetDiscount(discountLevel).
                 borrowDiscountSnap(address(this),usersWhoHaveBorrow
                 [i]);
2661             if(usersWhoHaveBorrow[i] != address(0) && exist){
2662                 changeUserBorrowDiscountInternal(
                     usersWhoHaveBorrow[i]);
2663                 changeLastBorrowBalanceAtBorrow(usersWhoHaveBorrow
                     [i]);
2664             }
2665         }
2666         for(uint i = 0 ; i < usersWhoHaveSupply.length ; i++){
2667             (bool exist,,,) = PlanetDiscount(discountLevel).
                 supplyDiscountSnap(address(this),usersWhoHaveSupply
                 [i]);
2668             if(usersWhoHaveSupply[i] != address(0) && exist){
2669                 changeUserSupplyDiscountInternal(usersWhoHaveSupply
                     [i]);
2670                 changeLastExchangeRateAtSupply(usersWhoHaveSupply[i
                     ]);
2671             }
2672         }
2673     }
```

Listing 12: Maximillion.sol (Lines 2625,2632)

```
2618     function updateDiscountForAll() external {
2619
2620         address[] memory usersWhoHaveBorrow = PlanetDiscount(
             discountLevel).returnBorrowUserArr(address(this));
2621         address[] memory usersWhoHaveSupply = PlanetDiscount(
             discountLevel).returnSupplyUserArr(address(this));
2622
2623
```

```
2624        for(uint i = 0 ; i < usersWhoHaveBorrow.length ; i++){
2625            (bool exist,,,,) = PlanetDiscount(discountLevel).
                    borrowDiscountSnap(address(this),usersWhoHaveBorrow
                    [i]);
2626            if(usersWhoHaveBorrow[i] != address(0) && exist){
2627                changeUserBorrowDiscountInternal(
                        usersWhoHaveBorrow[i]);
2628                changeLastBorrowBalanceAtBorrow(usersWhoHaveBorrow
                        [i]);
2629            }
2630        }
2631        for(uint i = 0 ; i < usersWhoHaveSupply.length ; i++){
2632            (bool exist,,,) = PlanetDiscount(discountLevel).
                    supplyDiscountSnap(address(this),usersWhoHaveSupply
                    [i]);
2633            if(usersWhoHaveSupply[i] != address(0) && exist){
2634                changeUserSupplyDiscountInternal(usersWhoHaveSupply
                        [i]);
2635                changeLastExchangeRateAtSupply(usersWhoHaveSupply[i
                        ]);
2636            }
2637        }
2638    }
```

Risk Level:

Likelihood - 1
Impact - 3

Recommendation:

It is recommended to set the max length to which a for loop can iterate, and avoid usage of nested loops. If possible, use pull over push strategy for external calls.

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue, as the team confirmed that these functions have a finite amount of things

to loop through.

3.6 (HAL-06) MISSING ZERO ADDRESS CHECK - LOW

Description:

There are multiple instances found where Address validation is missing. Lack of zero address validation has been found when assigning user supplied address values to state variables directly.

Code Location:

- In contract Gammatroller.sol:
  - _setBorrowCapGuardian lacks a zero address check on newBorrowCapGuardian.
  - _setPauseGuardian lacks a zero address check on newPauseGuardian.
  - _setPendingAdmin lacks a zero address check on newPendingAdmin, newPendingAdmin.
  - _setPendingImplementation lacks a zero address check on newPendingImplementation.
- In contract gAQUA_Delegate.sol:
  - initialize lacks a zero address check on underlying_.
  - _setPendingAdmin lacks a zero address check on newPendingAdmin.
- In contract gAQUA_Delegator.sol:
  - changeAddress lacks a zero address check on _newgGammaAddress, _newGammatroller, _newOracle.
  - constructor lacks a zero address check on admin_.
  - _setImplementation lacks a zero address check on implementation_.
- In contract gBNB.sol:
  - _setPendingAdmin lacks a zero address check on newPendingAdmin.
- In contract gGAMMA_Delegate.sol:

- `initialize` lacks a zero address check on `underlying_`.
- `_setPendingAdmin` lacks a zero address check on `newPendingAdmin`.
- `_setWithdrawFeeAddress` lacks a zero address check on `newWithdrawFeeAddress`.

- In contract `gGAMMA_Delegator.sol`:
  - `constructor` lacks a zero address check on `admin_`.
  - `_setImplementation` lacks a zero address check on `implementation_`.

- In contract `gToken_Delegate.sol`:
  - `initialize` lacks a zero address check on `underlying_`.
  - `_setPendingAdmin` lacks a zero address check on `newPendingAdmin`.

- In contract `gToken_Delegator.sol`:
  - `changeAddress` lacks a zero address check on `_newgGammaAddress`, `_newGammatroller`, `_newOracle`.
  - `constructor` lacks a zero address check on `admin_`.
  - `_setImplementation` lacks a zero address check on `implementation_`.

- In contract `Maximillion.sol`:
  - `_setPendingAdmin` lacks a zero address check on `newPendingAdmin`.

- In contract `PlanetDiscountDelegate.sol`:
  - `changeAddress` lacks a zero address check on `_newgGammaAddress`, `_newGammatroller`, `_newOracle`.

- In contract `PlanetDiscountDelegator.sol`:
  - `constructor` lacks a zero address check on `admin_`.
  - `_setAdmin` lacks a zero address check on `newAdmin`.
  - `_setImplementation` lacks a zero address check on `implementation_`.

- In contract `Reservoir.sol`:
  - `changeFoundationAddress` lacks a zero address check on `_newFoundation`.
  - `changeTreasuryAddress` lacks a zero address check on `_newTreasury`.

- In contract Unitroller.sol:
  - _setPendingAdmin lacks a zero address check on newPendingAdmin, newPendingAdmin.
  - _setPendingImplementation lacks a zero address check on newPendingImplementation.

Zero Address Validation missing before address assignment to these state variable.

Listing 13: Gammatroller.sol

```
1 pendingGammatrollerImplementation = newPendingImplementation
      (#448)
2 pendingAdmin = newPendingAdmin (#497)
3 pendingAdmin = newPendingAdmin (#3004)
4 borrowCapGuardian = newBorrowCapGuardian (#4304)
5 pauseGuardian = newPauseGuardian (#4324)
```

Listing 14: gAQUA_Delegate.sol

```
1 underlying = underlying_ (#2918)
2 pendingAdmin = newPendingAdmin (#2560)
```

Listing 15: gAQUA_Delegator.sol

```
1 gGammaAddress = _newgGammaAddress (#636)
2 gammatroller = _newGammatroller (#637)
3 oracle = _newOracle (#638)
4 admin = admin_ (#1225)
5 implementation = implementation_ (#1242)
```

Listing 16: gBNB.sol

```
1 pendingAdmin = newPendingAdmin (#2269)
```

Listing 17: gGAMMA_Delegate.sol

```
1 underlying = underlying_ (#2833)
2 pendingAdmin = newPendingAdmin (#2434)
```

```
3 withdrawFeeAddress = newWithdrawFeeAddress (#2705)
```

Listing 18: gGAMMA_Delegator.sol

```
1 admin = admin_ (#573)
2 implementation = implementation_ (#590)
```

Listing 19: gToken_Delegate.sol

```
1 underlying = underlying_ (#2919)
2 pendingAdmin = newPendingAdmin (#2561)
```

Listing 20: gToken_Delegator.sol

```
1 gGammaAddress = _newgGammaAddress (#636)
2 gammatroller = _newGammatroller (#637)
3 oracle = _newOracle (#638)
4 admin = admin_ (#1225)
5 implementation = implementation_ (#1242)
```

Listing 21: Maximillion.sol

```
1 pendingAdmin = newPendingAdmin (#2240)
```

Listing 22: PlanetDiscountDelegate.sol

```
1 gGammaAddress = _newgGammaAddress (#743)
2 gammatroller = _newGammatroller (#744)
3 oracle = _newOracle (#745)
```

Listing 23: PlanetDiscountDelegator.sol

```
1 admin = admin_ (#14)
2 implementation = implementation_ (#25)
3 admin = newAdmin (#38)
```

Listing 24: Reservoir.sol

```
1 foundation = _newFoundation (#420)
2 treasury = _newTreasury (#430)
```

Listing 25: Unitroller.sol

```
1 pendingAdmin = newPendingAdmin (#2119)
2 pendingGammatrollerImplementation = newPendingImplementation
     (#2499)
3 pendingAdmin = newPendingAdmin (#2550)
```

Risk Level:

Likelihood - 2
Impact - 2

Recommendation:

Although administrative restrictions are imposed to this function due to the role-based access controls (RBAC), it is recommended to add proper address validation when assigning user supplied input to a variable. This could be as simple as using the following statement:

Listing 26

```
1 require(address_input != 0, "Address is zero")
```

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue.

3.7 (HAL-07) EXPERIMENTAL FEATURES ENABLED - LOW

Description:

ABIEncoderV2 is enabled to be able to pass struct type into a function, both web3 and another contract. The use of experimental features could be dangerous on live deployments. The experimental ABI encoder does not handle non-integer values shorter than 32 bytes properly. This applies to bytesNN types, bool, enum and other types when they are part of an array or a struct and encoded directly from storage. This means these storage references have to be used directly inside abi.encode(. . .) as arguments in external function calls or in event data without prior assignment to a local variable. Using return does not trigger the bug. The types bytesNN and bool will result in corrupted data, while enum might lead to an invalid revert.

Furthermore, arrays with elements shorter than 32 bytes may not be handled correctly, even if the base type is an integer type. Encoding such arrays in the way described above can lead to other data in the encoding being overwritten if the number of elements encoded is not a multiple of the number of elements that fit a single slot. If nothing follows the array in the encoding (note that dynamically sized arrays are always encoded after statically sized arrays with statically sized content), or if only a single array is encoded, no other data is overwritten. There are known bugs that are publicly released while using this feature. However, the bug only manifests itself when all the following conditions are met:

Storage data involving arrays or structs is sent directly to an external function call, to abi.encode or to event data without prior assignment to a local (memory) variable.
There is an array that contains elements with size less than 32 bytes or a struct that has elements that share a storage slot or members of type bytesNN shorter than 32 bytes.
In addition to that, in the following situations, the code is NOT affected:

All the structs or arrays only use uint256 or int256 types.

If only using integer types (that may be shorter) and only encode at most one array at a time.
If only returning such data and do not use it in abi.encode, external calls or event data.

ABIEncoderV2 is enabled to be able to pass struct type into a function, both web3 and another contract. Naturally, any bug can have wildly varying consequences depending on the program control flow, but we expect that this is more likely to lead to malfunction than exploitability. The bug, when triggered, will under certain circumstances send corrupt parameters on method invocations to other contracts.

Code Location:

Listing 27

```
1 Gammatroller.sol#8: pragma experimental ABIEncoderV2;
2 UniswapConfig.sol#4: pragma experimental ABIEncoderV2;
3 GAMMA.sol#6: pragma experimental ABIEncoderV2;
4 UniswapAnchoredView.sol#4: pragma experimental ABIEncoderV2;
```

Risk Level:

Likelihood - 2
Impact - 2

Recommendation:

When possible, do not use experimental features in the final live deployment. Validate and check that all the conditions above are true for integers and arrays (i.e., all using uint256).

Reference:

Solidity Optimizer and ABIEncoderV2 Bug

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue.

3.8 (HAL-08) PRAGMA VERSION DEPRECATED - LOW

Description:

In the Green contracts, the current pragma version in use for the contracts is pragma 0.5.16, 0.5.17, and 0.5.8. While this version is still functional, and some security issues safely implemented by mitigating contracts with other utility contracts such as SafeMath.sol, the risk to the long-term sustainability and integrity of the solidity code increases.

Code Location:

Listing 28

```
1  BNB_INTEREST_RATE_MODEL.sol:pragma solidity ^0.5.16;
2  GAMMA.sol:pragma solidity ^0.5.16;
3  Gammatroller.sol:pragma solidity ^0.5.16;
4  Maximillion.sol:pragma solidity ^0.5.8;
5  Maximillion.sol:pragma solidity ^0.5.16;
6  PlanetDiscountDelegate.sol:pragma solidity ^0.5.16;
7  PlanetDiscountDelegator.sol:pragma solidity ^0.5.16;
8  PlanetDiscountStorage.sol:pragma solidity ^0.5.17;
9  Reservoir.sol:pragma solidity ^0.5.17;
10 Unitroller.sol:pragma solidity ^0.5.8;
11 gAQUA_Delegate.sol:pragma solidity ^0.5.16;
12 gAQUA_Delegator.sol:pragma solidity ^0.5.16;
13 gBNB.sol:pragma solidity ^0.5.8;
14 gGAMMA_Delegate.sol:pragma solidity ^0.5.16;
15 gGAMMA_Delegator.sol:pragma solidity ^0.5.16;
16 gToken_Delegate.sol:pragma solidity ^0.5.16;
17 gToken_Delegator.sol:pragma solidity ^0.5.16;
18 interestRateModel.sol:pragma solidity ^0.5.16;
```

Risk Level:

Likelihood - 2
Impact - 2

Recommendation:

If possible, consider using the latest stable pragma version that has been thoroughly tested to prevent potential undiscovered vulnerabilities, such as pragma between 0.6.12 - 0.7.6, or the latest pragma 0.8.9. For example, after the Solidity version 0.8.0 arithmetic operations revert to underflow and overflow by default, by using this version, utility contracts like SafeMath.sol would not be needed.

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue.

3.9 (HAL-09) MULTIPLE PRAGMA DEFINITION - LOW

Description:

Planet Finance contracts use different pragma versions. Contracts should be deployed with the same compiler version and flags that they have been tested with thoroughly.
Locking the pragma helps to ensure that contracts do not accidentally get deployed using another pragma, for example, either an outdated pragma version that might introduce bugs that affect the contract system negatively or a recently released pragma version which has not been extensively tested. The latest pragma version (0.8.9) was released in September 2021. Many pragma versions have been lately released, going from version 0.7.x to the recently released version 0.8.x. in just 8 months.

Reference: https://github.com/ethereum/solidity/releases

In the Solitidy Github repository, there is a json file with all bugs finding in the different compiler versions. It should be noted that pragma 0.6.12 and 0.7.6 are widely used by Solidity developers and have been extensively tested in many security audits.

Reference: https://github.com/ethereum/solidity/blob/develop/docs/bugs_by_version.json

Recommendation:

Consider locking and using a single pragma version without known bugs for the compiler version. If possible, consider using the latest stable pragma version that has been thoroughly tested to prevent potential undiscovered vulnerabilities, such as pragma between 0.6.12 - 0.7.6, or the latest pragma 0.8.0 - 0.8.9. For example, after the Solidity version 0.8.0 arithmetic operations revert to underflow and overflow by default, by using this version, utility contracts like SafeMath.sol would not be needed.

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue.

3.10 (HAL-10) FLOATING PRAGMA - LOW

Description:

Contracts should be deployed with the same compiler version and flags used during development and testing. Locking the pragma helps to ensure that contracts do not accidentally get deployed using another pragma. For example, an outdated pragma version might introduce bugs that affect the contract system negatively or recently released pragma versions may have unknown security vulnerabilities.

Code Location:

The following contracts and pragma versions where not locked:

Listing 29

```
BNB_INTEREST_RATE_MODEL.sol:pragma solidity ^0.5.16;
GAMMA.sol:pragma solidity ^0.5.16;
Gammatroller.sol:pragma solidity ^0.5.16;
gAQUA_Delegate.sol:pragma solidity ^0.5.16;
gAQUA_Delegator.sol:pragma solidity ^0.5.16;
gBNB.sol:pragma solidity ^0.5.8;
gGAMMA_Delegate.sol:pragma solidity ^0.5.16;
gGAMMA_Delegator.sol:pragma solidity ^0.5.16;
gToken_Delegate.sol:pragma solidity ^0.5.16;
gToken_Delegator.sol:pragma solidity ^0.5.16;
interestRateModel.sol:pragma solidity ^0.5.16;
Maximillion.sol:pragma solidity ^0.5.16;
Maximillion.sol:pragma solidity ^0.5.8;
Ownable.sol:pragma solidity ^0.6.12;
PlanetDiscountDelegate.sol:pragma solidity ^0.5.16;
PlanetDiscountDelegator.sol:pragma solidity ^0.5.16;
PlanetDiscountStorage.sol:pragma solidity ^0.5.17;
Reservoir.sol:pragma solidity ^0.5.17;
UniswapAnchoredView.sol:pragma solidity ^0.6.12;
UniswapConfig.sol:pragma solidity ^0.6.12;
UniswapLib.sol:pragma solidity ^0.6.12;
Unitroller.sol:pragma solidity ^0.5.8;
```

Risk Level:

Likelihood - 2
Impact - 2

Recommendation:

Consider locking the pragma version as it is not recommended to use a floating pragma in production. Apart from just locking the pragma version in the code, the sign (>=) needs to be removed. It is possible to lock the pragma by fixing the version both in truffle-config.js for the Truffle framework or in hardhat.config.js for the HardHat framework.

Remediation Plan:

RISK ACCEPTED: The Planet Finance team accepts the risk for this issue.

3.11 (HAL-11) IGNORE RETURN VALUES - INFORMATIONAL

Description:

The return value of an external call is not stored in a local or state variable. In contract Gammatroller.sol and gBNB.sol, there are instances where external methods are being called, and return value are being ignored.

Code Location:

Listing 30: Gammatroller.sol (Line 4253)

```
4244     function _supportMarket(GToken gToken) external returns (uint)
             {
4245         if (msg.sender != admin) {
4246             return fail(Error.UNAUTHORIZED, FailureInfo.
                    SUPPORT_MARKET_OWNER_CHECK);
4247         }
4248
4249         if (markets[address(gToken)].isListed) {
4250             return fail(Error.MARKET_ALREADY_LISTED, FailureInfo.
                    SUPPORT_MARKET_EXISTS);
4251         }
4252
4253         gToken.isGToken(); // Sanity check to make sure its really
                 a GToken
4254
4255         // Note that isGammaed is not in active use anymore
4256         markets[address(gToken)] = Market({isListed: true,
                isGammaed: false, collateralFactorMantissa: 0});
4257
4258         _addMarketInternal(address(gToken));
4259
4260         emit MarketListed(gToken);
4261
4262         return uint(Error.NO_ERROR);
4263     }
```

Listing 31: gBNB.sol (Line 1459)

```
1456     function accrueInterest() public returns (uint) {
1457
1458         if(isPriceUpdate)
1459         PriceOracle(gammatroller.oracle()).validate(address(this))
                 ;
1460
1461         AccrueInterestLocalVars memory vars;
```

Risk Level:

Likelihood - 1
Impact - 2

Recommendation:

Add return value check to avoid unexpected crash of the contract. Return value check will help in handling the exceptions better way.

Remediation Plan:

ACKNOWLEDGED: The Planet Finance team acknowledged this issue. However, the team claims that when the external call Gtoken.isGToken() is false, it will automatically revert.

3.12 (HAL-12) MISUSE OF A BOOLEAN CONSTANT - INFORMATIONAL

Description:

It was observed that some in-scope contracts misuse the boolean constant `false` and are directly used in a conditional `if` statement. Boolean constants in code have only a few legitimate uses. Other purposes (in complex expressions, as conditionals) indicate an error or, most likely, the persistence of faulty code.

Code Location:

Listing 32

```
Gammatroller.sol-3579- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3580: if (false) {
Gammatroller.sol-3581- maxAssets = maxAssets;
Gammatroller.sol-3582- }
--
Gammatroller.sol-3715- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3716: if (false) {
Gammatroller.sol-3717- maxAssets = maxAssets;
Gammatroller.sol-3718- }
--
Gammatroller.sol-3771- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3772: if (false) {
Gammatroller.sol-3773- maxAssets = maxAssets;
Gammatroller.sol-3774- }
--
Gammatroller.sol-3846- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3847: if (false) {
Gammatroller.sol-3848- maxAssets = maxAssets;
Gammatroller.sol-3849- }
--
```

```
Gammatroller.sol-3909- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3910: if (false) {
Gammatroller.sol-3911- maxAssets = maxAssets;
Gammatroller.sol-3912- }
--
Gammatroller.sol-3956- // Shh - we don't ever want this hook to be marked pure
Gammatroller.sol:3957: if (false) {
Gammatroller.sol-3958- maxAssets = maxAssets;
Gammatroller.sol-3959- }
--
gAQUA_Delegate.sol-3175- // Shh -- we don't ever want this hook to be marked pure
gAQUA_Delegate.sol:3176: if (false) {
gAQUA_Delegate.sol-3177- implementation = address(0);
gAQUA_Delegate.sol-3178- }
--
gAQUA_Delegate.sol-3186- function _resignImplementation() public {
gAQUA_Delegate.sol-3187- // Shh -- we don't ever want this hook to be marked pure
gAQUA_Delegate.sol:3188: if (false) {
gAQUA_Delegate.sol-3189- implementation = address(0);
gAQUA_Delegate.sol-3190- }
--
gGAMMA_Delegate.sol-3044-
gGAMMA_Delegate.sol-3045- // Shh -- we don't ever want this hook to be marked pure
gGAMMA_Delegate.sol:3046: if (false) {
gGAMMA_Delegate.sol-3047- implementation = address(0);
gGAMMA_Delegate.sol-3048- }
--
gGAMMA_Delegate.sol-3056- function _resignImplementation() public {
gGAMMA_Delegate.sol-3057- // Shh -- we don't ever want this hook to be marked pure
gGAMMA_Delegate.sol:3058: if (false) {
gGAMMA_Delegate.sol-3059- implementation = address(0);
gGAMMA_Delegate.sol-3060- }
--
gToken_Delegate.sol-3175-
gToken_Delegate.sol-3176- // Shh -- we don't ever want this hook to be marked pure
gToken_Delegate.sol:3177: if (false) {
```

```
57 gToken_Delegate.sol-3178- implementation = address(0);
58 gToken_Delegate.sol-3179- }
59 --
60 gToken_Delegate.sol-3187- function _resignImplementation() public
       {
61 gToken_Delegate.sol-3188- // Shh -- we don't ever want this hook
       to be marked pure
62 gToken_Delegate.sol:3189: if (false) {
63 gToken_Delegate.sol-3190- implementation = address(0);
64 gToken_Delegate.sol-3191- }
```

Risk Level:

Likelihood - 1
Impact - 2

Recommendation:

Consider updating the logic and simplifying the conditional statement. Remove these conditional statements to increase the readability of the code.

Remediation Plan:

ACKNOWLEDGED: The Planet Finance team acknowledged this issue and claims that the team doesn't use these functions, so the team sets these statements to false so that code won't execute.

3.13 (HAL-13) MISSING ZERO VALUE CHECK MIGHT LEADS TO UNNECESSARY GAS CONSUMPTION - INFORMATIONAL

Description:

It was observed that in the contract gToken_Delegate.sol function _addReserves lack a zero value validation before an internal call to function _addReservesInternal against the valid caller supplied value to state variable addAmount. Likewise, function _reduceReserves also lacks a zero value validation. It leads to unnecessary internal function checks and calculations, in such cases, gas can be optimized by a prior 'require' check to an internal function call.

Code Location:

Zero Address Validation missing before address assignment to these state variables.

Listing 33: gToken_Delegate.sol (Lines 3014,3015)

```
3014     function _addReserves(uint addAmount) external returns (uint)
            {
3015         return _addReservesInternal(addAmount);
3016     }
```

Listing 34: gToken_Delegate.sol

```
2669     function _addReservesInternal(uint addAmount) internal
            nonReentrant returns (uint) {
2670         uint error = accrueInterest();
2671         if (error != uint(Error.NO_ERROR)) {
2672             // accrueInterest emits logs on errors, but on top of
                    that we want to log the fact that an attempted
                    reduce reserves failed.
2673             return fail(Error(error), FailureInfo.
                    ADD_RESERVES_ACCRUE_INTEREST_FAILED);
2674         }
```

```
2675
2676         // _addReservesFresh emits reserve-addition-specific logs
                 on errors, so we don't need to.
2677         (error, ) = _addReservesFresh(addAmount);
2678         return error;
2679     }
```

Listing 35: gToken_Delegate.sol (Lines 2732,2739)

```
2732     function _reduceReserves(uint reduceAmount) external
             nonReentrant returns (uint) {
2733         uint error = accrueInterest();
2734         if (error != uint(Error.NO_ERROR)) {
2735             // accrueInterest emits logs on errors, but on top of
                    that we want to log the fact that an attempted
                    reduce reserves failed.
2736             return fail(Error(error), FailureInfo.
                    REDUCE_RESERVES_ACCRUE_INTEREST_FAILED);
2737         }
2738         // _reduceReservesFresh emits reserve-reduction-specific
                logs on errors, so we don't need to.
2739         return _reduceReservesFresh(reduceAmount);
2740     }
```

Risk Level:

Likelihood - 1
Impact - 2

Recommendation:

It is recommended to add a zero value validation on caller supplied input to state variable. This could be as simple as using the following statement:

Listing 36

```
1 require(addAmount > 0, "Reserve Amount to add cannot be zero")
```

Remediation Plan:

ACKNOWLEDGED: The Planet Finance team acknowledged this issue.

3.14 (HAL-14) USE OF BLOCK.TIMESTAMP - INFORMATIONAL

Description:

During a manual review, it was observed the usage of block.timestamp in several smart contracts. The contract developers should be aware that block.timestamp does not mean current time. The value of block.timestamp can be influenced by miners to a certain degree, so the testers should be warned that this may have some risk if miners collude on time manipulation to influence the price of oracles. Miners can influence the timestamp by a tolerance of 900 seconds.

Code Location:

Contracts that make use of block.timestamp or now:

Listing 37: PlanetDiscountDelegate.sol

```
#867: _borrowDis.lastUpdated = block.timestamp;
#919: _dis.lastUpdated = block.timestamp;
#930: _dis.lastUpdated = block.timestamp;
#938: _dis.lastUpdated = block.timestamp;
```

Listing 38: Gammatroller.sol

```
#174: require(now <= expiry, "Gamma::delegateBySig: signature
    expired");
```

Listing 39: GAMMA.sol

```
#172: require(now <= expiry, "Gamma::delegateBySig: signature
    expired");
```

Listing 40: UniswapAnchoredView.sol

```
#115: oldObservations[symbolHash].timestamp = block.timestamp;
#116: newObservations[symbolHash].timestamp = block.timestamp;
#138: oldObservations[symbolHash].timestamp = block.timestamp;
#139: newObservations[symbolHash].timestamp = block.timestamp;
#419: (uint nowCumulativePrice, uint oldCumulativePrice, uint
    oldTimestamp) = pokeWindowValues(config);
#422: require(block.timestamp > oldTimestamp, "now must come after
     before");
#424: uint timeElapsed = block.timestamp - oldTimestamp;
#428: FixedPoint.uq112x112 memory priceAverage = FixedPoint.
    uq112x112(uint224((nowCumulativePrice - oldCumulativePrice) /
    timeElapsed));
#476: uint timeElapsed = block.timestamp - newObservation.
    timestamp;
#481: newObservations[symbolHash].timestamp = block.timestamp;
```

Risk Level:

Likelihood - 1
Impact - 2

Recommendation:

Use block.number instead of block.timestamp or now to reduce the risk of MEV attacks. Check if the timescale of the project occurs across years, days, and months rather than seconds. If possible, it is recommended to use Oracles.

Remediation Plan:

ACKNOWLEDGED: The Planet Finance team acknowledged this issue.

3.15 (HAL-15) MISSING EVENTS EMITTING - INFORMATIONAL

Description:

It has been observed that important functionality is missing emitting event for a function on the Gammatroller.sol contract. These functions should emit events. Events are a method of informing the transaction initiator about the actions taken by the called function. It logs its emitted parameters in a specific log history, which can be accessed outside the contract using some filter parameters. These functions should emit events.

Code Location:

function initialize

Listing 41: Gammatroller.sol

```
1  initialExchangeRateMantissa = initialExchangeRateMantissa_
       (#1897)
```

Risk Level:

Likelihood - 1
Impact - 2

Recommendation:

For best security practices, consider as much as possible, declaring events at the end of the function. Events can be used to detect the end of the operation.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.16 (HAL-16) LACK OF TEST COVERAGE AND DOCUMENTATION - INFORMATIONAL

Description:

It was observed that the smart contract set lacked test cases and documentation. Whilst this does not correspond to a direct security risk, it is always recommended to write thorough tests and documentation to ensure that the code is easily maintainable and behaves correctly.

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

Halborn recommends writing test cases to ensure that critical functionality of the smart contracts behave correctly and to write documentation to ensure that code is easily maintainable.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.17 (HAL-17) UNIMPLEMENTED FUNCTIONS - INFORMATIONAL

Description:

During the test, It has been observed that contract Gammatroller.sol and Unitroller.sol does not implement the below-listed function. As a result, the contract might not be properly compiled. All unimplemented functions must be implemented on a contract that is meant to be used.

Code Location:

Listing 42: Gammatroller.sol (Lines 3293,3299,3306)

```
3293     function getCashPrior() internal view returns (uint);
3294
3295     /**
3296      * @dev Performs a transfer in, reverting upon failure.
             Returns the amount actually transferred to the protocol,
             in case of a fee.
3297      *  This may revert due to insufficient balance or
             insufficient allowance.
3298      */
3299     function doTransferIn(address from, uint amount) internal
           returns (uint);
3300
3301     /**
3302      * @dev Performs a transfer out, ideally returning an
             explanatory error code upon failure tather than reverting.
3303      *  If caller has not called checked protocol's balance, may
             revert due to insufficient cash held in the contract.
3304      *  If caller has checked protocol's balance, and verified it
             is >= amount, this should not revert in normal conditions.
3305      */
3306     function doTransferOut(address payable to, uint amount)
           internal;
```

Listing 43: Unitroller.sol (Lines 2352,2358,2365,2372)

```
2352     function getCashPrior() internal view returns (uint);
2353
2354     /**
2355      * @dev Checks whether or not there is sufficient allowance
             for this contract to move amount from `from` and
2356      *      whether or not `from` has a balance of at least `
             amount`. Does NOT do a transfer.
2357      */
2358     function checkTransferIn(address from, uint amount) internal
           view returns (Error);
2359
2360     /**
2361      * @dev Performs a transfer in, ideally returning an
             explanatory error code upon failure rather than reverting.
2362      *  If caller has not called `checkTransferIn`, this may
             revert due to insufficient balance or insufficient
             allowance.
2363      *  If caller has called `checkTransferIn` successfully, this
             should not revert in normal conditions.
2364      */
2365     function doTransferIn(address from, uint amount) internal
           returns (Error);
2366
2367     /**
2368      * @dev Performs a transfer out, ideally returning an
             explanatory error code upon failure tather than reverting.
2369      *  If caller has not called checked protocol's balance, may
             revert due to insufficient cash held in the contract.
2370      *  If caller has checked protocol's balance, and verified it
             is >= amount, this should not revert in normal conditions.
2371      */
2372     function doTransferOut(address payable to, uint amount)
           internal returns (Error);
```

Risk Level:

Likelihood - 1

Impact - 1

Recommendation:

Unimplemented functions should either be implemented or deleted out from the contracts.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.18 (HAL-18) REDUNDANT BOOLEAN COMPARISON - INFORMATIONAL

Description:

In the solidity language, Boolean constants can be used directly and do not need to be compared to true or false. In the Gammatroller.sol contract, boolean constants are compared with true.

Code Location:

Listing 44: Gammatroller.sol

```
1 marketToJoin.accountMembership[borrower] == true (#3460)
2 require(msg.sender == admin || state == true,only admin can
    unpause) (#4335)
3 require(msg.sender == admin || state == true,only admin can
    unpause) (#4345)
4 require(msg.sender == admin || state == true,only admin can
    unpause) (#4354)
5 require(msg.sender == admin || state == true,only admin can
    unpause) (#4363)
6 require(market.isListed == true,gammamarket is not listed) (#4399)
7 borrowers == true (#4560)
8 suppliers == true (#4567)
9 markets[address(gToken)].collateralFactorMantissa == 0 &&
    borrowGuardianPaused[address(gToken)] == true && gToken.
    reserveFactorMantissa() == 1e18 (#4657-4660)
```

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

It is recommended to compare boolean constants directly in the `require` or `if` statement.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.19 (HAL-19) UNUSED REDUNDANT CODE - INFORMATIONAL

Description:

During the test, It has been observed that some contract codes are not used. There are a few instances of unused code in the repository, each commented line references types/identifiers, but performs no action with them, so no code will be generated for such statements, and they can be removed. There might be more instances of unused code in the repository.

Code Location:

Listing 45

```
minter (Gammatroller.sol#3551)
mintAmount (Gammatroller.sol#3552)
gToken (Gammatroller.sol#3574)
minter (Gammatroller.sol#3575)
actualMintAmount (Gammatroller.sol#3576)
mintTokens (Gammatroller.sol#3577)
gToken (Gammatroller.sol#3636)
redeemer (Gammatroller.sol#3637)
gToken (Gammatroller.sol#3711)
borrower (Gammatroller.sol#3712)
borrowAmount (Gammatroller.sol#3713)
payer (Gammatroller.sol#3735)
borrower (Gammatroller.sol#3736)
repayAmount (Gammatroller.sol#3737)
gToken (Gammatroller.sol#3765)
payer (Gammatroller.sol#3766)
borrower (Gammatroller.sol#3767)
actualRepayAmount (Gammatroller.sol#3768)
borrowerIndex (Gammatroller.sol#3769)
liquidator (Gammatroller.sol#3792)
gTokenBorrowed (Gammatroller.sol#3839)
gTokenCollateral (Gammatroller.sol#3840)
liquidator (Gammatroller.sol#3841)
borrower (Gammatroller.sol#3842)
actualRepayAmount (Gammatroller.sol#3843)
```

```
26 seizeTokens (Gammatroller.sol#3844)
27 seizeTokens (Gammatroller.sol#3870)
28 gTokenCollateral (Gammatroller.sol#3903)
29 gTokenBorrowed (Gammatroller.sol#3904)
30 liquidator (Gammatroller.sol#3905)
31 borrower (Gammatroller.sol#3906)
32 seizeTokens (Gammatroller.sol#3907)
33 gToken (Gammatroller.sol#3951)
34 src (Gammatroller.sol#3952)
35 dst (Gammatroller.sol#3953)
36 transferTokens (Gammatroller.sol#3954)
37 minter (PlanetDiscountDelegate.sol#951)
38 exchangeRate (PlanetDiscountDelegate.sol#952)
```

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

Unused codes should be deleted from the repository. Consider updating the logic and remove redundant statements.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.20 (HAL-20) USE OF INLINE ASSEMBLY - INFORMATIONAL

Description:

Inline assembly is a way to access the Ethereum Virtual Machine at a low level. This discards several important safety features in Solidity and could incur in some risks should they used incorrectly.

Code Location:

The following contracts make use of inline assembly:

Listing 46

```
GAMMA.sol:302: assembly { chainId := chainid() }
Gammatroller.sol:304: assembly { chainId := chainid() }
Gammatroller.sol:541: assembly {
gAQUA_Delegate.sol:3089: assembly {
gAQUA_Delegate.sol:3124: assembly {
gAQUA_Delegator.sol:1642: assembly {
gAQUA_Delegator.sol:1669: assembly {
gAQUA_Delegator.sol:1687: assembly {
gGAMMA_Delegate.sol:2959: assembly {
gGAMMA_Delegate.sol:2994: assembly {
gGAMMA_Delegator.sol:964: assembly {
gGAMMA_Delegator.sol:991: assembly {
gGAMMA_Delegator.sol:1009: assembly {
gToken_Delegate.sol:3090: assembly {
gToken_Delegate.sol:3125: assembly {
gToken_Delegator.sol:1642: assembly {
gToken_Delegator.sol:1669: assembly {
gToken_Delegator.sol:1687: assembly {
PlanetDiscountDelegator.sol:56: assembly {
Unitroller.sol:2595: assembly {
```

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

When possible, it is not recommended to use inline assembly because it allows access to the Ethereum Virtual Machine (EVM) at a low level. An attacker could bypass many important safety features of Solidity.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.21 (HAL-21) WRONG CODE NOMENCLATURE - INFORMATIONAL

Description:

During the manual review, it was identified that one function functionality did not behave accordingly to its name. The function was named validateAquaAndGammaPrice and its functionality allowed to change the token price.

Code Location:

UniswapAnchoredView function: validateAquaAndGammaPrice

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

It is recommended to rename the function to ensure better maintainability of the codebase.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

3.22 (HAL-22) POSSIBLE MISUSE OF PUBLIC FUNCTIONS - INFORMATIONAL

Description:

In public functions, array arguments are immediately copied to memory, while external functions can read directly from calldata. Reading calldata is cheaper than memory allocation. Public functions need to write the arguments to memory because public functions may be called internally. Internal calls are passed internally by pointers to memory. Thus, the function expects its arguments being located in memory when the compiler generates the code for an internal function.
Also, methods do not necessarily have to be public if they are only called within the contract-in such case they should be marked internal.

Code Location:

Below are smart contracts and their corresponding functions affected:

Gamma.sol:
_become claimGamma delegate delegateBySig enterMarkets getAccountLiquidity getAllMarkets getHypotheticalAccountLiquidity getPriorVotes _grantGamma initialize _setBorrowPaused _setContributorGammaSpeed _setGammaSpeed _setGammatroller _setMintPaused _setPauseGuardian _setPriceOracle _setSeizePaused _setTransferPaused

Gammatroller.sol:
_become claimGamma enterMarkets getAccountLiquidity getAllMarkets getHypotheticalAccountLiquidity _grantGamma initialize _setBorrowPaused _setContributorGammaSpeed _setGammaSpeed _setGammatroller _setMintPaused _setPauseGuardian _setPriceOracle _setSeizePaused _setTransferPaused

GToken.sol:
borrowBalanceStored exchangeRateStored getTokenConfigByGToken initialize reserveFactorMantissa _setBorrowPaused _setGammaSpeed _setInterestRateModel _setMintPaused _setWithdrawFeeAddress

Maximillion.sol:
repayBehalf(address)

PlanetDelegatorInterface.sol:
_setImplementation(address)

PlanetDiscount.sol:
changeAddress(address,address,address) deListMarket(address) deListMarkets(address[]) deprecateMarket(address) listMarket(address) listMarkets(address[]) _setAdmin(address)

PlanetDiscountDelegate.sol:
changeAddress(address,address,address) deListMarket(address) deListMarkets(address[]) listMarket(address) listMarkets(address[])

PlanetDiscountDelegator.sol:
_setAdmin(address)

Reservoir.sol:
drip()

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

Consider, as much as possible, declaring external variables instead of public variables. As for best practice, you should use external if you expect that the function will only be called externally and use public if you need to call the function internally. To sum up, all can access to public functions, external functions only can be accessed externally, and internal functions can only be called within the contract.

Remediation Plan:

ACKNOWLEDGED: The issue was acknowledged by the Planet Finance team.

AUTOMATED TESTING

4.1 STATIC ANALYSIS REPORT

Description:

Halborn used automated testing techniques to enhance coverage of certain areas of the in-scope contracts. After Halborn verified all the contracts in the repository and was able to compile them correctly into their application binary interface (ABI) and binary formats, the tool Slither was used. Slither is a Solidity static analysis framework. This tool can statically verify mathematical relationships between Solidity variables to detect invalid or inconsistent usage of the contracts' application programming interfaces (APIs) across the entire code-base.

Results:

```
INFO:Detectors:
PlanetDiscountDelegate (PlanetDiscountDelegate.sol#734-976) contract sets array length with a user-controlled value:
        - usersWhoHaveBorrow[_market].push(borrower) (PlanetDiscountDelegate.sol#934)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#array-length-assignment

INFO:Detectors:
PlanetStorage.admin (PlanetDiscountDelegate.sol#17) is never initialized. It is used in:
        - PlanetDiscountDelegate.changeAddress(address,address,address) (PlanetDiscountDelegate.sol#736-751)
        - PlanetDiscountDelegate.listMarket(address) (PlanetDiscountDelegate.sol#753-758)
        - PlanetDiscountDelegate.listMarkets(address[]) (PlanetDiscountDelegate.sol#760-768)
        - PlanetDiscountDelegate.deListMarket(address) (PlanetDiscountDelegate.sol#770-775)
        - PlanetDiscountDelegate.deListMarkets(address[]) (PlanetDiscountDelegate.sol#777-785)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-state-variables

INFO:Detectors:
GErc20Delegator.delegateTo(address,bytes) (gToken_Delegator.sol#1640-1648) uses delegatecall to a input-controlled function id
        - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
GErc20Delegator.fallback() (gToken_Delegator.sol#1681-1695) uses delegatecall to a input-controlled function id
        - (success) = implementation.delegatecall(msg.data) (gToken_Delegator.sol#1685)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#controlled-delegatecall

INFO:Detectors:
Gammatroller (Gammatroller.sol#3337-4676) contract sets array length with a user-controlled value:
        - allMarkets.push(GToken(gToken)) (Gammatroller.sol#4269)
Gammatroller (Gammatroller.sol#3337-4676) contract sets array length with a user-controlled value:
        - accountAssets[borrower].push(gToken) (Gammatroller.sol#3471)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#array-length-assignment

INFO:Detectors:
Unitroller.fallback() (Gammatroller.sol#537-549) uses delegatecall to a input-controlled function id
        - (success) = implementation.delegatecall(msg.data) (Gammatroller.sol#539)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#controlled-delegatecall

INFO:Detectors:
Gammatroller.grantGammaInternal(address,uint256) (Gammatroller.sol#4586-4594) ignores return value by gamma.transfer(user,amount) (Gammatroller.sol#4590)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unchecked-transfer

INFO:Detectors:
UnitrollerAdminStorage.implementation (Gammatroller.sol#397) is never initialized. It is used in:
        - Gammatroller.adminOrInitializing() (Gammatroller.sol#4378-4380)
```

```
UniswapV2OracleLibrary.currentBlockTimestamp() (UniswapLib.sol#38-40) uses a weak PRNG: "uint32(block.timestamp % 2 ** 32) (UniswapLib.sol#39)"
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#weak-PRNG

INFO:Detectors:
Reservoir.drip() (Reservoir.sol#368-403) ignores return value by token_.transfer(gammaTroller,deltaDripGammaTroller_) (Reservoir.sol#396)
Reservoir.drip() (Reservoir.sol#368-403) ignores return value by token_.transfer(foundation,deltaDripFoundation_) (Reservoir.sol#397)
Reservoir.drip() (Reservoir.sol#368-403) ignores return value by token_.transfer(treasury,deltaDripTreasury_) (Reservoir.sol#398)
Reservoir.dripOnFarm(uint256) (Reservoir.sol#406-414) ignores return value by token.transfer(farmAddress,_amount) (Reservoir.sol#410)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unchecked-transfer

INFO:Detectors:
PlanetDiscountDelegator.fallback() (PlanetDiscountDelegator.sol#50-64) uses delegatecall to a input-controlled function id
        - (success) = implementation.delegatecall(msg.data) (PlanetDiscountDelegator.sol#54)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#controlled-delegatecall

INFO:Detectors:
GErc20Delegator.delegateTo(address,bytes) (gGAMMA_Delegator.sol#962-970) uses delegatecall to a input-controlled function id
        - (success,returnData) = callee.delegatecall(data) (gGAMMA_Delegator.sol#963)
GErc20Delegator.fallback() (gGAMMA_Delegator.sol#1003-1017) uses delegatecall to a input-controlled function id
        - (success) = implementation.delegatecall(msg.data) (gGAMMA_Delegator.sol#1007)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#controlled-delegatecall

INFO:Detectors:
Maximillion.repayBehalfExplicit(address,CEther) (Maximillion.sol#2750-2759) sends eth to arbitrary user
        Dangerous calls:
        - cEther_.repayBorrowBehalf.value(borrows)(borrower) (Maximillion.sol#2754)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#functions-that-send-ether-to-arbitrary-destinations

INFO:Detectors:
GErc20Delegator.delegateTo(address,bytes) (gAQUA_Delegator.sol#1640-1648) uses delegatecall to a input-controlled function id
        - (success,returnData) = callee.delegatecall(data) (gAQUA_Delegator.sol#1641)
GErc20Delegator.fallback() (gAQUA_Delegator.sol#1681-1695) uses delegatecall to a input-controlled function id
        - (success) = implementation.delegatecall(msg.data) (gAQUA_Delegator.sol#1685)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#controlled-delegatecall

INFO:Detectors:
UniswapV2OracleLibrary.currentBlockTimestamp() (UniswapLib.sol#38-40) uses a weak PRNG: "uint32(block.timestamp % 2 ** 32) (UniswapLib.sol#39)"
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#weak-PRNG
```

```
INFO:Detectors:
PlanetDiscountDelegate.changeUserBorrowDiscount(address).vars (PlanetDiscountDelegate.sol#887) is a local variable never initialized
PlanetDiscountDelegate.returnBorrowerStakedAsset(address,address).vars (PlanetDiscountDelegate.sol#790) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
EIP20NonStandardInterface (gToken_Delegator.sol#728-790) has incorrect ERC20 function interface:EIP20NonStandardInterface.transfer(address,uint256) (gToken_Delegator.sol#754)
EIP20NonStandardInterface (gToken_Delegator.sol#728-790) has incorrect ERC20 function interface:EIP20NonStandardInterface.transferFrom(address,address,uint256) (gToken_Delegator.sol#768)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-erc20-interface

INFO:Detectors:
Reentrancy in GErc20Delegator._setImplementation(address,bool,bytes) (gToken_Delegator.sol#1234-1247):
        External calls:
        - delegateToImplementation(abi.encodeWithSignature(_resignImplementation())) (gToken_Delegator.sol#1238)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        State variables written after the call(s):
        - implementation = implementation_ (gToken_Delegator.sol#1242)
Reentrancy in GErc20Delegator.constructor(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8,address,address,bytes) (gToken_Delegator.sol#1198-1226):
        External calls:
        - delegateTo(implementation_,abi.encodeWithSignature(initialize(address,address,address,uint256,string,string,uint8),underlying_,gammatroller_,interestRateModel_,initialExchangeRateMantissa_,name_,symbol_,decimals_)) (gToken_Delegator.sol#1212-1219)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        - _setImplementation(implementation_,false,becomeImplementationData) (gToken_Delegator.sol#1222)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        State variables written after the call(s):
        - admin = admin_ (gToken_Delegator.sol#1225)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#reentrancy-vulnerabilities-1

INFO:Detectors:
PlanetDiscount.returnBorrowerStakedAsset(address,address).vars (gToken_Delegator.sol#655) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
Gammatroller.mintVerify(address,address,uint256,uint256) (Gammatroller.sol#3572-3583) uses a Boolean constant improperly:
        -false (Gammatroller.sol#3580)
Gammatroller.borrowVerify(address,address,uint256) (Gammatroller.sol#3709-3719) uses a Boolean constant improperly:
        -false (Gammatroller.sol#3716)
Gammatroller.repayBorrowVerify(address,address,address,uint256,uint256) (Gammatroller.sol#3758-3775) uses a Boolean constant improperly:
        -false (Gammatroller.sol#3772)
Gammatroller.liquidateBorrowVerify(address,address,address,address,uint256,uint256) (Gammatroller.sol#3831-3850) uses a Boolean constant improperly:
        -false (Gammatroller.sol#3847)
Gammatroller.seizeVerify(address,address,address,address,uint256) (Gammatroller.sol#3896-3913) uses a Boolean constant improperly:
```

```
Gamma._writeCheckpoint(address,uint32,uint96,uint96) (Gammatroller.sol#268-279) uses a dangerous strict equality:
        - nCheckpoints > 0 && checkpoints[delegatee][nCheckpoints - 1].fromBlock == blockNumber (Gammatroller.sol#271)
GToken.accrueInterest() (Gammatroller.sol#2246-2324) uses a dangerous strict equality:
        - accrualBlockNumberPrior == currentBlockNumber (Gammatroller.sol#2252)
GToken.accrueInterest() (Gammatroller.sol#2246-2324) uses a dangerous strict equality:
        - require(bool,string)(mathErr == MathError.NO_ERROR,could not calculate block delta) (Gammatroller.sol#2268)
GToken.balanceOfUnderlying(address) (Gammatroller.sol#2052-2057) uses a dangerous strict equality:
        - require(bool,string)(mErr == MathError.NO_ERROR,balance could not be calculated) (Gammatroller.sol#2055)
GToken.borrowBalanceStored(address) (Gammatroller.sol#2133-2137) uses a dangerous strict equality:
        - require(bool,string)(err == MathError.NO_ERROR,borrowBalanceStored: borrowBalanceStoredInternal failed) (Gammatroller.sol#2135)
CarefulMath.divUInt(uint256,uint256) (Gammatroller.sol#1000-1006) uses a dangerous strict equality:
        - b == 0 (Gammatroller.sol#1001)
GToken.exchangeRateStored() (Gammatroller.sol#2190-2194) uses a dangerous strict equality:
        - require(bool,string)(err == MathError.NO_ERROR,exchangeRateStored: exchangeRateStoredInternal failed) (Gammatroller.sol#2192)
GToken.exchangeRateStoredInternal() (Gammatroller.sol#2201-2231) uses a dangerous strict equality:
        - _totalSupply == 0 (Gammatroller.sol#2203)
GToken.initialize(GammatrollerInterface,InterestRateModel,uint256,string,string,uint8) (Gammatroller.sol#1887-1918) uses a dangerous strict equality:
        - require(bool,string)(accrualBlockNumber == 0 && borrowIndex == 0,market may only be initialized once) (Gammatroller.sol#1894)
GToken.initialize(GammatrollerInterface,InterestRateModel,uint256,string,string,uint8) (Gammatroller.sol#1887-1918) uses a dangerous strict equality:
        - require(bool,string)(err == uint256(Error.NO_ERROR),setting gammatroller failed) (Gammatroller.sol#1902)
GToken.initialize(GammatrollerInterface,InterestRateModel,uint256,string,string,uint8) (Gammatroller.sol#1887-1918) uses a dangerous strict equality:
        - require(bool,string)(err == uint256(Error.NO_ERROR),setting interest rate model failed) (Gammatroller.sol#1910)
GToken.liquidateBorrowFresh(address,address,uint256,GTokenInterface) (Gammatroller.sol#2817-2886) uses a dangerous strict equality:
        - require(bool,string)(amountSeizeError == uint256(Error.NO_ERROR),LIQUIDATE_GAMMATROLLER_CALCULATE_AMOUNT_SEIZE_FAILED) (Gammatroller.sol#2862)
GToken.liquidateBorrowFresh(address,address,uint256,GTokenInterface) (Gammatroller.sol#2817-2886) uses a dangerous strict equality:
        - require(bool,string)(seizeError == uint256(Error.NO_ERROR),token seizure failed) (Gammatroller.sol#2876)
GToken.mintFresh(address,uint256) (Gammatroller.sol#2359-2424) uses a dangerous strict equality:
        - require(bool,string)(vars.mathErr == MathError.NO_ERROR,MINT_EXCHANGE_CALCULATION_FAILED) (Gammatroller.sol#2398)
GToken.mintFresh(address,uint256) (Gammatroller.sol#2359-2424) uses a dangerous strict equality:
        - require(bool,string)(vars.mathErr == MathError.NO_ERROR,MINT_NEW_TOTAL_SUPPLY_CALCULATION_FAILED) (Gammatroller.sol#2406)
GToken.mintFresh(address,uint256) (Gammatroller.sol#2359-2424) uses a dangerous strict equality:
        - require(bool,string)(vars.mathErr == MathError.NO_ERROR,MINT_NEW_ACCOUNT_BALANCE_CALCULATION_FAILED) (Gammatroller.sol#2409)
Exponential.mulExp(ExponentialNoError.Exp,ExponentialNoError.Exp) (Gammatroller.sol#1180-1200) uses a dangerous strict equality:
        - assert(bool)(err2 == MathError.NO_ERROR) (Gammatroller.sol#1197)
CarefulMath.mulUInt(uint256,uint256) (Gammatroller.sol#983-995) uses a dangerous strict equality:
        - a == 0 (Gammatroller.sol#984)
ExponentialNoError.mul_(uint256,uint256,string) (Gammatroller.sol#911-918) uses a dangerous strict equality:
        - a == 0 || b == 0 (Gammatroller.sol#912)
```

```
Reentrancy in GToken.liquidateBorrowInternal(address,uint256,GTokenInterface) (Gammatroller.sol#2791-2806):
        External calls:
        - error = gTokenCollateral.accrueInterest() (Gammatroller.sol#2798)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Gammatroller.sol#2805)
                - allowed = gammatroller.repayBorrowAllowed(address(this),payer,borrower,repayAmount) (Gammatroller.sol#2716)
                - allowed = gammatroller.liquidateBorrowAllowed(address(this),address(gTokenCollateral),liquidator,borrower,repayAmount) (Gammatroller.sol#2819)
                - allowed = gammatroller.seizeAllowed(address(this),seizerToken,liquidator,borrower,seizeTokens) (Gammatroller.sol#2925)
                - seizeError = gTokenCollateral.seize(liquidator,borrower,seizeTokens) (Gammatroller.sol#2872)
        State variables written after the call(s):
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Gammatroller.sol#2805)
                - totalBorrows = vars.totalBorrowsNew (Gammatroller.sol#2771)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Gammatroller.sol#2805)
                - totalReserves = vars.totalReservesNew (Gammatroller.sol#2968)
Reentrancy in GToken.redeemFresh(address,uint256,uint256) (Gammatroller.sol#2476-2570):
        External calls:
        - allowed = gammatroller.redeemAllowed(address(this),redeemer,vars.redeemTokens) (Gammatroller.sol#2516)
        State variables written after the call(s):
        - totalSupply = vars.totalSupplyNew (Gammatroller.sol#2559)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#reentrancy-vulnerabilities-1

INFO:Detectors:
GToken.repayBorrowFresh(address,address,uint256).vars (Gammatroller.sol#2726) is a local variable never initialized
GToken._addReservesFresh(uint256).actualAddAmount (Gammatroller.sol#3133) is a local variable never initialized
GToken.mintFresh(address,uint256).vars (Gammatroller.sol#2371) is a local variable never initialized
Gammatroller.borrowAllowed(address,address,uint256).err_scope_0 (Gammatroller.sol#3687) is a local variable never initialized
GToken.borrowFresh(address,uint256).vars (Gammatroller.sol#2616) is a local variable never initialized
GToken.seizeInternal(address,address,address,uint256).vars (Gammatroller.sol#2935) is a local variable never initialized
GToken.redeemFresh(address,uint256,uint256).vars (Gammatroller.sol#2479) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
Gammatroller._supportMarket(GToken) (Gammatroller.sol#4244-4263) ignores return value by gToken.isGToken() (Gammatroller.sol#4253)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unused-return

INFO:Detectors:
GErc20Delegate._becomeImplementation(bytes) (gAQUA_Delegate.sol#3171-3181) uses a Boolean constant improperly:
        -false (gAQUA_Delegate.sol#3176)
GErc20Delegate._resignImplementation() (gAQUA_Delegate.sol#3186-3193) uses a Boolean constant improperly:
        -false (gAQUA_Delegate.sol#3188)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#misuse-of-a-boolean-constant
CEther.updateDiscountForAll().exist_scope_1 (Maximillion.sol#2632) is a local variable never initialized
GToken.borrowFresh(address,uint256).vars (Maximillion.sol#1869) is a local variable never initialized
GToken.redeemFresh(address,uint256,uint256).vars (Maximillion.sol#1689) is a local variable never initialized
GToken.accrueInterest().vars (Maximillion.sol#1432) is a local variable never initialized
GToken.mintFresh(address,uint256).vars (Maximillion.sol#1552) is a local variable never initialized
GToken.repayBorrowFresh(address,address,uint256).vars (Maximillion.sol#1993) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
EIP20NonStandardInterface (gAQUA_Delegator.sol#728-790) has incorrect ERC20 function interface:EIP20NonStandardInterface.transfer(address,uint256) (gAQUA_Delegator.sol#754)
EIP20NonStandardInterface (gAQUA_Delegator.sol#728-790) has incorrect ERC20 function interface:EIP20NonStandardInterface.transferFrom(address,address,uint256) (gAQUA_Delegator.sol#768)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-erc20-interface

INFO:Detectors:
Reentrancy in GErc20Delegator._setImplementation(address,bool,bytes) (gAQUA_Delegator.sol#1234-1247):
        External calls:
        - delegateToImplementation(abi.encodeWithSignature(_resignImplementation())) (gAQUA_Delegator.sol#1238)
                - (success,returnData) = callee.delegatecall(data) (gAQUA_Delegator.sol#1641)
        State variables written after the call(s):
        - implementation = implementation_ (gAQUA_Delegator.sol#1242)
Reentrancy in GErc20Delegator.constructor(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8,address,address,bytes) (gAQUA_Delegator.sol#1198-1226):
        External calls:
        - delegateTo(implementation_,abi.encodeWithSignature(initialize(address,address,address,uint256,string,string,uint8),underlying_,gammatroller_,interestRateModel_,initialExchangeRateMantissa_,name_,symbol_,decimals_)) (gAQUA_Deleg
ator.sol#1212-1219)
                - (success,returnData) = callee.delegatecall(data) (gAQUA_Delegator.sol#1641)
        - _setImplementation(implementation_,false,becomeImplementationData) (gAQUA_Delegator.sol#1222)
                - (success,returnData) = callee.delegatecall(data) (gAQUA_Delegator.sol#1641)
        State variables written after the call(s):
        - admin = admin_ (gAQUA_Delegator.sol#1225)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#reentrancy-vulnerabilities-1

INFO:Detectors:
PlanetDiscount.returnBorrowerStakedAsset(address,address).vars (gAQUA_Delegator.sol#655) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
BaseJumpRateModelV2.getSupplyRate(uint256,uint256,uint256,uint256) (interestRateModel.sol#332-337) performs a multiplication on the result of a division:
        -rateToPool = borrowRate.mul(oneMinusReserveFactor).div(1e18) (interestRateModel.sol#335)
        -utilizationRate(cash,borrows,reserves).mul(rateToPool).div(1e18) (interestRateModel.sol#336)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#divide-before-multiply
Reentrancy in GToken.borrowFresh(address,uint256) (Maximillion.sol#1852-1925):
        External calls:
        - allowed = gammatroller.borrowAllowed(address(this),borrower,borrowAmount) (Maximillion.sol#1854)
        - changeUserBorrowDiscountInternal(borrower) (Maximillion.sol#1872)
                - (accountBorrows[borrower].principal,accountBorrows[borrower].interestIndex,totalBorrows) = PlanetDiscount(discountLevel).changeUserBorrowDiscount(borrower) (Maximillion.sol#1839)
        State variables written after the call(s):
        - accountBorrows[borrower].principal = vars.accountBorrowsNew (Maximillion.sol#1910)
        - accountBorrows[borrower].interestIndex = borrowIndex (Maximillion.sol#1911)
        - totalBorrows = vars.totalBorrowsNew (Maximillion.sol#1912)
Reentrancy in GToken.liquidateBorrowInternal(address,uint256,GToken) (Maximillion.sol#2074-2089):
        External calls:
        - error = gTokenCollateral.accrueInterest() (Maximillion.sol#2081)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Maximillion.sol#2088)
                - allowed = gammatroller.liquidateBorrowAllowed(address(this),address(gTokenCollateral),liquidator,borrower,repayAmount) (Maximillion.sol#2102)
                - PlanetDiscount(discountLevel).changeLastBorrowAmountDiscountGiven(borrower,newBorrow) (Maximillion.sol#1844)
                - allowed = gammatroller.repayBorrowAllowed(address(this),payer,borrower,repayAmount) (Maximillion.sol#1983)
                - (accountBorrows[borrower].principal,accountBorrows[borrower].interestIndex,totalBorrows) = PlanetDiscount(discountLevel).changeUserBorrowDiscount(borrower) (Maximillion.sol#1839)
                - seizeError = gTokenCollateral.seize(liquidator,borrower,seizeTokens) (Maximillion.sol#2150)
                - gammatroller.liquidateBorrowVerify(address(this),address(gTokenCollateral),liquidator,borrower,repayAmount,seizeTokens) (Maximillion.sol#2157)
                - gammatroller.repayBorrowVerify(address(this),payer,borrower,vars.repayAmount,vars.borrowerIndex) (Maximillion.sol#2061)
        State variables written after the call(s):
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Maximillion.sol#2088)
                - accrualBlockNumber = vars.currentBlockNumber (Maximillion.sol#1486)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Maximillion.sol#2088)
                - borrowIndex = vars.borrowIndexNew (Maximillion.sol#1487)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Maximillion.sol#2088)
                - (accountBorrows[borrower].principal,accountBorrows[borrower].interestIndex,totalBorrows) = PlanetDiscount(discountLevel).changeUserBorrowDiscount(borrower) (Maximillion.sol#1839)
                - totalBorrows = vars.totalBorrowsNew (Maximillion.sol#1488)
                - totalBorrows = vars.totalBorrowsNew (Maximillion.sol#2049)
        - liquidateBorrowFresh(msg.sender,borrower,repayAmount,gTokenCollateral) (Maximillion.sol#2088)
                - totalReserves = vars.totalReservesNew (Maximillion.sol#1489)
Reentrancy in GToken.redeemFresh(address,uint256,uint256) (Maximillion.sol#1682-1786):
        External calls:
        - changeUserSupplyDiscountInternal(redeemer) (Maximillion.sol#1686)
                - (totalSupply,accountTokens[minter]) = PlanetDiscount(discountLevel).changeUserSupplyDiscount(minter) (Maximillion.sol#1530)
        - allowed = gammatroller.redeemAllowed(address(this),redeemer,vars.redeemTokens) (Maximillion.sol#1726)
        State variables written after the call(s):
        - totalSupply = vars.totalSupplyNew (Maximillion.sol#1771)
Reentrancy in GToken.repayBorrowFresh(address,address,uint256) (Maximillion.sol#1975-2064):
        External calls:
        - changeUserBorrowDiscountInternal(borrower) (Maximillion.sol#1980)
                - (accountBorrows[borrower].principal,accountBorrows[borrower].interestIndex,totalBorrows) = PlanetDiscount(discountLevel).changeUserBorrowDiscount(borrower) (Maximillion.sol#1839)
        - allowed = gammatroller.repayBorrowAllowed(address(this),payer,borrower,repayAmount) (Maximillion.sol#1983)
        State variables written after the call(s):
        - accountBorrows[borrower].principal = vars.accountBorrowsNew (Maximillion.sol#2047)
        - accountBorrows[borrower].interestIndex = borrowIndex (Maximillion.sol#2048)
        - totalBorrows = vars.totalBorrowsNew (Maximillion.sol#2049)
```

```
GToken._addReservesFresh(uint256).actualAddAmount (gToken_Delegate.sol#2690) is a local variable never initialized
GErc20.updateDiscountForAll().exist_scope_1 (gToken_Delegate.sol#3054) is a local variable never initialized
GToken.repayBorrowFresh(address,address,uint256).vars (gToken_Delegate.sol#2277) is a local variable never initialized
GToken.redeemFresh(address,uint256,uint256).vars (gToken_Delegate.sol#1969) is a local variable never initialized
GToken.mintFresh(address,uint256).vars (gToken_Delegate.sol#1843) is a local variable never initialized
GToken.borrowFresh(address,uint256).vars (gToken_Delegate.sol#2150) is a local variable never initialized
GToken.seizeInternal(address,address,address,uint256).vars (gToken_Delegate.sol#2492) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables

INFO:Detectors:
GToken.accrueInterest() (gToken_Delegate.sol#1705-1785) ignores return value by gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
GErc20.initialize(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8) (gToken_Delegate.sol#2908-2921) ignores return value by EIP20Interface(underlying).totalSupply() (gToken_Delegate.sol#2920)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unused-return

INFO:Detectors:
EIP20NonStandardInterface (gGAMMA_Delegator.sol#14-76) has incorrect ERC20 function interface:EIP20NonStandardInterface.transfer(address,uint256) (gGAMMA_Delegator.sol#40)
EIP20NonStandardInterface (gGAMMA_Delegator.sol#14-76) has incorrect ERC20 function interface:EIP20NonStandardInterface.transferFrom(address,address,uint256) (gGAMMA_Delegator.sol#54)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-erc20-interface

INFO:Detectors:
Reentrancy in GErc20Delegator._setImplementation(address,bool,bytes) (gGAMMA_Delegator.sol#582-595):
        External calls:
        - delegateToImplementation(abi.encodeWithSignature(_resignImplementation())) (gGAMMA_Delegator.sol#586)
                - (success,returnData) = callee.delegatecall(data) (gGAMMA_Delegator.sol#963)
        State variables written after the call(s):
        - implementation = implementation_ (gGAMMA_Delegator.sol#590)
Reentrancy in GErc20Delegator.constructor(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8,address,address,bytes) (gGAMMA_Delegator.sol#546-574):
        External calls:
        - delegateTo(implementation_,abi.encodeWithSignature(initialize(address,address,address,uint256,string,string,uint8),underlying_,gammatroller_,interestRateModel_,initialExchangeRateMantissa_,name_,symbol_,decimals_)) (gGAMMA_Delegator.sol#560-567)
                - (success,returnData) = callee.delegatecall(data) (gGAMMA_Delegator.sol#963)
        - _setImplementation(implementation_,false,becomeImplementationData) (gGAMMA_Delegator.sol#570)
                - (success,returnData) = callee.delegatecall(data) (gGAMMA_Delegator.sol#963)
        State variables written after the call(s):
        - admin = admin_ (gGAMMA_Delegator.sol#573)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#reentrancy-vulnerabilities-1

INFO:Detectors:
EIP20NonStandardInterface (Maximillion.sol#672-734) has incorrect ERC20 function interface:EIP20NonStandardInterface.transfer(address,uint256) (Maximillion.sol#698)
EIP20NonStandardInterface (Maximillion.sol#672-734) has incorrect ERC20 function interface:EIP20NonStandardInterface.transferFrom(address,address,uint256) (Maximillion.sol#712)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-erc20-interface

INFO:Detectors:
Reentrancy in GToken._addReservesInternal(uint256) (gToken_Delegate.sol#2669-2679):
        External calls:
        - error = accrueInterest() (gToken_Delegate.sol#2670)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
        State variables written after the call(s):
        - (error,None) = _addReservesFresh(addAmount) (gToken_Delegate.sol#2677)
                - totalReserves = totalReservesNew (gToken_Delegate.sol#2717)
Reentrancy in GToken._reduceReserves(uint256) (gToken_Delegate.sol#2732-2740):
        External calls:
        - error = accrueInterest() (gToken_Delegate.sol#2733)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
        State variables written after the call(s):
        - _reduceReservesFresh(reduceAmount) (gToken_Delegate.sol#2739)
                - totalReserves = totalReservesNew (gToken_Delegate.sol#2787)
Reentrancy in GToken._setInterestRateModel(InterestRateModel) (gToken_Delegate.sol#2802-2810):
        External calls:
        - error = accrueInterest() (gToken_Delegate.sol#2803)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
        State variables written after the call(s):
        - _setInterestRateModelFresh(newInterestRateModel) (gToken_Delegate.sol#2809)
                - interestRateModel = newInterestRateModel (gToken_Delegate.sol#2840)
Reentrancy in GToken._setReserveFactor(uint256) (gToken_Delegate.sol#2625-2633):
        External calls:
        - error = accrueInterest() (gToken_Delegate.sol#2626)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
        State variables written after the call(s):
        - _setReserveFactorFresh(newReserveFactorMantissa) (gToken_Delegate.sol#2632)
                - reserveFactorMantissa = newReserveFactorMantissa (gToken_Delegate.sol#2657)
Reentrancy in GToken.borrowFresh(address,uint256) (gToken_Delegate.sol#2132-2206):
        External calls:
        - allowed = gammatroller.borrowAllowed(address(this),borrower,borrowAmount) (gToken_Delegate.sol#2134)
        - changeUserBorrowDiscountInternal(borrower) (gToken_Delegate.sol#2153)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
                - (accountBorrows[borrower].principal,accountBorrows[borrower].interestIndex,totalBorrows) = PlanetDiscount(discountLevel).changeUserBorrowDiscount(borrower) (gToken_Delegate.sol#2118)
        State variables written after the call(s):
        - accountBorrows[borrower].principal = vars.accountBorrowsNew (gToken_Delegate.sol#2190)
        - accountBorrows[borrower].interestIndex = borrowIndex (gToken_Delegate.sol#2191)
        - totalBorrows = vars.totalBorrowsNew (gToken_Delegate.sol#2192)
Reentrancy in GToken.borrowInternal(uint256) (gToken_Delegate.sol#2072-2080):
        External calls:
        - error = accrueInterest() (gToken_Delegate.sol#2073)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
        - borrowFresh(msg.sender,borrowAmount) (gToken_Delegate.sol#2079)
                - gammatroller.oracle().validate(address(this)) (gToken_Delegate.sol#1707)
                - [illegible]
PlanetDiscountDelegate.changeAddress(address,address,address)._newGammatroller (PlanetDiscountDelegate.sol#736) lacks a zero-check on :
                - gammatroller = _newGammatroller (PlanetDiscountDelegate.sol#744)
PlanetDiscountDelegate.changeAddress(address,address,address)._newOracle (PlanetDiscountDelegate.sol#736) lacks a zero-check on :
                - oracle = _newOracle (PlanetDiscountDelegate.sol#745)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation

INFO:Detectors:
Exponential.divScalarByExpTruncate(uint256,ExponentialNoError.Exp).fraction (gToken_Delegator.sol#384) shadows:
        - ExponentialNoError.fraction(uint256,uint256) (gToken_Delegator.sol#191-193) (function)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#local-variable-shadowing

INFO:Detectors:
PlanetDiscount.changeAddress(address,address,address)._newgGammaAddress (gToken_Delegator.sol#631) lacks a zero-check on :
                - gGammaAddress = _newgGammaAddress (gToken_Delegator.sol#636)
PlanetDiscount.changeAddress(address,address,address)._newGammatroller (gToken_Delegator.sol#631) lacks a zero-check on :
                - gammatroller = _newGammatroller (gToken_Delegator.sol#637)
PlanetDiscount.changeAddress(address,address,address)._newOracle (gToken_Delegator.sol#631) lacks a zero-check on :
                - oracle = _newOracle (gToken_Delegator.sol#638)
GErc20Delegator.constructor(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8,address,address,bytes).admin_ (gToken_Delegator.sol#1205) lacks a zero-check on :
                - admin = admin_ (gToken_Delegator.sol#1225)
GErc20Delegator._setImplementation(address,bool,bytes).implementation_ (gToken_Delegator.sol#1234) lacks a zero-check on :
                - implementation = implementation_ (gToken_Delegator.sol#1242)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation

INFO:Detectors:
Reentrancy in GErc20Delegator._setImplementation(address,bool,bytes) (gToken_Delegator.sol#1234-1247):
        External calls:
        - delegateToImplementation(abi.encodeWithSignature(_resignImplementation())) (gToken_Delegator.sol#1238)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        - delegateToImplementation(abi.encodeWithSignature(_becomeImplementation(bytes),becomeImplementationData)) (gToken_Delegator.sol#1244)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        Event emitted after the call(s):
        - NewImplementation(oldImplementation,implementation) (gToken_Delegator.sol#1246)
Reentrancy in GErc20Delegator.constructor(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8,address,address,bytes) (gToken_Delegator.sol#1198-1226):
        External calls:
        - delegateTo(implementation_,abi.encodeWithSignature(initialize(address,address,address,uint256,string,string,uint8),underlying_,gammatroller_,interestRateModel_,initialExchangeRateMantissa_,name_,symbol_,decimals_)) (gToken_Delegator.sol#1212-1219)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        - _setImplementation(implementation_,false,becomeImplementationData) (gToken_Delegator.sol#1222)
                - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
        Event emitted after the call(s):
        - NewImplementation(oldImplementation,implementation) (gToken_Delegator.sol#1246)
                - _setImplementation(implementation_,false,becomeImplementationData) (gToken_Delegator.sol#1222)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#reentrancy-vulnerabilities-3

INFO:Detectors:
Exponential.divScalarByExpTruncate(uint256,ExponentialNoError.Exp).fraction (Gammatroller.sol#1169) shadows:
        - ExponentialNoError.fraction(uint256,uint256) (Gammatroller.sol#953-955) (function)
Gammatroller.updateGammaSupplyIndex(address).gammaAccrued (Gammatroller.sol#1433) shadows:
```

AUTOMATED TESTING

```
Unitroller._setPendingAdmin(address).newPendingAdmin (Gammatroller.sol#487) lacks a zero-check on :
                - pendingAdmin = newPendingAdmin (Gammatroller.sol#497)
GToken._setPendingAdmin(address).newPendingAdmin (Gammatroller.sol#2994) lacks a zero-check on :
                - pendingAdmin = newPendingAdmin (Gammatroller.sol#3004)
Gammatroller._setBorrowCapGuardian(address).newBorrowCapGuardian (Gammatroller.sol#4297) lacks a zero-check on :
                - borrowCapGuardian = newBorrowCapGuardian (Gammatroller.sol#4304)
Gammatroller._setPauseGuardian(address).newPauseGuardian (Gammatroller.sol#4315) lacks a zero-check on :
                - pauseGuardian = newPauseGuardian (Gammatroller.sol#4324)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation

INFO:Detectors:
Gammatroller.getHypotheticalAccountLiquidityInternal(address,GToken,uint256,uint256) (Gammatroller.sol#4035-4091) has external calls inside a loop: (oErr,vars.gTokenBalance,vars.borrowBalance,vars.exchangeRateMantissa) = asset.getAccountSnapshot(account) (Gammatroller.sol#4050)
Gammatroller.getHypotheticalAccountLiquidityInternal(address,GToken,uint256,uint256) (Gammatroller.sol#4035-4091) has external calls inside a loop: vars.oraclePriceMantissa = oracle.getUnderlyingPrice(asset) (Gammatroller.sol#4058)
Gammatroller.claimGamma(address[],GToken[],bool,bool) (Gammatroller.sol#4556-4577) has external calls inside a loop: borrowIndex = Exp(gToken.borrowIndex()) (Gammatroller.sol#4561)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation/#calls-inside-a-loop

INFO:Detectors:
Variable 'Gammatroller.borrowAllowed(address,address,uint256).err (Gammatroller.sol#3665)' in Gammatroller.borrowAllowed(address,address,uint256) (Gammatroller.sol#3652-3701) potentially used before declaration: (err,shortfall) = getHypotheticalAccountLiquidityInternal(borrower,GToken(gToken),0,borrowAmount) (Gammatroller.sol#3687)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#pre-declaration-usage-of-local-variables

INFO:Detectors:
Reentrancy in GToken.borrowFresh(address,uint256) (Gammatroller.sol#2599-2663):
        External calls:
        - allowed = gammatroller.borrowAllowed(address(this),borrower,borrowAmount) (Gammatroller.sol#2601)
        State variables written after the call(s):
        - accountBorrows[borrower].principal = vars.accountBorrowsNew (Gammatroller.sol#2651)
        - accountBorrows[borrower].interestIndex = borrowIndex (Gammatroller.sol#2652)
        - totalBorrows = vars.totalBorrowsNew (Gammatroller.sol#2653)
Reentrancy in GToken.mintFresh(address,uint256) (Gammatroller.sol#2359-2424):
        External calls:
        - allowed = gammatroller.mintAllowed(address(this),minter,mintAmount) (Gammatroller.sol#2361)
        State variables written after the call(s):
        - accountTokens[minter] = vars.accountTokensNew (Gammatroller.sol#2413)
        - totalSupply = vars.totalSupplyNew (Gammatroller.sol#2412)
Reentrancy in GToken.redeemFresh(address,uint256,uint256) (Gammatroller.sol#2476-2570):
        External calls:
        - allowed = gammatroller.redeemAllowed(address(this),redeemer,vars.redeemTokens) (Gammatroller.sol#2516)
        State variables written after the call(s):
        - accountTokens[redeemer] = vars.accountTokensNew (Gammatroller.sol#2560)
Reentrancy in GToken.repayBorrowFresh(address,address,uint256) (Gammatroller.sol#2714-2781):
        External calls:
        - allowed = gammatroller.repayBorrowAllowed(address(this),payer,borrower,repayAmount) (Gammatroller.sol#2716)
        State variables written after the call(s):
        - accountBorrows[borrower].principal = vars.accountBorrowsNew (Gammatroller.sol#2769)
        - accountBorrows[borrower].interestIndex = borrowIndex (Gammatroller.sol#2770)
Exponential.divScalarByExpTruncate(uint256,ExponentialNoError.Exp).fraction (gAQUA_Delegate.sol#664) shadows:
        - ExponentialNoError.fraction(uint256,uint256) (gAQUA_Delegate.sol#471-473) (function)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#local-variable-shadowing

INFO:Detectors:
GErc20.initialize(address,GammatrollerInterface,InterestRateModel,uint256,string,string,uint8).underlying_ (gAQUA_Delegate.sol#2907) lacks a zero-check on :
                - underlying = underlying_ (gAQUA_Delegate.sol#2918)
GToken._setPendingAdmin(address).newPendingAdmin (gAQUA_Delegate.sol#2550) lacks a zero-check on :
                - pendingAdmin = newPendingAdmin (gAQUA_Delegate.sol#2560)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation

INFO:Detectors:
Variable 'GErc20.updateDiscountForAll().exist (gAQUA_Delegate.sol#3046)' in GErc20.updateDiscountForAll() (gAQUA_Delegate.sol#3039-3059) potentially used before declaration: (exist) = PlanetDiscount(discountLevel).supplyDiscountSnap(address(this),usersWhoHaveSupply[i_scope_0]) (gAQUA_Delegate.sol#3053)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#pre-declaration-usage-of-local-variables

INFO:Detectors:
Reentrancy in GToken.mintFresh(address,uint256) (gAQUA_Delegate.sol#1830-1904):
        External calls:
        - allowed = gammatroller.mintAllowed(address(this),minter,mintAmount) (gAQUA_Delegate.sol#1832)
        - changeUserSupplyDiscountInternal(minter) (gAQUA_Delegate.sol#1845)
                - (totalSupply,accountTokens[minter]) = PlanetDiscount(discountLevel).changeUserSupplyDiscount(minter) (gAQUA_Delegate.sol#1820)
        State variables written after the call(s):
        - changeUserSupplyDiscountInternal(minter) (gAQUA_Delegate.sol#1845)
                - (totalSupply,accountTokens[minter]) = PlanetDiscount(discountLevel).changeUserSupplyDiscount(minter) (gAQUA_Delegate.sol#1820)
        - accountTokens[minter] = vars.accountTokensNew (gAQUA_Delegate.sol#1889)
        - changeUserSupplyDiscountInternal(minter) (gAQUA_Delegate.sol#1845)
                - (totalSupply,accountTokens[minter]) = PlanetDiscount(discountLevel).changeUserSupplyDiscount(minter) (gAQUA_Delegate.sol#1820)
        - totalSupply = vars.totalSupplyNew (gAQUA_Delegate.sol#1888)
Reentrancy in GToken.redeemFresh(address,uint256,uint256) (gAQUA_Delegate.sol#1961-2064):
        External calls:
        - changeUserSupplyDiscountInternal(redeemer) (gAQUA_Delegate.sol#1965)
                - (totalSupply,accountTokens[minter]) = PlanetDiscount(discountLevel).changeUserSupplyDiscount(minter) (gAQUA_Delegate.sol#1820)
        - allowed = gammatroller.redeemAllowed(address(this),redeemer,vars.redeemTokens) (gAQUA_Delegate.sol#2005)
        State variables written after the call(s):
        - accountTokens[redeemer] = vars.accountTokensNew (gAQUA_Delegate.sol#2050)
Reentrancy in GToken.seizeInternal(address,address,address,uint256) (gAQUA_Delegate.sol#2479-2539):
        External calls:
        - allowed = gammatroller.seizeAllowed(address(this),seizerToken,liquidator,borrower,seizeTokens) (gAQUA_Delegate.sol#2481)
        State variables written after the call(s):
        - accountTokens[borrower] = vars.borrowerTokensNew (gAQUA_Delegate.sol#2526)
        - accountTokens[liquidator] = vars.liquidatorTokensNew (gAQUA_Delegate.sol#2527)
        - totalReserves = vars.totalReservesNew (gAQUA_Delegate.sol#2524)
        - totalSupply = vars.totalSupplyNew (gAQUA_Delegate.sol#2525)
Reentrancy in GToken.transferTokens(address,address,address,uint256) (gAQUA_Delegate.sol#1388-1448):
        External calls:
        - allowed = gammatroller.transferAllowed(address(this),src,dst,tokens) (gAQUA_Delegate.sol#1390)
        State variables written after the call(s):
UniswapAnchoredView.validate(address) (UniswapAnchoredView.sol#242-306) uses timestamp for comparisons
        Dangerous comparisons:
        - error2 != Error.NO_ERROR (UniswapAnchoredView.sol#255)
        - error3 != Error.NO_ERROR (UniswapAnchoredView.sol#262)
        - anchorPrice >= 2 ** 248 (UniswapAnchoredView.sol#270)
        - error4 != Error.NO_ERROR (UniswapAnchoredView.sol#282)
        - reportedPrice >= 2 ** 248 (UniswapAnchoredView.sol#289)
UniswapAnchoredView.pokeFailedOverPrice(bytes32) (UniswapAnchoredView.sol#314-326) uses timestamp for comparisons
        Dangerous comparisons:
        - error != Error.NO_ERROR (UniswapAnchoredView.sol#319)
        - require(bool,string)(anchorPrice < 2 ** 248,Anchor price too large) (UniswapAnchoredView.sol#322)
UniswapAnchoredView.calculateAnchorPriceFromEthPrice(UniswapConfig.TokenConfig) (UniswapAnchoredView.sol#333-350) uses timestamp for comparisons
        Dangerous comparisons:
        - error != Error.NO_ERROR (UniswapAnchoredView.sol#336)
        - error != Error.NO_ERROR (UniswapAnchoredView.sol#346)
UniswapAnchoredView.convertReportedPrice(UniswapConfig.TokenConfig,int256) (UniswapAnchoredView.sol#358-375) uses timestamp for comparisons
        Dangerous comparisons:
        - err != Error.NO_ERROR (UniswapAnchoredView.sol#369)
UniswapAnchoredView.isWithinAnchor(uint256,uint256) (UniswapAnchoredView.sol#378-392) uses timestamp for comparisons
        Dangerous comparisons:
        - reporterPrice > 0 (UniswapAnchoredView.sol#379)
        - err != Error.NO_ERROR (UniswapAnchoredView.sol#383)
        - (Error.NO_ERROR,anchorRatio <= upperBoundAnchorRatio && anchorRatio >= lowerBoundAnchorRatio) (UniswapAnchoredView.sol#389)
UniswapAnchoredView.fetchAnchorPrice(bytes32,UniswapConfig.TokenConfig,uint256) (UniswapAnchoredView.sol#418-463) uses timestamp for comparisons
        Dangerous comparisons:
        - require(bool,string)(block.timestamp > oldTimestamp,now must come after before) (UniswapAnchoredView.sol#422)
        - error1 != Error.NO_ERROR (UniswapAnchoredView.sol#431)
        - error2 != Error.NO_ERROR (UniswapAnchoredView.sol#451)
UniswapAnchoredView.pokeWindowValues(UniswapConfig.TokenConfig) (UniswapAnchoredView.sol#469-486) uses timestamp for comparisons
        Dangerous comparisons:
        - timeElapsed >= anchorPeriod (UniswapAnchoredView.sol#477)
UniswapAnchoredView.mul(uint256,uint256) (UniswapAnchoredView.sol#510-519) uses timestamp for comparisons
        Dangerous comparisons:
        - a == 0 (UniswapAnchoredView.sol#511)
        - c / a != b (UniswapAnchoredView.sol#514)
UniswapV2OracleLibrary.currentCumulativePrices(address) (UniswapLib.sol#43-61) uses timestamp for comparisons
        Dangerous comparisons:
        - blockTimestampLast != blockTimestamp (UniswapLib.sol#52)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#block-timestamp

INFO:Detectors:
Reservoir.changeFoundationAddress(address)._newFoundation (Reservoir.sol#416) lacks a zero-check on :
                - foundation = _newFoundation (Reservoir.sol#420)
Reservoir.changeTreasuryAddress(address)._newTreasury (Reservoir.sol#426) lacks a zero-check on :
                - treasury = _newTreasury (Reservoir.sol#430)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation
```

AUTOMATED TESTING

```
INFO:Detectors:
Redundant expression "minter (PlanetDiscountDelegate.sol#951)" inPlanetDiscountDelegate (PlanetDiscountDelegate.sol#734-976)
Redundant expression "exchangeRate (PlanetDiscountDelegate.sol#952)" inPlanetDiscountDelegate (PlanetDiscountDelegate.sol#734-976)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#redundant-statements

INFO:Detectors:
Low level call in GErc20Delegator.delegateTo(address,bytes) (gToken_Delegator.sol#1640-1648):
        - (success,returnData) = callee.delegatecall(data) (gToken_Delegator.sol#1641)
Low level call in GErc20Delegator.delegateToViewImplementation(bytes) (gToken_Delegator.sol#1667-1675):
        - (success,returnData) = address(this).staticcall(abi.encodeWithSignature(delegateToImplementation(bytes),data)) (gToken_Delegator.sol#1668)
Low level call in GErc20Delegator.fallback() (gToken_Delegator.sol#1681-1695):
        - (success) = implementation.delegatecall(msg.data) (gToken_Delegator.sol#1685)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-level-calls

INFO:Detectors:
Redundant expression "this (gToken_Delegator.sol#544)" inContext (gToken_Delegator.sol#538-547)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#redundant-statements

INFO:Detectors:
Gammatroller.addToMarketInternal(GToken,address) (Gammatroller.sol#3452-3476) compares to a boolean constant:
        -marketToJoin.accountMembership[borrower] == true (Gammatroller.sol#3460)
Gammatroller._setMintPaused(GToken,bool) (Gammatroller.sol#4332-4340) compares to a boolean constant:
        -require(bool,string)(msg.sender == admin || state == true,only admin can unpause) (Gammatroller.sol#4335)
Gammatroller._setBorrowPaused(GToken,bool) (Gammatroller.sol#4342-4350) compares to a boolean constant:
        -require(bool,string)(msg.sender == admin || state == true,only admin can unpause) (Gammatroller.sol#4345)
Gammatroller._setTransferPaused(bool) (Gammatroller.sol#4352-4359) compares to a boolean constant:
        -require(bool,string)(msg.sender == admin || state == true,only admin can unpause) (Gammatroller.sol#4354)
Gammatroller._setSeizePaused(bool) (Gammatroller.sol#4361-4368) compares to a boolean constant:
        -require(bool,string)(msg.sender == admin || state == true,only admin can unpause) (Gammatroller.sol#4363)
Gammatroller.setGammaSpeedInternal(GToken,uint256) (Gammatroller.sol#4389-4420) compares to a boolean constant:
        -require(bool,string)(market.isListed == true,gammamarket is not listed) (Gammatroller.sol#4399)
Gammatroller.claimGamma(address[],GToken[],bool,bool) (Gammatroller.sol#4556-4577) compares to a boolean constant:
        -suppliers == true (Gammatroller.sol#4567)
Gammatroller.claimGamma(address[],GToken[],bool,bool) (Gammatroller.sol#4556-4577) compares to a boolean constant:
        -borrowers == true (Gammatroller.sol#4560)
Gammatroller.isDeprecated(GToken) (Gammatroller.sol#4656-4662) compares to a boolean constant:
        -markets[address(gToken)].collateralFactorMantissa == 0 && borrowGuardianPaused[address(gToken)] == true && gToken.reserveFactorMantissa() == 1e18 (Gammatroller.sol#4657-4660)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#boolean-equality

INFO:Detectors:
Low level call in Unitroller.fallback() (Gammatroller.sol#537-549):
        - (success) = implementation.delegatecall(msg.data) (Gammatroller.sol#539)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-level-calls
```

```
GToken (Gammatroller.sol#1877-3320) does not implement functions:
        - GToken.doTransferIn(address,uint256) (Gammatroller.sol#3299)
        - GToken.doTransferOut(address,uint256) (Gammatroller.sol#3306)
        - GToken.getCashPrior() (Gammatroller.sol#3293)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unimplemented-functions

INFO:Detectors:
Redundant expression "this (gAQUA_Delegate.sol#820)" inContext (gAQUA_Delegate.sol#814-823)
Redundant expression "data (gAQUA_Delegate.sol#3173)" inGErc20Delegate (gAQUA_Delegate.sol#3161-3194)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#redundant-statements

INFO:Detectors:
Low level call in Unitroller.fallback() (Unitroller.sol#2590-2603):
        - (success) = implementation.delegatecall(msg.data) (Unitroller.sol#2592)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-level-calls

INFO:Detectors:
GToken (Unitroller.sol#817-2373) does not implement functions:
        - GToken.checkTransferIn(address,uint256) (Unitroller.sol#2358)
        - GToken.doTransferIn(address,uint256) (Unitroller.sol#2365)
        - GToken.doTransferOut(address,uint256) (Unitroller.sol#2372)
        - GToken.getCashPrior() (Unitroller.sol#2352)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#unimplemented-functions

INFO:Detectors:
Redundant expression "data (gGAMMA_Delegate.sol#3043)" inGErc20Delegate (gGAMMA_Delegate.sol#3031-3064)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#redundant-statements

INFO:Detectors:
Gamma.slitherConstructorConstantVariables() (GAMMA.sol#8-305) uses literals with too many digits:
        - totalSupply = 100000000e18 (GAMMA.sol#19)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#too-many-digits

INFO:Detectors:
Redundant expression "this (Reservoir.sol#22)" inContext (Reservoir.sol#16-25)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#redundant-statements

INFO:Detectors:
Reservoir.slitherConstructorConstantVariables() (Reservoir.sol#262-562) uses literals with too many digits:
        - maxGammaDrippedPerDay = 100000 (Reservoir.sol#303)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#too-many-digits

INFO:Detectors:
Low level call in PlanetDiscountDelegator.fallback() (PlanetDiscountDelegator.sol#50-64):
        - (success) = implementation.delegatecall(msg.data) (PlanetDiscountDelegator.sol#54)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-level-calls
```

According to the test results, some findings found by these tools were considered as false positives, while some of these findings were real security concerns. All relevant findings were reviewed by the auditors and addressed in the report as security concerns.

4.2 AUTOMATED SECURITY SCAN

Description:

Halborn used automated security scanners to assist with detection of well-known security issues, and to identify low-hanging fruits on the target contracts. Among the tools used was MythX, a security analysis service for Ethereum smart contracts. MythX performed a scan on the testers machine and sent the compiled results to the analyzers to locate any vulnerabilities. Only security-related findings are shown below.

Results:

Report for PlanetDiscountDelegate.sol
https://dashboard.mythx.io/#/console/analyses/53207a63-cce7-4ec4-bfc5-121024beb9c1

Line	SWC Title	Severity	Short Description
1	(SWC-103) Floating Pragma	Low	A floating pragma is set.
651	(SWC-123) Requirement Violation	Low	Requirement violation.
712	(SWC-123) Requirement Violation	Low	Requirement violation.
715	(SWC-113) DoS with Failed Call	Low	Multiple calls are executed in the same transaction.

Report for PlanetDiscountStorage.sol
https://dashboard.mythx.io/#/console/analyses/a956871e-fff2-4e7b-9221-7104dbe13a50

Line	SWC Title	Severity	Short Description
1	(SWC-103) Floating Pragma	Low	A floating pragma is set.

Report for Reservoir.sol
https://dashboard.mythx.io/#/console/analyses/c861a5e1-7850-452d-9484-8ee14a86e708

Line	SWC Title	Severity	Short Description
7	(SWC-103) Floating Pragma	Low	A floating pragma is set.
341	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
372	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for PlanetDiscountDelegator.sol
https://dashboard.mythx.io/#/console/analyses/f54bfed0-84a3-4dae-acac-b816b1c2cd53

Line	SWC Title	Severity	Short Description
1	(SWC-103) Floating Pragma	Low	A floating pragma is set.
37	(SWC-112) Delegatecall to Untrusted Callee	High	The contract delegates execution to another contract with a user-supplied address.

Report for GAMMA.sol

Line	SWC Title	Severity	Short Description
194	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
267	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for PlanetDiscountDelegate.sol

Line	SWC Title	Severity	Short Description
651	(SWC-123) Requirement Violation	Low	Requirement violation.
712	(SWC-123) Requirement Violation	Low	Requirement violation.
715	(SWC-113) DoS with Failed Call	Low	Multiple calls are executed in the same transaction.

Report for Maximillion.sol

Line	SWC Title	Severity	Short Description
1237	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for PlanetDiscountDelegator.sol

Line	SWC Title	Severity	Short Description
37	(SWC-112) Delegatecall to Untrusted Callee	High	The contract delegates execution to another contract with a user-supplied address.

Report for Unitroller.sol

Line	SWC Title	Severity	Short Description
1204	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for priceOracle.sol

Line	SWC Title	Severity	Short Description
1062	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
2287	(SWC-123) Requirement Violation	Low	Requirement violation.
2434	(SWC-123) Requirement Violation	Low	Requirement violation.

Report for gErc20_delegate.sol

Line	SWC Title	Severity	Short Description
1469	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for Gammatroller.sol

Line	SWC Title	Severity	Short Description
196	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
269	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
2090	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
4665	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for gErc20Delegate_Discount.sol

Line	SWC Title	Severity	Short Description
1543	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for gEther_Discount.sol

Line	SWC Title	Severity	Short Description
1237	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

Report for Reservoir.sol

Line	SWC Title	Severity	Short Description
341	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.
372	(SWC-120) Weak Sources of Randomness from Chain Attributes	Low	Potential use of "block.number" as source of randonmness.

All relevant valid findings were founded in the manual code review.

THANK YOU FOR CHOOSING

// HALBORN