

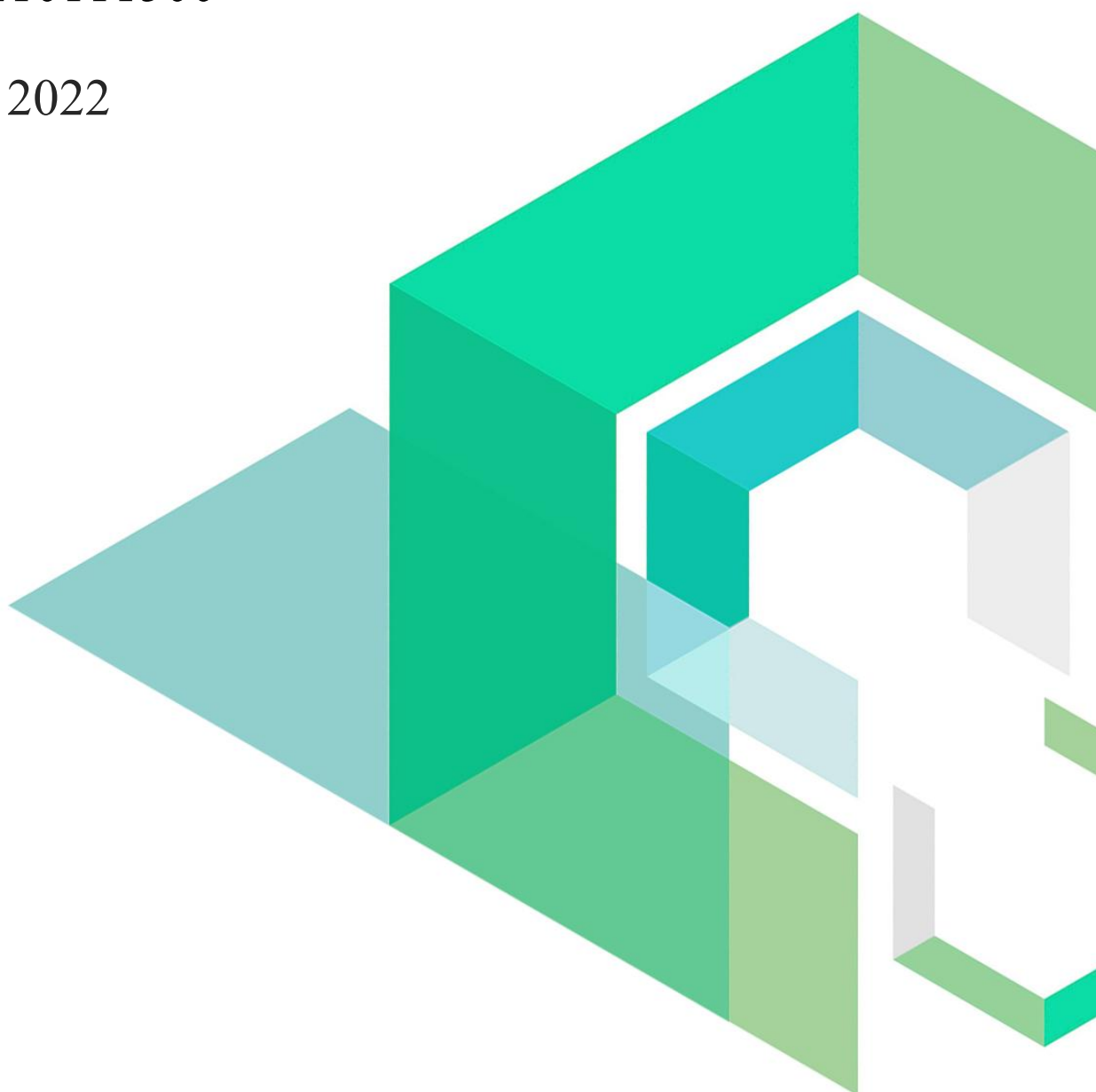
LeverFi

Smart Contract Security Audit

V1.1

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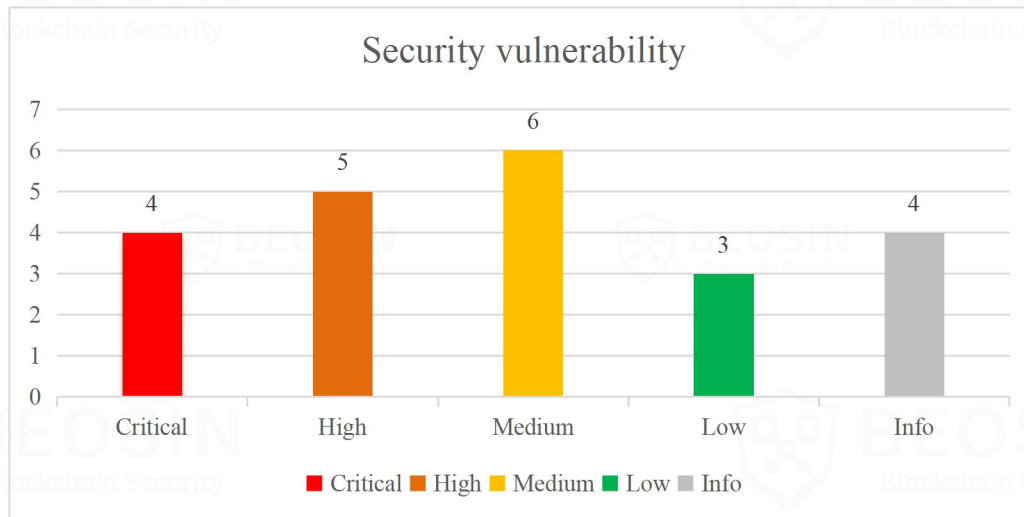
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Summary of audit results

After auditing, 4 Critical-risk, 5 High-risk, 6 Medium-risk, 3 Low-risk and 4 Info-risk items were identified in the LeverFi project. Specific audit details will be presented in the **Findings** section. Users should pay attention to the following aspects when interacting with this project:



*Notes:

● Risk Description:

1. This project only audits the internal code of the project, and does not audit the interactive contract. Audited contracts include UserConfiguration.sol, CollateralLogic.sol, CollateralPoolLogic.sol, GeneralLogic.sol, LiquidationLogic.sol, PositionLogic.sol, ReserveLogic.sol, ReservePoolLogic.sol, TradeLogic.sol, ValidationLogic.sol, ChainLinkPriceOracleGetter.sol, CurveLPOracleGetter.sol, MockPriceOracle.sol, StargateLPOracleGetter.sol, TriCryptoOracle.sol, AaveReinvestmentLogic.sol, ConvexReinvestmentLogic.sol, StargateReinvestmentLogic.sol, ReinvestmentProxy.sol, ZeroexSwapAdapter.sol, DataTypes.sol, UnwrapLp.sol, BonusPool.sol, Configurator.sol, UserData.sol and Ledger.sol
2. There is test code in the project, please do not use the test code, such as MockPriceOracle.sol, etc.
3. This audit report is only for the current code, but the business logic contract of the current project can be upgraded, and the code after the upgrade cannot be determined. After the upgrade, the risk of loss of funds and data may be introduced. When users interact with this project, they need to pay attention to whether the upgraded logic contract is consistent with the audit code.

- **Project Description:**

- 1. Business overview**

The LeverFi project is a revenue aggregation project that allows liquidity providers to provide funds to earn interest. Liquidity providers deposit funds into lending pools, and lenders earn interest from borrowing leveraged traders. Idle assets in lending pools that are not used (unused liquidity) by traders will be deployed to other DeFi protocols for yield. When a trader deposits BTC, ETH, Curve-LP, Uni-LP and other collaterals in the collateral pool, the contract will deposit the collateral into the DeFi protocol to obtain benefits, while allowing traders to perform leveraged transactions. Leveraged trades are only entered, stored and settled within the LeverFi platform. If a trade loses close to the value of the deposited collateral, the liquidator system will make a margin call to the trader.

1 Overview

1.1 Project Overview

Project Name	LeverFi
Platform	Ethereum
Github	https://github.com/LeverFi/main-contracts
Commit	ed904fe9caabab160fdaed965094613236ba9308(original) 507b98052874d5b3caeca60337f69a2faa8075b0(fixed)

1.2 Audit Overview

Audit work duration: August 4, 2022 – October 11, 2022

Audit methods: Formal Verification, Static Analysis, Typical Case Testing and Manual Review.

Audit team: Beosin Security Team

2 Findings

Index	Risk description	Severity level	Status
LeverFi-1	The <i>initialize</i> function lacks permission check	Critical	Fixed
LeverFi-2	The <i>swapPosition</i> function lacks permission check	Critical	Fixed
LeverFi-3	The <i>swap</i> function is improperly designed	Critical	Fixed
LeverFi-4	The <i>withdrawLiquidationWalletLong</i> function is improperly designed	Critical	Fixed
LeverFi-5	DoS attack	High	Fixed
LeverFi-6	The <i>_calculateRewards</i> function design flaw	High	Fixed
LeverFi-7	The <i>_depositReserve</i> function is improperly designed	High	Fixed
LeverFi-8	The <i>configureAsset</i> function is improperly designed	High	Fixed
LeverFi-9	Clearing mechanism error	High	Fixed
LeverFi-10	The <i>getNormalizedDebt</i> function is improperly designed	Medium	Fixed
LeverFi-11	Implementation flaws in the <i>reinvestReserveSupply</i> and <i>reinvestCollateralSupply</i> functions	Medium	Fixed
LeverFi-12	Unsafe call	Medium	Fixed
LeverFi-13	The <i>configureReserve</i> function design flaw	Medium	Fixed
LeverFi-14	Centralization risk	Medium	Fixed
LeverFi-15	The <i>_repayShort</i> function is improperly designed	Medium	Fixed
LeverFi-16	Improperly designed <i>_depositCollateral</i> function	Low	Fixed
LeverFi-17	The <i>validateTrade</i> function check error	Low	Fixed
LeverFi-18	The <i>configureCollateral</i> function cannot modify reinvestment	Low	Fixed
LeverFi-19	lack of judgment on value	Info	Fixed
LeverFi-20	The <i>getUserLiquidity</i> function design flaw	Info	Fixed
LeverFi-21	Lack of judgment on whether to add assets	Info	Fixed
LeverFi-22	Admin permission not initialized	Info	Fixed

Finding Details:

[LeverFi-1] The *initialize* function lacks permission check

Severity Level	Critical
Type	Business Security
Lines	AaveReinvestmentLogic.sol,ConvexReinvestmentLogic.sol#L47,79
Description	In the initialize of the ConvexReinvestmentLogic and AaveReinvestmentLogic contracts, there is no permission to check and use the Initializable contract, which will cause anyone to call this function to modify it, thereby withdrawing the funds in the contract.

```

37
38  function initialize(
39      address asset_,
40      address receipt_,
41      address platform_,
42      address[] memory,
43      address treasury_,
44      address ledger_,
45      uint256,
46      bytes memory
47  ) public {
48      asset = asset_;
49      addressStorage[RECEIPT] = receipt_;
50      addressStorage[PLATFORM] = platform_;
51      treasury = treasury_;
52      ledger = ledger_;
53
54      // Fees does not applied to this type of reinvestment (auto-accruing reward).
55      feeMantissa = 0;
56  }

```

Figure 1 Source code of AaveReinvestmentLogic contract(Unfixed)

```

69  /**
70  function initialize(
71      address asset_,
72      address receipt_,
73      address platform_,
74      address[] memory rewards_,
75      address treasury_,
76      address ledger_,
77      uint256 feeMantissa_,
78      bytes memory data
79  ) public {
80      asset = asset_;
81      addressStorage[RECEIPT] = receipt_;
82      addressStorage[PLATFORM] = platform_;
83      treasury = treasury_;
84      ledger = ledger_;
85      feeMantissa = feeMantissa_;
86
87      (uint256 poolId_, address rewardPool_) = abi.decode(data, (uint256, address));
88      uintStorage[POOL_ID] = poolId_;
89      addressStorage[REWARD_POOL] = rewardPool_;
90
91      uintStorage[REWARD_LENGTH] = rewards_.length;
92
93      for (uint256 i = 0; i < rewards_.length; i++) {
94          setRewards(i, RewardConfig(i, rewards_[i], 0, 0));
95      }
96  }

```

Figure 2 Source code of ConvexReinvestmentLogic contract(Unfixed)

Recommendations It is recommended to use the Initializable contract.

Fixed.

```
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```

```
function initialize(
    address asset_,
    address receipt_,
    address platform_,
    address[] memory,
    address treasury_,
    address ledger_,
    uint256,
    bytes memory
) external initializer onlyOwner {
    asset = asset_;
    addressStorage[RECEIPT] = receipt_;
    addressStorage[PLATFORM] = platform_;
    treasury = treasury_;
    ledger = ledger_;

    // Fees does not applied to this type of reinvestment (auto-accruing reward).
    feeMantissa = 0;
}
```

Figure 3 Source code of AaveReinvestmentLogic contract(Fixed)

```

70  */
71  function initialize(
72      address asset_,
73      address receipt_,
74      address platform_,
75      address[] memory rewards_,
76      address treasury_,
77      address ledger_,
78      uint256 feeMantissa_,
79      bytes memory data
80  ) external initializer onlyOwner {
81      asset = asset_;
82      addressStorage[RECEIPT] = receipt_;
83      addressStorage[PLATFORM] = platform_;
84      treasury = treasury_;
85      ledger = ledger_;
86      feeMantissa = feeMantissa_;
87
88      (uint256 poolId_, address rewardPool_) = abi.decode(data, (uint256, address));
89      uintStorage[POOL_ID] = poolId_;
90      addressStorage[REWARD_POOL] = rewardPool_;
91
92      uintStorage[REWARD_LENGTH] = rewards_.length;
93
94      for (uint256 i = 0; i < rewards_.length; i++) {
95          setRewards(i, RewardConfig(i, rewards_[i], 0, 0));
96      }
97  }

```

Figure 4 Source code of ConvexReinvestmentLogic contract(Fixed)

[LeverFi-2] The *swapPosition* function lacks permission check

Severity Level	Critical
Type	General Vulnerability
Lines	Ledger.sol#L1147
Description	The <i>swapPosition</i> function lacks permission verification. Anyone can execute this function and use the contract's tokens to swap, which will result in a loss of contract funds.

```

1146
1147 ✓ function swapPosition(address assetIn, address assetOut, uint256 amount, bytes memory data) external {
1148 ✓     TradeLogic.executeTrade(
1149         _reserveConfig,
1150         assetConfig,
1151         _userPosition[LIQUIDATION_WALLET],
1152         userConfig[LIQUIDATION_WALLET],
1153 ✓         DataTypes.ExecuteSwapParams(
1154             LIQUIDATION_WALLET,
1155             treasury,
1156             assetIn,
1157             assetOut,
1158             amount,
1159             tradeFeeMantissa,
1160             0,
1161             0,
1162             0,
1163             data,
1164             false,
1165             false
1166         )
1167     );
1168 }
1169

```

Figure 5 Source code of *swapPosition* function(Unfixed)

```

79
80 /**
81  * function executeTrade(
82  *     mapping(address => DataTypes.ReserveConfig) storage reserveConfig,
83  *     mapping(address => DataTypes.AssetConfig) storage assetConfig,
84  *     mapping(address => DataTypes.UserPosition) storage userPosition,
85  *     DataTypes.UserConfiguration storage userConfig,
86  *     DataTypes.ExecuteSwapParams memory params
87  * ) external {
88     ExecuteTradeVars memory vars;
89     vars.assetConfigCache[0] = assetConfig[params.shortAsset];
90     vars.assetConfigCache[1] = assetConfig[params.longAsset];
91     executeShorting(
92         reserveConfig[params.shortAsset],
93         vars.assetConfigCache[0],
94         userPosition[params.shortAsset],
95         userConfig,
96         params.amount,
97         true
98     );
99     if (params.applyFees) {
100         vars.feeAmount = params.amount.wadMul(params.tradeFeeMantissa);
101         params.amount = params.amount - vars.feeAmount;
102         IERC20Upgradeable(params.shortAsset).safeTransfer(params.treasury, vars.feeAmount);
103     }
104     if (
105         IERC20Upgradeable(params.shortAsset).allowance(address(this), address(vars.assetConfigCache[0].swapAdapter)) < params.amount
106     ) {
107         IERC20Upgradeable(params.shortAsset).safeApprove(address(vars.assetConfigCache[0].swapAdapter), type(uint256).max);
108     }
109     vars.receivedAmount = vars.assetConfigCache[0].swapAdapter.swap(params.shortAsset, params.longAsset, params.amount, params.data);
110     uint256 increaseShortAmount = GeneralLogic.getAssetUsed(
111         vars.assetConfigCache[0],

```

Figure 6 Source code of *executeTrade* function

Recommendations	It is recommended to add the permission check of the function caller.
Status	Fixed.

```

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function swapPosition(address assetIn, address assetOut, uint256 amount, bytes memory data) external onlyLiquidateExecutor {
    TradeLogic.executeTrade(
        _reserveConfig,
        assetConfig,
        _userPosition[LIQUIDATION_WALLET],
        userConfig[LIQUIDATION_WALLET],
        DataTypes.ExecuteSwapParams(
            LIQUIDATION_WALLET,
            treasury,
            assetIn,
            assetOut,
            amount,
            tradeFeeMantissa,
            0,
            0,
            0,
            data,
            false,
            false
        )
    );
}

```

Figure 7 Source code of *swapPosition* function(Fixed)

[LeverFi-3] The *swap* function is improperly designed

Severity Level	Critical
Type	Business Security
Lines	Ledger.sol,ZeroexSwapAdapter.sol#L20-54
Description	When trading, the user can pass in the specified asset for swap, instead of swapping according to the actual asset, so that the user can pass in the fake tokens in exchange for the funds of the protocol.

```

445 function trade(address shortAsset, address longAsset, uint256 amount, bytes memory data) external {
446     executeTrade(msg.sender, shortAsset, longAsset, amount, data);
447 }
448
449 /**

```

Figure 8 Source code of *trade* function

```

79 /**
80 function executeTrade(
81     mapping(address => DataTypes.ReserveConfig) storage reserveConfig,
82     mapping(address => DataTypes.AssetConfig) storage assetConfig,
83     mapping(address => DataTypes.UserPosition) storage userPosition,
84     DataTypes.UserConfiguration storage userConfig,
85     DataTypes.ExecuteSwapParams memory params
86 ) external {
87     ExecuteTradeVars memory vars;
88     vars.assetConfigCache[0] = assetConfig[params.shortAsset];
89     vars.assetConfigCache[1] = assetConfig[params.longAsset];
90     executeShorting(
91         reserveConfig[params.shortAsset],
92         vars.assetConfigCache[0],
93         userPosition[params.shortAsset],
94         userConfig,
95         params.amount,
96         true
97     );
98     if (params.applyFees) {
99         vars.feeAmount = params.amount.wadMul(params.tradeFeeMantissa);
100         params.amount = params.amount - vars.feeAmount;
101         IERC20Upgradeable(params.shortAsset).safeTransfer(params.treasury, vars.feeAmount);
102     }
103     if (
104         IERC20Upgradeable(params.shortAsset).allowance(address(this), address(vars.assetConfigCache[0].swapAdapter)) < params.amount
105     ) {
106         IERC20Upgradeable(params.shortAsset).safeApprove(address(vars.assetConfigCache[0].swapAdapter), type(uint256).max);
107     }
108     vars.receivedAmount = vars.assetConfigCache[0].swapAdapter.swap(params.shortAsset, params.longAsset, params.amount, params.data);
109     uint256 increaseShortAmount = GeneralLogic.getAssetUsed(
110         vars.assetConfigCache[0].

```

Figure 9 Source code of *executeTrade* function

```

20 /**
21 function swap(address, address, uint256 amountToSwap, bytes memory swapBytesData) external override returns (uint256) {
22     (address approveRouter, address sellingAsset, address buyingAsset, bytes memory swapBytes) = abi.decode(swapBytesData, (address,address,address,bytes));
23     uint256 buyingAssetBalancePrior = IERC20Upgradeable(buyingAsset).balanceOf(address(this));
24     IERC20Upgradeable(sellingAsset).safeTransferFrom(msg.sender, address(this), amountToSwap);
25
26     // approve to appropriate router (Note: router is the part of swapBytes data. Do not take from the swap func arg. The function arg is given because for other swaps like linch
27
28     IERC20Upgradeable(sellingAsset).safeIncreaseAllowance(approveRouter, amountToSwap);
29
30     (bool success, bytes memory data) = approveRouter.call(swapBytes);
31
32     if(!success){
33         assembly {
34             let returndata_size := mload(data)
35             revert(add(32, data), returndata_size)
36         }
37     }
38
39     // check balance after swap
40     uint256 buyingAssetBalance = IERC20Upgradeable(buyingAsset).balanceOf(address(this));
41     uint256 receivedAmount = buyingAssetBalance - buyingAssetBalancePrior;
42
43     IERC20Upgradeable(buyingAsset).safeTransfer(msg.sender, receivedAmount);
44
45     return receivedAmount;
46 }

```

Figure 10 Source code of *swap* function(Unfixed)

Recommendations It is recommended that the code use the incoming params.shortAsset and params.longAsset instead of relying on the selling asset and buy asset in the data entered by the user.

Status Fixed.

```

32 function swap(address sellingAsset, address buyingAsset, uint256 amountToSwap, bytes memory swapBytesData) external override returns (uint256) {
33     (address approveRouter, bytes memory swapBytes) = abi.decode(swapBytesData, (address, address, address, bytes));
34     require(routersList[approveRouter], "disabled router address");
35     uint256 buyingAssetBalancePrior = IERC20Upgradeable(buyingAsset).balanceOf(address(this));
36     IERC20Upgradeable(sellingAsset).safeTransferFrom(msg.sender, address(this), amountToSwap);
37
38     // approve to appropriate router (Note: router is the part of swapBytes data. Do not take from the swap func arg. The function arg is given because for other swaps like lynch
39     IERC20Upgradeable(sellingAsset).safeIncreaseAllowance(approveRouter, amountToSwap);
40
41     (bool success, bytes memory data) = approveRouter.call(swapBytes);
42
43     if(!success){
44         assembly {
45             let returndata_size := mload(data)
46             revert(add(32, data), returndata_size)
47         }
48     }
49
50     // check balance after swap
51     uint256 buyingAssetBalance = IERC20Upgradeable(buyingAsset).balanceOf(address(this));
52     uint256 receivedAmount = buyingAssetBalance - buyingAssetBalancePrior;
53
54     IERC20Upgradeable(buyingAsset).safeTransfer(msg.sender, receivedAmount);
55     return receivedAmount;
56 }

```

Figure 11 Source code of swap function(Fixed)

[LeverFi-4] The *withdrawLiquidationWalletLong* function is improperly designed

Severity Level	Critical
Type	Business Security
Lines	LiquidationLogic.sol#L277-308
Description	Liquidation wallets can withdraw funds from liquidity providers through this function.

```

276
277
278 function executeWithdrawLiquidationWalletLong(
279     mapping(uint256 => DataTypes.ReserveData) storage reserves,
280     IUserData userData,
281     DataTypes.ExecuteWithdrawLiquidationWalletLong memory params
282 ) external {
283     DataTypes.ReserveData storage reserve = reserves[params.pid];
284
285     reserve.updateIndex();
286
287     DataTypes.ReserveDataCache memory reserveCache = reserve.cache();
288
289     DataTypes.UserPosition memory currPosition = userData.getUserPosition(params.liquidationWallet, params.asset);
290
291     require(currPosition._type == DataTypes.PositionType.Long, Errors.INVALID_POSITION_TYPE);
292
293     if (currPosition.amount < params.amount) {
294         params.amount = currPosition.amount;
295     }
296
297     require(params.amount != 0, Errors.INVALID_ZERO_AMOUNT);
298
299     userData.changePosition(
300         params.liquidationWallet,
301         params.pid,
302         DataTypes.UserPosition(params.amount, DataTypes.PositionType.Short),
303         reserveCache.currBorrowIndexRay,
304         params.decimals
305     );
306
307     IERC20Upgradeable(params.asset).safeTransfer(params.treasury, params.amount);
308
309     emit WithdrawnLiquidationWalletLong(params.asset, params.amount);
310 }
311

```

Figure 12 Source code of *executeWithdrawLiquidationWalletLong* function(Unfixed)

Recommendations	It is recommended that the liquidation wallet can only receive funds through PNL.
Status	Fixed.


```

336 function executeWithdrawLiquidationWalletLong(
337     mapping(address => DataTypes.AssetConfig) storage assetConfigs,
338     mapping(uint256 => DataTypes.ReserveData) storage reserves,
339     mapping(uint256 => DataTypes.CollateralData) storage collaterals,
340     IUserData userData,
341     DataTypes.ExecuteWithdrawLiquidationWalletLong memory params
342 ) external {
343     DataTypes.ReserveData storage reserve = reserves[params.pid];
344
345     reserve.updateIndex();
346
347     DataTypes.ReserveDataCache memory reserveCache = reserve.cache();
348
349     DataTypes.UserPosition memory currPosition = userData.getUserPosition(params.liquidationWallet, params.asset);
350
351     require(currPosition._type == DataTypes.PositionType.Long, Errors.INVALID_POSITION_TYPE);
352
353     if (currPosition.amount < params.amount) {
354         params.amount = currPosition.amount;
355     }
356
357     (,,,, int256 pnlUsd,,,,) = GeneralLogic.getUserLiquidity(
358         reserves,
359         collaterals,
360         assetConfigs,
361         userData,
362         DataTypes.GetUserLiquidityParams(
363             params.liquidationWallet,
364             params.leverageFactor,
365             params.liquidationRatioMantissa
366         )
367     );
368
369     require(pnlUsd > 0, "available leverage not positive");
370
371     (uint256 assetPrice, uint256 assetPriceDecimal) = params.assetConfig.oracle.getAssetPrice(params.asset);
372
373     uint256 assetPriceInWad = assetPrice.unitToWad(assetPriceDecimal);
374
375     uint256 maxAmount = uint256(pnlUsd).wadDiv(assetPriceInWad).wadToUnit(params.assetConfig.decimals);
376
377     if (maxAmount < params.amount) {
378         params.amount = maxAmount;
379     }
380

```

Figure 13 Source code of *executeWithdrawLiquidationWalletLong* function(Fixed)

[LeverFi-5] DoS attack

Severity Level	High
Type	General Vulnerability
Lines	AaveReinvestmentLogic.sol,ConvexReinvestmentLogic.sol#L65,70,110,116-120
Description	<p>There is a DoS vulnerability in the <i>invest</i> function of the AaveReinvestmentLogic and ConvexReinvestmentLogic contracts. If someone sends a token to the contract in advance, the user will fail to call the contract. Because the judgment here is that the amount input by the user must be equal to the contractBalance in the contract, if someone maliciously transfers money to the contract, the judgment will never be satisfied. Similarly, "IERC20Upgradeable(asset).balanceOf(address(this)) == 0" also has this problem.</p>

```

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--
function invest(uint256 amount) external override onlyLender {
    IERC20Upgradeable(asset).safeTransferFrom(msg.sender, address(this), amount);
    uint256 contractBalance = IERC20Upgradeable(asset).balanceOf(address(this));
    require(contractBalance > 0, "reinvestment_adapter do not have underlying assets to invest");
    require(contractBalance == amount, "investing amount is different");
    IERC20Upgradeable(asset).safeApprove(platform(), amount);
    IAaveLendingPoolV2(platform()).deposit(asset, amount, address(this), 0);
    require(IERC20Upgradeable(asset).balanceOf(address(this)) == 0, "reinvestment_adapter still has underlying assets to invest");
}

```

Figure 14 Source code of *invest* function (AaveReinvestmentLogic.sol)(Unfixed)

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--
function invest(
    uint256 amount
) external override onlyLender {
    IERC20Upgradeable(asset).safeTransferFrom(msg.sender, address(this), amount);
    uint256 contractBalance = IERC20Upgradeable(asset).balanceOf(address(this));
    require(contractBalance > 0, "reinvestment_adapter do not have underlying assets to invest");
    require(contractBalance == amount, "investing amount is different");
    IERC20Upgradeable(asset).safeApprove(platform(), amount);
    IConvexBooster(platform()).deposit(poolId(), amount, true);
    require(
        IERC20Upgradeable(asset).balanceOf(address(this)) == 0,
        "reinvestment_adapter still has underlying assets to invest"
    );
}

```

Figure 15 Source code of *invest* function (ConvexReinvestmentLogic.sol)(Unfixed)

Recommendations	It is recommended to delete the code.
Status	Fixed.
	<pre> 58 59 60 61 62 63 64 65 66 67 68 -- function invest(uint256 amount) external override onlyLender { IERC20Upgradeable(asset).safeTransferFrom(msg.sender, address(this), amount); require(IERC20Upgradeable(asset).balanceOf(address(this)) >= amount, "not enough underlying amount to invest"); IERC20Upgradeable(asset).safeApprove(platform(), amount); IAaveLendingPoolV2(platform()).deposit(asset, amount, address(this), 0); } </pre>

Figure 16 Source code of *invest* function (AaveReinvestmentLogic.sol)(Fixed)

```

102  /**
103  * function invest(
104  *   uint256 amount
105  * ) external override onlyLender {
106  *   IERC20Upgradeable(asset).safeTransferFrom(msg.sender, address(this), amount);
107  *
108  *   require(IERC20Upgradeable(asset).balanceOf(address(this)) >= amount, "not enough underlying amount to invest");
109  *
110  *   IERC20Upgradeable(asset).safeApprove(platform(), amount);
111  *   IConvexBooster(platform()).deposit(poolId(), amount, true);
112  * }
113  */

```

Figure 17 Source code of *invest* function (ConvexReinvestmentLogic.sol)(Fixed)

[LeverFi-6] The `_calculateRewards` function design flaw

Severity Level	High
Type	Business Security
Lines	ConvexReinvestmentLogic.sol#L189-226
Description	Design flaw in the <code>_calculateRewards</code> function of the <code>ConvexReinvestmentLogic</code> contract. Because the user does not update the value of <code>acquiredBalance</code> after receiving the reward, it will result in an error in the calculation of the reward.

```

188
189
190     function _calculateRewards(
191         address user,
192         uint256 currBalance,
193         RewardConfig memory reward,
194         UserReward memory userReward,
195         bool isClaim
196     ) internal returns (RewardConfig memory, UserReward memory) {
197
198         address crvRewards = IConvexBooster(platform()).poolInfo(poolId()).crvRewards;
199         IConvexRewards(crvRewards).getReward();
200         uint256 accruedBalance = IERC20Upgradeable(reward.asset).balanceOf(address(this));
201
202         if (totalSupply() > 0 && accruedBalance > reward.remaining) {
203             reward.integral += (accruedBalance - reward.remaining) * 1e20 / totalSupply();
204         }
205
206         if (isClaim || reward.integral > userReward.integral) {
207             uint256 receivable = (reward.integral - userReward.integral) * currBalance / 1e20;
208
209             if (isClaim) {
210                 receivable += userReward.claimable;
211
212                 IERC20Upgradeable(reward.asset).safeTransfer(user, receivable);
213                 userReward.claimable = 0;
214             } else {
215                 userReward.claimable += receivable;
216             }
217             userReward.integral = reward.integral;
218         }
219
220         if (accruedBalance != reward.remaining) {
221             reward.remaining = accruedBalance;
222         }
223
224         return (reward, userReward);
225     }
226
227
228

```

Figure 18 Source code of `_calculateRewards` function(Unfixed)

Recommendations	It is recommended to update the <code>acquiredBalance</code> after claiming the reward.
Status	Fixed.

```

180
181 function _calculateRewards(
182     address user,
183     uint256 currBalance,
184     RewardConfig memory reward,
185     UserReward memory userReward,
186     bool isClaim
187 ) internal returns (RewardConfig memory, UserReward memory) {
188
189     address crvRewards = IConvexBooster(platform()).poolInfo(poolId()).crvRewards;
190     IConvexRewards(crvRewards).getReward();
191
192     uint256 accruedBalance = IERC20Upgradeable(reward.asset).balanceOf(address(this));
193
194     if (totalSupply() > 0 && accruedBalance > reward.remaining) {
195         reward.integral += (accruedBalance - reward.remaining) * 1e20 / totalSupply();
196     }
197
198     if (isClaim || reward.integral > userReward.integral) {
199         uint256 receivable = (reward.integral - userReward.integral) * currBalance / 1e20;
200
201         if (isClaim) {
202             receivable += userReward.claimable;
203
204             IERC20Upgradeable(reward.asset).safeTransfer(user, receivable);
205             userReward.claimable = 0;
206             accruedBalance -= receivable;
207         } else {
208             userReward.claimable += receivable;
209         }
210         userReward.integral = reward.integral;
211     }
212
213     if (accruedBalance != reward.remaining) {
214         reward.remaining = accruedBalance;
215     }
216
217     return (reward, userReward);
218 }
219

```

Figure 19 Source code of `_calculateRewards` function (ConvexReinvestmentLogic.sol)(Fixed)

[LeverFi-7] The `_depositReserve` function is improperly designed

Severity Level	High
Type	Business Security
Lines	Ledger.sol#L812-825
Description	<p>First of all, in the <code>getReserveSupply</code> function, if the function uses true, then <code>poolAmount</code> will not use the <code>UtilizedSupply</code> part. Go back to the <code>_depositReserve</code> function of the Ledger contract and calculate the part of <code>shareAmountRay</code> that does not use <code>UtilizedSupply</code>, then the calculated share will be wrong. In the <code>_withdrawReserve</code> function, the <code>poolAmount</code> is added with <code>UtilizedSupply</code>. The calculated <code>shareAmountRay</code> is smaller than expected, which will lead to arbitrage space. Similarly, the part of <code>UtilizedSupply</code> should also be used when calculating <code>currUserReserveBalance</code>.</p>

```

798 //***** INTERNAL *****/
799 function _depositReserve(address user, address asset, uint256 amount) internal {
800     DataTypes.AssetConfig memory assetConfigCache = assetConfig[asset];
801     DataTypes.ReserveConfig storage reserve = _reserveConfig[asset];
802     uint256 unit = assetConfigCache.decimals;
803
804     ValidationLogic.validateDepositReserve(reserve, assetConfigCache, amount);
805
806     reserve.updateIndex();
807
808     uint256 currUserReserveBalance;
809     // is first deposit
810     if (userReserveShareRay[user][asset] == 0) {
811         userConfig[user].setUsingReserve(reserve.assetId, true);
812     } else {
813         currUserReserveBalance = ShareBaseAccounting.getAbsoluteAmount(
814             userReserveShareRay[user][asset],
815             reserve.scaledTotalSupplyRay,
816             reserve.getReserveSupply(assetConfigCache, true).unitToRay(unit)
817             ).rayToUnit(unit);
818     }
819
820     uint256 shareAmountRay = ShareBaseAccounting.getShareAmount(
821         amount.unitToRay(unit),
822         reserve.scaledTotalSupplyRay,
823         reserve.getReserveSupply(assetConfigCache, true).unitToRay(unit)
824     );
825
826     // update user info
827     userReserveShareRay[user][asset] += shareAmountRay;
828     reserve.scaledTotalSupplyRay += shareAmountRay;
829
830     IERC20Upgradeable(asset).safeTransferFrom(user, address(this), amount);
831
832     if (reserve.reinvestment != address(0)) {
833         if (IERC20Upgradeable(reserve.asset).allowance(address(this), reserve.reinvestment) < amount) {
834             IERC20Upgradeable(reserve.asset).safeApprove(reserve.reinvestment, type(uint256).max);
835         }
836
837         IReinvestment(reserve.reinvestment).checkpoint(user, currUserReserveBalance);
838         IReinvestment(reserve.reinvestment).invest(amount);
839     } else {
840         reserve.liquidSupply += amount;
841     }
842
843     emit DepositedReserve(user, asset, reserve.reinvestment, amount);
844 }
845

```

Figure 20 Source code of `_depositReserve` function(Unfixed)

Recommendations	It is recommended to set the <code>getReserveSupply</code> function to false.
Status	Fixed.

```

844 ✓ function _depositReserve(address user, address asset, uint256 amount) internal {
845     DataTypes.AssetConfig memory assetConfigCache = assetConfig[asset];
846     DataTypes.ReserveConfig storage reserve = _reserveConfig[asset];
847     uint256 unit = assetConfigCache.decimals;
848
849     ValidationLogic.validateDepositReserve(reserve, assetConfigCache, amount);
850
851     reserve.updateIndex();
852     uint256 currReserveSupply = reserve.getReserveSupply(assetConfigCache, false);
853     uint256 currUserReserveBalance;
854
855     // is first deposit
856 ✓ if (userReserveShareRay[user][asset] == 0) {
857     userConfig[user].setUsingReserve(reserve.assetId, true);
858 ✓ } else {
859 ✓     currUserReserveBalance = ShareBaseAccounting.getAbsoluteAmount(
860         userReserveShareRay[user][asset],
861         reserve.scaledTotalSupplyRay,
862         currReserveSupply.unitToRay(unit)
863     ).rayToUnit(unit);
864 }
865
866 ✓ uint256 shareAmountRay = ShareBaseAccounting.getShareAmount(
867     amount.unitToRay(unit),
868     reserve.scaledTotalSupplyRay,
869     currReserveSupply.unitToRay(unit)
870 );
871
872 // update user info
873 userReserveShareRay[user][asset] += shareAmountRay;
874 reserve.scaledTotalSupplyRay += shareAmountRay;
875
876 IERC20Upgradeable(asset).safeTransferFrom(user, address(this), amount);
877
878 ✓ if (reserve.reinvestment != address(0)) {
879 ✓     if (IERC20Upgradeable(reserve.asset).allowance(address(this), reserve.reinvestment) < amount) {
880         IERC20Upgradeable(reserve.asset).safeApprove(reserve.reinvestment, 0);
881         IERC20Upgradeable(reserve.asset).safeApprove(reserve.reinvestment, type(uint256).max);
882     }
883
884     IReinvestment(reserve.reinvestment).checkpoint(user, currUserReserveBalance);
885     IReinvestment(reserve.reinvestment).invest(amount);
886 ✓ } else {
887     reserve.liquidSupply += amount;
888 }
889
890 emit DepositedReserve(user, asset, reserve.reinvestment, amount);
891 }

```

Figure 21 Source code of `_depositReserve` function(Fixed)

[LeverFi-8] The *configureAsset* function is improperly designed

Severity Level	High
Type	Business Security
Lines	Ledger.sol#L231
Description	In the Ledger contract, when the <i>configureAsset</i> function modifies the configuration, it will replace <i>assetLength</i> with the latest index, which will cause data confusion.

```

220  */
221  function configureAsset(
222      address asset,
223      uint256 decimals,
224      address longReinvestment,
225      ISwapAdapter swapAdapter,
226      IPriceOracleGetter oracle,
227      DataTypes.AssetState state,
228      DataTypes.AssetMode mode
229  ) public onlyOperator {
230      assetConfig[asset] = DataTypes.AssetConfig(
231          assetLength,
232          decimals,
233          longReinvestment,
234          swapAdapter,
235          oracle,
236          state,
237          mode
238      );
239
240      emit ConfiguredAsset(asset, decimals, longReinvestment, address(swapAdapter), address(oracle), state, mode);
241  }
242  ...

```

Figure 22 Source code of *configureAsset* function(Unfixed)

Recommendations	It is recommended that <i>assetId</i> should remain unchanged when set.
-----------------	---

Status	Fixed.
--------	--------

```

234  function configureAsset(
235      address asset,
236      uint256 decimals,
237      address longReinvestment,
238      ISwapAdapter swapAdapter,
239      IPriceOracleGetter oracle,
240      DataTypes.AssetState state,
241      DataTypes.AssetMode mode
242  ) public onlyOperator {
243      DataTypes.AssetConfig storage _assetConfig = assetConfig[asset];
244
245      _assetConfig.decimals = decimals;
246      _assetConfig.longReinvestment = longReinvestment;
247      _assetConfig.swapAdapter = swapAdapter;
248      _assetConfig.oracle = oracle;
249      _assetConfig.state = state;
250      _assetConfig.mode = mode;
251
252      emit ConfiguredAsset(asset, decimals, longReinvestment, address(swapAdapter), address(oracle), state, mode);
253  }
254

```

Figure 23 Source code of *configureAsset* function(Fixed)

[LeverFi-9] Clearing mechanism error

Severity Level	High
Type	Business Security
Lines	LiquidationLogic.sol#L189-221
Description	When liquidation is performed in the <i>executeForeclosure</i> function, the debt repaid by the liquidation wallet is not recorded correctly, which will cause the liquidation wallet to use a small amount of funds to pay off a large debt.

```

188     } else {
189         uint256 userShortAbsoluteAmount = userAssetPosition.amount
190             .rayMul(vars.reserveConfigCache.currBorrowIndexRay)
191             .rayToUnit(vars.assetConfig.decimals);
192
193         uint256 amountToRepay = userShortAbsoluteAmount;
194         // repay user short with liquidation wallet if has any
195         if (liquidationAssetPosition.amount > 0 && liquidationAssetPosition._type == DataTypes.PositionType.Long) {
196             if (userShortAbsoluteAmount >= liquidationAssetPosition.amount) {
197                 amountToRepay = liquidationAssetPosition.amount;
198             }
199             TradeLogic.executeLonging(
200                 reserveConfigs[vars.asset],
201                 vars.assetConfig,
202                 userAssetPosition,
203                 userConfigs[vars.user],
204                 params.treasury,
205                 amountToRepay,
206                 false
207             );
208         }
209         vars.newPosition = TradeLogic.getNewPosition(
210             vars.assetConfig,
211             liquidationAssetPosition,
212             DataTypes.UserPosition[amountToRepay], DataTypes.PositionType.Short,
213             vars.reserveConfigCache.currBorrowIndexRay
214         );
215         liquidationAssetPosition.amount = vars.newPosition.amount;
216         liquidationAssetPosition._type = vars.newPosition._type;
217         userConfigs[params.liquidationWallet].setUsingPosition(vars.poolId, vars.newPosition.amount > 0);
218         userAssetPosition.amount = 0;
219         userAssetPosition._type = DataTypes.PositionType.Long;
220         userConfigs[vars.user].setUsingPosition(vars.poolId, false);
221     }
222 }

```

Figure 24 Source code of *executeForeclosure* function(Unfixed)

Recommendations It is recommended to use the actual amount, not the amount paid for the user.

Status Fixed.

```

191     } else {
192         uint256 userShortAbsoluteAmount = userAssetPosition.amount
193             .rayMul(vars.reserveConfigCache.currBorrowIndexRay)
194             .rayToUnit(vars.assetConfig.decimals);
195
196         uint256 amountToRepay = userShortAbsoluteAmount;
197         // repay user short with liquidation wallet if has any
198         if (liquidationAssetPosition.amount > 0 && liquidationAssetPosition._type == DataTypes.PositionType.Long) {
199             if (userShortAbsoluteAmount >= liquidationAssetPosition.amount) {
200                 amountToRepay = liquidationAssetPosition.amount;
201             }
202             TradeLogic.executeLonging(
203                 reserveConfigs[vars.asset],
204                 vars.assetConfig,
205                 userAssetPosition,
206                 userConfigs[vars.user],
207                 params.treasury,
208                 amountToRepay,
209                 false
210             );
211         }
212         vars.newPosition = TradeLogic.getNewPosition(
213             vars.assetConfig,
214             liquidationAssetPosition,
215             DataTypes.UserPosition[userShortAbsoluteAmount], DataTypes.PositionType.Short,
216             vars.reserveConfigCache.currBorrowIndexRay
217         );
218         liquidationAssetPosition.amount = vars.newPosition.amount;
219         liquidationAssetPosition._type = vars.newPosition._type;
220         userConfigs[params.liquidationWallet].setUsingPosition(vars.poolId, vars.newPosition.amount > 0);
221         userAssetPosition.amount = 0;
222         userAssetPosition._type = DataTypes.PositionType.Long;
223         userConfigs[vars.user].setUsingPosition(vars.poolId, false);
224     }
225 }

```

Figure 25 Source code of *executeForeclosure* function(Fixed)

[LeverFi-10] The *getNormalizedDebt* function is improperly designed

Severity Level	Medium
Type	Business Security
Lines	ReserveLogic.sol#L59-64
Description	When querying currBorrowIndexRay through the <i>getNormalizedDebt</i> function, if user B borrows money right after user A at the same time. At this time, according to the code logic, their currBorrowIndexRay is the same, but when user B borrows money, the utilization rate changes. Theoretically currBorrowIndexRay will be different, which will result in less interest repaid by users who borrow later.

```

55     function getNormalizedDebt(
56         DataTypes.ReserveConfig memory reserve
57     ) internal view returns (uint256, uint256, uint256) {
58         uint256 timestamp = reserve.lastUpdatedTimestamp;
59         if (timestamp == block.timestamp) {
60             return (
61                 reserve.reserveIndexRay,
62                 reserve.protocolIndexRay,
63                 reserve.reserveIndexRay + reserve.protocolIndexRay
64             );
65         } else {
66             uint256 currBorrowIndexRay = reserve.reserveIndexRay + reserve.protocolIndexRay;
67             uint256 interestRateRay = getInterestRate(
68                 reserve.scaledUtilizedSupplyRay,
69                 reserve.scaledTotalSupplyRay,
70                 reserve.protocolRateMantissaRay,
71                 reserve.utilizationBaseRateMantissaRay,
72                 reserve.kinkMantissaRay,
73                 reserve.multiplierAnnualRay,
74                 reserve.jumpMultiplierAnnualRay
75             );
76             if (interestRateRay == 0) {
77                 return (
78                     reserve.reserveIndexRay,
79                     reserve.protocolIndexRay,
80                     reserve.reserveIndexRay + reserve.protocolIndexRay
81                 );
82             }

```

Figure 26 Source code of *getNormalizedDebt* function(Unfixed)

Recommendations	It is recommended to delete the if judgment.
Status	Fixed.


```

59     function getNormalizedDebt(
60         DataTypes.ReserveConfig memory reserve
61     ) internal view returns (uint256, uint256, uint256) {
62         uint256 currBorrowIndexRay = reserve.reserveIndexRay + reserve.protocolIndexRay;
63         uint256 interestRateRay = getInterestRate(
64             reserve.scaledUtilizedSupplyRay,
65             reserve.scaledTotalSupplyRay,
66             reserve.protocolRateMantissaRay,
67             reserve.utilizationBaseRateMantissaRay,
68             reserve.kinkMantissaRay,
69             reserve.multiplierAnnualRay,
70             reserve.jumpMultiplierAnnualRay
71         );
72         if (interestRateRay == 0) {
73             return (
74                 reserve.reserveIndexRay,
75                 reserve.protocolIndexRay,
76                 reserve.reserveIndexRay + reserve.protocolIndexRay
77             );
78         }
79         uint256 cumulatedInterestIndexRay = InterestUtils.getCompoundedInterest(
80             interestRateRay, reserve.lastUpdatedTimestamp, block.timestamp
81         );
82         uint256 growthIndexRay = currBorrowIndexRay.rayMul(cumulatedInterestIndexRay) - currBorrowIndexRay;
83         uint256 protocolInterestRatio = reserve.protocolRateMantissaRay.rayDiv(interestRateRay);
84         uint256 nextReserveIndexRay = reserve.reserveIndexRay + growthIndexRay.rayMul(MathUtils.RAY - protocolInterestRatio);
85         uint256 nextProtocolIndexRay = reserve.protocolIndexRay + growthIndexRay.rayMul(protocolInterestRatio);
86         return (
87             nextReserveIndexRay,
88             nextProtocolIndexRay,
89             nextProtocolIndexRay + nextReserveIndexRay
90         );
91     }
92 }

```

Figure 27 Source code of *getNormalizedDebt* function(Fixed)

[LeverFi-11] Implementation flaws in the *reinvestReserveSupply* and *reinvestCollateralSupply* functions

Severity Level	Medium
Type	Business Security
Lines	Ledger.sol#L759-795
Description	In the <i>reinvestReserveSupply</i> and <i>reinvestCollateralSupply</i> functions, the lack of approve for New_reinvestment will cause the function call to fail.

```

759  /**
760   * function reinvestReserveSupply(address asset) external onlyOperator {
761
762   *   DataTypes.ReserveConfig storage reserveConfig = _reserveConfig[asset];
763   *   require(reserveConfig.state == DataTypes.AssetState.Disabled, "state is not disabled");
764   *   require(reserveConfig.reinvestment != address(0), "reinvestment is not set");
765   *   IReinvestment(reserveConfig.reinvestment).invest(reserveConfig.liquidSupply);
766   *   emit ReinvestedReserveSupply(asset, reserveConfig.liquidSupply);
767   *   reserveConfig.liquidSupply = 0;
768   * }
769
770  /**
771  * @notice Reinvests collateral supply
772  * @param asset Underlying asset address
773  * @param reinvestment Address where the asset is reinvested in
774  */
775  function reinvestCollateralSupply(address asset, address reinvestment) external onlyOperator {
776
777   *   uint256 poolId = collateralPoolList[asset][reinvestment];
778   *   DataTypes.CollateralConfig storage collateralConfig = _collateralConfig[poolId];
779   *   require(collateralConfig.state == DataTypes.AssetState.Disabled, "state is not disabled");
780   *   require(collateralConfig.reinvestment != address(0), "reinvestment is not set");
781   *   IReinvestment(collateralConfig.reinvestment).invest(collateralConfig.liquidSupply);
782   *   emit ReinvestedCollateralSupply(asset, reinvestment, collateralConfig.liquidSupply);
783   *   collateralConfig.liquidSupply = 0;
784   * }
785
786  }
787
788  }
789
790  }
791
792  }
793
794  }
795
796  }

```

Figure 28 Source code of related functions(Unfixed)

Recommendations	It is recommended to increase approve.
Status	Fixed.

```

802  */
803  function reinvestReserveSupply(address asset) external onlyOperator {
804
805      DataTypes.ReserveConfig storage reserveConfig = _reserveConfig[asset];
806
807      require(reserveConfig.state == DataTypes.AssetState.Disabled, "state is not disabled");
808      require(reserveConfig.reinvestment != address(0), "reinvestment is not set");
809
810      IERC20Upgradeable(asset).safeApprove(reserveConfig.reinvestment, reserveConfig.liquidSupply);
811      Reinvestment(reserveConfig.reinvestment).invest(reserveConfig.liquidSupply);
812
813      emit ReinvestedReserveSupply(asset, reserveConfig.liquidSupply);
814
815      reserveConfig.liquidSupply = 0;
816
817  }
818
819  /**
820   * @notice Reinvests collateral supply
821   * @param asset Underlying asset address
822   * @param reinvestment Address where the asset is reinvested in
823   */
824  function reinvestCollateralSupply(address asset, address reinvestment) external onlyOperator {
825
826      uint256 poolId = collateralPoolList[asset][reinvestment];
827      DataTypes.CollateralConfig storage collateralConfig = _collateralConfig[poolId];
828
829      require(collateralConfig.state == DataTypes.AssetState.Disabled, "state is not disabled");
830      require(collateralConfig.reinvestment != address(0), "reinvestment is not set");
831
832      IERC20Upgradeable(asset).safeApprove(collateralConfig.reinvestment, collateralConfig.liquidSupply);
833      Reinvestment(collateralConfig.reinvestment).invest(collateralConfig.liquidSupply);
834
835      emit ReinvestedCollateralSupply(asset, reinvestment, collateralConfig.liquidSupply);
836
837      collateralConfig.liquidSupply = 0;
838
839  }
840
841

```

Figure 29 Source code of related functions(Fixed)

[LeverFi-12] Unsafe call

Severity Level	Medium
Type	General Vulnerability
Lines	ZeroexSwapAdapter.sol#L35
Description	<p>Unsafe call method. In the <i>swap</i> function of the ZeroexSwapAdapter contract, because the swapBytesData parameter is controllable, the approveRouter and swapBytes are also controllable. Then an attacker can use call to perform arbitrary operations. For example, approveRouter is specified as a token, and the swapBytes parameter is the token authorization behavior (the contract is authorized to the attacker), then the attacker can withdraw the tokens in the contract.</p> <pre> 17 18 19 20 function swap(address, address, uint256 amountToSwap, bytes memory swapBytesData) external override returns (uint256) { 21 22 (address approveRouter, address sellingAsset, address buyingAsset, bytes memory swapBytes) = abi.decode(swapBytesData, (address,address,address,bytes)); 23 24 uint256 buyingAssetBalancePrior = IERC20Upgradeable(buyingAsset).balanceOf(address(this)); 25 26 IERC20Upgradeable(sellingAsset).safeTransferFrom(msg.sender, address(this), amountToSwap); 27 28 29 30 31 // approve to appropriate router (Note: router is the part of swapBytes data. Do not take from the swap func arg. The function arg is given because for other swaps like 1inch 32 33 IERC20Upgradeable(sellingAsset).safeIncreaseAllowance(approveRouter, amountToSwap); 34 35 (bool success, bytes memory data) = approveRouter.call(swapBytes); 36 37 if(!success){ 38 assembly { 39 let returndata_size := mload(data) 40 revert(add(32, data), returndata_size) 41 } 42 } 43 44 // check balance after swap 45 uint256 buyingAssetBalance = IERC20Upgradeable(buyingAsset).balanceOf(address(this)); 46 uint256 receivedAmount = buyingAssetBalance - buyingAssetBalancePrior; 47 48 49 50 IERC20Upgradeable(buyingAsset).safeTransfer(msg.sender, receivedAmount); 51 52 return receivedAmount; 53 54 } 55 </pre>

Figure 30 Source code of *swap* function (ZeroexSwapAdapter.sol)(Unfixed)

Recommendations	It is recommended to directly call this interface for swap instead of using the call method.
-----------------	--

Status	Fixed.
<pre> 20 21 // @param router Router address to enable 22 function configureRoutersList(address router, bool value) external onlyOwner { 23 emit ConfiguredRoutersList(router, routersList[router], value); 24 routersList[router] = value; 25 } </pre>	

Figure 31 Source code of *configureRoutersList* function (ZeroexSwapAdapter.sol)(Fixed)

[LeverFi-13] The *configureReserve* function design flaw

Severity Level	Medium
Type	Business Security
Lines	Ledger.sol#L304
Description	<p>First, in the <i>configureReserve</i> function, the operator can modify the reinvestment arbitrarily. It is assumed that the operator initially sets the reinvestment to a non-zero address, and the user stakes during this period, and then the operator sets the reinvestment to zero. At this time, when the user stakes in, the calculation of the <i>getShareAmount</i> function in the <i>_depositReserve</i> function will be wrong, because the <i>getReserveAvailableSupply</i> function here can only obtain the total amount of reserve.reinvestment that is zero, and does not obtain the amount of reinvestment that is not zero, so the calculation error is caused.</p>

```

290 function configureReserve(
291     address asset,
292     address reinvestment,
293     uint256 feeMantissaRay,
294     uint256 protocolRateMantissaRay,
295     uint256 utilizationBaseRateMantissaRay,
296     uint256 kinkMantissaRay,
297     uint256 multiplierPerAnnualRay,
298     uint256 jumpMultiplierPerAnnualRay,
299     DataTypes.AssetState state
300 ) public onlyOperator {
301     DataTypes.ReserveConfig storage reserve = _reserveConfig[asset];
302
303     require(jumpMultiplierPerAnnualRay >= multiplierPerAnnualRay, "Jump multiplier must be greater or equal normal multiplier");
304     reserve.reinvestment = reinvestment;
305     reserve.feeMantissaRay = feeMantissaRay;
306     reserve.protocolRateMantissaRay = protocolRateMantissaRay;
307     reserve.utilizationBaseRateMantissaRay = utilizationBaseRateMantissaRay;
308     reserve.kinkMantissaRay = kinkMantissaRay;
309     reserve.multiplierAnnualRay = multiplierPerAnnualRay;
310     reserve.jumpMultiplierAnnualRay = jumpMultiplierPerAnnualRay;
311     reserve.state = state;
312
313     emit ConfiguredReserve(
314         asset,
315         reinvestment,
316         feeMantissaRay,
317         utilizationBaseRateMantissaRay,
318         kinkMantissaRay,
319         multiplierPerAnnualRay,
320         jumpMultiplierPerAnnualRay,
321         state
322     );
323 }

```

Figure 32 Source code of *configureReserve* function (Ledger.sol)(Unfixed)


```

797 /***** INTERNAL *****/
798 function _depositReserve(address user, address asset, uint256 amount) internal {
799     DataTypes.AssetConfig memory assetConfigCache = assetConfig[asset];
800     DataTypes.ReserveConfig storage reserve = _reserveConfig[asset];
801     uint256 unit = assetConfigCache.decimals;
802
803     ValidationLogic.validateDepositReserve(reserve, assetConfigCache, amount);
804
805     reserve.updateIndex();
806
807     uint256 currUserReserveBalance;
808     // is first deposit
809     if (userReserveShareRay[user][asset] == 0) {
810         userConfig[user].setUsingReserve(reserve.assetId, true);
811     } else {
812         currUserReserveBalance = ShareBaseAccounting.getAbsoluteAmount(
813             userReserveShareRay[user][asset],
814             reserve.scaledTotalSupplyRay,
815             reserve.getReserveSupply(assetConfigCache, true).unitToRay(unit)
816         ).rayToUnit(unit);
817     }
818
819     uint256 shareAmountRay = ShareBaseAccounting.getShareAmount(
820         amount.unitToRay(unit),
821         reserve.scaledTotalSupplyRay,
822         reserve.getReserveSupply(assetConfigCache, true).unitToRay(unit)
823     );
824

```

Figure 33 Source code of `_depositReserve` function (Ledger.sol)(Unfixed)

```

22 function getReserveSupply(
23     DataTypes.ReserveConfig storage reserve,
24     DataTypes.AssetConfig memory assetConfig,
25     bool claimable
26 ) internal view returns (uint256 poolAmount) {
27     if (!claimable) {
28         poolAmount += getUtilizedSupply(reserve, assetConfig);
29     }
30     poolAmount += GeneralLogic.getReserveAvailableSupply(reserve);
31 }
32

```

Figure 34 Source code of `getReserveSupply` function (ReserveLogic.sol)(Unfixed)

```

24
25 function getReserveAvailableSupply(
26     DataTypes.ReserveConfig memory reserve
27 ) public view returns (uint256 supply) {
28     if (reserve.reinvestment == address(0)) {
29         supply = reserve.liquidSupply;
30     } else {
31         supply = IReinvestment(reserve.reinvestment).totalSupply();
32     }
33 }

```

Figure 35 Source code of `getReserveAvailableSupply` function (GeneralLogic.sol)(Unfixed)

Recommendations It is recommended that the project side add a state in which users cannot stake.

Status Fixed. The project party has added this function to avoid the situation that users can still stake when modifying the reinvestment.

```

338     */
339     function configureReserveReinvestment(
340         address asset,
341         address reinvestment
342     ) public onlyOperator {
343         DataTypes.ReserveConfig storage reserve = _reserveConfig[asset];
344
345         require(reserve.assetId != 0, "asset reserve is not initialized");
346         require(reserve.state == DataTypes.AssetState.Disabled);
347
348         emit ConfiguredReserveReinvestment(asset, reserve.reinvestment, reinvestment);
349
350         reserve.reinvestment = reinvestment;
351     }
352

```

Figure 36 Source code of *configureReserveReinvestment* function (Ledger.sol)(Fixed)

[LeverFi-14] Centralization risk

Severity Level	Medium
Type	Business Security
Lines	Ledger.sol
Description	In the Ledger contract, the operator permission can modify the relevant parameters in the contract, which is high permission.

```

140 ~/
147 function setLeverageFactor(uint256 leverageFactor_) external onlyOperator {
148     require(leverageFactor_ >= 1e18, "leverage factor cannot be lower than 1x");
149     require(leverageFactor_ <= 10e18, "leverage factor cannot be lower than 10x");
150
151     emit LeverageFactorUpdated(leverageFactor, leverageFactor_);
152
153     leverageFactor = leverageFactor_;
154 }
155
156 /**
157  * @notice Setter for tradeFeeMantissa
158  * @param tradeFeeMantissa_ The new tradeFeeMantissa
159  */
160 function setTradeFee(uint256 tradeFeeMantissa_) external onlyOperator {
161     require(tradeFeeMantissa_ <= 0.1e18, "fee cannot be more than 10%");
162
163     emit TradeFeeUpdated(tradeFeeMantissa, tradeFeeMantissa_);
164
165     tradeFeeMantissa = tradeFeeMantissa_;
166 }
167
168 /**
169  * @notice Setter for liquidationRatioMantissa
170  * @param liquidationRatioMantissa_ The new liquidationRatioMantissa
171  */
172 function setLiquidationRatio(uint256 liquidationRatioMantissa_) external onlyOperator {
173     require(liquidationRatioMantissa_ >= 0.5e18, "fee cannot be less than 50%");
174     require(liquidationRatioMantissa_ <= 0.9e18, "fee cannot be more than 90%");
175
176     emit LiquidationRatioUpdated(liquidationRatioMantissa, liquidationRatioMantissa_);
177
178     liquidationRatioMantissa = liquidationRatioMantissa_;
179 }
180
181 /***** CORE FUNCTIONS *****/

```

Figure 37 Source code of related functions

```

234 function configureAsset(
235     address asset,
236     uint256 decimals,
237     address longReinvestment,
238     ISwapAdapter swapAdapter,
239     IPriceOracleGetter oracle,
240     DataTypes.AssetState state,
241     DataTypes.AssetMode mode
242 ) public onlyOperator {
243     DataTypes.AssetConfig storage _assetConfig = assetConfig[asset];
244
245     _assetConfig.decimals = decimals;
246     _assetConfig.longReinvestment = longReinvestment;
247     _assetConfig.swapAdapter = swapAdapter;
248     _assetConfig.oracle = oracle;
249     _assetConfig.state = state;
250     _assetConfig.mode = mode;
251
252     emit ConfiguredAsset(asset, decimals, longReinvestment, address(swapAdapter), address(oracle), state, mode);
253 }
254

```

Figure 38 Source code of *configureAsset* function

Recommendations	It is recommended to use a multi-signature wallet to manage operator permissions.
Status	Fixed. The project party is planned that a Gnosis multi-signature wallet will be used as

operator for the Ledger.

[LeverFi-15] The `_repayShort` function is improperly designed

Severity Level	Medium
Type	Business Security
Lines	Ledger.sol#1074-1107
Description	The essence of the <code>_repayShort</code> function is that the user repays the debt, but the user can use the <code>_repayShort</code> function to add positions. Because the function does not determine whether the user's position is long, and the money transferred by the user is not transferred to the investment contract. When the last user wants to withdraw funds, it will cause the call to fail because the user withdraws funds from the investment contract.

```

1074 function _repayShort(address user, address asset, uint256 amount) internal {
1075     _reserveConfig[asset].updateIndex();
1076
1077     (uint256 positionAbsoluteAmount,) = GeneralLogic.getUserPosition(
1078         assetConfig[asset],
1079         _userPosition[user][asset],
1080         _reserveConfig[asset].getBorrowIndex()
1081     );
1082
1083     // cap amount to max repayable
1084     if (amount > positionAbsoluteAmount) {
1085         amount = positionAbsoluteAmount;
1086     }
1087
1088     ValidationLogic.validateRepayShort(
1089         userLastTradeBlock[user],
1090         DataTypes.ValidateRepayShortParams(
1091             user,
1092             asset,
1093             amount
1094         )
1095     );
1096
1097     IERC20Upgradeable(asset).safeTransferFrom(user, address(this), amount);
1098
1099     TradeLogic.executeLonging(
1100         _reserveConfig[asset],
1101         assetConfig[asset],
1102         _userPosition[user][asset],
1103         userConfig[user],
1104         treasury,
1105         amount,
1106         false
1107     );
1108

```

Figure 39 Source code of `_repayShort` function(Unfixed)

Recommendations	It is recommended to judge whether the user's position is a short type in <code>validateRepayShort</code> .
Status	Fixed.

```

1074 function _repayShort(address user, address asset, uint256 amount) internal {
1075     _reserveConfig[asset].updateIndex();
1076
1077     (uint256 positionAbsoluteAmount,) = GeneralLogic.getUserPosition(
1078         assetConfig[asset],
1079         _userPosition[user][asset],
1080         _reserveConfig[asset].getBorrowIndex()
1081     );
1082
1083     // cap amount to max repayable
1084     if (amount > positionAbsoluteAmount) {
1085         amount = positionAbsoluteAmount;
1086     }
1087
1088     ValidationLogic.validateRepayShort(
1089         userLastTradeBlock[user],
1090         DataTypes.ValidateRepayShortParams(
1091             user,
1092             asset,
1093             amount
1094         )
1095     );
1096
1097     IERC20Upgradeable(asset).safeTransferFrom(user, address(this), amount);
1098
1099     TradeLogic.executeLonging(
1100         _reserveConfig[asset],
1101         assetConfig[asset],
1102         _userPosition[user][asset],
1103         userConfig[user],
1104         treasury,
1105         amount,
1106         true
1107     );
1108
1109     emit RepaidShort(user, asset, amount);

```

Figure 40 Source code of `_repayShort` function(Fixed)

[LeverFi-16] Improperly designed `_depositCollateral` function

Severity Level	Low
Type	Business Security
Lines	Ledger.sol#L914-916
Description	In the <code>_depositCollateral</code> function, when verifying whether the stake meets the requirements, the current user's share (<code>currUserDepositShareRay</code>) plus the amount is incorrectly used to determine whether the minimum stake amount is met.

```

908  function _depositCollateral(address user, address asset, address reinvestment, uint256 amount) internal {
909      uint256 collateralPoolId = collateralPoolList[asset][reinvestment];
910      DataTypes.AssetConfig memory assetConfigCache = assetConfig[asset];
911      DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolId];
912      uint256 unit = assetConfigCache.decimals;
913
914      uint256 currUserDepositShareRay = userCollateralShareRay[user][collateralPoolId];
915
916      ValidationLogic.validateDepositCollateral(collateral, assetConfigCache, userLastTradeBlock[user], amount, currUserDepositShareRay);
917  }

```

Figure 41 Source code of `_depositCollateral` function(Unfixed)

Recommendations	It is recommended to use the current user's stake amount.
Status	Fixed.

```

939  function _depositCollateral(address user, address asset, address reinvestment, uint256 amount) internal {
940      uint256 collateralPoolId = collateralPoolList[asset][reinvestment];
941      DataTypes.AssetConfig memory assetConfigCache = assetConfig[asset];
942      DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolId];
943      uint256 unit = assetConfigCache.decimals;
944
945      uint256 currUserDepositShareRay = userCollateralShareRay[user][collateralPoolId];
946
947      uint256 currCollateralBalance;
948      // is first deposit
949      if (currUserDepositShareRay == 0) {
950          userConfig[user].setUsingCollateral(collateralPoolId, true);
951      } else {
952          currCollateralBalance = ShareBaseAccounting.getAbsoluteAmount(
953              currUserDepositShareRay,
954              collateral.scaledTotalSupplyRay,
955              GeneralLogic.getCollateralSupply(collateral).unitToRay(unit)
956          ).rayToUnit(unit);
957      }
958
959      ValidationLogic.validateDepositCollateral(collateral, assetConfigCache, userLastTradeBlock[user], amount, currCollateralBalance);
960  }

```

Figure 42 Source code of `_depositCollateral` function(Fixed)

[LeverFi-17] The *validateTrade* function check error

Severity Level	Low
Type	Business Security
Lines	ValidationLogic.sol#L170-174
Description	In the <i>validateTrade</i> function, the state of reserve is repeatedly judged, and the state of assetConfig should be judged here.

```

162     function validateTrade(
163         mapping(address => DataTypes.ReserveConfig) storage reserve,
164         mapping(address => DataTypes.AssetConfig) storage assetConfig,
165         mapping(address => DataTypes.UserPosition) storage userPosition,
166         uint256 userLastTradeBlock,
167         DataTypes.ValidateTradeParams memory params
168     ) external view {
169         ValidateTradeVars memory vars;
170         require(reserve[params.shortAsset].state == DataTypes.AssetState.Active, "selling asset not active");
171         require(reserve[params.longAsset].state == DataTypes.AssetState.Active, "buying asset not active");
172         require(reserve[params.shortAsset].state == DataTypes.AssetState.Active, "selling asset not active");
173         require(reserve[params.longAsset].state == DataTypes.AssetState.Active, "buying asset not active");
174         require(userLastTradeBlock != block.number, "cannot execute trade with other actions");
175         require(params.tradeAmount != 0, "amount is zero");
176         if (userPosition[params.shortAsset]._type == DataTypes.PositionType.Short) {
177             vars.amountToShort = params.tradeAmount;

```

Figure 43 Source code of *validateTrade* function(Unfixed)

Recommendations It is recommended to modify reserve to assetConfig.

Status Fixed.

```

160     /**
161     */
162     function validateTrade(
163         mapping(address => DataTypes.ReserveConfig) storage reserve,
164         mapping(address => DataTypes.AssetConfig) storage assetConfig,
165         mapping(address => DataTypes.UserPosition) storage userPosition,
166         uint256 userLastTradeBlock,
167         DataTypes.ValidateTradeParams memory params
168     ) external view {
169         ValidateTradeVars memory vars;
170         require(assetConfig[params.shortAsset].state == DataTypes.AssetState.Active, "selling asset not active");
171         require(assetConfig[params.longAsset].state == DataTypes.AssetState.Active, "buying asset not active");
172         require(reserve[params.shortAsset].state == DataTypes.AssetState.Active, "selling asset not active");
173         require(reserve[params.longAsset].state == DataTypes.AssetState.Active, "buying asset not active");
174         require(userLastTradeBlock != block.number, "cannot execute trade with other actions");
175         require(params.tradeAmount != 0, "amount is zero");
176         if (userPosition[params.shortAsset]._type == DataTypes.PositionType.Short) {
177             vars.amountToShort = params.tradeAmount;
178         } else {
179             if (userPosition[params.shortAsset].amount < params.tradeAmount) {

```

Figure 44 Source code of *validateTrade* function(Fixed)

[LeverFi-18] The *configureCollateral* function cannot modify reinvestment

Severity Level	Low
Type	Business Security
Lines	Ledger.sol#
Description	Because reinvestment cannot be set in the <i>configureCollateral</i> function, but there is a function for reinvesting new reinvestment in the contract, the reinvestment function will not be available.

```

361     function initializeCollateral(
362         address asset,
363         address reinvestment,
364         uint256 feeMantissa,
365         uint256 ltv,
366         uint256 minDeposit
367     ) external onlyOperator {
368         require(collateralPoolList[asset][reinvestment] == 0, "already initialized");
369
370         collateralPoolLength++;
371         collateralPoolList[asset][reinvestment] = collateralPoolLength;
372
373         DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolLength];
374
375         configureCollateral(asset, reinvestment, feeMantissa, ltv, minDeposit, DataTypes.AssetState.Active);
376
377         collateral.poolId = collateralPoolLength;
378         collateral.asset = asset;
379         collateral.reinvestment = reinvestment;
380
381         emit InitializedCollateral(collateral.poolId, asset, reinvestment);
382     }
383

```

Figure 45 Source code of *initializeCollateral* function

```

393     function configureCollateral(
394         address asset,
395         address reinvestment,
396         uint256 feeMantissa,
397         uint256 ltv,
398         uint256 minDeposit,
399         DataTypes.AssetState state
400     ) public onlyOperator {
401         DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolList[asset][reinvestment]];
402
403         collateral.feeMantissa = feeMantissa;
404         collateral.ltv = ltv;
405         collateral.minBalance = minDeposit;
406         collateral.state = state;
407
408         emit ConfiguredCollateral(asset, reinvestment, feeMantissa, ltv, minDeposit, state);
409     }
410

```

Figure 46 Source code of *configureCollateral* function

```

825     function reinvestCollateralSupply(address asset, address reinvestment) external onlyOperator {
826
827
828         uint256 poolId = collateralPoolList[asset][reinvestment];
829         DataTypes.CollateralConfig storage collateralConfig = _collateralConfig[poolId];
830
831         require(collateralConfig.state == DataTypes.AssetState.Disabled, "state is not disabled");
832         require(collateralConfig.reinvestment != address(0), "reinvestment is not set");
833
834         IERC20Upgradeable(asset).safeApprove(collateralConfig.reinvestment, collateralConfig.liquidSupply);
835         IReinvestment(collateralConfig.reinvestment).invest(collateralConfig.liquidSupply);
836
837         emit ReinvestedCollateralSupply(asset, reinvestment, collateralConfig.liquidSupply);
838
839         collateralConfig.liquidSupply = 0;
840     }
841

```

Figure 47 Source code of *reinvestCollateralSupply* function

Recommendations It is recommended to add `collateralPoolList[asset][new_reinvestment] = collateralPoolList[asset][reinvestment]; del collateralPoolList[asset][reinvestment]` to the `configureCollateral` function, and then update the reinvestment in the new collateral. When setting, you should also judge whether `collateralPoolList[asset][new_reinvestment]` has been set. Of course, when setting, also judge the state, which can only be set when Disabled.

Status

Fixed.

```

274
275
276
277
278
279
280
281
282
function setCollateralReinvest(uint256 pid, address newReinvestment) external onlyConfigurator {
    DataTypes.CollateralData storage collateral = collaterals[pid];
    require(collateral.asset != address(0), Errors.POOL_NOT_INITIALIZED);
    collateralList[collateral.asset][newReinvestment] = pid;
    delete collateralList[collateral.asset][collateral.reinvestment];
    collateral.reinvestment = newReinvestment;
}

```

Figure 48 Source code of *setCollateralReinvestment* function(Fixed)

[LeverFi-19] lack of judgment on value

Severity Level	Info
Type	Business Security
Lines	Ledger.sol#L137-161
Description	The following function lacks judgment on the input value, resulting in any value can be set.

```

136  */
137  function setLeverageFactor(uint256 leverageFactor_) external onlyOperator {
138      emit LeverageFactorUpdated(leverageFactor, leverageFactor_);
139
140      leverageFactor = leverageFactor_;
141  }
142
143  /**
144   * @notice Setter for tradeFeeMantissa
145   * @param tradeFeeMantissa_ The new tradeFeeMantissa
146   */
147  function setTradeFee(uint256 tradeFeeMantissa_) external onlyOperator {
148      emit TradeFeeUpdated(tradeFeeMantissa, tradeFeeMantissa_);
149
150      tradeFeeMantissa = tradeFeeMantissa_;
151  }
152
153  /**
154   * @notice Setter for liquidationRatioMantissa
155   * @param liquidationRatioMantissa_ The new liquidationRatioMantissa
156   */
157  function setLiquidationRatio(uint256 liquidationRatioMantissa_) external onlyOperator {
158      emit LiquidationRatioUpdated(liquidationRatioMantissa, liquidationRatioMantissa_);
159
160      liquidationRatioMantissa = liquidationRatioMantissa_;
161  }
162

```

Figure 49 Source code of related functions(Unfixed)

```

118  function initialize(
119      address treasury_,
120      uint256 leverageFactor_,
121      uint256 liquidationRatioMantissa_,
122      uint256 tradeFeeMantissa_
123  ) public initializer {
124      treasury = treasury_;
125      leverageFactor = leverageFactor_;
126      liquidationRatioMantissa = liquidationRatioMantissa_;
127      tradeFeeMantissa = tradeFeeMantissa_;
128
129      _grantRole(OPERATOR_ROLE, msg.sender);
130      _grantRole(LIQUIDATE_EXECUTOR, msg.sender);
131  }
132

```

Figure 50 Source code of *initialize* function(Unfixed)

Recommendations	It is recommended to judge the range of the input value.
Status	Fixed.


```

137  */
138  ✓ function setLeverageFactor(uint256 leverageFactor_) external onlyOperator {
139      require(leverageFactor_ >= 1e18, "leverage factor cannot be lower than 1x");
140      require(leverageFactor_ <= 10e18, "leverage factor cannot be lower than 10x");
141
142      emit LeverageFactorUpdated(leverageFactor, leverageFactor_);
143
144      leverageFactor = leverageFactor_;
145  }
146
147  /**
148  * @notice Setter for tradeFeeMantissa
149  * @param tradeFeeMantissa_ The new tradeFeeMantissa
150  */
151  ✓ function setTradeFee(uint256 tradeFeeMantissa_) external onlyOperator {
152      require(tradeFeeMantissa_ <= 0.1e18, "fee cannot be more than 10%");
153
154      emit TradeFeeUpdated(tradeFeeMantissa, tradeFeeMantissa_);
155
156      tradeFeeMantissa = tradeFeeMantissa_;
157  }
158
159  /**
160  * @notice Setter for liquidationRatioMantissa
161  * @param liquidationRatioMantissa_ The new liquidationRatioMantissa
162  */
163  ✓ function setLiquidationRatio(uint256 liquidationRatioMantissa_) external onlyOperator {
164      require(liquidationRatioMantissa_ >= 0.5e18, "fee cannot be less than 50%");
165      require(liquidationRatioMantissa_ <= 0.9e18, "fee cannot be more than 90%");
166
167      emit LiquidationRatioUpdated(liquidationRatioMantissa, liquidationRatioMantissa_);
168
169      liquidationRatioMantissa = liquidationRatioMantissa_;
170  }
171

```

Figure 51 Source code of related functions(Fixed)

```

119  function initialize(
120      address treasury_,
121      uint256 leverageFactor_,
122      uint256 liquidationRatioMantissa_,
123      uint256 tradeFeeMantissa_
124  ) public initializer {
125      require(leverageFactor_ >= 1e18, "leverage factor cannot be lower than 1x");
126      require(leverageFactor_ <= 10e18, "leverage factor cannot be lower than 10x");
127      require(liquidationRatioMantissa_ >= 0.5e18, "fee cannot be less than 50%");
128      require(liquidationRatioMantissa_ <= 0.9e18, "fee cannot be more than 90%");
129      require(tradeFeeMantissa_ <= 0.1e18, "fee cannot be more than 10%");
130
131      treasury = treasury_;
132      leverageFactor = leverageFactor_;
133      liquidationRatioMantissa = liquidationRatioMantissa_;
134      tradeFeeMantissa = tradeFeeMantissa_;
135
136      _setRoleAdmin(OPERATOR_ROLE, OPERATOR_ROLE);
137      _setRoleAdmin(LIQUIDATE_EXECUTOR, OPERATOR_ROLE);
138
139      _grantRole(OPERATOR_ROLE, msg.sender);
140      _grantRole(LIQUIDATE_EXECUTOR, msg.sender);
141  }
142

```

Figure 52 Source code of *initialize* function(Fixed)

[LeverFi-20] The *getUserLiquidity* function design flaw

Severity Level	Info
Type	Business Security
Lines	GeneralLogic.sol#L185-188
Description	When calculating availableLeverageUsd, whether vars.pnlUsd>0 or vars.pnlUsd<0, should use (int256(vars.totalCollateralUsdPostLtv) + vars.pnlUsd) * int256(params.leverageFactor) / int256(1e18) - int(vars.totalShortUsd)), because the part of the revenue can still be used as part of the user.

```

176     }
177     }
178     vars.userConfigCache.collateral = vars.userConfigCache.collateral >> 1;
179     vars.userConfigCache.position = vars.userConfigCache.position >> 1;
180     vars.i++;
181 }
182 vars.pnlUsd = int256(vars.totalLongUsd) - int256(vars.totalShortUsd);
183 vars.isLiquidatable = (int256(vars.totalCollateralUsdPreltv.wadMul(params.liquidationRatioMantissa)) + vars.pnlUsd) < 0;
184 vars.totalLeverageUsd = vars.totalCollateralUsdPostLtv.wadMul(params.leverageFactor);
185 vars.availableLeverageUsd = vars.pnlUsd > 0
186 ? (int256(vars.totalCollateralUsdPostLtv) * int256(params.leverageFactor) / int256(1e18) - int(vars.totalShortUsd)
187 : (int256(vars.totalCollateralUsdPostLtv) + vars.pnlUsd) * int256(params.leverageFactor) / int256(1e18) - int(vars.totalShortUsd);
188 return (
189     vars.totalCollateralUsdPreltv,
190     vars.totalCollateralUsdPostLtv,
191     vars.totalLongUsd,
192     vars.totalShortUsd,
193     vars.pnlUsd,
194     vars.totalLeverageUsd,
195     vars.availableLeverageUsd,
196     vars.isLiquidatable
197 );
198 }
199
200

```

Figure 53 Source code of *getUserLiquidity* function(Unfixed)

Recommendations	It is recommended to treat the revenue part as the part used by the user.
Status	Fixed.

```

180     }
181     }
182     vars.pnlUsd = int256(vars.totalLongUsd) - int256(vars.totalShortUsd);
183     vars.isLiquidatable = (int256(vars.totalCollateralUsdPreltv.wadMul(params.liquidationRatioMantissa)) + vars.pnlUsd) < 0;
184     vars.totalLeverageUsd = vars.totalCollateralUsdPostLtv.wadMul(params.leverageFactor);
185     vars.availableLeverageUsd = (int256(vars.totalCollateralUsdPostLtv) + vars.pnlUsd) * int256(params.leverageFactor) / int256(1e18) - int(vars.totalShortUsd);
186     return (
187         vars.totalCollateralUsdPreltv,
188         vars.totalCollateralUsdPostLtv,
189         vars.totalLongUsd,
190         vars.totalShortUsd,
191         vars.pnlUsd,
192         vars.totalLeverageUsd,
193         vars.availableLeverageUsd,
194         vars.isLiquidatable
195     );
196 }
197
198

```

Figure 54 Source code of *getUserLiquidity* function(Fixed)

[LeverFi-21] Lack of judgment on whether to add assets

Severity Level	Info
Type	Business Security
Lines	Ledger.sol#L175-197,244-275
Description	In the <i>initializeAsset</i> function of the Ledger contract, it is not determined whether the asset has been added. If the operator is not set properly, it will cause an error in the <i>assetList</i> record. Similarly, the <i>initializeCollateral</i> function should also determine whether the <i>collateralPoolList[asset][reinvestment]</i> has been added.

```

175 function initializeAsset(
176     address asset,
177     uint256 decimals,
178     address longReinvestment,
179     ISwapAdapter swapAdapter,
180     IPriceOracleGetter oracle,
181     DataTypes.AssetState state,
182     DataTypes.AssetMode mode
183 ) external onlyOperator {
184     assetLength++;
185     assetList[assetLength] = asset;
186
187     configureAsset(
188         asset,
189         decimals,
190         longReinvestment,
191         swapAdapter,
192         oracle,
193         state,
194         mode
195     );
196
197     emit InitializedAssetConfig(assetLength, asset);
198
199

```

Figure 55 Source code of *initializeAsset* function(Unfixed)

```

334 function initializeCollateral(
335     address asset,
336     address reinvestment,
337     uint256 feeMantissa,
338     uint256 ltv,
339     uint256 minDeposit
340 ) external onlyOperator {
341     collateralPoolLength++;
342     collateralPoolList[asset][reinvestment] = collateralPoolLength;
343
344     DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolLength];
345
346     configureCollateral(asset, reinvestment, feeMantissa, ltv, minDeposit, DataTypes.AssetState.Active);
347
348     collateral.poolId = collateralPoolLength;
349     collateral.asset = asset;
350     collateral.reinvestment = reinvestment;
351
352     emit InitializedCollateral(collateral.poolId, asset, reinvestment);
353

```

Figure 56 Source code of *initializeCollateral* function(Unfixed)

Recommendations It is recommended to determine whether the asset has been added.

Status Fixed.

```

183 ~/
184 function initializeAsset(
185     address asset,
186     uint256 decimals,
187     address longReinvestment,
188     ISwapAdapter swapAdapter,
189     IPriceOracleGetter oracle,
190     DataTypes.AssetState state,
191     DataTypes.AssetMode mode
192 ) external onlyOperator {
193     require(assetConfig[asset].assetId == 0, "already initialized");
194
195     assetLength++;
196     assetList[assetLength] = asset;
197
198     configureAsset(
199         asset,
200         decimals,
201         longReinvestment,
202         swapAdapter,
203         oracle,
204         state,
205         mode
206     );
207
208     emit InitializedAssetConfig(assetLength, asset);
209 }
210

```

Figure 57 Source code of *initializeAsset* function(Fixed)

```

361 ~/
362 function initializeCollateral(
363     address asset,
364     address reinvestment,
365     uint256 feeMantissa,
366     uint256 ltv,
367     uint256 minDeposit
368 ) external onlyOperator {
369     require(collateralPoolList[asset][reinvestment] == 0, "already initialized");
370
371     collateralPoolLength++;
372     collateralPoolList[asset][reinvestment] = collateralPoolLength;
373
374     DataTypes.CollateralConfig storage collateral = _collateralConfig[collateralPoolLength];
375
376     configureCollateral(asset, reinvestment, feeMantissa, ltv, minDeposit, DataTypes.AssetState.Active);
377
378     collateral.poolId = collateralPoolLength;
379     collateral.asset = asset;
380     collateral.reinvestment = reinvestment;
381
382     emit InitializedCollateral(collateral.poolId, asset, reinvestment);
383 }
384

```

Figure 58 Source code of *initializeCollateral* function(Fixed)

[LeverFi-22] Admin permission not initialized

Severity Level	Info
Type	Business Security
Lines	Ledger.sol#L
Description	In the initialize function, there is no initial admin permission, which will result in the subsequent failure to change the permissions of OPERATOR_ROLE and LIQUIDATE_EXECUTOR.

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3 Appendix

3.1 Vulnerability Assessment Metrics and Status in Smart Contracts

3.1.1 Metrics

In order to objectively assess the severity level of vulnerabilities in blockchain systems, this report provides detailed assessment metrics for security vulnerabilities in smart contracts with reference to CVSS 3.1 (Common Vulnerability Scoring System Ver 3.1).

According to the severity level of vulnerability, the vulnerabilities are classified into four levels: "critical", "high", "medium" and "low". It mainly relies on the degree of impact and likelihood of exploitation of the vulnerability, supplemented by other comprehensive factors to determine of the severity level.

Impact Likelihood	Severe	High	Medium	Low
Probable	Critical	High	Medium	Low
Possible	High	High	Medium	Low
Unlikely	Medium	Medium	Low	Info
Rare	Low	Low	Info	Info

3.1.2 Degree of impact

- **Severe**

Severe impact generally refers to the vulnerability can have a serious impact on the confidentiality, integrity, availability of smart contracts or their economic model, which can cause substantial economic losses to the contract business system, large-scale data disruption, loss of authority management, failure of key functions, loss of credibility, or indirectly affect the operation of other smart contracts associated with it and cause substantial losses, as well as other severe and mostly irreversible harm.

- **High**

High impact generally refers to the vulnerability can have a relatively serious impact on the confidentiality, integrity, availability of the smart contract or its economic model, which can cause a greater economic loss, local functional unavailability, loss of credibility and other impact to the contract business system.

- **Medium**

Medium impact generally refers to the vulnerability can have a relatively minor impact on the confidentiality, integrity, availability of the smart contract or its economic model, which can cause a small amount of economic loss to the contract business system, individual business unavailability and other impact.

- **Low**

Low impact generally refers to the vulnerability can have a minor impact on the smart contract, which can pose certain security threat to the contract business system and needs to be improved.

3.1.4 Likelihood of Exploitation

- **Probable**

Probable likelihood generally means that the cost required to exploit the vulnerability is low, with no special exploitation threshold, and the vulnerability can be triggered consistently.

- **Possible**

Possible likelihood generally means that exploiting such vulnerability requires a certain cost, or there are certain conditions for exploitation, and the vulnerability is not easily and consistently triggered.

- **Unlikely**

Unlikely likelihood generally means that the vulnerability requires a high cost, or the exploitation conditions are very demanding and the vulnerability is highly difficult to trigger.

- **Rare**

Rare likelihood generally means that the vulnerability requires an extremely high cost or the conditions for exploitation are extremely difficult to achieve.

3.1.5 Fix Results Status

Status	Description
Fixed	The project party fully fixes a vulnerability.
Partially Fixed	The project party did not fully fix the issue, but only mitigated the issue.
Acknowledged	The project party confirms and chooses to ignore the issue.

3.2 Audit Categories

No.	Categories	Subitems
1	Coding Conventions	Compiler Version Security
		Deprecated Items
		Redundant Code
		require/assert Usage
		Gas Consumption
2	General Vulnerability	Integer Overflow/Underflow
		Reentrancy
		Pseudo-random Number Generator (PRNG)
		Transaction-Ordering Dependence
		DoS (Denial of Service)
		Function Call Permissions
		call/delegatecall Security
		Returned Value Security
		tx.origin Usage
		Replay Attack
		Overriding Variables
		Third-party Protocol Interface Consistency
3	Business Security	Business Logics
		Business Implementations
		Manipulable Token Price
		Centralized Asset Control
		Asset Tradability
		Arbitrage Attack

Beosin classified the security issues of smart contracts into three categories: Coding Conventions, General Vulnerability, Business Security. Their specific definitions are as follows:

- **Coding Conventions**

Audit whether smart contracts follow recommended language security coding practices. For example, smart contracts developed in Solidity language should fix the compiler version and do not use deprecated keywords.

- **General Vulnerability**

General Vulnerability include some common vulnerabilities that may appear in smart contract projects. These vulnerabilities are mainly related to the characteristics of the smart contract itself, such as integer overflow/underflow and denial of service attacks.

- **Business Security**

Business security is mainly related to some issues related to the business realized by each project, and has a relatively strong pertinence. For example, whether the lock-up plan in the code match the white paper, or the flash loan attack caused by the incorrect setting of the price acquisition oracle.

*Note that the project may suffer stake losses due to the integrated third-party protocol. This is not something Beosin can control. Business security requires the participation of the project party. The project party and users need to stay vigilant at all times.

3.3 Disclaimer

The Audit Report issued by Beosin is related to the services agreed in the relevant service agreement. The Project Party or the Served Party (hereinafter referred to as the "Served Party") can only be used within the conditions and scope agreed in the service agreement. Other third parties shall not transmit, disclose, quote, rely on or tamper with the Audit Report issued for any purpose.

The Audit Report issued by Beosin is made solely for the code, and any description, expression or wording contained therein shall not be interpreted as affirmation or confirmation of the project, nor shall any warranty or guarantee be given as to the absolute flawlessness of the code analyzed, the code team, the business model or legal compliance.

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The Audit Report issued by Beosin in no way provides investment advice on any project, nor should it be utilized as investment suggestions of any type. This report represents an extensive evaluation process designed to help our customers improve code quality while mitigating the high risks in Blockchain.

3.4 About BEOSIN

BEOSIN is the first institution in the world specializing in the construction of blockchain security ecosystem. The core team members are all professors, postdocs, PhDs, and Internet elites from world-renowned academic institutions. BEOSIN has more than 20 years of research in formal verification technology, trusted computing, mobile security and kernel security, with overseas experience in studying and collaborating in project research at well-known universities. Through the security audit and defense deployment of more than 2,000 smart contracts, over 50 public blockchains and wallets, and nearly 100 exchanges worldwide, BEOSIN has accumulated rich experience in security attack and defense of the blockchain field, and has developed several security products specifically for blockchain.

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