Biconomy - LiquidityPoolManager

Smart Contract Security Audit

Prepared by: **Halborn**

Date of Engagement: **July 6th - 16th, 2021, September 4th - 10th, 2021**

Visit: **Halborn.com**

DOCUMENT REVISION HISTORY

VERSION	MODIFICATION	DATE	AUTHOR
0.1	Document Creation	07/12/2021	Gabi Urrutia
0.9	Document Edits	07/15/2021	Ataberk Yavuzer
1.0	Final Review	07/16/2021	Gabi Urrutia
1.1	Remediation Plan	09/10/2021	Ataberk Yavuzer

CONTACTS

CONTACT	COMPANY	EMAIL
Rob Behnke	Halborn	Rob.Behnke@halborn.com
Steven Walbroehl	Halborn	Steven.Walbroehl@halborn.com
Gabi Urrutia	Halborn	Gabi.Urrutia@halborn.com
Ataberk Yavuzer	Halborn	Ataberk.Yavuzer@halborn.com

EXECUTIVE OVERVIEW

1.1 INTRODUCTION

Biconomy engaged Halborn to conduct a security assessment on a smart contract beginning on July 6th, 2021 and ending July 16th, 2021. The security assessment was scoped to the smart contract provided in the Github repository Biconomy Repository Halborn conducted this audit to measure security risk and identify any new vulnerabilities introduced during the final stages of development before the production release. The security assessment was scoped to the smart contract LiquidityPoolManager.sol.

After the first version of the report was completed and the findings were resolved, new updates were made to the code and these updates were included in the audit again. A new one week engagement was held.

1.2 AUDIT SUMMARY

The team at Halborn was provided a week for the engagement and assigned a full time security engineer to audit the security of the smart contract. The security engineer is a blockchain and smart-contract security expert with advanced penetration testing, smart-contract hacking, and deep knowledge of multiple blockchain protocols.

The purpose of this audit to achieve the following:

- Ensure that smart contract functions operate as intended.
- Identify potential security issues with the smart contracts.

Though this security audit's outcome is satisfactory, only the most essential aspects were tested and verified to achieve objectives and deliverables set in the scope due to time and resource constraints. It is essential to note the use of the best practices for secure smart-contract development.

1.3 TEST APPROACH & METHODOLOGY

Halborn performed a combination of manual and automated security testing to balance efficiency, timeliness, practicality, and accuracy in regard to the scope of the smart contract audit. While manual testing is recommended to uncover flaws in logic, process,and implementation; automated testing techniques help enhance coverage of smart contracts 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.
- Scanning of solidity files for vulnerabilities, security hotspots or bugs. (MythX)
- Static Analysis of security for scoped contract, and imported functions.(Slither)
- Testnet deployment (RemixIDE)

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. It's quantitative model ensures repeatable and accurate measurement while enabling users to see the underlying vulnerability characteristics that was 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.

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

1.4 SCOPE

IN-SCOPE:
The security assessment was scoped to the smart contracts:
- LiquidityPoolManager.sol

Commit ID: 15c76b914caa7430aee61fd11c789ef19de205b9

The second security assessment was scoped to the following contracts:
- LiquidityPoolManager.sol

Final Commit ID: 2bf135537270ecfe01846853be7905fafbd80384

OUT-OF-SCOPE:
Other smart contracts in the repository, external libraries and economics attacks.

2. ASSESSMENT SUMMARY & FINDINGS OVERVIEW

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL
0	1	0	4	3

LIKELIHOOD

IMPACT

			(HAL-01)	
	(HAL-02) (HAL-03)			
(HAL-06)	(HAL-04) (HAL-05)			
(HAL-07) (HAL-08)				

EXECUTIVE OVERVIEW

SECURITY ANALYSIS	RISK LEVEL	REMEDIATION DATE
HAL01 - RENOUNCING PAUSER ROLE WHEN CONTRACT IS PAUSED	High	SOLVED - 07/27/2021
HAL02 - OWNER CAN RENOUNCE OWNERSHIP	Low	SOLVED - 07/28/2021
HAL03 - LACK OF ZERO ADDRESS CHECK ON CONSTRUCTOR	Low	SOLVED - 07/27/2021
HAL04 - TAUTOLOGY EXPRESSIONS	Low	SOLVED - 07/27/2021
HAL05 - POSSIBLE RE-ENTRANCY	Low	SOLVED - 09/12/2021
HAL06 - EXPERIMENTAL FEATURES ENABLED	Informational	SOLVED - 07/27/2021
HAL07 - POSSIBLE MISUSE OF PUBLIC FUNCTIONS	Informational	SOLVED - 07/27/2021
HAL08 - MISSING EVENTS EMITTING	Informational	SOLVED - 07/27/2021

FINDINGS & TECH DETAILS

3.1 (HAL-01) RENOUNCING PAUSER ROLE WHEN CONTRACT IS PAUSED - HIGH

Description:

There are multiple roles on the LiquidityPoolManager contract such as Owner, Pauser and TrustedForwarder. According to the contract functions, it is possible to set Owner and Pauser addresses to zero by using renounceOwnership and renouncePauser functions. The Pauser role can pause the contract. If the private key of this Pauser is compromised, an attacker can pause the contract and renounce the pauser role, then the attacker can render the contract useless forever.

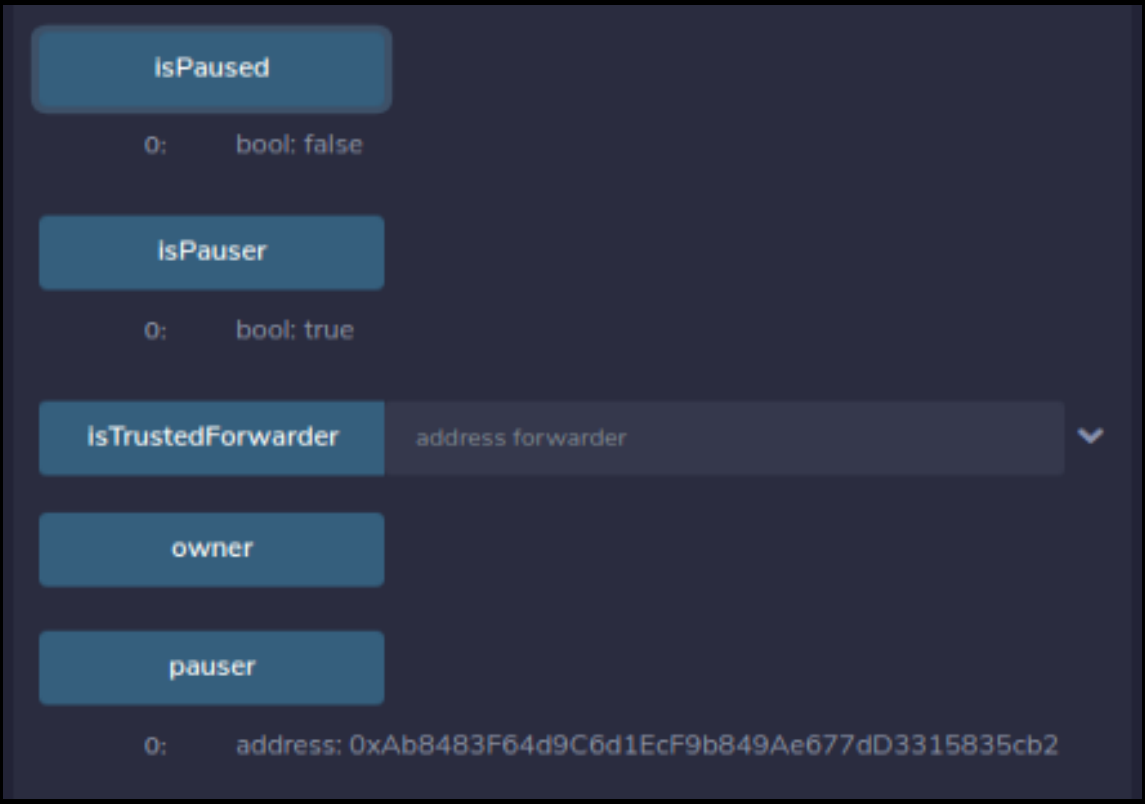
Risk Level:

Likelihood - 4
Impact - 4

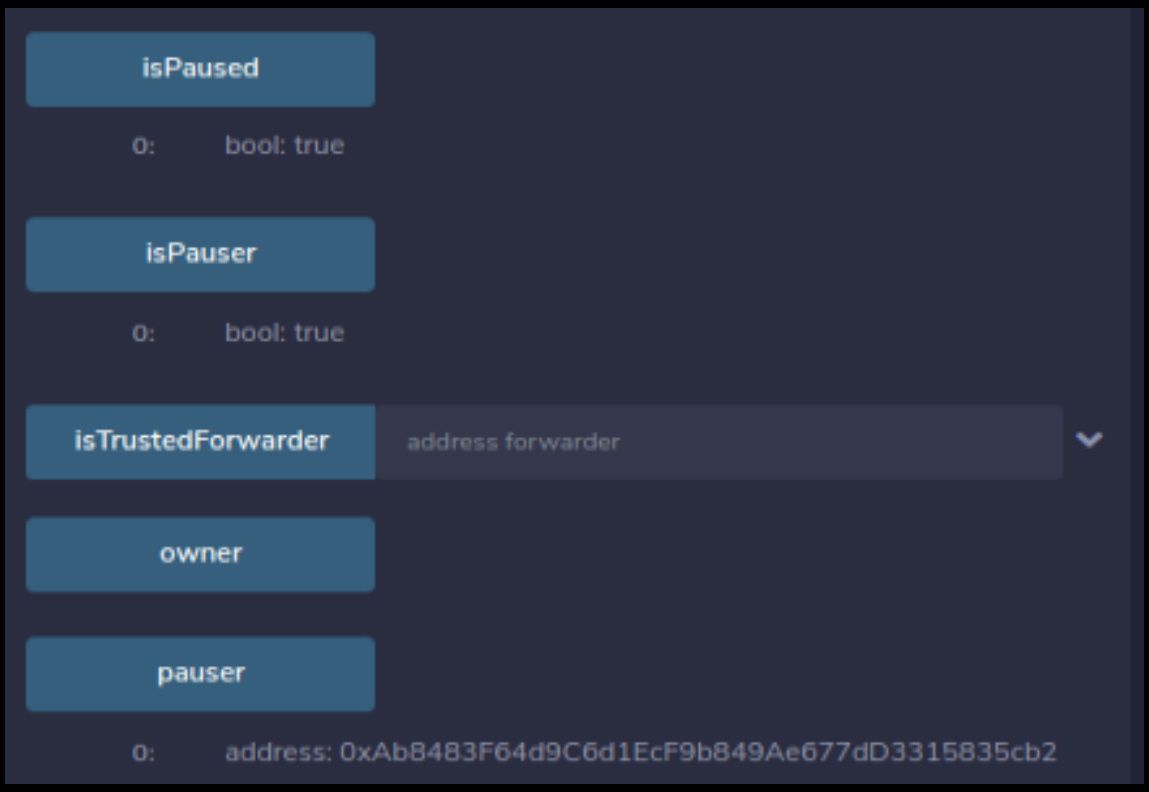
Proof Of Concept:

This attack has three stages which are described below:

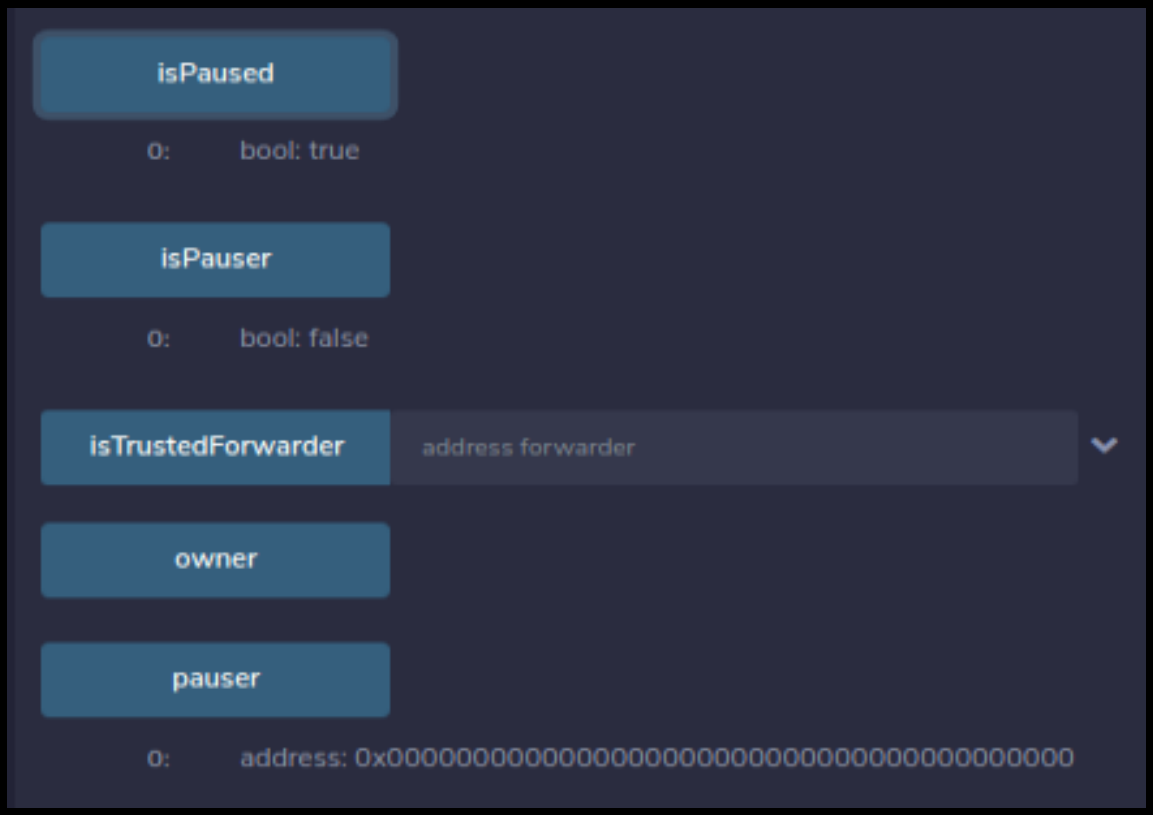
1. In the first screenshot, everything looks proper. Three functions are called during the step one: `isPaused()`, `isPauser()` and `pauser()` public functions in order.



2. After the first step, the `pause()` function has to be called by any user which has `Pauser` role. It can be seen that `isPaused()` function returned `true` as a boolean variable on the following screenshot.



3. Finally, the `renouncePauser()` function needs to be called on the contract that is in the pause state. After this action, the Pauser address will be set to address(0) and the contract will never be able to return from the paused state.



Recommendation:

It is recommended to add the whenNotPaused modifier to the renouncePauser function. In addition, the pauser role should not be the address(0) for not disrupting the flow of the contract.

Remediation Plan:

SOLVED: Biconomy Team solved this issue by adding whenNotPaused modifier to the renouncePauser function.

3.2 (HAL-02) OWNER CAN RENOUNCE OWNERSHIP - LOW

Description:

The Owner of the contract is usually the account that deploys the contract. As a result, the Owner is able to perform some privileged functions like setBaseGas() and setExecutorManager(). In the LiquidityPoolManager.sol smart contract, the renounceOwnership function is used to renounce the Owner permission. Renouncing ownership before transferring would result in the contract having no Owner, eliminating the ability to call privileged functions.

Risk Level:

Likelihood - 2
Impact - 3

Code Location:

Listing 1: LiquidityPoolManager.sol Ownable (Lines 15)

```
15 contract LiquidityPoolManager is ReentrancyGuard, Ownable,
       BaseRelayRecipient, Pausable {
16
```

Recommendation:

It's recommended that the Owner is not able to call renounceOwnership without transferring the Ownership to other address before. In addition, if a multi-signature wallet is used, calling renounceOwnership function should be confirmed for two or more users. As an other solution, Renounce Ownership functionality can be disabled with the following line.

Listing 2: Disable RenounceOwnerShip (Lines 1)

```
1 function renounceOwnership () public override onlyOwner {
2     revert ("can 't renounceOwnership here "); // not possible
          with this smart contract
3 }
```

Remediation Plan:

SOLVED: Biconomy Team added a new statement for renounceOwnership and renouncePauser functions to solve the issue.

3.3 (HAL-03) LACK OF ZERO ADDRESS CHECK ON CONSTRUCTOR - LOW

Description:

The LiquidityPoolManager contract includes different type of roles. For example, there is Owner role for setting the adminFee value. For another example, the Pauser role pauses the contract if something wrong with the transactions or contract logic. It is important to provide these roles to valid addresses. These roles should be driven by people. There are too many address checks in the LiquidityPoolManager contract to keep these roles safe. For example, it is not possible to set Owner, Pauser and TrustedForwarder addresses to address(0) after initialization of the contract. However, it is possible to set Pauser address to address(0) because of the lack of address control on constructor.

Risk Level:

Likelihood - 2
Impact - 3

Code Location:

Listing 3: LiquidityPoolManager.sol (Lines 68,69,70,71)

```
67     constructor(address _executorManagerAddress, address owner,
           address pauser, address _trustedForwarder, uint256
           _adminFee) public Ownable(owner) Pausable(pauser) {
68         require(_executorManagerAddress != address(0), "
               ExecutorManager Contract Address cannot be 0");
69         require(owner != address(0), "Owner Address cannot be 0");
70         require(_trustedForwarder != address(0), "TrustedForwarder
               Contract Address cannot be 0");
71         require(_adminFee != 0, "AdminFee cannot be 0");
72         executorManager = ExecutorManager(_executorManagerAddress)
               ;
73         trustedForwarder = _trustedForwarder;
74         adminFee = _adminFee;
```

```
75          baseGas = 21000;
76      }
```

Recommendation:

Implementing zero address check on constructor strongly recommended by Halborn team.

Remediation Plan:

SOLVED: Biconomy Team added address control check to the constructor.

3.4 (HAL-04) TAUTOLOGY EXPRESSIONS - LOW

Description:

In contract LiquidityPoolManager.sol, tautology expressions have been detected. Such expressions are of no use since they always evaluate true/false regardless of the context they are used in.

Risk Level:

Likelihood - 2
Impact - 2

Code Location:

Listing 4: LiquidityPoolManager.sol (Lines 154)

```
153 function addTokenLiquidity( address tokenAddress, uint256 amount )
        public tokenChecks(tokenAddress) whenNotPaused {
154         require(amount > 0, "amount should be greater then 0");
```

Listing 5: LiquidityPoolManager.sol (Lines 273)

```
272  function withdrawErc20(address tokenAddress) public onlyOwner
        whenNotPaused {
273         uint256 profitEarned = (IERC20(tokenAddress).balanceOf(
                address(this))).sub(tokensInfo[tokenAddress].liquidity)
                ;
274         require(profitEarned > 0, "Profit earned is 0");
275         address payable sender = _msgSender();
```

Recommendation:

Correct the expressions. Since amount and profitEarned variables are declared as type uint256, they are always greater or equal to 0.

Remediation Plan:

SOLVED: Biconomy Team fixed expressions on modifiers related to the current issue.

3.5 (HAL-05) POSSIBLE RE-ENTRANCY - LOW

Description:

The Re-Entrancy attack is performed when it is possible to interrupt an execution in the middle, initiated over, and both runs can complete without any errors in execution. In the context of Ethereum Smart Contracts, Re-Entrancy can lead to serious vulnerabilities such as loss of assets.

During the tests, a pattern seen in Smart contract re-entrancy attacks was detected. The new withdraw functions added with the latest update are using `call.value()` method which is less secure than `transfer` and `send` against possible re-entrancy attacks. These new functions are only callable by contract owner. This situation decreases the severity of the issue.

```
328         function withdrawNative() external onlyOwner whenNotPaused {
329 +           uint256 profitEarned = (address(this).balance)
330 +                                   .sub(tokensInfo[NATIVE].liquidity)
331 +                                   .sub(adminFeeAccumulatedByToken[NATIVE])
332 +                                   .sub(gasFeeAccumulatedByToken[NATIVE]);
333             require(profitEarned != 0, "Profit earned is 0");
334 +
335             address payable sender = _msgSender();
336             (bool success, ) = sender.call{ value: profitEarned }("");
337             require(success, "Native Transfer Failed");
338
339             emit fundsWithdraw(address(this), sender, profitEarned);
340         }
```

Code Location:

Listing 6: LiquidityPoolManager.sol (Lines 163)

```
156 function removeNativeLiquidity(uint256 amount) external
        whenNotPaused nonReentrant {
157         require(amount != 0 , "Amount cannot be 0");
158         address payable sender = _msgSender();
159         require(tokensInfo[NATIVE].liquidityProvider[sender] >=
                amount, "Not enough balance");
160         tokensInfo[NATIVE].liquidityProvider[sender] = tokensInfo[
                NATIVE].liquidityProvider[sender].sub(amount);
161         tokensInfo[NATIVE].liquidity = tokensInfo[NATIVE].
                liquidity.sub(amount);
162
163         (bool success, ) = sender.call{ value: amount }("");
164         require(success, "Native Transfer Failed");
165
166         emit LiquidityRemoved( NATIVE, amount, sender);
167     }
```

Listing 7: LiquidityPoolManager.sol (Lines 254)

```
247 function sendFundsToUser( address tokenAddress, uint256 amount,
        address payable receiver, bytes memory depositHash, uint256
        tokenGasPrice ) external nonReentrant onlyExecutor tokenChecks(
        tokenAddress) whenNotPaused {
248         uint256 initialGas = gasleft();
249
250         . . .
251
252         if (tokenAddress == NATIVE) {
253             require(address(this).balance >= amountToTransfer, "
                    Not Enough Balance");
254             (bool success, ) = receiver.call{ value:
                    amountToTransfer }("");
255             require(success, "Native Transfer Failed");
256         } else {
257             require(IERC20(tokenAddress).balanceOf(address(this))
                    >= amountToTransfer, "Not Enough Balance");
258             SafeERC20.safeTransfer(IERC20(tokenAddress), receiver,
                     amountToTransfer);
259         }
```

Listing 8: LiquidityPoolManager.sol (Lines 336)

```
328 function withdrawNative() external onlyOwner whenNotPaused {
329         uint256 profitEarned = (address(this).balance)
330                                 .sub(tokensInfo[NATIVE].liquidity)
331                                 .sub(adminFeeAccumulatedByToken[
                                        NATIVE])
332                                 .sub(gasFeeAccumulatedByToken[
                                        NATIVE]);
333         require(profitEarned != 0, "Profit earned is 0");
334
335         address payable sender = _msgSender();
336         (bool success, ) = sender.call{ value: profitEarned }("");
337         require(success, "Native Transfer Failed");
338
339         emit fundsWithdraw(address(this), sender, profitEarned);
340     }
```

Listing 9: LiquidityPoolManager.sol (Lines 346)

```
342 function withdrawNativeAdminFee(address payable receiver) external
        onlyOwner whenNotPaused {
343         uint256 adminFeeAccumulated = adminFeeAccumulatedByToken[
                NATIVE];
344         require(adminFeeAccumulated != 0, "Admin Fee earned is 0")
                ;
345         adminFeeAccumulatedByToken[NATIVE] = 0;
346         (bool success, ) = receiver.call{ value:
                adminFeeAccumulated }("");
347         require(success, "Native Transfer Failed");
348
349         emit AdminFeeWithdraw(address(this), receiver,
                adminFeeAccumulated);
350     }
```

Listing 10: LiquidityPoolManager.sol (Lines 356)

```
352 function withdrawNativeGasFee(address payable receiver) external
        onlyOwner whenNotPaused {
353         uint256 gasFeeAccumulated = gasFeeAccumulatedByToken[
                NATIVE];
354         require(gasFeeAccumulated != 0, "Gas Fee earned is 0");
355         gasFeeAccumulatedByToken[NATIVE] = 0;
```

```
356         (bool success, ) = receiver.call{ value: gasFeeAccumulated
                }("");
357         require(success, "Native Transfer Failed");
358
359         emit GasFeeWithdraw(address(this), receiver,
                gasFeeAccumulated);
360     }
```

Recommendation:

It is recommended to use:

Listing 11: Recommendation

```
1 (bool success, ) = receiver.send(adminFeeAccumulated);
```

instead of

Listing 12: Recommendation

```
1 (bool success, ) = receiver.call{ value: adminFeeAccumulated }("")
      ;
```

since the send() method has gas limit **(2300)** while call.value() method uses all remaining gas.

Remediation Plan:

SOLVED: Biconomy Team solved this issue by replacing the call.value() method with send() method which has gas limit.

3.6 (HAL-06) EXPERIMENTAL FEATURES ENABLED - INFORMATIONAL

Description:

ABIEncoderV2 is enabled and 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. The types **bytesNN** and **bool** will result in corrupted data while enum might lead to an invalid revert.

Risk Level:

Likelihood - 1
Impact - 2

Code Location:

Listing 13: LiquidityPoolManager.sol (Lines 4)

```
1 // SPDX-License-Identifier: MIT
2
3 pragma solidity 0.7.6;
4 pragma experimental ABIEncoderV2;
```

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).

Remediation Plan:

SOLVED: Biconomy Team removed experimental keyword on pragma section.

3.7 (HAL-07) 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`. In addition to that if a function not used in the contract second time, `external` keyword should be appended to the function for a better gas optimization.

Code Location:

Misused Functions Without External Keyword:

Listing 14: LiquidityPoolManager.sol

```
changeAdminFee()
setExecutorManager()
setTrustedForwarder()
setTokenTransferOverhead()
addSupportedToken()
removeSupportedToken()
updateTokenCap()
addNativeLiquidity()
removeNativeLiquidity()
addTokenLiquidity()
removeTokenLiquidity()
depositNative()
sendFundsToUser()
withdrawErc20()
withdrawNative()
```

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:

SOLVED: Biconomy Team replaced external to public in several functions.

3.8 (HAL-08) MISSING EVENTS EMITTING - INFORMATIONAL

Description:

It has been observed that critical functionality is missing emitting event for setTrustedForwarder and changeAdminFee functions. These functions should emit events after completing the transactions.

Risk Level:

Likelihood - 1
Impact - 1

Code Location:

Listing 15: LiquidityPoolManager.sol

```
82     function changeAdminFee(uint256 newAdminFee) public onlyOwner
           whenNotPaused {
83         require(newAdminFee != 0, "Admin Fee cannot be 0");
84         adminFee = newAdminFee;
85     }
```

Listing 16: LiquidityPoolManager.sol

```
104 function setTrustedForwarder( address forwarderAddress ) public
       onlyOwner {
105         require(forwarderAddress != address(0), "Forwarder Address
                cannot be 0");
106         trustedForwarder = forwarderAddress;
107     }
```

Recommendation:

Consider emitting an event when calling setTrustedForwarder and changeAdminFee functions.

Listing 17

```
1 event changeAdminFee(uint256 newAdminFee);
2 event setTrustedForwarder(address forwarderAddress);
```

Remediation Plan:

SOLVED: Biconomy Team solved this issue by defining new events on the contract to notify users such as AdminFeeChanged and TrustedForwarderChanged.

AUTOMATED TESTING

4.1 STATIC ANALYSIS REPORT

Description:

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

Results:

LiquidityPoolManager.sol

```
INFO:Detectors:
ExecutorManager.constructor(address).owner (contracts/6/ExecutorManager.sol#23) shadows:
        - Ownable.owner() (contracts/6/libs/Ownable.sol#40-42) (function)
LiquidityPoolManager.constructor(address,address,address,address,uint256).owner (contracts/6/insta-swaps/LiquidityPoolManager.sol#67) shadows:
        - Ownable.owner() (contracts/6/libs/Ownable.sol#40-42) (function)
LiquidityPoolManager.constructor(address,address,address,address,uint256).pauser (contracts/6/insta-swaps/LiquidityPoolManager.sol#67) shadows:
        - Pausable.pauser() (contracts/6/libs/Pausable.sol#82-84) (function)
Ownable.constructor(address).owner (contracts/6/libs/Ownable.sol#22) shadows:
        - Ownable.owner() (contracts/6/libs/Ownable.sol#40-42) (function)
Pausable.constructor(address).pauser (contracts/6/libs/Pausable.sol#39) shadows:
        - Pausable.pauser() (contracts/6/libs/Pausable.sol#82-84) (function)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#local-variable-shadowing
INFO:Detectors:
LiquidityPoolManager.setTrustedForwarder(address) (contracts/6/insta-swaps/LiquidityPoolManager.sol#104-107) should emit an event for:
        - trustedForwarder = forwarderAddress (contracts/6/insta-swaps/LiquidityPoolManager.sol#106)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-events-access-control
INFO:Detectors:
LiquidityPoolManager.changeAdminFee(uint256) (contracts/6/insta-swaps/LiquidityPoolManager.sol#82-85) should emit an event for:
        - adminFee = newAdminFee (contracts/6/insta-swaps/LiquidityPoolManager.sol#84)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-events-arithmetic
INFO:Detectors:
Pausable.constructor(address).pauser (contracts/6/libs/Pausable.sol#39) lacks a zero-check on :
                - _pauser = pauser (contracts/6/libs/Pausable.sol#40)
LiquidityPoolManager.withdrawNative().sender (contracts/6/insta-swaps/LiquidityPoolManager.sol#285) lacks a zero-check on :
                - (success) = sender.call{value: profitEarned}() (contracts/6/insta-swaps/LiquidityPoolManager.sol#286)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-zero-address-validation
```

All relevant findings were founded in the manual code review.

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 fruit on the targets for this engagement. 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. In addition, security detections are only in scope.

Results:

LiquidityPoolManager.sol

Report for insta-swaps/LiquidityPoolManager.sol
https://dashboard.mythx.io/#/console/analyses/75c0192e-4ff5-4773-aca5-a5e28dadb87c

Line	SWC Title	Severity	Short Description
78	(SWC-000) Unknown	Medium	Function could be marked as external.
82	(SWC-000) Unknown	Medium	Function could be marked as external.
95	(SWC-000) Unknown	Medium	Function could be marked as external.
99	(SWC-000) Unknown	Medium	Function could be marked as external.
104	(SWC-000) Unknown	Medium	Function could be marked as external.
109	(SWC-000) Unknown	Medium	Function could be marked as external.
113	(SWC-000) Unknown	Medium	Function could be marked as external.
121	(SWC-000) Unknown	Medium	Function could be marked as external.
125	(SWC-000) Unknown	Medium	Function could be marked as external.
131	(SWC-000) Unknown	Medium	Function could be marked as external.
140	(SWC-000) Unknown	Medium	Function could be marked as external.
153	(SWC-000) Unknown	Medium	Function could be marked as external.
163	(SWC-000) Unknown	Medium	Function could be marked as external.
176	(SWC-000) Unknown	Medium	Function could be marked as external.
223	(SWC-000) Unknown	Medium	Function could be marked as external.
231	(SWC-000) Unknown	Medium	Function could be marked as external.
272	(SWC-000) Unknown	Medium	Function could be marked as external.
282	(SWC-000) Unknown	Medium	Function could be marked as external.

All relevant findings were founded in the manual code review.

THANK YOU FOR CHOOSING

// HALBORN