ParaSwap PortikusV2

Security Audit Report

September 25, 2024

Contents

1 Introduction

1.1 About ParaSwap PortikusV2

`Portikus` is an intent-based protocol designed to facilitate gasless swaps through the execution of signed user intents by authorized agents. The protocol's architecture is centered around a registry of agents and modules and a factory for adapter creation. The key aspects of the protocol include Intent Execution, Permission Management and Modularity and Extensibility.

1.2 Audit Scope

This is the repository and commit id we used in the audit:

- https://github.com/paraswap/portikus-contracts/tree/feat/v2
- CommitID: a82704f

And this is the final version representing all fixes implemented for the issues identified in the audit:

- https://github.com/paraswap/portikus-contracts/tree/feat/v2
- CommitID: 5e25c76

2 | Overall Assessment

This report has been compiled to identify issues and vulnerabilities within the `ParaSwap PortikusV2` protocol. Throughout this audit, we identified several issues spanning various severity levels. By employing auxiliary tool techniques to supplement our thorough manual code review, we have discovered the following findings.

Severity	Count	Acknowledged	Won't Do	Addressed
Critical	-	-	-	-
High	1	-	-	1
Medium	1	-	-	1
Low	2	2	-	-
Informational	-	-	-	-
Total	4	2	-	2

3 | Vulnerability Summary

3.1 Overview

Click on an issue to jump to it, or scroll down to see them all.

3.2 Security Level Reference

In web3 smart contract audits, vulnerabilities are typically classified into different severity levels based on the potential impact they can have on the security and functionality of the contract. Here are the definitions for critical-severity, high-severity, medium-severity, and low-severity vulnerabilities:

Severity	Description
C-X (Critical)	A severe security flaw with immediate and significant negative consequences. It poses high risks, such as unauthorized access, financial losses, or complete disruption of functionality. Requires immediate attention and remediation.
H-X (High)	Significant security issues that can lead to substantial risks. Although not as severe as critical vulnerabilities, they can still result in unauthorized access, manipulation of contract state, or financial losses. Prompt remediation is necessary.
M-X (Medium)	Moderately impactful security weaknesses that require attention and remediation. They may lead to limited unauthorized access, minor financial losses, or potential disruptions to functionality.
L-X (Low)	Minor security issues with limited impact. While they may not pose significant risks, it is still recommended to address them to maintain a robust and secure smart contract.
I-X (Informational)	Warnings and things to keep in mind when operating the protocol. No immediate action required.
U-X (Undetermined)	Identified security flaw requiring further investigation. Severity and impact need to be determined. Additional assessment and analysis are necessary.

3.3 Vulnerability Details

3.3.1 [H-1] Bypass of Fees for ETH Orders in directSettleBatch()

Target	Category	IMPACT	LIKELIHOOD	STATUS
DirectSettlementModule.sol	Business Logic	High	Medium	Addressed

The `DirectSettlementModule` contract provides the `directSettleBatch()` function to facilitate the agent in settling a batch of orders in a single call. During our code review, we noticed that the agent can bypass the fees (protocol fees and partner fees) by settling multiple orders whose destination token is the native ETH.

In the following, we show the code snippet from the `DirectSettlementModule::_post()` function, which is used to process fees and pay for the order. Specifically, if the destination token is ETH, there is a check to ensure the amount of ETH received (`msg.value`) is greater than the required amount (line 154). Afterward, the function invokes the `processFees()` function to compute and collect the fees (line 159). It is important to note that the fees are recorded for the fee owners but are not reduced from the `msg.value`. Finally, the output asset is transferred to the order beneficiary (line 162).

However, if an agent tries to settle a batch of orders with ETH as the destination token, it is easy to pass the check `msg.value < amount` (line 154) for each order, because `msg.value` represents the total ETH amount used to settle all the orders. As a result, the agent can provide a crafted amount of ETH that only covers the order beneficiaries' payments, excluding the fees. This leaves a bad debt of ETH in the adapter, and the fee owners cannot be paid their fees.

Based on this, it is recommended to add a check in the `directSettleBatch()` function to ensure that the received `msg.value` is sufficient to cover the total required amount, including both the orders and the associated fees.

DirectSettlementModule::_post()

```
135 function _post(Order memory order, uint256 amount, bytes32 orderHash) internal {
136   // Init returnAmount, protocolFee and partnerFee
137   uint256 returnAmount;
138   uint256 protocolFee;
139   uint256 partnerFee;
140   // If beneficiary is not set, transfer to the owner
141   address beneficiary;
142   if (order.beneficiary == address(0)) {
143       beneficiary = order.owner;
144   } else {
145       beneficiary = order.beneficiary;
146   }
```

```
147     // Revert if the amount is less than the destAmount
148     if (amount < order.destAmount) {
149         revert InsufficientReturnAmount();
150     }
151     // Receive the output assets and process fees
152     if (order.destToken == ERC20UtilsLib.ETH_ADDRESS) {
153         // Check if the received ETH is less than the amount
154         if (msg.value < amount) {
155             revert InsufficientReturnAmount();
156         }
157         // Process fees
158         (returnAmount, partnerFee, protocolFee) =
159             order.partnerAndFee.processFees(ERC20UtilsLib.ETH_ADDRESS, amount,
                    order.expectedDestAmount);
160     } else {...}
161     // Transfer the output asset to the beneficiary
162     order.destToken.transferTo(beneficiary, returnAmount);
163     ...
164 }
```

Note that the same issue exists in the `FillableDirectSettlementModule` contract as well.

Remediation Add a proper check in the `directSettleBatch()` function to ensure that the received `msg.value` is sufficient to cover the total required amount.

3.3.2 [M-1] Revised Logic to Install Module in install()

Target	Category	IMPACT	LIKELIHOOD	STATUS
ModuleManagerLib.sol	Business Logic	Medium	Medium	Addressed

The `ModuleManagerLib::install()` function is responsible for installing new modules into the adapter. This process involves fetching the function selectors of the module and updating internal mappings to link the module's functions with its storage.

The code snippet below highlights the logic of how a module is added to the modules array and how the function selectors are associated with the module in the `moduleToSelectors` mapping. Afterward, the reverse association from the function selectors to the module is set up in the `selectorToModule` mapping.

However, there is a lack of recording the module's position (`ms.moduleToSelectors[module].moduleAddressPosition`), which is necessary to maintain the modules list. Out analysis shows that the module's position should be set to `ms.modules.length -1`.

Additionally, there is a potential flaw in how the function selectors's positions are calculated and tracked. Specifically, the position of each function selector (`functionSelectorPosition`) is calculated starting from the module's selectors length (`ms.moduleToSelectors[module].selectors.length`), rather

than from 0 (line 101). A recommended approach is to start the function selectors's positions from 0.

Example Privileged Operations in `ExecutorManager`

```
90  function install(address module) external {
91    // Get adapter module storage
92    ModuleStorage storage ms = modulesStorage();
93    // Get module function selectors
94    bytes4[] memory selectors = IModule(module).selectors();
95    // Add module to modules
96    ms.modules.push(module);
97    // Set selectors in moduleToSelectors
98    ms.moduleToSelectors[module].selectors = selectors;
99
100   // Get selector position
101   uint32 selectorPosition = uint32(ms.moduleToSelectors[module].selectors.length
          );
102   // Set module in selectorToModule
103   for (uint256 i = 0; i < selectors.length; i++) {
104       address oldModule = ms.selectorToModule[selectors[i]].moduleAddress;
105       // If a selector is already set, revert as it would cause a conflict
106       if (oldModule != address(0)) {
107           // If a selector is already set the owner should uninstall the old
                  module first
108           revert SelectorAlreadySet(selectors[i], oldModule);
109       }
110       ms.selectorToModule[selectors[i]].functionSelectorPosition =
              selectorPosition;
111       ms.selectorToModule[selectors[i]].moduleAddress = module;
112       // Increase selectorPosition
113       selectorPosition++;
114   }
115 }
```

Remediation Revisit the `install()` function to properly update the the module's position and the function selectors's positions.

3.3.3 [L-1] Potential Risks Associated with Centralization

Target	Category	IMPACT	LIKELIHOOD	STATUS
Multiple Contracts	Security	Medium	Low	Acknowledged

In the `PortikusV2` protocol, the presence of a privileged `owner` accountintroduces risks of centralization, as it holds significant control and authority over critical operations governing the protocol. In the following, we highlight the representative functions that are potentially affected by the privileges

associated with this privileged account.

Examples of Privileged Operations

```
function install(address module) external {
  // Get adapter module storage
  ModuleStorage storage ms = modulesStorage();
  // Get module function selectors
  bytes4[] memory selectors = IModule(module).selectors();
  // Add module to modules
  ms.modules.push(module);
  // Set selectors in moduleToSelectors
  ms.moduleToSelectors[module].selectors = selectors;

  // Get selector position
  uint32 selectorPosition = uint32(ms.moduleToSelectors[module].selectors.length
      );
  // Set module in selectorToModule
  for (uint256 i = 0; i < selectors.length; i++) {
      address oldModule = ms.selectorToModule[selectors[i]].moduleAddress;
      // If a selector is already set, revert as it would cause a conflict
      if (oldModule != address(0)) {
          // If a selector is already set the owner should uninstall the old
              module first
          revert SelectorAlreadySet(selectors[i], oldModule);
      }
      ms.selectorToModule[selectors[i]].functionSelectorPosition =
          selectorPosition;
      ms.selectorToModule[selectors[i]].moduleAddress = module;
      // Increase selectorPosition
      selectorPosition++;
  }
}

function setProtocolFeeClaimer(address protocolFeeClaimer) external onlyOwner {
  protocolFeeClaimer.setFeeClaimer();
}

/// @inheritdoc IRegistry
function registerAgent(address[] calldata _agents) external onlyOwner {
  // Loop through the agents and register them
  for (uint256 i = 0; i < _agents.length; i++) {
      address agent = _agents[i];
      if (!isAgentRegistered[agent]) {
          agents.push(agent);
          isAgentRegistered[agent] = true;
          emit AgentRegistered(agent);
      }
  }
}
```

```
155 /// @inheritdoc IRegistry
156 function registerModule(address[] calldata _modules) external onlyOwner {
157   // Loop through the modules and register them
158   for (uint256 i = 0; i < _modules.length; i++) {
159       address module = _modules[i];
160       if (!isModuleRegistered[module]) {
161           modules.push(module);
162           isModuleRegistered[module] = true;
163           emit ModuleRegistered(module);
164       }
165   }
166 }
```

Remediation To mitigate the identified issue, it is recommended to introduce multi-sig mechanism to undertake the roles of the privileged accounts. Moreover, it is advisable to implement timelocks to govern all modifications to the privileged operations.

3.3.4 [L-2] Improved Validation of Module in install()

Target	Category	IMPACT	LIKELIHOOD	STATUS
ModuleManagerLib.sol	Coding Practices	Low	Low	Acknowledged

The `install()` function in the `ModuleManagerLib` library is responsible for installing a new module by adding the module's function selectors and updating the mappings to link the module's address with the selectors. However, the current implementation lacks a validation check to ensure that the selectors array is not empty before proceeding with the installation. This omission can lead to issues in the `uninstall()` function.

As the code snippet shows, the `uninstall()` function retrieves the `selectors.length` and checks whether the module has been installed by ensuring that `selectors.length` is greater than zero (line 116). If the module's selectors length is zero, the `uninstall()` function fails to properly remove the module because the selectors array is empty. This can leave the protocol in an inconsistent state.

Based on this, it is recommended to add a validation check in the `install()` function to ensure that the selectors array is not empty.

ModuleManagerLib.sol

```
91 function install(address module) external {
92   // Get adapter module storage
93   ModuleStorage storage ms = modulesStorage();
94   // Get module function selectors
95   bytes4[] memory selectors = IModule(module).selectors();
```

```
96    // Add module to modules
97    ms.modules.push(module);
98    // Set selectors in moduleToSelectors
99    ms.moduleToSelectors[module].selectors = selectors;
100   ...
101 }

103 /*////////////////////////////////////////////////////////////
104                             UNINSTALL
105 ////////////////////////////////////////////////////////////*/

107 /// @notice Remove a module from the adapter, removing all of its function
        selectors
108 /// @param module The address of the module to uninstall
109 function uninstall(address module) external {
110   // Get adapter module storage
111   ModuleStorage storage ms = modulesStorage();
112   // Get module function selectors
113   bytes4[] memory selectors = ms.moduleToSelectors[module].selectors;

115   // Check if the module is actually installed
116   if (selectors.length == 0) {
117       revert ModuleNotInstalled(module);
118   }
119   ...
120 }
```

Remediation Add a validation check in the `install()` function to ensure that the module's selectors array is not empty.

Response By Team The team will make sure to only register valid modules.

4 Appendix

4.1 About AstraSec

AstraSec is a blockchain security company that serves to provide high-quality auditing services for blockchain-based protocols. With a team of blockchain specialists, AstraSec maintains a strong commitment to excellence and client satisfaction. The audit team members have extensive audit experience for various famous DeFi projects. AstraSec's comprehensive approach and deep blockchain understanding make it a trusted partner for the clients.

4.2 Disclaimer

The information provided in this audit report is for reference only and does not constitute any legal, financial, or investment advice. Any views, suggestions, or conclusions in the audit report are based on the limited information and conditions obtained during the audit process and may be subject to unknown risks and uncertainties. While we make every effort to ensure the accuracy and completeness of the audit report, we are not responsible for any errors or omissions in the report.

We recommend users to carefully consider the information in the audit report based on their own independent judgment and professional advice before making any decisions. We are not responsible for the consequences of the use of the audit report, including but not limited to any losses or damages resulting from reliance on the audit report.

This audit report is for reference only and should not be considered a substitute for legal documents or contracts.

4.3 Contact

Phone	+86 156 0639 2692
Email	contact@astrasec.ai
Twitter	https://twitter.com/AstraSecAI