BEOSIN
Web3 Security & Compliance

KIP Protocol

Smart Contract Security Audit

No. 202412021606

Dec 2nd, 2024

SECURING BLOCKCHAIN ECOSYSTEM

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Contents

Summary of Audit Results

After auditing, 2 Low-risk and 1 info item were identified in the KIP Protocol. Specific audit details will be presented in the Findings section. Users should pay attention to the following aspects when interacting with this project:

Low	Fixed : 2 Acknowledged: 0
Info	Fixed : 1 Acknowledged: 0

- **Project Description:**

1. Basic Token Information

Token name	KIP
Token symbol	KIP
Token decimals	18
Total supply	10,000,000,000
Token type	ERC-20

Table 1 KIP info

2. Business overview

KIP Protocol is a node reward management project that primarily manages the token rewards of `kipNode` based on the ERC721 standard. It allows `kipNode` owners to set delegation addresses and claim rewards through signed data, with each signature having an `expiration_time`. Once rewards are claimed, they must wait at least the `CLAIM_INTERVAL` time before they can withdraw. Additionally, if there are multiple withdrawals, the interval between two withdrawals must be greater than the `WITHDRAW_INTERVAL`. Furthermore, the contract allows fines to be imposed on the owner to reduce the amount that can be withdrawn.The KIP token involved in the project is a standard ERC20 token.

1 Overview

1.1 Project Overview

Project Name	KIP Protocol
Project Language	Solidity
Platform	Ethereum
Code Base	0x1F88E9956c8f8F64c8D5fEF5eD8A818E2237112c
Commit Hash	75c0d39dc1e20fdd2c1c213074c62b1d278f8bd6 (kip-token-contracts: inital) 73950ddf6054b29a2bffc3855e13e08b532cdca8 (kip-checker-reward-contract: inital) 4502265b3ccae232cfdeaa8ee0250e85168ec32a (kip-checker-reward-contract: fixed)

1.2 Audit Overview

Audit work duration: Nov 28, 2024 – Dec 02, 2024

Audit team: Beosin Security Team

1.3 Audit Method

The audit methods are as follows:

1. Formal Verification

Formal verification is a technique that uses property-based approaches for testing and verification. Property specifications define a set of rules using Beosin's library of security expert rules. These rules call into the contracts under analysis and make various assertions about their behavior. The rules of the specification play a crucial role in the analysis. If the rule is violated, a concrete test case is provided to demonstrate the violation.

2. Manual Review

Using manual auditing methods, the code is read line by line to identify potential security issues. This ensures that the contract's execution logic aligns with the client's specifications and intentions, thereby safeguarding the accuracy of the contract's business logic.

The manual audit is divided into three groups to cover the entire auditing process:

The Basic Testing Group is primarily responsible for interpreting the project's code and conducting comprehensive functional testing.

The Simulated Attack Group is responsible for analyzing the audited project based on the collected historical audit vulnerability database and security incident attack models. They identify potential attack vectors and collaborate with the Basic Testing Group to conduct simulated attack tests.

The Expert Analysis Group is responsible for analyzing the overall project design, interactions with third parties, and security risks in the on-chain operational environment. They also conduct a review of the entire audit findings.

3. Static Analysis

Static analysis is a function of examining code during compilation or static analysis to detect issues. Beosin-VaaS can detect more than 100 common smart contract vulnerabilities through static analysis, such as reentrancy and block parameter dependency. It allows early and efficient discovery of problems to improve code quality and security.

2 Findings

Index	Risk description	Severity level	Status
KIP Protocol-01	Centralization Risk	Low	Fixed
KIP Protocol-02	Inconsistent Key Variables	Low	Fixed
KIP Protocol-03	Missing event trigger	Info	Fixed

Finding Details:

[KIP Protocol-01] Centralization Risk

Severity Level	Low
Lines	KIP.sol #L8-10
Type	Business Security
Description	The initially pre-mined KIP tokens are all stored in the beneficiary's address, which poses a centralization risk due to overly concentrated token distribution. If the private key for this address is compromised, it could result in the loss of these tokens.
Recommendation	It is recommended to transfer the owner's permissions to a multi-signature wallet (such as Gnosis Safe) to manage the minted tokens. This can help prevent token misuse or security incidents caused by a single point of failure.
Status	**Fixed.** The project team claims that the token holding address will be a multi-signature address.

[KIP Protocol-02] Inconsistent Key Variables

Severity Level	Low
Lines	EIP712Paymaster.sol #L28 - 31
Type	Business Security
Description	In the `EIP712Paymaster` contract, there is a function `setPaymaster` that can set the state of the paymaster. However, in the `NodeReward` contract, when setting the paymaster state, the `setPaymaster` interface of EIP712Paymaster is not called. Instead, the state variable of this contract is directly modified. This could lead to a situation where the paymaster state is inconsistent between the two contracts.
Recommendation	It is recommended that the project team confirm the business logic, either by removing the `setPaymaster` interface from the `EIP712Paymaster` or by calling the EIP712Paymaster function in the `NodeReward` contract to modify the state.
Status	**Fixed.** The project team removed `EIP712Paymaster.sol` entirely from the project.

[KIP Protocol-03] Missing event trigger

Severity Level	Info
Lines	NodeReward.sol #L172-178,106-125
Type	Coding Conventions
Description	1. It is recommended to emit events when modifying critical variables is a recommended practice as it provides a standardized way to capture and communicate important changes within the contract. Events enable transparency and allow external systems and users to easily track and react to these modifications. 2. Since both claim and withdraw in the NodeReward contract are time-related, it is recommended to add a timestamp to the events.
Recommendation	It is recommended to trigger the corresponding events in the contract when modifying the key variables in the following functions: `addReverter`, `delReverter`.
Status	**Fixed.** The project team has added corresponding events and introduced key parameters within those events.

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	Medium	Medium	Low
Unlikely	Medium	Medium	Low	Info
Rare	Low	Low	Info	Info

3.1.2 Degree of impact

- **Critical**

Critical 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.

3.1.3 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.

3.1.4 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.

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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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