Security Assessment

Kaizen.Finance

Sept 15th, 2021

Table of Contents

Summary

This report has been prepared for Kaizen to discover issues and vulnerabilities in the source code of the Kaizen.Finance project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

Additionally, this audit is based on a premise that all external smart contracts are safely implemented.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

Overview

Project Summary

Project Name	Kaizen.Finance
Platform	Ethereum
Language	Solidity
Codebase	https://github.com/KaizenFinance/CollateralizedToken
Commit	aba38db65963656bf0bf368de68775b1be01d779

Audit Summary

Delivery Date	Sept 15, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	1	0	0	1	0	0
Medium	1	0	0	1	0	0
Minor	0	0	0	0	0	0
Informational	1	0	0	1	0	0
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
CTK	CollateralizedToken.sol	a4964364b3522d3eef2c50ef441ee98ead16e0733513a9bc36a543088e5cef53
ERC	ERC20TokenImplementationOriginal.sol	8fc0b0f033465e3ea1399fa8b5f119dd682423f1cff5a8fecd520be8be9eec2f

Understandings

Overview

The `VestingToken` contract of KaiZen Finance is a project that helps users to launch a vesting schedule on the blockchain. A vesting schedule is about gradually unlocking a certain amount of tokens to recipients during a certain period.

`vesting` token is the certificate that recipients hold to swap the `original token` that is allocated to recipients. `vesting` token balance of any user/address contains the following two states: `Unlocked balance`, the amount of the vesting tokens that may already be swapped to original tokens; `Locked balance`, the amount of the vesting tokens that may not yet be swapped to original tokens. The exchange ratio between vesting tokens and original tokens is 1:1. External users deposit `original token` into `VestingToken` as collateral and airdrop `vesting` token to recipients by calling the `airdrop()` function. And the `Admin` can transfer unused collateral in `original token` to a specified address.

The vesting timeline contains three key time points, `TGE(Token Generation Event)`, `startTickTimestamp`, and `endTickTimestamp`. The `block.timestamp` is used to determine whether or not the aforementioned key timepoint is reached. In the beginning, all minted `vesting` tokens are locked in the `VestingToken` contract. At `TGE`, the `tgePercentage` amount, whose value is set during the initialization step, of one user's `vesting` token while it is being unlocked. There is nothing that happens in the `cliffDuration` between `TGE` and `startTickTimestamp`. After `TGE`, all remaining locked `vesting` tokens would be gradually unlocked in the duration between `startTickTimestamp` and `endTickTimestamp`. That duration is equally divided into multiple periods, each period is called `tick`. The minimal acceptable `tick` period is 60 seconds. In each `tick` , the formula `lockedVestingToken * [(currentTick - lastUpdateTick) / (lastTick - lastUpdateTick)]` is used to calculate how many locked `vesting` tokens would be unlocked. If the `lastTick` is reached, the all-locked `vesting` token is unlocked. Recipients can use the unlocked `vesting` tokens to swap the original token.

Users also can transfer their holding `vesting` token, which is locked or unlocked, by calling the `customTransfer()` function or `ERC20` standard transfer methods.

Privileged Functions

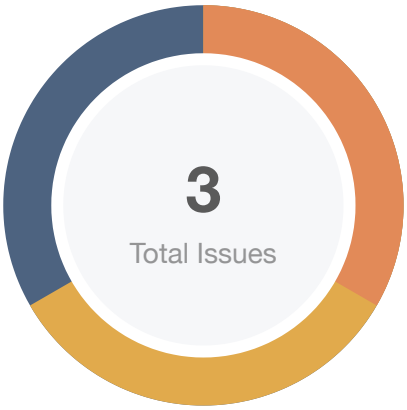
The contract contains the following privileged functions that are restricted by the `onlyAdmin` modifier. They are used to modify the contract configurations and address attributes. We group these functions below:

The `onlyAdmin` modifier:

- `setTgeTimestamp()` in `CollateralizedToken.sol`

- `withdrawUnusedCollateral()` in `CollateralizedToken.sol`

Findings



Critical	**0** (0.00%)
Major	**1** (33.33%)
Medium	**1** (33.33%)
Minor	**0** (0.00%)
Informational	**1** (33.33%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
CTK-01	Privileged Ownership	**Centralization / Privilege**	**Major**	Acknowledged
CTK-02	Missing Input Validation	Volatile Code	Informational	Acknowledged
ERC-01	Token Minted To Designated Address	Control Flow	Medium	Acknowledged

CTK-01 | Privileged Ownership

Category	Severity	Location	Status
Centralization / Privilege	**Major**	CollateralizedToken.sol: 905, 912	Acknowledged

Description

The role `admin` has the authority over the listed functions. Any compromise to the `admin` account may allow a potential hacker to take advantage of this and execute malicious acts.

- `setTgeTimestamp()` in `CollateralizedToken.sol`
- `withdrawUnusedCollateral()` in `CollateralizedToken.sol`

Recommendation

We advise the client to carefully manage the role `admin` account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., Multisignature wallets.

Indicatively, here are some feasible suggestions that would also mitigate the potential risk at the different levels in terms of short-term and long-term scenarios:

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

The response from the client is as below:

Sure, we are aware of these facts, applicable to the whole crypto industry. Would recommend users using multisig wallets and automate their creation in the future.

CTK-02 | Missing Input Validation

Category	Severity	Location	Status
Volatile Code	Informational	CollateralizedToken.sol: 787~791	Acknowledged

Description

The given input is missing the check for `_tgeTimestamp` validation.

Recommendation

We advise adding the check for the passed-in values to prevent unexpected errors as below:

```
787  function setTgeTimestamp(Vesting storage _self, uint256 _tgeTimestamp) internal
onlyBeforeTge(_self) {
788      require(_tgeTimestamp >= block.timestamp, "CollateralizedToken: _tgeTimestamp is
before current block timestamp");
789
790      _self.tgeTimestamp = _tgeTimestamp;
791
792      emit SetTgeTimestamp(_tgeTimestamp);
793  }
```

Alleviation

The response from the client is as below:

It's done to let token owners initiate TGE timestamp even after TGE because the team is always busy on TGE day and may forget to set it up.

ERC-01 | Token Minted To Designated Address

Category	Severity	Location	Status
Control Flow	Medium	ERC20TokenImplementationOriginal.sol: 223	Acknowledged

Description

The function `initialize()` will be called to sets all of the initial states for the contract. According to its logic, `totalSupply` tokens will be mint to `recipient`.

Recommendation

Please ensure the accuracy of `recipient` when calling this function. We also advise the client to adopt Multisig, Timelock, and/or DAO in the project to manage this address.

Alleviation

The response from the client is as below:

We specially added the “recipient” entity to let issuer mint tokens to the secure destination that may be MultiSig, DAOs, or others. We would provide users with the one-click multisig wallet creation tool for this process and inform them about the importance of security of token destination (recipient).

Appendix

Finding Categories

Centralization / Privilege

Centralization / Privilege findings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.

Control Flow

Control Flow findings concern the access control imposed on functions, such as owner-only functions being invoke-able by anyone under certain circumstances.

Volatile Code

Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

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