



Code Security Assessment

Heroes Chained Token

Jan 13th, 2022



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About

Summary

This report has been prepared for Heroes Chained (5 more contracts) to discover issues and vulnerabilities in the source code of the Heroes Chained Token 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.

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	Heroes Chained Token
Platform	AVAX
Language	Solidity
Codebase	https://testnet.snowtrace.io/address/0x2ebe8e6c225f20104a5fd298a09de889bad49c14 https://testnet.snowtrace.io/address/0x69aa0e68d21c3f7771625c58ceb3614580883143
Commit	

Audit Summary

Delivery Date	Jan 13, 2022
Audit Methodology	Static Analysis, Manual Review

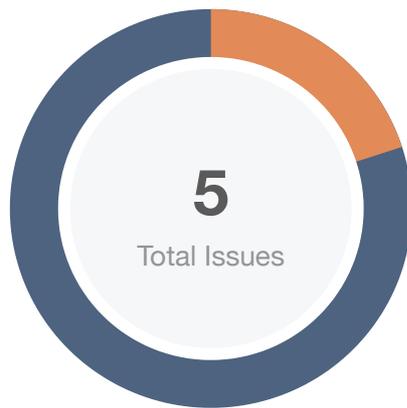
Vulnerability Summary

Vulnerability Level	Total	⚠ Pending	⊗ Declined	ℹ Acknowledged	🔄 Partially Resolved	✅ Resolved
● Critical	0	0	0	0	0	0
● Major	1	0	0	0	0	1
● Medium	0	0	0	0	0	0
● Minor	0	0	0	0	0	0
● Informational	4	0	0	0	0	4
● Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
HCH	HeroesChained.sol	4d076ac31ccd4661fa219cafcd51a7cfa4075708d207d6f97b0999b41fc0832

Findings



■ Critical	0 (0.00%)
■ Major	1 (20.00%)
■ Medium	0 (0.00%)
■ Minor	0 (0.00%)
■ Informational	4 (80.00%)
■ Discussion	0 (0.00%)

ID	Title	Category	Severity	Status
HCH-01	Variables That Could Be Declared as <code>immutable</code>	Gas Optimization	● Informational	☑ Resolved
HCH-02	Unlocked Compiler Version	Language Specific	● Informational	☑ Resolved
HCH-03	Too Many Digits	Coding Style	● Informational	☑ Resolved
HCH-04	Centralization Risk in HeroesChained.sol	Centralization / Privilege	● Major	☑ Resolved
HCH-05	Function Visibility Optimization	Gas Optimization	● Informational	☑ Resolved

HCH-01 | Variables That Could Be Declared as `immutable`

Category	Severity	Location	Status
Gas Optimization	● Informational	HeroesChained.sol: 668	☑ Resolved

Description

The linked variables assigned in the constructor can be declared as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since they will not be stored in storage.

Recommendation

We recommend declaring these variables as immutable. Please note that the `immutable` keyword only works in Solidity version `v0.6.5` and up.

Alleviation

[Certik]: The Heroes Chained team heeded the advice and resolved the finding in the deployment [0x69aa0e68d21c3f7771625c58ceb3614580883143](https://etherscan.io/address/0x69aa0e68d21c3f7771625c58ceb3614580883143)

HCH-02 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	● Informational	HeroesChained.sol: 6	✓ Resolved

Description

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to different compiler versions. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.8.2` the contract should contain the following line:

```
pragma solidity 0.8.2;
```

Alleviation

[Certik]: The Heroes Chained team heeded the advice and resolved the finding by locking the compiler version to `0.8.2` in the deployment [0x69aa0e68d21c3f7771625c58ceb3614580883143](#)

HCH-03 | Too Many Digits

Category	Severity	Location	Status
Coding Style	● Informational	HeroesChained.sol: 671	✓ Resolved

Description

HeroesChained's constructor uses literals with too many digits. Literals with many digits are difficult to read and review.

Recommendation

We advise the client to use the scientific notation to improve readability.

Alleviation

[Certik]: The Heroes Chained team heeded the advice and resolved the finding in the deployment [0x69aa0e68d21c3f7771625c58ceb3614580883143](https://etherscan.io/address/0x69aa0e68d21c3f7771625c58ceb3614580883143)

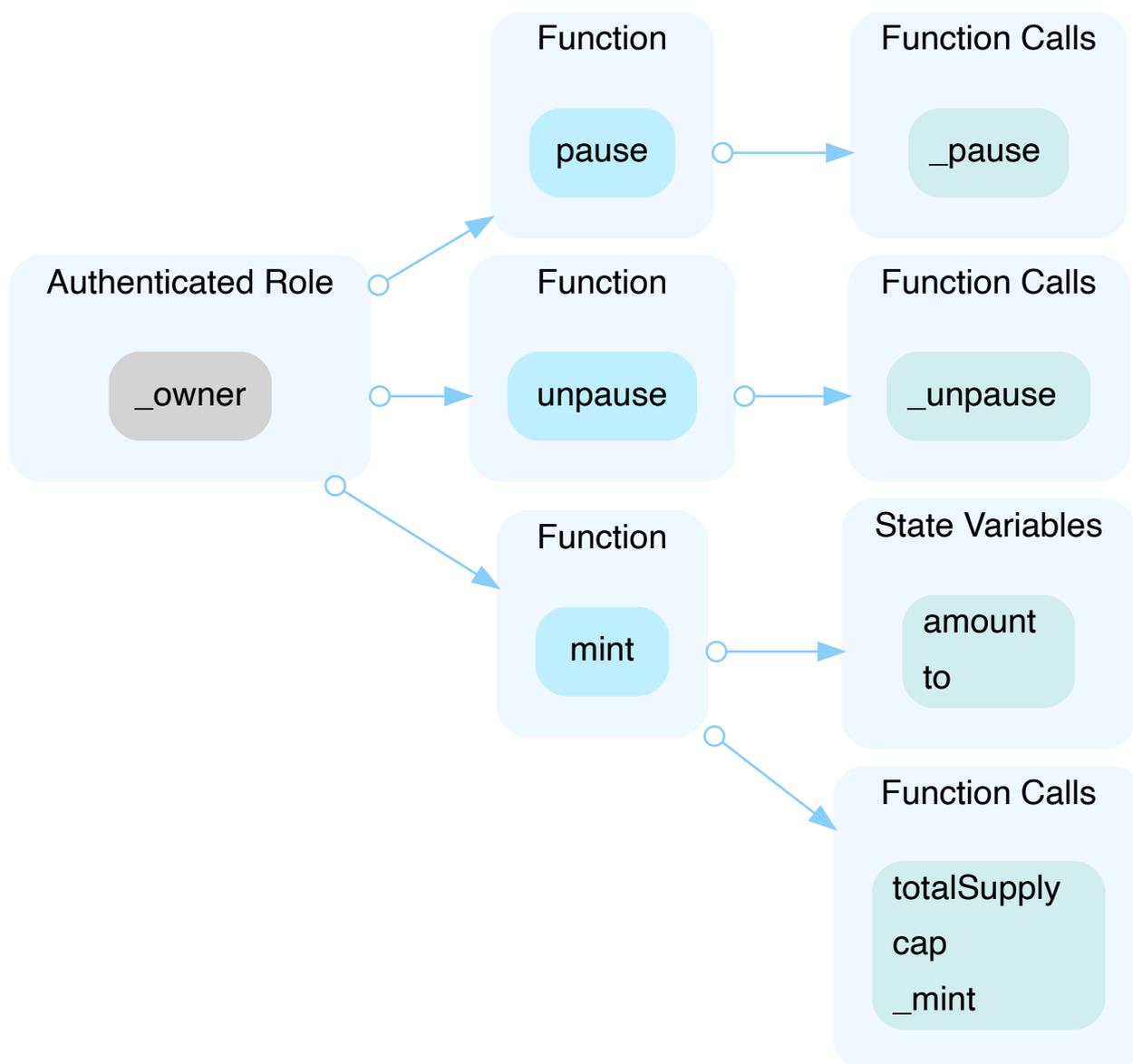
HCH-04 | Centralization Risk in HeroesChained.sol

Category	Severity	Location	Status
Centralization / Privilege	● Major	HeroesChained.sol: 674~676, 678~680, 682~685, 643~645, 651~654	👍 Resolved

Description

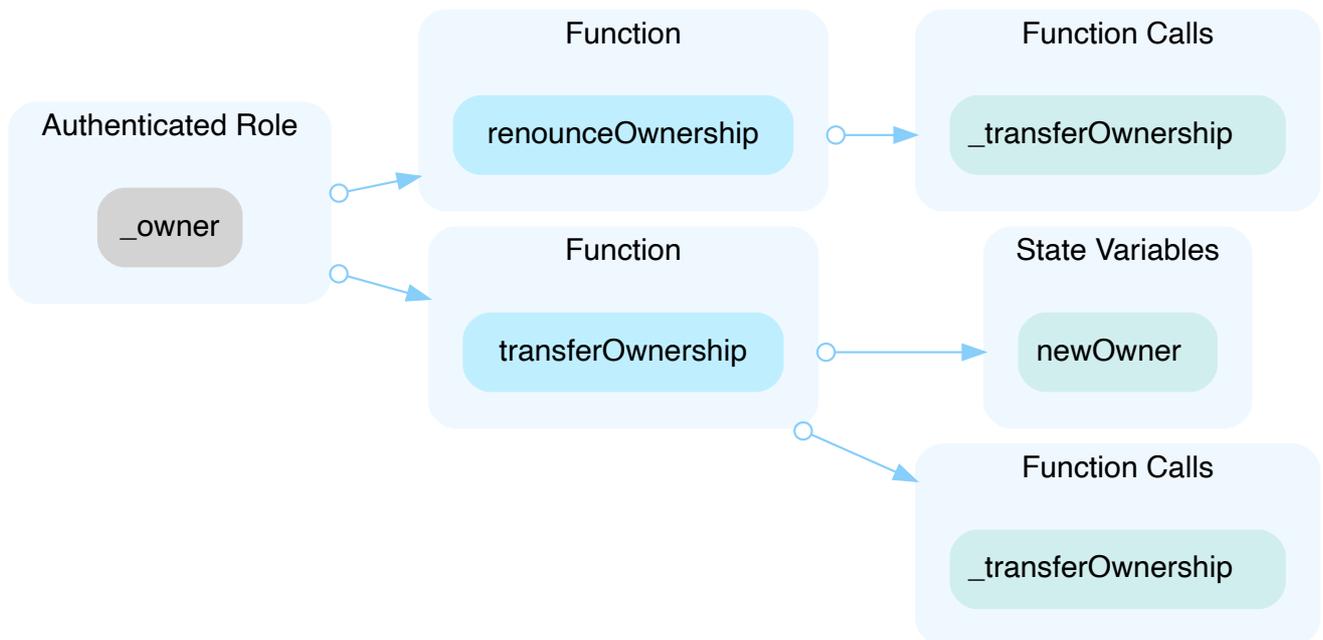
In the contract, `HeroesChained`, the role, `_owner`, has the authority over the functions shown in the diagram below.

Any compromise to the privileged account which has access to `_owner` may allow the hacker to take advantage of this and access sensitive functionalities.



In the contract, `Ownable`, the role, `_owner`, has the authority over the functions shown in the diagram below.

Any compromise to the privileged account which has access to `_owner` may allow the hacker to take advantage of this and access sensitive functionalities.



Recommendation

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multi-signature wallets.

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

Short Term:

Timelock and Multi sign ($\frac{2}{3}$, $\frac{3}{5}$) combination *mitigate* by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;
AND
- A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, *mitigate* by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
AND
- A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered *fully resolved*.

- Renounce the ownership and never claim back the privileged roles. OR
- Remove the risky functionality.

Alleviation

[Certik]: The Heroes Chained team heeded the advice and resolved the finding by removing the highlighted functions in the deployment [0x69aa0e68d21c3f7771625c58ceb3614580883143](#)

HCH-05 | Function Visibility Optimization

Category	Severity	Location	Status
Gas Optimization	● Informational	HeroesChained.sol: 487~489, 502~509, 651~654, 643~645, 674~676, 682~685, 678~680	☑ Resolved

Description

`public` functions that are never called by the contract could be declared as `external`. `external` functions are more efficient than `public` functions.

Recommendation

Consider using the `external` attribute for public functions that are never called within the contract.

Alleviation

[Certik]: The Heroes Chained team heeded the advice and resolved the finding in the deployment [0x69aa0e68d21c3f7771625c58ceb3614580883143](https://etherscan.io/address/0x69aa0e68d21c3f7771625c58ceb3614580883143)

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.

Gas Optimization

Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

Coding Style

Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

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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