Security Assessment

Green

Nov 19th, 2021

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Summary

This report has been prepared for Green to discover issues and vulnerabilities in the source code of the Green 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	Green
Platform	Ethereum
Language	Solidity
Codebase	https://github.com/green-blockchain/green-contract/blob/main/contract/green.sol
Commit	4c244049d3d743b1e4db1c41a1a29aaf0efd703e 9b177127c750f140b5c167adf20c77df873b6f76

Audit Summary

Delivery Date	Nov 19, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

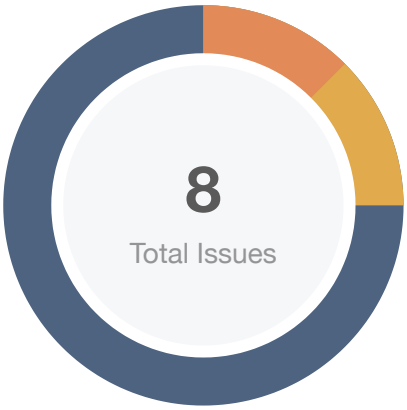
Vulnerability Summary

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	6	0	0	5	0	1
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
GGC	Green.sol	b4eb704a6a3d48666e80c6749528baeb760886cf2945c287942a58760260abc8

Findings



Critical	**0** (0.00%)
Major	**1** (12.50%)
Medium	**1** (12.50%)
Minor	**0** (0.00%)
Informational	**6** (75.00%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
GGC-01	Unlocked Compiler Version	Language Specific	Informational	Resolved
GGC-02	Centralization Risk	**Centralization / Privilege**	**Major**	Acknowledged
GGC-03	Unused Return Value	Coding Style	Informational	Acknowledged
GGC-04	Visibility Specifiers Missing	Language Specific	Informational	Acknowledged
GGC-05	Redundant Condition Checking	Logical Issue	Informational	Acknowledged
GGC-06	Function Visibility Optimization	Gas Optimization	Informational	Acknowledged
GGC-07	Redundant Codes	Logical Issue	Informational	Acknowledged
GGC-08	Incorrect Event Emit	Logical Issue	Medium	Acknowledged

GGC-01 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	projects/Green/contracts/Green.sol (63af1b5): 1	Resolved

Description

The contract contains unlocked compiler versions. An unlocked compiler version in the contract's source code 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 differing compiler version numbers. This can lead to ambiguity when debugging as compiler-specific bugs may occur in the codebase that would be difficult to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

It is a general practice to alternatively lock the compiler at a specific version rather than allow a range of compiler versions to be utilized to avoid compiler-specific bugs and in doing so be able to identify emerging ones more easily. We recommend locking the compiler at the lowest possible version that supports all the capabilities wished by the codebase. This will ensure that the project utilizes a compiler version that has been in use for the longest time and as such is less likely to contain yet-undiscovered bugs.

Alleviation

The client locked the compiler at `0.4.25`.

GGC-02 | Centralization Risk

Category	Severity	Location	Status
Centralization / Privilege	Major	projects/Green/contracts/Green.sol (63af1b5): 64, 189, 212	Acknowledged

Description

To bridge the gap in trust between the administrators need to express a sincere attitude regarding the considerations of the administrator team's anonymity.

The `owner` has the responsibility to notify users about the following capabilities:

- transfer ownership of the contract to a new account through `transferOwnership()`
- transfer ERC20 tokens that were accidentally sent to itself through `transferAnyERC20Token()`
- mint uncapped tokens to any address through `distributeMinting()`

Recommendation

We advise the client to carefully manage the privileged account's private keys 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 via 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 the short-term and long-term:

- 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

`[Green]`: We have an internal 7/12 multi-signature wallet strategy using shamir secrets in order to access the private key for the transferOwnership / transferAnyERC20Token / distributeMinting. We have a policy to have board meet and asses the need for recycling to transferOwnership every quarter. We have planned to do more transparency into full community of board decisions and voting history in 2022.

GGC-03 | Unused Return Value

Category	Severity	Location	Status
Coding Style	Informational	projects/Green/contracts/Green.sol (63af1b5): 108, 118, 131, 144, 158, 169, 189, 198, 212	Acknowledged

Description

The return values `balance`, `remaining` and `success` are declared but never used in the function body.

Recommendation

We advise the client to remove or comment out the function parameter.

Alleviation

No alleviation.

GGC-04 | Visibility Specifiers Missing

Category	Severity	Location	Status
Language Specific	Informational	projects/Green/contracts/Green.sol (63af1b5): 84, 85	Acknowledged

Description

The linked variable declaration does not have a visibility specifier explicitly set.

Recommendation

Inconsistencies in the default visibility the Solidity compilers impose can cause issues in the functionality of the codebase. We advise that visibility specifier for the linked variable is explicitly set.

Alleviation

No alleviation.

GGC-05 | Redundant Condition Checking

Category	Severity	Location	Status
Logical Issue	Informational	projects/Green/contracts/Green.sol (63af1b5): 213	Acknowledged

Description

The modifier `onlyOwner` has checked that sender must be the owner.

Recommendation

We advise the client to remove the aforementioned line.

Alleviation

No alleviation.

GGC-06 | Function Visibility Optimization

Category	Severity	Location	Status
Gas Optimization	Informational	projects/Green/contracts/Green.sol (63af1b5): 99, 108, 158, 118, 131, 144, 43, 64, 67, 169, 179, 189, 198, 212	Acknowledged

Description

`public` functions that are never called by the contract could be declared `external`. When the inputs are arrays, `external` functions are more efficient than `public` functions.

Recommendation

We advise that the functions' visibility specifiers are set to `external` and the array-based arguments change their data location from `memory` to `calldata`, optimizing the gas cost of the function.

Alleviation

No alleviation.

GGC-07 | Redundant Codes

Category	Severity	Location	Status
Logical Issue	Informational	projects/Green/contracts/Green.sol (63af1b5): 91~93	Acknowledged

Description

The `_totalSupply` is a `uint` type and its initial value is always 0. Besides, transfer 0 tokens to the address `0xE8E90A87392218e01C4DA185e75F4210681926Dd` is redundant.

Recommendation

We advise the client to remove them.

Alleviation

`[Green]`: The `_totalSupply` was used for code readability at the time.

GGC-08 | Incorrect Event Emit

Category	Severity	Location	Status
Logical Issue	Medium	projects/Green/contracts/Green.sol (63af1b5): 230	Acknowledged

Description

Solidity events give an abstraction on top of the EVM's logging functionality. Applications can subscribe and listen to these events through the RPC interface of an Ethereum client.
The event `Transfer` in this contract is used to record the transfer between addresses. when the first parameter is `address(0)`, the transfer could be considered to be a `mint` operation. So in the event emitting in the function `mintToken()`, the first parameter should be the `address(0)` rather than the `owner`.

Recommendation

We advise the client to change the `owner` to `address(0)` in event `Transfer` emitting in the `mintToken()`.

Alleviation

`[Green]`: Although not ideal, we acknowledge that all transfers from the owner are only on mint. There are no functions or processes in our operations that would allow or require the owner to do any transfer.

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.

Logical Issue

Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.

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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