Code Security Assessment

AOCO

Feb 17th, 2022

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Summary

This report has been prepared for AOCO to discover issues and vulnerabilities in the source code of the AOCO 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	AOCO
Platform	Other
Language	Solidity
Codebase	https://bscscan.com/address/0x6316B03FF4319173d36711dF37f3DaC107964C47#code
Commit	

Audit Summary

Delivery Date	Feb 17, 2022
Audit Methodology	Static Analysis, Manual Review

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Mitigated	Resolved
Critical	0	0	0	0	0	0	0
Major	1	0	0	0	0	0	1
Medium	1	0	0	1	0	0	0
Minor	1	0	0	1	0	0	0
Informational	9	0	0	9	0	0	0
Discussion	0	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
AOC	AOCO.sol	3ac95cdd5c6e73550ee79c8d4413e13b5e6a9ae6aabb99681ff242a02be93335

Findings

Critical	**0** (0.00%)
Major	**1** (8.33%)
Medium	**1** (8.33%)
Minor	**1** (8.33%)
Informational	**9** (75.00%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
AOC-01	Decimals too small	Volatile Code	Informational	Acknowledged
AOC-02	Incorrect error message	Logical Issue	Minor	Acknowledged
AOC-03	Initial token distribution	**Centralization / Privilege**	**Medium**	Acknowledged
AOC-04	Optimization of function `transferFrom()`	Gas Optimization	Informational	Acknowledged
AOC-05	Centralization risk in AOCO.sol	**Centralization / Privilege**	**Major**	Resolved
AOC-06	Redundant code components	Volatile Code	Informational	Acknowledged
AOC-07	Variables that could be declared as `constant`	Gas Optimization	Informational	Acknowledged
AOC-08	Missing emit events	Coding Style	Informational	Acknowledged
AOC-09	Improper usage of `public` and `external` type	Gas Optimization	Informational	Acknowledged
AOC-10	Unlocked compiler version	Language Specific	Informational	Acknowledged
AOC-11	Division before multiplication	Logical Issue	Informational	Acknowledged
AOC-12	Pure function read state variable	Compiler Error	Informational	Acknowledged

AOC-01 | Decimals Too Small

Category	Severity	Location	Status
Volatile Code	Informational	AOCO.sol: 443	Acknowledged

Description

The token's decimal is set too small, which could result in much loss in circulation.

Recommendation

We recommend the team check the logic and the loss from the precision is within tolerance.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-02 | Incorrect Error Message

Category	Severity	Location	Status
Logical Issue	Minor	AOCO.sol: 545	Acknowledged

Description

The error message in `require(_isExcluded[account], "Account is already excluded")` does not describe the error correctly.

Recommendation

The message "Account is already excluded" can be changed to "Account is not excluded" .

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-03 | Initial Token Distribution

Category	Severity	Location	Status
Centralization / Privilege	**Medium**	AOCO.sol: 446~447	Acknowledged

Description

All of the `AOCO` are sent to the contract deployer when deploying the contract. This could be a centralization risk as the deployer can distribute `AOCO` tokens without obtaining the consensus of the community.

Recommendation

We recommend the team to be transparent regarding the initial token distribution process, and the team shall make enough efforts to restrict the access of the private key.

Alleviation

The team acknowledged this issue and they stated the following:

"The distribution of tokens has been agreed upon by all members of the community for full community autonomy and decentralization."

AOC-04 | Optimization Of Function `transferFrom()`

Category	Severity	Location	Status
Gas Optimization	Informational	AOCO.sol: 487	Acknowledged

Description

If the allowance is not sufficient to cover the amount of transfer, timely approving allows the transaction to rollback earlier to save gas.

Recommendation

We recommend the team bring `)approve` before `_transfer` to save gas.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

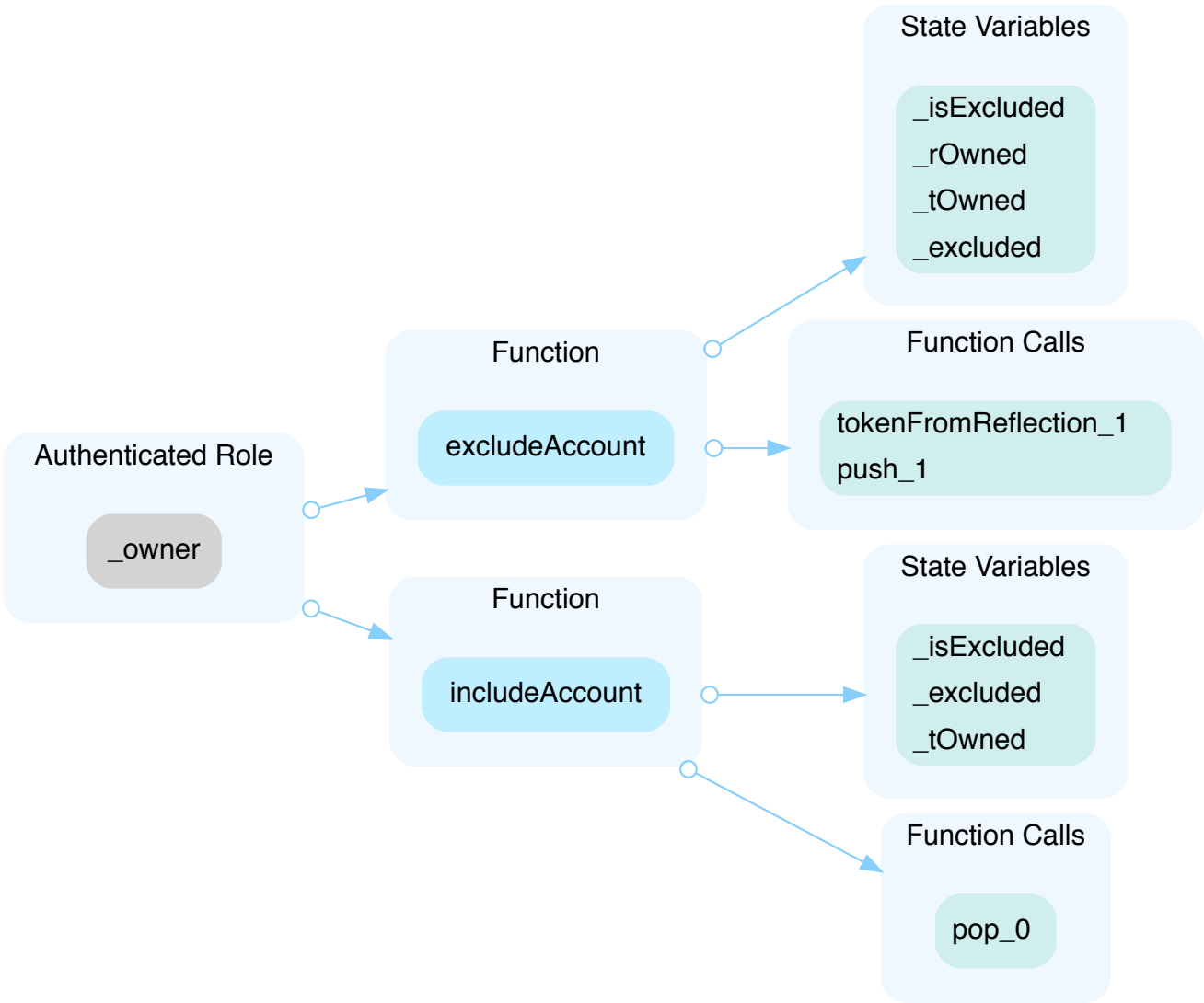
AOC-05 | Centralization Risk In AOCO.sol

Category	Severity	Location	Status
Centralization / Privilege	Major	AOCO.sol: 535~542, 544~555, 407~410, 416~420	Resolved

Description

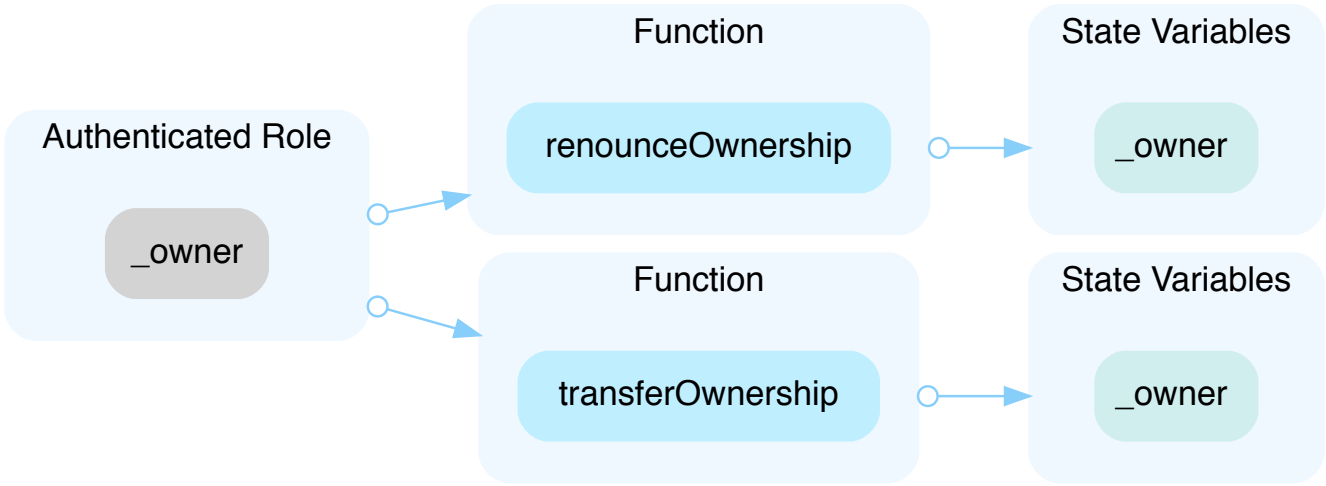
In the contract `AOCO` the role `_owner` has authority over the functions shown in the diagram below.

Any compromise to the `_owner` account may allow the hacker to take advantage of this authority and add accounts or remove accounts from the reward-excluded list.



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

Any compromise to the `_owner` account may allow the hacker to take advantage of this authority and change the owner of the contract.



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., multisignature 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 (⅔, ⅗) 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

The team resolved the issue by transferring the ownership to zero address.

- Transaction info of transferring ownership to zero address
- Current state of the contract

AOC-06 | Redundant Code Components

Category	Severity	Location	Status
Volatile Code	Informational	AOCO.sol: 16~19	Acknowledged

Description

The linked statements do not affect the functionality of the codebase and appear to be either leftovers from test code or older functionality.

Recommendation

We advise to remove the redundant statements for production environments.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-07 | Variables That Could Be Declared As `constant`

Category	Severity	Location	Status
Gas Optimization	Informational	AOCO.sol: 441, 442, 443	Acknowledged

Description

The linked variables could be declared as `constant` since these state variables are never modified.

Recommendation

We recommend to declare these variables as `constant`.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-08 | Missing Emit Events

Category	Severity	Location	Status
Coding Style	Informational	AOCO.sol: 535~542, 544~555	Acknowledged

Description

There should always be events emitted in the sensitive functions that are controlled by centralization roles.

Recommendation

It is recommended emitting events for the sensitive functions that are controlled by centralization roles.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-09 | Improper Usage Of `public` And `external` Type

Category	Severity	Location	Status
Gas Optimization	Informational	AOCO.sol: 388~390, 407~410, 416~420, 450~452, 454~456, 458~460, 462~464, 466~469, 471~474, 476~478, 480~483, 485~489, 491~494, 496~499, 501~503, 505~507, 509~516, 518~527	Acknowledged

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

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-10 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	AOCO.sol: 9	Acknowledged

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 `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-11 | Division Before Multiplication

Category	Severity	Location	Status
Logical Issue	Informational	AOCO.sol: 631	Acknowledged

Description

Mathematical operations in the aforementioned function perform divisions before multiplications. Performing multiplication before division can sometimes avoid loss of precision.

Recommendation

We advise the client to apply multiplications before divisions if integer overflow would not happen in functions.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

AOC-12 | Pure Function Read State Variable

Category	Severity	Location	Status
Compiler Error	Informational	AOCO.sol: 462	Acknowledged

Description

The function `totalSupply()` is declared with `pure` identifier, but it reads the state variable `_tTotal`.

Recommendation

We recommend the team use the `view` identifier instead.

Alleviation

The team acknowledged this issue and they stated the following:

"It will not have any impact on the security of the contract."

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.

Volatile Code

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

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.

Compiler Error

Compiler Error findings refer to an error in the structure of the code that renders it impossible to compile using the specified version of the project.

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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