HACKEN

SMART CONTRACT CODE REVIEW AND SECURITY ANALYSIS REPORT

Customer: Astra
Date: June 10th, 2022

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Document

Name	Smart Contract Code Review and Security Analysis Report for Astra.
Approved By	Evgeniy Bezuglyi | SC Department Head at Hacken OU
Type	Vesting
Platform	EVM
Language	Solidity
Methods	Architecture Review, Functional Testing, Computer-Aided Verification, Manual Review
Website	https://astra.finance
Timeline	18.04.2022 - 10.06.2022
Changelog	22.04.2022 - Initial Review 10.06.2022 - Second Review

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Introduction

Hacken OÜ (Consultant) was contracted by Astra (Customer) to conduct a Smart Contract Code Review and Security Analysis. This report presents the findings of the security assessment of the Customer's smart contracts.

Scope

The scope of the project is smart contracts in the repository:

Initial review scope

Repository:
https://github.com/astradao/astra-private
Commit:
094078482cb6671d3610426edd4167c6c621985b
Technical Documentation: Yes
JS tests: Yes
Contract:
File: ./astra-smartcontracts/main/version-6/treasury-vesting.sol
SHA3: c1434c1951b60915205a52c70504c298202e8846968e0f22d4beee54

Second review scope

Repository:
https://github.com/astradao/astra-private
Commit:
094078482cb6671d3610426edd4167c6c621985b
Technical Documentation: Yes
JS tests: Yes
Contract:
File: ./astra-smartcontracts/main/version-6/treasury-vesting.sol
SHA3: 5ccc743dce353089ced1862b0c4104feda52507c480f5800de49990e

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Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to assets loss or data manipulations.
High	High-level vulnerabilities are difficult to exploit; however, they also have a significant impact on smart contract execution, e.g., public access to crucial functions
Medium	Medium-level vulnerabilities are important to fix; however, they cannot lead to assets loss or data manipulations.
Low	Low-level vulnerabilities are mostly related to outdated, unused, etc. code snippets that cannot have a significant impact on execution

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Executive Summary

The Score measurements details can be found in the corresponding section of the methodology.

Documentation quality

The Customer provided appropriate functional and technical requirements.
The total Documentation Quality score is **10** out of **10**.

Code quality

The total CodeQuality score is **10** out of **10**. Code is easy to read.

Architecture quality

The architecture quality score is **10** out of **10**. The structure is clear.

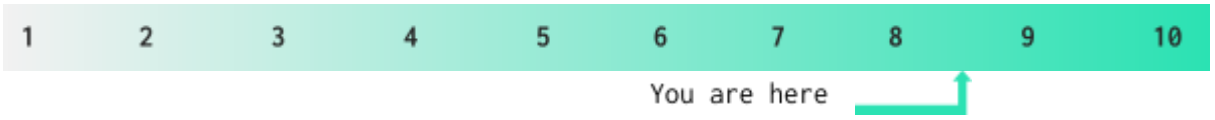
Security score

As a result of the audit, security engineers found **2** medium and **1** low severity issues. The security score is **8** out of **10**.

All found issues are displayed in the “Findings” section.

Summary

According to the assessment, the Customer's smart contract has the following score: **8.6**.



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Checked Items

We have audited provided smart contracts for commonly known and more specific vulnerabilities. Here are some of the items that are considered:

Item	Type	Description	Status
Default Visibility	SWC-100 SWC-108	Functions and state variables visibility should be set explicitly. Visibility levels should be specified consciously.	Passed
Integer Overflow and Underflow	SWC-101	If unchecked math is used, all math operations should be safe from overflows and underflows.	Passed
Outdated Compiler Version	SWC-102	It is recommended to use a recent version of the Solidity compiler.	Failed
Floating Pragma	SWC-103	Contracts should be deployed with the same compiler version and flags that they have been tested thoroughly.	Passed
Unchecked Call Return Value	SWC-104	The return value of a message call should be checked.	Not Relevant
Access Control & Authorization	CWE-284	Ownership takeover should not be possible. All crucial functions should be protected. Users could not affect data that belongs to other users.	Passed
SELFDESTRUCT Instruction	SWC-106	The contract should not be destroyed until it has funds belonging to users.	Not Relevant
Check-Effect-Interaction	SWC-107	Check-Effect-Interaction pattern should be followed if the code performs ANY external call.	Failed
Uninitialized Storage Pointer	SWC-109	Storage type should be set explicitly if the compiler version is < 0.5.0.	Not Relevant
Assert Violation	SWC-110	Properly functioning code should never reach a failing assert statement.	Not Relevant
Deprecated Solidity Functions	SWC-111	Deprecated built-in functions should never be used.	Not Relevant
Delegatecall to Untrusted Callee	SWC-112	Delegatecalls should only be allowed to trusted addresses.	Not Relevant
DoS (Denial of Service)	SWC-113 SWC-128	Execution of the code should never be blocked by a specific contract state unless it is required.	Passed
Race Conditions	SWC-114	Race Conditions and Transactions Order Dependency should not be possible.	Passed

Authorization through tx.origin	SWC-115	tx.origin should not be used for authorization.	Not Relevant
Block values as a proxy for time	SWC-116	Block numbers should not be used for time calculations.	Passed
Signature Unique Id	SWC-117 SWC-121 SWC-122	Signed messages should always have a unique id. A transaction hash should not be used as a unique id.	Not Relevant
Shadowing State Variable	SWC-119	State variables should not be shadowed.	Passed
Weak Sources of Randomness	SWC-120	Random values should never be generated from Chain Attributes.	Not Relevant
Incorrect Inheritance Order	SWC-125	When inheriting multiple contracts, especially if they have identical functions, a developer should carefully specify inheritance in the correct order.	Passed
Calls Only to Trusted Addresses	EEA-Level-2 SWC-126	All external calls should be performed only to trusted addresses.	Passed
Presence of unused variables	SWC-131	The code should not contain unused variables if this is not justified by design.	Passed
EIP standards violation	EIP	EIP standards should not be violated.	Not Relevant
Assets integrity	**Custom**	Funds are protected and cannot be withdrawn without proper permissions.	Passed
User Balances manipulation	**Custom**	Contract owners or any other third party should not be able to access funds belonging to users.	Not Relevant
Data Consistency	**Custom**	Smart contract data should be consistent all over the data flow.	Passed
Flashloan Attack	**Custom**	When working with exchange rates, they should be received from a trusted source and not be vulnerable to short-term rate changes that can be achieved by using flash loans. Oracles should be used.	Not Relevant
Token Supply manipulation	**Custom**	Tokens can be minted only according to rules specified in a whitepaper or any other documentation provided by the customer.	Not Relevant
Gas Limit and Loops	**Custom**	Transaction execution costs should not depend dramatically on the amount of data stored on the contract. There should not be any cases when execution fails due to the block gas limit.	Passed

Style guide violation	**Custom**	Style guides and best practices should be followed.	Passed
Requirements Compliance	**Custom**	The code should be compliant with the requirements provided by the Customer.	Passed
Repository Consistency	**Custom**	The repository should contain a configured development environment with a comprehensive description of how to compile, build and deploy the code.	Passed
Tests Coverage	**Custom**	The code should be covered with unit tests. Test coverage should be 100%, with both negative and positive cases covered. Usage of contracts by multiple users should be tested.	Passed

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System Overview

Astra is a mixed-purpose system that includes the contract from the audit scope:

- TokenVesting – simple vesting contract with the ability to connect Chainlink Keeper for automated vesting releasing. Airdrop function for p2p giveaways is provided.

Privileged roles

- The owner has the ability to:
  - create vestings
  - revoke vestings if a revocable parameter was provided on creation
  - withdraw unvested assets
  - update period for Chainlink Keeper automated releasing

Some keypoints for user

- The owner can revoke a vesting if, on creation, such a parameter was provided. On revoking, all vested tokens till the moment are automatically released to the beneficiary account.

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Findings

Critical

No critical severity issues were found.

High

No high severity issues were found.

Medium

1. **Potential gas limit exceeding**

   A loop around an only increasing array may exceed Gas in the future when the array becomes too big.

   This could lead to the breaking of the automated tool.

   Contract: treasury-vesting.sol

   Function: performUpkeep

   Recommendation: implement an array of only actual vesting ids, perform automation only for those ones.

   Status: Fixed (second scope)

2. **Unchecked integer overflow/underflow**

   Unchecked math is a common cause of losing assets and double-spending attacks. This particular case may cause such problems if the provided *token* violates *ERC-20* standard.

   Leaving math unchecked may become dangerous, along with other errors. It may cause problems in future development.

   Contract: treasury-vesting.sol

   Functions: multisendToken, getLastVestingScheduleForHolder

   Recommendation: provide corresponding checks.

   Status: Fixed (second scope)

3. **Possible locking of Ether**

   Empty receive and fallback functions may cause locking of *ether* on the smart contract without any ability to transfer it to another account.

   Leaving payable receive and fallback functions on a contract that do nothing with *ether* may lead to unpleasant results for users who accidentally call the contract with attached *ether*.

   Contract: treasury-vesting.sol

   Functions: receive, fallback

   Recommendation: remove these functions.

Status: Fixed (second scope)

4. **Check-Effect-Interaction pattern violation**

   This pattern is designed to prevent reentering attacks, but it saves Gas and keeps the project's code clear.

   Violation of the Check-Effect-Interaction pattern may cause problems in future development.

   Contract: treasury-vesting.sol

   Function: revoke

   Recommendation: put any external calls or calls that make those ones inside at the end of the function.

   Status: Reported

5. **Chainlink automation may be prevented**

   A user may force call *performUpkeep* function in order to prevent next automated upkeep.

   It may happen because the *keeperLastUpdatedTime* variable is updated even if the upkeep is not done. The variable is used in the validation of is the upkeep applicable, so automated upkeep may never happen.

   Contract: treasury-vesting.sol

   Function: performUpkeep

   Recommendation: update the variable only when upkeep is applicable and done.

   Status: New

Low

1. **Unused events**

   Events *Released* and *Revoked* are defined but never used.

   Contract: treasury-vesting.sol

   Function:

   Recommendation: if mentioned events should be emitted, do this or remove them.

   Status: Fixed (second scope)

2. **Unused modifier**

   Modifier *onlyIfVestingScheduleExists* is defined but never used.

   Contract: treasury-vesting.sol

   Recommendation: if mentioned modifier should be used, do this or remove it.

Status: Fixed (second scope)

3. **Boolean equality**

   Boolean constants can be used directly and do not need to be compared to *true* or *false*.

   Contract: treasury-vesting.sol

   Functions: performUpkeep, _computeReleasableAmount, revoke, onlyIfVestingScheduleExists, onlyIfVestingScheduleNotRevoked

   Recommendation: remove the equality to the boolean constant.

   Status: Fixed (second scope)

4. **Functions that can be declared as external**

   To save Gas, public functions that are never called in the contract should be declared as *external*.

   Contract: treasury-vesting.sol

   Functions: addUserDetails, revoke, withdraw, getWithdrawableAmount, computeNextVestingScheduleIdForHolder, getLastVestingScheduleForHolder

   Recommendation: the functions above should be declared as *external*.

   Status: Fixed (second scope)

5. **Copy-pasting of well-known contracts**

   It is better to import well-known contracts from the initial source, for example, from the OpenZeppelin repository. These contracts are in development, so importing them from open libraries will make code more flexible.

   Contract: treasury-vesting.sol

   Imports: SafeMath, IERC20, ERC20, SafeERC20, Ownable (OwnableUpgradeable), Context, Initializable

   Recommendation: change local imports to imports from the initial source.

   Status: Fixed (second scope)

6. **Mixing levels of abstraction**

   Several *view* functions create abstraction around contract data defined, but they are not used in the contract code or used particularly.

   Contract: treasury-vesting.sol

   Functions: getVestingSchedulesCount, getVestingSchedule, getCurrentTime

   Recommendation: provide abstraction levels consciously.

Status: Fixed (second scope)

7. **Outdated Compiler Version**

   Using an outdated compiler version can be problematic, especially if publicly disclosed bugs and issues affect the current compiler version.

   Contract: treasury-vesting.sol

   Recommendation: use a recent version of the Solidity compiler.

   Status: Reported

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Disclaimers

Hacken Disclaimer

The smart contracts given for audit have been analyzed by the best industry practices at the date of this report, with cybersecurity vulnerabilities and issues in smart contract source code, the details of which are disclosed in this report (Source Code); the Source Code compilation, deployment, and functionality (performing the intended functions).

The audit makes no statements or warranties on the security of the code. It also cannot be considered a sufficient assessment regarding the utility and safety of the code, bug-free status, or any other contract statements. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only — we recommend proceeding with several independent audits and a public bug bounty program to ensure the security of smart contracts.

Technical Disclaimer

Smart contracts are deployed and executed on a blockchain platform. The platform, its programming language, and other software related to the smart contract can have vulnerabilities that can lead to hacks. Thus, the audit cannot guarantee the explicit security of the audited smart contracts.