Smart Contract Code Review and Security Analysis Report

Customer: Current (Gibraltar) Ltd
Date: 16.08.2018

HACKEN

HACKEN CYBERSECURITY ECOSYSTEM.

Document:

Name	Smart Contract Code Review and Security Analysis Report for Current (Gibraltar) Ltd
Date	16.08.2018
Platform	Ethereum / Solidity
Link	https://github.com/CurrentMediaNetwork/CRNC/tree/master/contracts
Version	6551329ef1780d855ca9b0f6970b6d6480edd939

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Introduction

Current (Gibraltar) Ltd (Customer) contacted Hacken OÜ (Consultant) to conduct Smart Contract Code Review and Security Analysis. This report presents the findings of the security assessment of Customer`s smart contract and its code review conducted between 10.08.2018 – 16.08.2018.

Scope

This project concerns Current (Gibraltar) Ltd smart contracts, which can be found on Github at the link below:

https://github.com/CurrentMediaNetwork/CRNC/tree/master/contracts

The report was made for commit version: 6551329ef1780d855ca9b0f6970b6d6480edd939

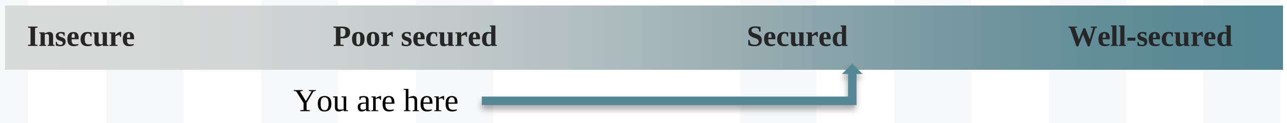
The full list of audited contracts is CurrentToken.sol, Custodial.sol, Pausable.sol, PausableToken.sol.

We have scanned this smart contract for common and company-specific vulnerabilities. The following list includes common vulnerabilities that were considered:

- Reentrancy
- Timestamp Dependence
- Gas Limit and Loops
- DoS with (Unexpected) Throw
- DoS with Block Gas Limit
- Transaction-Ordering Dependence
- Byte array vulnerabilities
- Style guide violation
- Transfer forwards all gas
- ERC20 API violation
- Malicious libraries
- Compiler version not fixed
- Unchecked external call - Unchecked math
- Unsafe type inference
- Implicit visibility level

Executive Summary

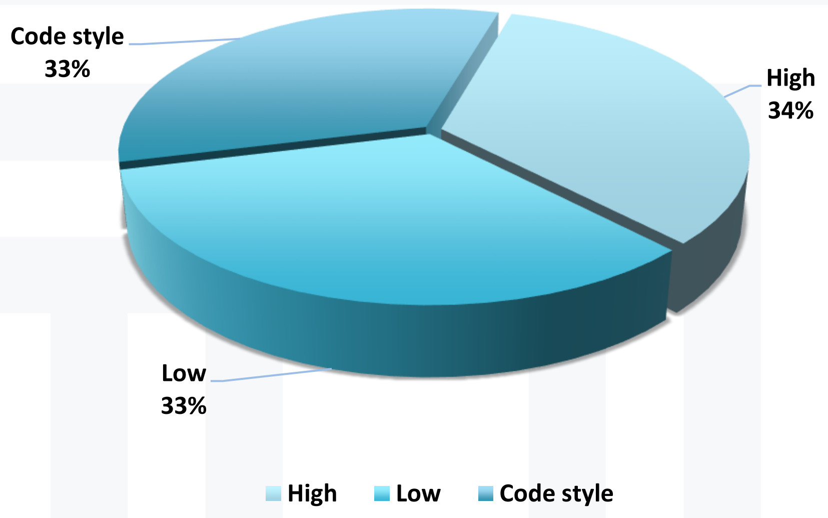
According to our assessment, the level of the smart contracts' security is middle with one high severity vulnerability found.



Our team performed an analysis of the code's functionality, manual audit, and automated checks with solc, Mythril and remix IDE (see Appendix B pic 1-8). All the issues discovered by the automated tools analysis were manually reviewed, and valid vulnerabilities are presented in the Audit overview section. The general overview is presented in the AS-IS section, and all discovered issues can be found in the Audit overview section.

We found 1 high-level vulnerability, 1 low-level vulnerability, and 1 code style issue.

Graph 1. The distribution of vulnerabilities.



Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can directly lead to token loss
High	High-level vulnerabilities are difficult to exploit; however, they have a significant impact on the execution of the smart contract (e.g. public access to crucial functions)
Medium	Medium-level vulnerabilities have moderate security impact; however, they can't lead to token loss
Low	Low-level vulnerabilities are mostly related to outdated or unused code snippets that can't have a significant impact on the execution
Lowest / Code Style / Info	Lowest-level vulnerabilities, code style violations, and info statements can't affect the execution of a smart contract and can be ignored.

AS-IS overview

CurrentToken contract overview

The CurrentToken.sol contract contains the SafeMath library, the ERC20 contract, the Pausable contract, the PausableToken contract, the Custodial contract, the StandardToken contract, and the CurrentToken contract.

The SafeMath library defines Math operations with safety checks that detect errors.

The ERC20 contract defines interface according to the ERC20 standard.

The StandardToken contract is based on the ERC20 contract and defines parameters of functions according to the ERC20 standard: mapping allowed, the function transferFrom, the function approve, the function allowance, the function increaseApproval, the function decreaseApproval.

The Custodial contract implements basic authorization control of functions.

The Pausable contract is based on the Custodial contract and allows to implement a stop mechanism.

The PausableToken contract inherits StandardToken and Pausable contracts. It is a modified StandardToken with pausable transfers.

The CurrentToken contract is based on the PausableToken contract and describes custom ERC20 tokens for Current (Gibraltar) Ltd.

The CurrentToken.sol contract describes a custom ERC20 token with the following parameters:

- name – Current
- symbol – CRNC
- decimals – 18

The CurrentToken contract constructor sets:

- communityAddress _ to _communityAddress
- presaleAddress to _presaleAddress
- gibraltarAddress to _gibraltarAddress
- distributorAddress to _distributorAddress
- totalSupply_ to 100000000000000000000000000
- _initSupply to _communityTokens.add(_presaleTokens.add(_gibraltarTokens))
- balances[communityAddress] to _communityTokens
- balances[presaleAddress] to _presaleTokens
- balances[gibraltarAddress] to _gibraltarTokens

CurrentToken.sol has 2 functions:

- batchTransfer is a public function – transfers batches with a specified number of tokens to a specified array of addresses. It has the whenNotPaused modifier.
- batchTransferWhenPaused is a public function – transfers batches with a specified number of tokens to a specified array of addresses. It functions only if the msg.sender is whitelisted and has the whenPaused modifier.

Custodial contract overview

The Custodial.sol contract provides the onlyCustodian modifier, which prevents anyone from running functions on a non-custodian account. Custodial is an analog of the OpenZeppelin Ownable contract.

Custodial contract constructor sets:

- custodian to _custodian

Custodial.sol has 1 modifier:

- onlyCustodian – checks whether msg.sender is a custodian.

Custodial.sol has 2 functions:

- renounceCustody is a public function – changes custodian to the address(0). It has the onlyCustodian modifier.
- transferCustody is a public function – changes custodian to a specified address. It has the onlyCustodian modifier.

Overview of changes in OpenZeppelin contracts

onlyOwner modifier was changed to onlyCustodian in Pausable.sol. Internal constructor from Custodial was added.

Audit overview

Critical

No critical severity vulnerabilities were found.

High

1. The CurrentToken constructor sets addresses for _communityTokens, _presaleTokens, and _gibraltarTokens; after that, it redistributes tokens to these accounts. In case the same addresses are passed to the constructor, account balances will be overridden, which will cause token loss. To solve the issue, Customer needs to add several checks to the code: checks that ascertain that _communityTokens, _presaleTokens, and _gibraltarTokens don't have the same addresses and checks that exclude the 0x0 addresses (See Appendix A pic. 1 for evidence).

Medium

No medium severity vulnerabilities were found.

Low

2. The compiler version is not locked. Consider locking the compiler version with the latest one (See Appendix A pic. 2 for evidence).

```
pragma solidity ^0.4.24; // bad: compiles w 0.4.24 and above
pragma solidity 0.4.24; // good: compiles w 0.4.24 only
```

Lowest / Code style / Info

Code style issues

3. The visibility modifier is not the first on the list of modifiers; it should be the first of modifiers in CurrentToken line 46

Conclusion

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools. Detailed description of the functionality of the contract is presented in the AS-IS overview section of the report.

The audit team has found 1 high and 1 low-security issue in the course of manual and automated audits. These vulnerabilities are listed in the audit overview section. The recommendations listed in the Audit overview should be implemented.

The overall quality of reviewed contracts is relatively good and the discovered issues can't affect the security if _communityTokens, _presaleTokens, and _gibraltarTokens are set differently in the constructor.

Disclaimers

Disclaimer

The audited smart contracts have been analyzed in accordance with the best industry practices available when this report was released. The report concerns several aspects of the smart contract source code and the related cybersecurity vulnerabilities and issues - compilation, deployment, and functionality.

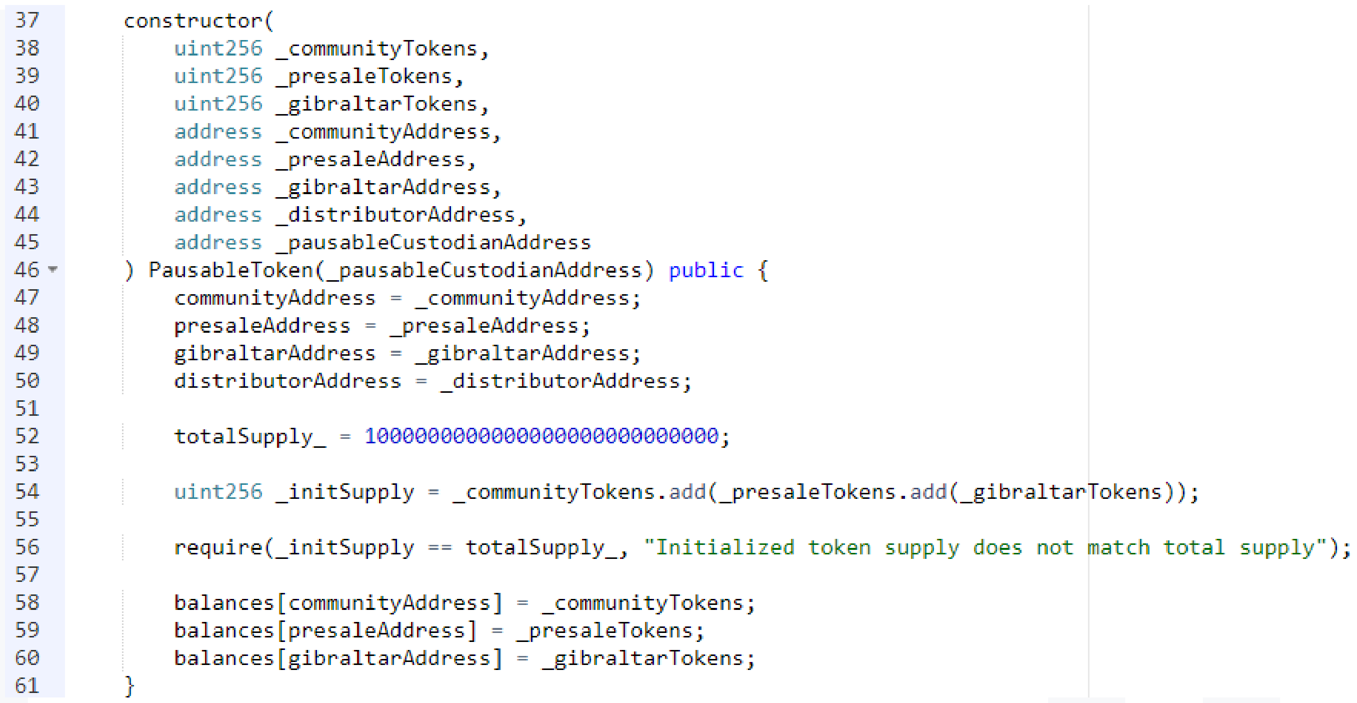
The audit gives no warranties regarding the security of the code. Further, it cannot be considered a sufficient assessment of the utility and safety of the code, bugfree status, or any other statements of the contract. While the conducted analysis relied on experts and advanced techniques, it is important to note that you should not rely on this report only - we recommend to proceed 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 may have its own vulnerabilities that can lead to hacks. Thus, the audit can't guarantee the explicit security of the audited smart contracts.

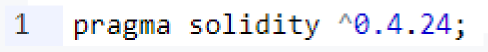
Appendix A. Evidences

Pic 1. Constructor in CurrentToken:



```
    constructor(
        uint256 _communityTokens,
        uint256 _presaleTokens,
        uint256 _gibraltarTokens,
        address _communityAddress,
        address _presaleAddress,
        address _gibraltarAddress,
        address _distributorAddress,
        address _pausableCustodianAddress
    ) PausableToken(_pausableCustodianAddress) public {
        communityAddress = _communityAddress;
        presaleAddress = _presaleAddress;
        gibraltarAddress = _gibraltarAddress;
        distributorAddress = _distributorAddress;

        totalSupply_ = 10000000000000000000000000000;

        uint256 _initSupply = _communityTokens.add(_presaleTokens.add(_gibraltarTokens));

        require(_initSupply == totalSupply_, "Initialized token supply does not match total supply");

        balances[communityAddress] = _communityTokens;
        balances[presaleAddress] = _presaleTokens;
        balances[gibraltarAddress] = _gibraltarTokens;
    }
```

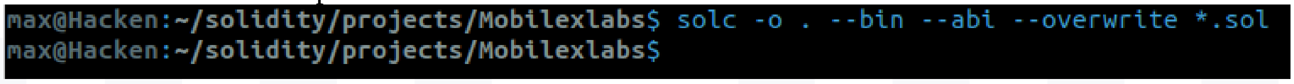
Pic 2. The compiler version is not locked:



```
pragma solidity ^0.4.24;
```

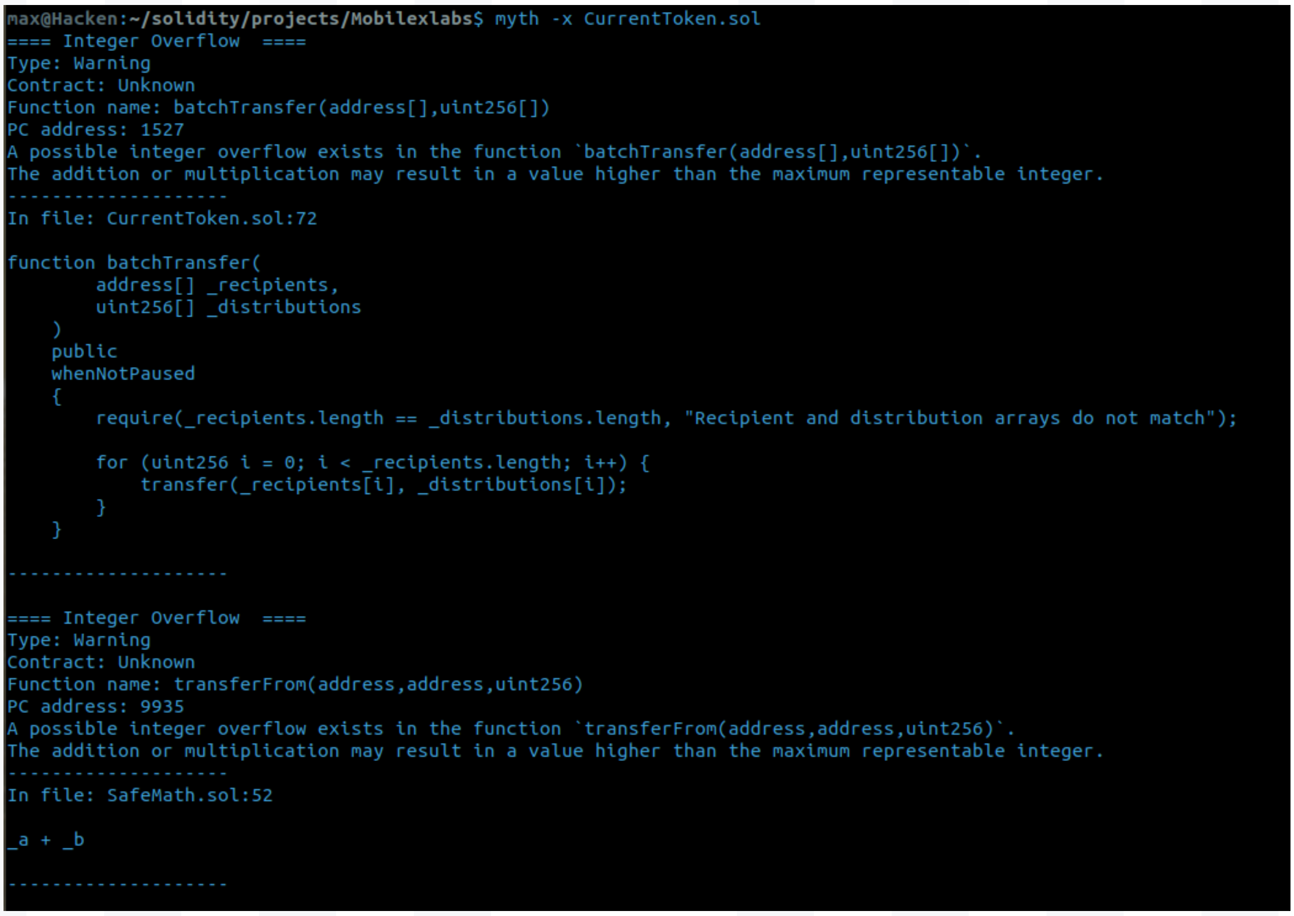
Appendix B. Automated tools reports

Pic 1. Solc automated report:



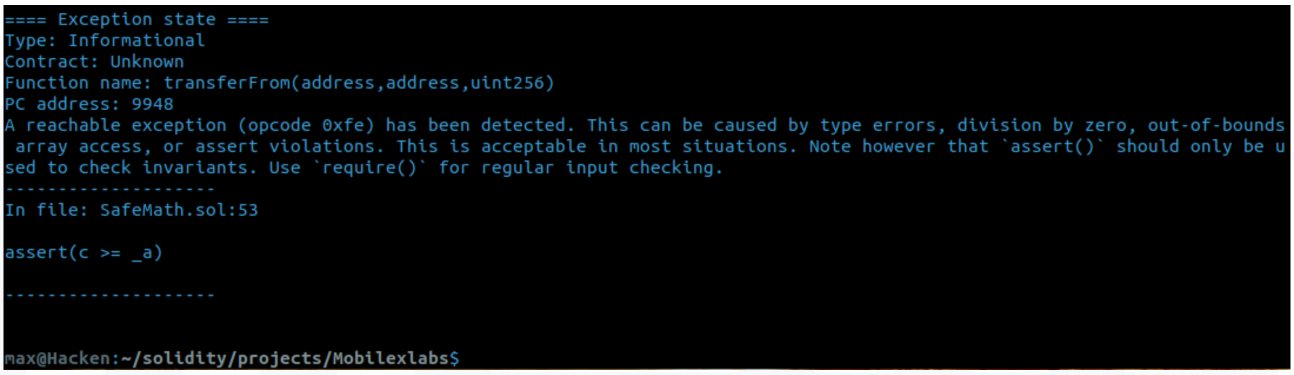
```
max@Hacken:~/solidity/projects/Mobilexlabs$ solc -o . --bin --abi --overwrite *.sol
max@Hacken:~/solidity/projects/Mobilexlabs$
```

Pic 2. Mythril CurrentToken automated report:



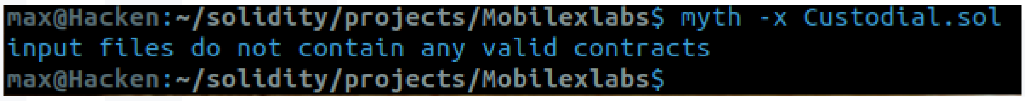
```
max@Hacken:~/solidity/projects/Mobilexlabs$ myth -x CurrentToken.sol
==== Integer Overflow  ====
Type: Warning
Contract: Unknown
Function name: batchTransfer(address[],uint256[])
PC address: 1527
A possible integer overflow exists in the function `batchTransfer(address[],uint256[])`.
The addition or multiplication may result in a value higher than the maximum representable integer.
--------------------
In file: CurrentToken.sol:72

function batchTransfer(
        address[] _recipients,
        uint256[] _distributions
    )
    public
    whenNotPaused
    {
        require(_recipients.length == _distributions.length, "Recipient and distribution arrays do not match");

        for (uint256 i = 0; i < _recipients.length; i++) {
            transfer(_recipients[i], _distributions[i]);
        }
    }

--------------------

==== Integer Overflow  ====
Type: Warning
Contract: Unknown
Function name: transferFrom(address,address,uint256)
PC address: 9935
A possible integer overflow exists in the function `transferFrom(address,address,uint256)`.
The addition or multiplication may result in a value higher than the maximum representable integer.
--------------------
In file: SafeMath.sol:52

_a + _b

--------------------
```

Pic 3. Mythril CurrentToken automated report:



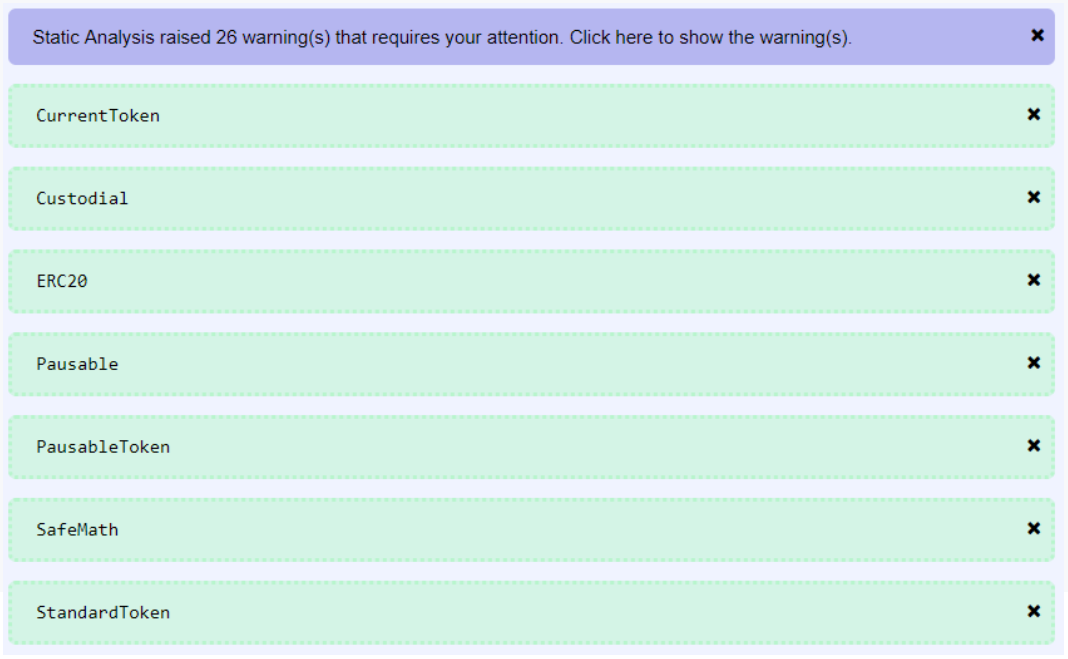
```
==== Exception state ====
Type: Informational
Contract: Unknown
Function name: transferFrom(address,address,uint256)
PC address: 9948
A reachable exception (opcode 0xfe) has been detected. This can be caused by type errors, division by zero, out-of-bounds
 array access, or assert violations. This is acceptable in most situations. Note however that `assert()` should only be u
sed to check invariants. Use `require()` for regular input checking.
--------------------
In file: SafeMath.sol:53

assert(c >= _a)

--------------------


max@Hacken:~/solidity/projects/Mobilexlabs$
```

Pic 4. Mythril Custodial automated report:



```
max@Hacken:~/solidity/projects/Mobilexlabs$ myth -x Custodial.sol
input files do not contain any valid contracts
max@Hacken:~/solidity/projects/Mobilexlabs$
```

Pic 5. Remix IDE automated report part 1:



Static Analysis raised 26 warning(s) that requires your attention. Click here to show the warning(s). ✖

CurrentToken ✖

Custodial ✖

ERC20 ✖

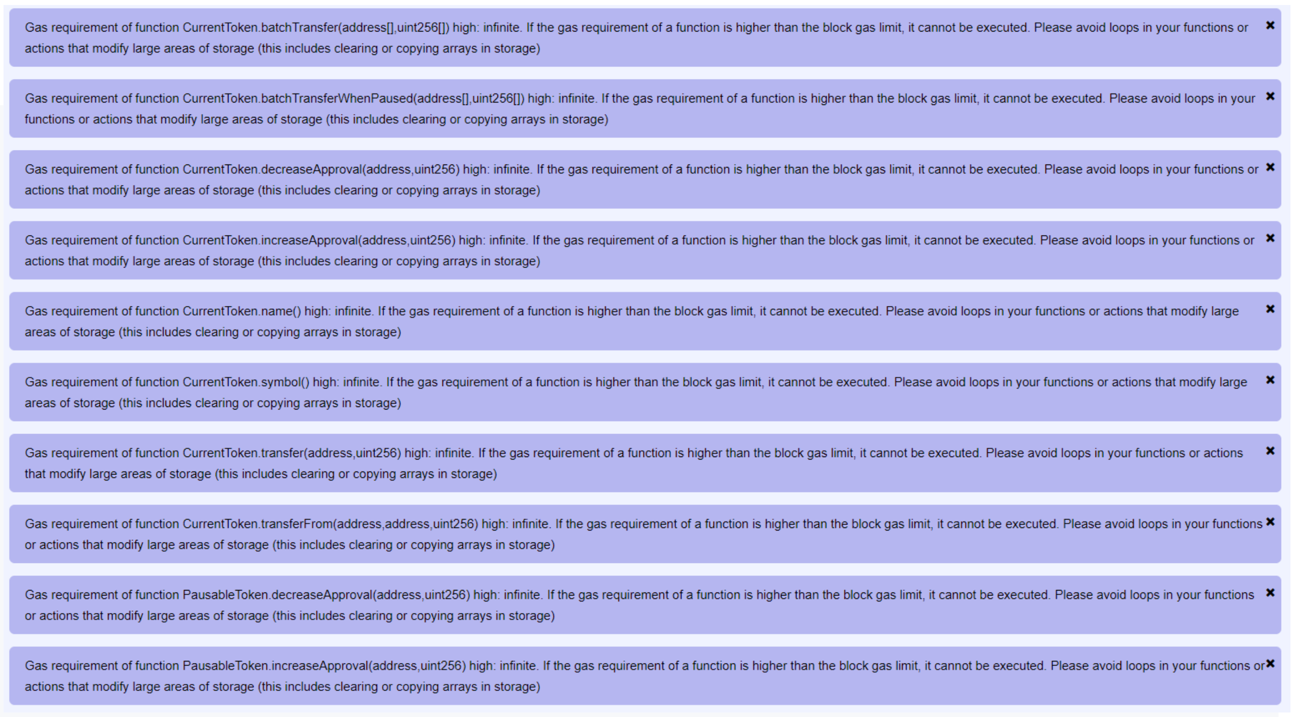
Pausable ✖

PausableToken ✖

SafeMath ✖

StandardToken ✖

Pic 6. Remix IDE automated report part 2:


Gas requirement of function CurrentToken.batchTransfer(address[],uint256[]) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.batchTransferWhenPaused(address[],uint256[]) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.decreaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.increaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.name() high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.symbol() high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

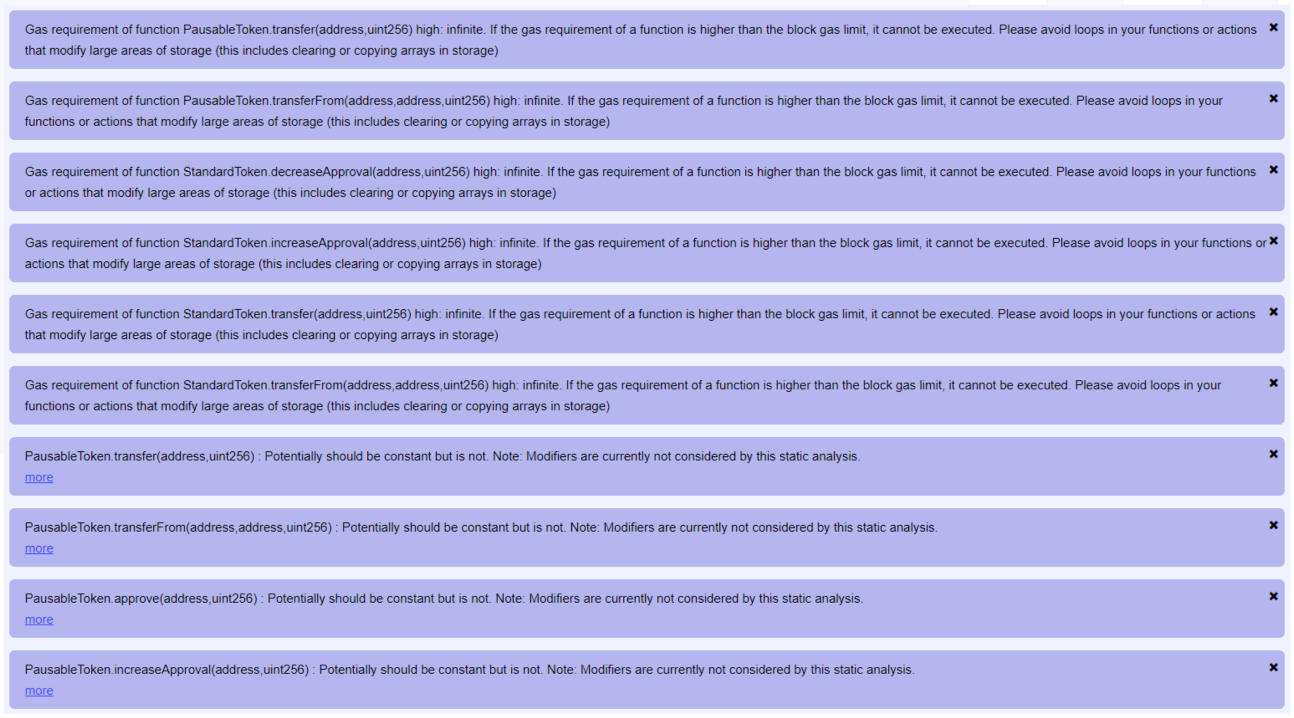
Gas requirement of function CurrentToken.transfer(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function CurrentToken.transferFrom(address,address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function PausableToken.decreaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function PausableToken.increaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Pic 7. Remix IDE automated report part 3:


Gas requirement of function PausableToken.transfer(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function PausableToken.transferFrom(address,address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function StandardToken.decreaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function StandardToken.increaseApproval(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function StandardToken.transfer(address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Gas requirement of function StandardToken.transferFrom(address,address,uint256) high: infinite. If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

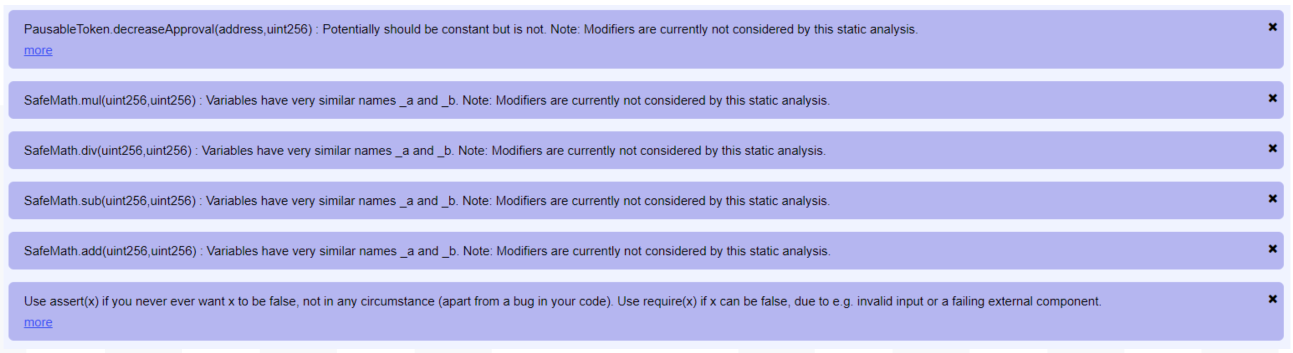
PausableToken.transfer(address,uint256) : Potentially should be constant but is not. Note: Modifiers are currently not considered by this static analysis.
more

PausableToken.transferFrom(address,address,uint256) : Potentially should be constant but is not. Note: Modifiers are currently not considered by this static analysis.
more

PausableToken.approve(address,uint256) : Potentially should be constant but is not. Note: Modifiers are currently not considered by this static analysis.
more

PausableToken.increaseApproval(address,uint256) : Potentially should be constant but is not. Note: Modifiers are currently not considered by this static analysis.
more

Pic 8. Remix IDE automated report part 4:



PausableToken.decreaseApproval(address,uint256) : Potentially should be constant but is not. Note: Modifiers are currently not considered by this static analysis.
more

SafeMath.mul(uint256,uint256) : Variables have very similar names _a and _b. Note: Modifiers are currently not considered by this static analysis.

SafeMath.div(uint256,uint256) : Variables have very similar names _a and _b. Note: Modifiers are currently not considered by this static analysis.

SafeMath.sub(uint256,uint256) : Variables have very similar names _a and _b. Note: Modifiers are currently not considered by this static analysis.

SafeMath.add(uint256,uint256) : Variables have very similar names _a and _b. Note: Modifiers are currently not considered by this static analysis.

Use assert(x) if you never ever want x to be false, not in any circumstance (apart from a bug in your code). Use require(x) if x can be false, due to e.g. invalid input or a failing external component.
more