Security Assessment

C98Stake

Dec 8th, 2021

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Summary

This report has been prepared for coin98 to discover issues and vulnerabilities in the source code of the C98Stake 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	C98Stake
Description	C98 Stake
Platform	Ethereum
Language	Solidity
Codebase	C98Stake.sol
Commit	

Audit Summary

Delivery Date	Dec 08, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

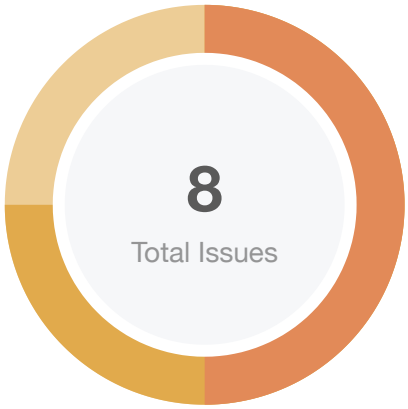
Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	4	0	0	2	0	2
Medium	2	0	0	1	0	1
Minor	2	0	0	2	0	0
Informational	0	0	0	0	0	0
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
CSC	C98Stake.sol	7bb10b8eb2ecfbd27f5abcb07bf8e961dd15b6390b4a733ea8f09bfa04a29b93

Findings



Critical	**0** (0.00%)
Major	**4** (50.00%)
Medium	**2** (25.00%)
Minor	**2** (25.00%)
Informational	**0** (0.00%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
CSC-01	Missing Input Validation	Volatile Code	Minor	Acknowledged
CSC-02	Lack of authorization check in function `renaming()`	Logical Issue	Major	Resolved
CSC-03	Lack of authorization check in function `unstake()`	Logical Issue	Major	Resolved
CSC-04	Unchecked Value of ERC-20 `transfer()`/`transferFrom()` Call	Volatile Code	Medium	Resolved
CSC-05	Centralization Risk	**Centralization / Privilege**	**Major**	Acknowledged
CSC-06	Didn't update `StakeInfos` in function configurePackage()	Logical Issue	Major	Acknowledged
CSC-07	Divide Before Multiply	Mathematical Operations	Minor	Acknowledged
CSC-08	Uncertain Income Source of Reward Token	Logical Issue	Medium	Acknowledged

CSC-01 | Missing Input Validation

Category	Severity	Location	Status
Volatile Code	Minor	projects/C98Stake/C98Stake.sol (32df7cb): 1386~1390	Acknowledged

Description

The given input is missing the check for the non-zero address.

Recommendation

We advise adding the check for the passed-in values to prevent unexpected error.

CSC-02 | Lack of authorization check in function `renaming()`

Category	Severity	Location	Status
Logical Issue	Major	projects/C98Stake/C98Stake.sol (32df7cb): 1600~1602	Resolved

Description

Any user can rename any _tokenId by sending naming_fee.

```
1     function renaming (uint256 _tokenId,string memory _name) public {
2         StakeInfo storage stakeInfo = StakeInfos[_tokenId];
3         require(C98Token.transferFrom(msg.sender, address(this), naming_fee));
```

Recommendation

We advise checking whether this is intended, if not please make sure msg.sender is the owner of _tokenId, and also require only the owner can rename _tokenId's name.

Alleviation

Fixed in provided code.

CSC-03 | Lack of authorization check in function `unstake()`

Category	Severity	Location	Status
Logical Issue	Major	projects/C98Stake/C98Stake.sol (32df7cb): 1618~1622	Resolved

Description

An user can call unstake() successfully even if he is not the owner.

```
1     function unstake(uint256 _tokenId) public {
2         StakeInfo storage stakeInfo = StakeInfos[_tokenId];
3         uint256 _profit = getStakedByTokenId(_tokenId);
4         require(_profit > 0, "Not meet unstake condition");
5         require(ownerOf(_tokenId) == stakeInfo.owner, "Not meet owner condition");
```

Recommendation

We advise checking whether this is intended, if not please make sure msg.sender is the owner of _tokenId.

Alleviation

Fixed in provided code.

CSC-04 | Unchecked Value of ERC-20 `transfer()`/`transferFrom()` Call

Category	Severity	Location	Status
Volatile Code	Medium	projects/C98Stake/C98Stake.sol (32df7cb): 1628~1629, 1650	Resolved

Description

The linked `transfer()`/`transferFrom()` invocations do not check the return value of the function call which should yield a `true` result in case of proper ERC-20 implementation.

Recommendation

As many tokens do not follow the ERC-20 standard faithfully, they may not return a `bool` variable in this function's execution meaning that simply expecting it can cause incompatibility with these types of tokens. Instead, we advise that OpenZeppelin's `SafeERC20.sol` implementation is utilized for interacting with the `transfer()` and `transferFrom()` functions of ERC-20 tokens. The OZ implementation optionally checks for a return value rendering compatible with all ERC-20 token implementations.

Alleviation

Fixed in provided code.

CSC-05 | Centralization Risk

Category	Severity	Location	Status
Centralization / Privilege	Major	projects/C98Stake/C98Stake.sol (32df7cb)	Acknowledged

Description

In the contract `C98Stake.sol`, the role `Owner` has the authority over the following function:

- configureFixedVariable()
- unRegister()
- register()
- setBaseURI()
- withdraw()

Any compromise to the `Owner` account may allow the hacker to take advantage of this, especially the withdraw() function may take over all the funds.

```
1     function withdraw(uint256 _amount) public onlyOwner {
2         require(_amount > 0);
3         require(C98Token.balanceOf(address(this)) >= _amount);
4         C98Token.transfer(msg.sender, _amount);
5     }
```

Recommendation

We advise the client to carefully manage the `Owner` account's private key 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 smart-contract-based accounts with enhanced security practices, e.g., Multisignature wallets.

Indicatively, here is some feasible suggestions that would also mitigate the potential risk at the different level in term of 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.

CSC-06 | Didn't update `StakeInfos` in function configurePackage()

Category	Severity	Location	Status
Logical Issue	Major	projects/C98Stake/C98Stake.sol (32df7cb): 1419~1428	Acknowledged

Description

Function configurePackage() only update `PackageInfos` but not update `StakeInfos`, while the profit calculation still use old `time` and `rate`.

```
    function configurePackage(
        string memory _package,
        uint256 _min,
        uint256 _max,
        uint256 _time,
        uint256 _rate
    )
        public
        onlyOwner()
    {
        require(validPackage(_package), "Package not found");
        require(_min>0 && _max >0 && _min < _max, "Wrong numeric format");

        PackageInfos[_package].min = _min;
        PackageInfos[_package].max = _max;
        PackageInfos[_package].time = _time;
        PackageInfos[_package].rate = _rate;
    }
```

```
getStakedByTokenId() {
...
        } else {
            uint256 calRate = timeStaked < stakeInfo.packageTime ? floating_rate:
stakeInfo.rate;

            uint256 amountProfitBySeconds =
stakeInfo.amount.mul(calRate).div(Percent).div(yearTimestamp);
            return amountProfitBySeconds.mul(timeStaked);
        }
...
```

Recommendation

We advise to also update `stakeInfos` in function configurePackage().

CSC-07 | Divide Before Multiply

Category	Severity	Location	Status
Mathematical Operations	Minor	projects/C98Stake/C98Stake.sol (32df7cb): 1517~1518, 1251	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 to order multiplication before division.

CSC-08 | Uncertain Income Source of Reward Token

Category	Severity	Location	Status
Logical Issue	Medium	projects/C98Stake/C98Stake.sol (32df7cb)	Acknowledged

Description

According to the implementations of this contract, the users can stake C98 tokens into a package and earn a profit after unstake().

```
    function getStakedByTokenId(uint256 _tokenId) public view returns (uint256) {
        StakeInfo memory stakeInfo = StakeInfos[_tokenId];
        uint256 current = block.timestamp;
        uint256 timeStaked = current - stakeInfo.time;

        if(!stakeInfo.flag || (timeStaked < locked_time)){
            return 0;
        } else {
            uint256 calRate = timeStaked < stakeInfo.packageTime ? floating_rate:
stakeInfo.rate;

            uint256 amountProfitBySeconds =
stakeInfo.amount.mul(calRate).div(Percent).div(yearTimestamp);
            return amountProfitBySeconds.mul(timeStaked);
        }
    }

    function unstake(uint256 _tokenId) public {
        StakeInfo storage stakeInfo = StakeInfos[_tokenId];
        uint256 _profit = getStakedByTokenId(_tokenId);
    ...
```

The profit tokens are all sent from this contract, so the users may not get the full amount of rewards when the balance in this contract is insufficient.

Recommendation

We recommend ensuring every package of this contract has enough profit tokens for users.

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.

Mathematical Operations

Mathematical Operation findings relate to mishandling of math formulas, such as overflows, incorrect operations etc.

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.

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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