Cyberscope

Audit Report

Tea-Fi

October 2024

Files TeaStaking.sol, SignatureHandler.sol

Audited by © cyberscope

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Risk Classification

The criticality of findings in Cyberscope's smart contract audits is determined by evaluating multiple variables. The two primary variables are:

1. **Likelihood of Exploitation**: This considers how easily an attack can be executed, including the economic feasibility for an attacker.
2. **Impact of Exploitation**: This assesses the potential consequences of an attack, particularly in terms of the loss of funds or disruption to the contract's functionality.

Based on these variables, findings are categorized into the following severity levels:

1. **Critical**: Indicates a vulnerability that is both highly likely to be exploited and can result in significant fund loss or severe disruption. Immediate action is required to address these issues.
2. **Medium**: Refers to vulnerabilities that are either less likely to be exploited or would have a moderate impact if exploited. These issues should be addressed in due course to ensure overall contract security.
3. **Minor**: Involves vulnerabilities that are unlikely to be exploited and would have a minor impact. These findings should still be considered for resolution to maintain best practices in security.
4. **Informative**: Points out potential improvements or informational notes that do not pose an immediate risk. Addressing these can enhance the overall quality and robustness of the contract.

Severity	Likelihood / Impact of Exploitation
Critical	Highly Likely / High Impact
Medium	Less Likely / High Impact or Highly Likely/ Lower Impact
Minor / Informative	Unlikely / Low to no Impact

Review

Audit Updates

Initial Audit	26 Sep 2024 https://github.com/cyberscope-io/audits/blob/main/1-tea/v1/audit.pdf
Corrected Phase 2	25 Oct 2024 https://github.com/cyberscope-io/audits/blob/main/1-tea/v2/audit.pdf
Corrected Phase 3	30 Oct 2024

Source Files

Filename	SHA256
TeaStaking.sol	e21f2ff4398c004a52c53f0e26e08202623e453e60721a1f60707a2683e70732
SignatureHandler.sol	fd5e011d999af74ed56d486cd56565c3b3adb21c7a947a39c2f01759203e504b
interfaces/ITeaVesting.sol	fada2cede0083f79f8a58be620e46c32fbe350f5ab46dc9c340007e3cd45190e
interfaces/ITeaStaking.sol	6f344b6a4bc977308d59061177eb922e2f3b8a9613d8421f1722b80488db93d9
interfaces/IStruct.sol	6c461aa9f2e7944000d8e6600db6b78b9eeb78741e7294e06197dc27f3a61bd5

Audit Scope

The staking process heavily depends on the `TeaVesting` contract, as it plays a crucial role not only in determining users' vesting allocations for staking but also in completing the withdrawal functionality. The current contract calls and interacts with the TeaVesting contract to validate vesting amounts and to facilitate the unlocking of rewards during the withdrawal process. Any inaccurate data or malfunction within the TeaVesting contract can halt the correct execution of this contract, potentially leading to blocked withdrawals or incorrect reward calculations. Therefore, it is highly recommended that the team deploy and utilize a TeaVesting contract that has been thoroughly audited to ensure the overall integrity of the system and prevent any disruptions or vulnerabilities in the staking and withdrawal processes.

Overview

The `TeaStaking` contract is designed to manage the staking of Tea tokens and approved presale tokens, allowing users to earn rewards and track their stakes. It facilitates token staking with options for Tea tokens or vested allocations from the TeaVesting contract, enabling users to earn rewards over time. The contract ensures that rewards are distributed according to staking rules and incorporates cooldown periods for Tea token withdrawals, enhancing the security and predictability of the staking process.

Stake Functionality

The `stake` function allows users to stake their Tea tokens or utilize their vested allocations from the TeaVesting contract. Users can stake multiple tokens in a single transaction, provided the token is valid and not already staked. Users reaching a minimum threshold stake amount gain VIP status, which locks their tokens for one year. The function records each stake with a unique ID, updating the total staked tokens and maintaining a detailed record of each user's stakes and relevant information.

Unstake Functionality

The `unstake` function initiates the unstaking process, allowing users to begin withdrawing their staked tokens. Regardless of the token type (Tea tokens or other presale tokens), a two-week cooldown period is applied after unstaking. Once this cooldown period has passed, users can call the `withdraw` function to retrieve their tokens and any accumulated rewards. This cooldown mechanism provides a structured timeline for withdrawals, ensuring that all tokens follow the same waiting period before they can be accessed. The function also updates user-specific staking data and the total staked token count in the contract.

Withdraw Functionality

The `withdraw` function lets users claim their staked tokens and rewards after meeting the claim cooldown requirements. If the user attempts to withdraw tokens before the cooldown period is complete, the function reverts the transaction. During this process, the

function transfers the staked tokens and calculated rewards to the user, updates the contract's staking records, and emits a withdrawal event to notify relevant parties.

Rewards Distribution Functionality

Rewards distribution is managed by the `updateRewardPerShare` function, which calculates and accumulates rewards based on the total staked tokens and the time elapsed. The contract continually updates the rewards per share, ensuring all users receive rewards proportional to their staking amounts and duration. This approach guarantees equitable reward distribution across stakers.

DEFAULT_ADMIN_ROLE Functionalities

The `DEFAULT_ADMIN_ROLE` enables certain administrative privileges, such as initializing staking with a specific allocation and reward distribution start time. The admin can also execute emergency withdrawals of Tea tokens from the contract, excluding staked amounts. This administrative flexibility enhances the contract's overall resilience and maintains security in emergency situations.

Findings Breakdown

Critical	0
Medium	0
Minor / Informative	6

Severity	Unresolved	Acknowledged	Resolved	Other
Critical	0	0	0	0
Medium	0	0	0	0
Minor / Informative	0	6	0	0

Diagnostics

Critical Medium Minor / Informative

Severity	Code	Description	Status
●	IVT	Incorrect Vesting Transfer	Acknowledged
●	MVN	Misleading Variable Naming	Acknowledged
●	ODV	Operator Dependency Vulnerability	Acknowledged
●	PTAI	Potential Transfer Amount Inconsistency	Acknowledged
●	OCTD	Transfers Contract's Tokens	Acknowledged
●	UVC	Unfavorable VIP Conditions	Acknowledged

IVT - Incorrect Vesting Transfer

Criticality	Minor / Informative
Location	TeaStaking.sol#L244
Status	Acknowledged

Description

The contract, during the execution of the `withdraw` function, calls the `transferOwnerOnChain` function of the vesting contract to transfer the ownership of the vesting to the user. However, the usage of the `user` parameter is misleading since it does not align with the actual implementation of the vesting contract. The vesting contract may be designed to transfer ownership to the zero address (`ZERO_ADDRESS`), irrespective of the provided `user` address. This discrepancy indicates that the current code does not reflect the intended functionality and may lead to unexpected behavior or errors in the ownership transfer process.

```
  function withdraw(uint256[] memory _ids) public nonReentrant
{
        address user = _msgSender();

        for (uint256 i = 0; i < _ids.length; i++) {
            ...

ITeaVesting(teaVesting).transferOwnerOnChain(token,
address(this), user);
            }
            ...
            emit Withdrawal(user, token, _availableTokens,
_reward);
        }
    }
```

Recommendation

To enhance clarity and ensure accurate functionality, it's recommended to replace the `user` parameter with the `ZERO_ADDRESS` in the `transferOwnerOnChain` function. This adjustment aligns with the intended behavior of the vesting contract, ensuring

ownership transfer accurately reflects the contract’s purpose and avoids potential inconsistencies or unintended misuse of the function.

Although the current implementation functions correctly, using the `user` parameter is unnecessary and may introduce ambiguity. Replacing it with the `ZERO_ADDRESS` both improves readability and aligns the contract with standard ownership transfer practices.

Team Update

The team has acknowledged that this is not a security issue and states:

In the Vesting contract there is already a check during the ownership transfer, that if this is the user's address, then the next owner is a zero address.

MVN - Misleading Variable Naming

Criticality	Minor / Informative
Location	TeaStaking.sol#L149,260,307
Status	Acknowledged

Description

The contract uses the variable `rewardDebt` within the `stake` function correctly to represent the user's proportional share of accumulated rewards that the contract should deduct from the user, based on their staking amount and the time of the staking. However, in other parts of the contract, such as the `_unstake` function, the same `rewardDebt` variable is used to represent the user's pending rewards to claim, which as a result is misleading. This inconsistency in naming can cause confusion, as `rewardDebt` in the `stake` function is intended to represent a debt or liability of the contract, while in other parts it denotes the user's unclaimed rewards.

```
   function stake(address[] calldata tokens, uint256[] calldata
amounts, OffChainStruct[] calldata offChainData) external {
        ...
            uint256 newId = ++counter;
            stakes[newId] = (
                Stake({
                    vip: _vip,
                    token: _token,
                    stakedTokens: _amount,
                    availableTokens: 0,
                    rewardDebt: _amount * rewardPerShare /
ACCUMULATED_PRECISION,
                    claimCooldown: 0,
                    lockedPeriod: _lockedPeriod
                })
            );
            ...
            }

    function _unstake(uint256[] memory ids, uint256[] calldata
rewardsWithLoyalty) private {
        ...
            userStake.rewardDebt = _proof;
            ...nstaked(user, _id, amount);
        }
    }

    function harvest(uint256 id) public view returns (uint256
reward) {
        Stake storage userStake = stakes[id];
        uint256 accumulatedReward = userStake.stakedTokens *
rewardPerShare / ACCUMULATED_PRECISION;
        return accumulatedReward - userStake.rewardDebt;
    }
```

Recommendation

It is recommended to maintain the current use of `rewardDebt` within the `stake` function as it accurately reflects the users's debt. However, in other parts of the contract where `rewardDebt` is used to denote pending rewards, consider renaming it to `pendingReward` or `unclaimedReward` to better represent its purpose. This will ensure clarity and consistency in the code, reducing the risk of misunderstandings and potential errors during maintenance and auditing.

ODV - Operator Dependency Vulnerability

Criticality	Minor / Informative
Location	TeaStaking.sol#L209,217
Status	Acknowledged

Description

The contract contains the `unstake` function that must be called before the `withdraw` function, allowing users to claim their tokens. However, the `unstake` function requires a signature verification from an operator. If the operator is unable to sign the transaction, due to issues like a backend failure or unavailability, the required signature cannot be obtained, and users will be unable to proceed with unstaking and withdrawing their tokens. This dependency will lock users out of their funds under those conditions.

```
  function unstake(UnstakeParam calldata unstakeParams)
external {
        (bool success, string memory errorReason) =
_verifyUnstakeSignature(_msgSender(), unstakeParams);
        require(success, errorReason);

        _unstake(unstakeParams.ids,
unstakeParams.rewardsWithLoyalty);
    }


    function withdraw(uint256[] memory ids) external
nonReentrant {
        address user = _msgSender();
        uint256 length = ids.length;

       ...

            Stake storage userStake = stakes[_id];
            if (userStake.availableTokens == 0) {
                revert NeedToUnstakeFirst(_id);
            }
            ...
            }
```

Recommendation

It is recommended to include an emergency withdrawal function that allows users to claim their staked amounts without requiring a signature verification in cases where the operator is unavailable. This will ensure that users have a fallback mechanism to access their funds in emergency situations, improving the resilience and reliability of the contract.

Team Update

The team has acknowledged that this is not a security issue and states:

The backend is designed to be highly reliable, ensuring that operator downtime is extremely rare.

PTAI - Potential Transfer Amount Inconsistency

Criticality	Minor / Informative
Location	TeaStaking.sol#L166
Status	Acknowledged

Description

The `safeTransferFrom` function is used to transfer a specified amount of tokens to an address. The fee or tax is an amount that is charged to the sender of an ERC20 token when tokens are transferred to another address. According to the specification, the transferred amount could potentially be less than the expected amount. This may produce inconsistency between the expected and the actual behavior.

The following example depicts the diversion between the expected and actual amount.

Tax	Amount	Expected	Actual
No Tax	100	100	100
10% Tax	100	100	90

```
 function stake(address[] calldata _tokens, uint256[] calldata
_amounts, OffChainStruct calldata _offChain)
        external
    {
        ...
        address user = _msgSender();

        for (uint256 i = 0; i < length; ++i) {
            address _token = tokens[i];
            uint256 _amount = amounts[i];

            if (_amount == 0) revert NoZeroAmount();
            if (!checkTokenValidity(_token)) revert
OnlyValidToken();
            if (_isTeaToken(_token)) {
                teaToken.safeTransferFrom(user, address(this),
_amount);

                totalStakedTea += _amount;
            } else {

            ...

            uint256 newId = ++counter;
            stakes[newId] = (
                Stake({
                    vip: _vip,
                    token: _token,
                    stakedTokens: _amount,
                    availableTokens: 0,
                    rewardDebt: _amount * rewardPerShare /
ACCUMULATED_PRECISION,
                    claimCooldown: 0,
                    lockedPeriod: _lockedPeriod
                })
            );
        ...
```

Recommendation

The team is advised to take into consideration the actual amount that has been transferred instead of the expected.

It is important to note that an ERC20 transfer tax is not a standard feature of the ERC20 specification, and it is not universally implemented by all ERC20 contracts. Therefore, the

contract could produce the actual amount by calculating the difference between the transfer call.

```
Actual Transferred Amount = Balance After Transfer - Balance Before Transfer
```

Team Update

The team has acknowledged that this is not a security issue and states:

The TeaStaking contract was designed to be used with our tokens - TEA and presale tokens. They do not have transfer fees, otherwise the team would have included this logic in the staking process.

OCTD - Transfers Contract's Tokens

Criticality	Minor / Informative
Location	TeaStaking.sol#L140
Status	Acknowledged

Description

The `DEFAULT_ADMIN_ROLE` role has the authority to claim all the balance of the tea tokens on the contract. The `DEFAULT_ADMIN_ROLE` role may take advantage of it by calling the `emergencyWithdraw` function.

```
    function emergencyWithdraw() external {
        _checkRole(DEFAULT_ADMIN_ROLE, msg.sender);
        IERC20(teaToken).safeTransfer(msg.sender,
IERC20(teaToken).balanceOf(address(this)));
    }
```

Recommendation

The team should carefully manage the private keys of the `DEFAULT_ADMIN_ROLE's` account. We strongly recommend a powerful security mechanism that will prevent a single user from accessing the contract admin functions.

Temporary Solutions:

These measurements do not decrease the severity of the finding

- Introduce a time-locker mechanism with a reasonable delay.
- Introduce a multi-signature wallet so that many addresses will confirm the action.
- Introduce a governance model where users will vote about the actions.

Permanent Solution:

- Renouncing the ownership, which will eliminate the threats but it is non-reversible.

Team Update

The team has acknowledged that this is not a security issue and states:

The owner is a multisig contract where the administrators are 3 people and to implement a transaction, at least 2 signatures are needed, which minimizes centralization. This function doesn’t affect the main logic, it was added only for tokens not to be locked in smart-contract by mistake.

UVC - Unfavorable VIP Conditions

Criticality	Minor / Informative
Location	TeaStaking.sol#L149
Status	Acknowledged

Description

The contract assigns VIP status to users who stake an amount greater than or equal to the `VIP_AMOUNT` . However, instead of providing additional benefits or rewards to these VIP users, the contract imposes an additional lock duration of one year on their staked tokens. As a result, users who stake large amounts and attain VIP status will be unable to unstake or withdraw their tokens until the lock period has passed, which could be a disincentive for high-value stakers.

```
    function stake(address[] calldata _tokens, uint256[] calldata
_amounts, OffChainStruct calldata _offChain)
        external
    {
        ...

            bool _vip = false;
            uint256 _lockedPeriod = 0;
            if (_amount >= VIP_AMOUNT) {
                _vip = true;
                _lockedPeriod = block.timestamp + ONE_YEAR;
            }
            ...
            }

    function _unstake(uint256[] memory _ids, uint256[] calldata
_rewardsWithLoyalty) private {
        ...
        address user = _msgSender();

        for (uint256 i = 0; i < _ids.length; i++) {
            ...

            Stake storage userStake = stakes[_id];
            if (userStake.vip && !(block.timestamp > endDate + 30 days))
{
                if (block.timestamp < userStake.lockedPeriod) revert
LockedPeriodNotPassed(_id);
            }
        ...
```

Recommendation

It is recommended to reconsider the design of the VIP status and its associated conditions. Instead of imposing a lengthy lock period, the contract should provide additional rewards or incentives for VIP users, such as higher reward rates or exclusive benefits. This change will make the VIP status more attractive and encourage users to stake larger amounts without the concern of being locked out from their funds for an extended period.

Team Update

The team has acknowledged that this is not a security issue and states:

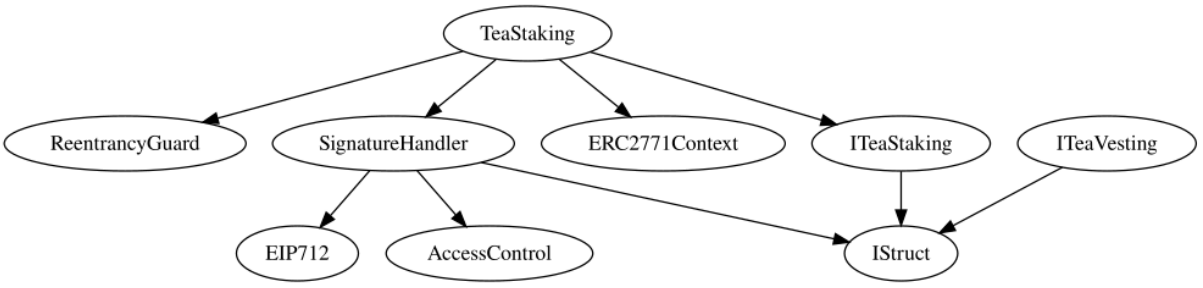
In our system VIP accounts will get discounts on transaction fees and different amount of rewards which will be calculated by our back-end.

Functions Analysis

Contract	Type	Bases		
	Function Name	**Visibility**	**Mutability**	**Modifiers**
TeaStaking	Implementation	ITeaStaking, ReentrancyGuard, SignatureHandler, ERC2771Context		
		Public	✓	ERC2771Context SignatureHandler
	initializeStaking	External	✓	-
	emergencyWithdraw	External	✓	-
	stake	External	✓	-
	unstake	External	✓	-
	withdraw	External	✓	nonReentrant
	getUserIds	Public		-
	harvest	Public		-
	getTotalUserStakedTokens	Public		-
	updateRewardPerShare	Public	✓	-
	checkTokenValidity	Public		-
	_unstake	Private	✓	
	_isIdValid	Private		
	_removeFromSystem	Private	✓	
	_isTeaToken	Private		

	_msgSender	Internal		
	_msgData	Internal		
	_contextSuffixLength	Internal		
SignatureHandler	Implementation	EIP712, AccessControl, IStruct		
		Public	✓	EIP712
	_verifyUnstakeSignature	Internal	✓	
	_verifySignature	Internal	✓	
	hashTypedDataV4	External		-
ITeaStaking	Interface	IStruct		
	stake	External	✓	-
	unstake	External	✓	-
	withdraw	External	✓	-
	getUserIds	External		-
	harvest	External		-
	getTotalUserStakedTokens	External		-

Inheritance Graph



Flow Graph


Legend
Internal Call
External Call
Defined Contract
Undefined Contract
ITeaStaking (iface)
stake
unstake
withdraw
getUserIds
harvest
getTotalUserStakedTokens
updateRewardPerShare
SignatureHandler
<Constructor>
_grantRole
_verifyUnstakeSignature
NoZeroAddress
hasRole
hashTypedDataV4
_verifySignature
_hashTypedDataV4
IStruct (iface)
_hashTypedDataV4
ECDSA
recover
TeaStaking
NoZeroAddress
WrongDecimalNumber
<Constructor>
IERC20Metadata
_grantRole
OnlyValidToken
checkTokenValidity
_isTeaToken
NotEnoughLockedTokens
AddressesMismatch
StakingAlreadyInitialized
NoZeroAmount
initializeStaking
_checkRole
StakingNotActive
stake
InvalidArrayLengths
updateRewardPerShare
LockedPeriodNotPassed
harvest
InvalidCalculationReward
unstake
NothingToUnstake
unstake
_msgSender
_verifyUnstakeSignature
_isIdValid
emergencyWithdraw
InvalidId
getUserIds
NeedToUnstakeFirst
getTotalUserStakedTokens
withdraw
_removeFromSystem
_msgData
ClaimCooldownNotPassed
_contextSuffixLength
ITeaVesting (iface)
getVestingTokens
transferOwnerOfChain
getVestingUsers
transferOwnerOnChain
claim
getUserUnlockReward
IERC20Metadata
decimals
safeTransferFrom
safeTransfer
balanceOf
ERC2771Context
_msgSender
_msgData
_contextSuffixLength

Summary

The Tea-Fi Staking contract facilitates staking and reward distribution for Tea and presale tokens. This audit reviews security vulnerabilities, business logic issues, and potential optimizations to ensure safe and efficient operation. The team has acknowledged the findings.

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Blockchain technology and cryptographic assets present a high level of ongoing risk Cyberscope's position is that each company and individual are responsible for their own due diligence and continuous security Cyberscope's goal is to help reduce the attack vectors and the high level of variance associated with utilizing new and consistently changing technologies and in no way claims any guarantee of security or functionality of the technology we agree to analyze. The assessment services provided by Cyberscope are subject to dependencies and are under continuing development. You agree that your access and/or use including but not limited to any services reports and materials will be at your sole risk on an as-is where-is and as-available basis Cryptographic tokens are emergent technologies and carry with them high levels of technical risk and uncertainty. The assessment reports could include false positives false negatives and other unpredictable results. The services may access and depend upon multiple layers of third parties.

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Cyberscope is one of the leading smart contract audit firms in the crypto space and has built a high-profile network of clients and partners.

The Cyberscope team

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