Cyberscope

Audit Report

Rewardable

October 2024

Address	0x1986Cc18D8eC7574472543l0D2604f85741aA732
Network	BASE
Repository	https://github.com/artiffine-vojtech/rewardable-contracts
Commit	8d7fccd715603efb34170a7f5e44f551676f1a01
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

Repository	https://github.com/artiffine-vojtech/rewardable-contracts
Commit	8d7fccd715603efb34170a7f5e44f551676f1a01

Contract Name	RewardableLZ
Explorer	https://basescan.org/address/0x1986cc18d8ec757447254310d2604f85741aa732
Address	0x1986cc18d8ec757447254310d2604f85741aa732
Network	BASE
Symbol	REWARD
Decimals	18
Total Supply	1,000,000,000

Audit Updates

Initial Audit	16 Oct 2024
Test Deploys	https://sepolia.etherscan.io/address/0x3352f7d515b9f632bef30dcbfbc119aa53041ccf https://sepolia.etherscan.io/address/0x9d825f32affc489022abfed2db3de4cec58e94e2 https://sepolia.etherscan.io/address/0x0bba5be03a5525bd87c1a23a841196ab24dae217 https://sepolia.etherscan.io/address/0x3f19aEdB6845AE846Ab9Dd09a370c6527cB2c924

Source Files

Filename	SHA256
UniV3IncentivesController.sol	4586a275506c94238a134dc7e8221b368344fa2b556f8844788406363b467174
TokenProxy.sol	ff956778f628fefaf3eeb28f27313a6ac2a892f6d2031104c4ac7e1f70740dfe
TokenEmissionsController.sol	f7ccfce92c251bb3d6da7b00657bd215e955a6b57520f0373718d9a0495da5d7
RewardableLZ.sol	cf5150b549a897d13b10c4f4b52fdb9f37543f69b2bf4372db9aec0d684e246d
RewardDistributorV1LZ.sol	1e6403babf50fce2465d2dfef62e02d2448d2f38a17c0f4309ade1da311c5df9
utils/Adminable.sol	dd9b574e06f0b2d79b3790f29af71725f283fd2963e0a451408830dc91bb021a
interfaces/ITokenProxy.sol	1a5e4b837c67f06cdb530795f14cce57a69461cb09a5593e8e0d0a03ab304d49

interfaces/ITokenIncentivesController.sol	bf963104b7eb2732d83c55552b60b843eb5be28b5605b3f727784900292b05c4
interfaces/ITokenEmissionsController.sol	6e1b89b897c4d450981a9267e79c0fdb0da6dd5dc036673606e5843205bff815
interfaces/ITokenControllerCommons.sol	fbceb0c013dd04294f19ce9d775d4fa1298cb2ba052f4dc65a3964d07948430d
interfaces/INonfungiblePositionManager.sol	a63f7f90d44b812e7c3291cc9a678e8577f4ff8d9bdc6e4e80bd9c66a4f3dc6a
interfaces/INFTWithLevel.sol	de00c89d26a022c5ab9e9bfcc5cb4d1068ffe308e5dc6d0ec821165d6a355f93

Overview

Rewardable is a decentralised staking platform designed to facilitate the seamless distribution of rewards for staked tokens and liquidity positions. The protocol's primary functionalities encompass three core smart contracts: the Rewardable token, the TokenEmissionsController and the UniV3IncentivesController.

Rewardable token

The rewardable token is a LayerZero token that supports minting and burning across multiple networks without the need of a bridge.

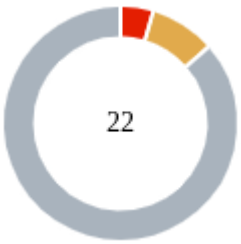
TokenEmissionsController

The TokenEmissionsController is responsible for the staking and distribution of rewards for the tokens in the system. The contract supports distributing rewards in multiple coins. Staked funds remain locked for a minimum of 2 months, with a maximum lock-up period of up to 4 months. Tokens staked for a longer lock-up period benefit from higher rewards. After the lock-up period, users can withdraw their tokens, and the accrued rewards are claimed during the withdrawal process. Additionally, users can claim accumulated rewards without affecting their staked positions.

UniV3IncentivesController

The UniV3IncentivesController is responsible for the handling of staked liquidity positions of a Uniswap V3 pair and the distribution of staking rewards. The contract distributes rewards proportionally to the liquidity of the position. Positions of higher liquidity earn more rewards. Staked positions can be withdrawn from the contract immediately after they are deposited as there is no locking period. Rewards can also be distributed in multiple coins.

Findings Breakdown



Critical	1
Medium	2
Minor / Informative	19

Severity	Unresolved	Acknowledged	Resolved	Other
Critical	1	0	0	0
Medium	2	0	0	0
Minor / Informative	19	0	0	0

Diagnostics

Critical Medium Minor / Informative

Severity	Code	Description	Status
	MAC	Missing Access Control	Unresolved
	ISRP	Inadequate Signature Replay Protection	Unresolved
	PLAM	Potential Liquidity Amount Manipulation	Unresolved
	APW	Admin Privileged Withdrawals	Unresolved
	CCR	Contract Centralization Risk	Unresolved
	IAC	Inadequate Access Control	Unresolved
	IAI	Inadequate Admin Initialization	Unresolved
	ISV	Inadequate Signature Verification	Unresolved
	MCM	Misleading Comment Messages	Unresolved
	MEM	Missing Error Messages	Unresolved
	MSC	Missing Sanity Check	Unresolved
	MTLV	Missing Time Lock Validation	Unresolved
	MU	Modifiers Usage	Unresolved

●	PLTM	Potential Lock Time Manipulation	Unresolved
●	PTAI	Potential Transfer Amount Inconsistency	Unresolved
●	RFD	Redundant Function Declaration	Unresolved
●	RSML	Redundant SafeMath Library	Unresolved
●	SVMC	Signature Validation Missing ChainID	Unresolved
●	TSI	Tokens Sufficiency Insurance	Unresolved
●	L04	Conformance to Solidity Naming Conventions	Unresolved
●	L16	Validate Variable Setters	Unresolved
●	L19	Stable Compiler Version	Unresolved

MAC - Missing Access Control

Criticality	Critical
Location	RewardDistributorV1LZ.sol#L174,216
Status	Unresolved

Description

The contract implements the `createTask` and `topUpTask` functions to initialise and add rewards to a task, respectively. In both cases, the `safeTransferFrom` method is used to transfer an approved allowance of reward tokens from the `_sponsor` address to the contract. Since both functions are public and can be called on behalf of other users, if a user has approved a significant amount of reward tokens to the contract, any third party could potentially call these functions to drain their balance into the contract.

```
function createTask(uint _rewardAmount, address _sponsor) public
returns (uint id) {
    require(_rewardAmount > 0, '_rewardAmount = 0');
    rewardToken.safeTransferFrom(_sponsor, address(this)
    _rewardAmount);
    uint amountAfterFees = _processFees(_rewardAmount);
    taskRewards.push(amountAfterFees);
    id = taskRewards.length - 1;
    emit TaskCreated(id, amountAfterFees, _sponsor);
}
```

```
function topUpTask(uint _rewardAmount, uint _id, address _sponsor)
public {
    require(_rewardAmount > 0, 'Top up amount is 0');
    require(taskRewards.length > _id, 'Task does not exist');
    rewardToken.safeTransferFrom(_sponsor, address(this),
_rewardAmount);
    uint amountAfterFees = _processFees(_rewardAmount);
    taskRewards[_id] += amountAfterFees;
    emit TaskToppedUp(_id, amountAfterFees, _sponsor);
}
```

Recommendation

The team is advised to revise the implementation of the `createTask` and `topUpTask` functions to prevent loss of funds. A permanent solution would involve requiring that the `_sponsor` is the caller of the functions.

ISRP - Inadequate Signature Replay Protection

Criticality	Medium
Location	RewardDistributorV1LZ.sol#L233
Status	Unresolved

Description

The contract uses signature verification to process user requests for withdrawing rewards. The signed data consists of a predefined message, the receiver's address, and the total amount the receiver can withdraw. However, the signature lacks a nonce. A nonce is a unique value used to identify individual transactions, ensuring that each signature is distinct. Without a nonce, previously valid signatures can be replayed, potentially allowing unauthorized withdrawals.

```
(uint totalAmount, bytes32 message, bytes memory signature) =
abi.decode(_data, (uint, bytes32, bytes));
bytes32 expectedMessage = keccak256(abi.encodePacked('\x19Ethereum Signed
Message:\n52', _identity, totalAmount));
require(message == expectedMessage, 'Invalid proof of rewards');
require(message.recover(signature) == tokenAdmin, 'Invalid proof signer');
```

Recommendation

Implementing a nonce in the signature is advised to prevent replay attacks. The contract could include a counter variable within the signature body that increments after each withdrawal request, ensuring that each subsequent request uses a unique nonce.

PLAM - Potential Liquidity Amount Manipulation

Criticality	Medium
Location	UniV3IncentivesController.sol#L109
Status	Unresolved

Description

The contract allows users to deposit liquidity positions for a specific trading pair. To determine the liquidity of a position, the contract calls the `positions` function from the `NonfungiblePositionManager`. The value returned by this function is used to calculate the user's balance for the reward system. However, this method has some limitations due to the non-linear nature of liquidity calculations, which depend on the price range of the position.

Specifically, depositing the same amount of tokens within a narrower price range results in a higher liquidity value compared to a broader range with the same amount. This is in part due to the calculated liquidity being inversely proportional to the expression `sqrt(Pu)-sqrt(Pl)`, where `Pu` is the upper price limit and `Pl` is the lower price limit of the position.

Therefore, interpreting liquidity as an absolute number allows smaller positions concentrated in a narrower price range to appear more significant than larger positions spread over a wider range. This effectively incentivizes users to divide their funds into multiple smaller positions within narrow ranges and deposit them into the contract. By following this strategy, a user may accumulate enough liquidity to claim the majority of the rewards. Consequently, it becomes possible to withdraw a disproportionately large amount of rewards from relatively smaller positions.

```
function deposit(uint[] calldata _nftIds) external {
    updateReward(msg.sender, rewardTokens);
    uint length = _nftIds.length;
    for (uint i = 0; i < length; i++) {
    uint nftId = _nftIds[i];
    (
    ,
    ,
    address _token0,
    address _token1,
    ,
    int24 _tickLower,
    int24 _tickUpper,
    uint128 liquidity,
    ,
    ,
    ,
    ) = INonfungiblePositionManager(address(nft)).positions(nftId);
    require(posConfig.tickLower <= _tickLower, 'Invalid lower
tick');
    require(posConfig.tickUpper >= _tickUpper, 'Invalid upper
tick');
    require(posConfig.token0 == _token0, 'Invalid token0');
    require(posConfig.token1 == _token1, 'Invalid token1');
    require(liquidity > 0, 'Invalid liquidity');
    positions[msg.sender].add(nftId);
    nftLiquidity[nftId] = liquidity;
    userLiquidity[msg.sender] += liquidity;
    totalLiquidity += liquidity;
    nft.safeTransferFrom(msg.sender, address(this), nftId);
    emit Deposited(msg.sender, nftId, liquidity);
    }
}
```

Recommendation

The team is advised to revise the implementation of the reward mechanism in the UniV3IncentivesController contract. Using a position's liquidity as a record of the staked balance is prone to errors and may lead to several potential threats, including price manipulation. Implementing restrictions on the tick range is also not a viable solution, as users could still provide liquidity on a single tick within that range. An alternative approach would be to require users to provide their liquidity through the contract, ensuring proper control over the price distribution.

APW - Admin Privileged Withdrawals

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L117
Status	Unresolved

Description

The `withdraw` function in the staking contract allows the `withdrawingAdmin` to withdraw staked tokens on behalf of any staker after the expiration of the locking period. This functionality can be exploited if the `withdrawingAdmin` account is compromised or misused.

```
function withdraw(uint _amount, address _onBehalfOf) external {
    require(msg.sender == _onBehalfOf || msg.sender ==
withdrawingAdmin, 'Not withdrawing admin');
    require(userLockTime[_onBehalfOf] <= block.timestamp,
'Locked');
    Balances storage bal = balances[_onBehalfOf];
    require(_amount <= bal.staked, 'Amount greater than staked');
    _updateReward(_onBehalfOf, rewardTokens);
    if (msg.sender == _onBehalfOf) {
        _getReward(rewardTokens);
    }
    uint scaled = _amount.mul(bal.lockBoost).div(10);
    if (bal.boosted) {
        uint multiplier = _getMultiplier(bal.nftId);
        scaled = scaled.mul(multiplier).div(10);
    }
    if (_amount == bal.staked) {
        scaled = bal.scaled;
        bal.lockBoost = 0;
    }
    bal.staked = bal.staked.sub(_amount);
    bal.lockScaled = bal.staked.mul(bal.lockBoost).div(10);
    bal.scaled = bal.scaled.sub(scaled);
    totalScaled = totalScaled.sub(scaled);
    stakingToken.safeTransfer(msg.sender, _amount);
    emit Withdrawn(_onBehalfOf, _amount, scaled);
}
```

Recommendation

To mitigate this issue, the privilege of the withdrawingAdmin should be restricted to prevent unauthorized withdrawals. Consider implementing a multisignature (multisig) mechanism where multiple trusted parties must approve an action. Additionally, role-based access control could be used to segregate duties and limit the scope of administrative actions.

CCR - Contract Centralization Risk

Criticality	Minor / Informative
Location	UniV3IncentivesController.sol#L214,223 RewardDistributorV1LZ.sol#L233,288,297,306,316,326,330,336,345,358,383,385 TokenEmissionsController.sol#L94,117,223,232
Status	Unresolved

Description

The contract's functionality and behavior are heavily dependent on external parameters or configurations. While external configuration can offer flexibility, it also poses several centralization risks that warrant attention. Centralization risks arising from the dependence on external configuration include Single Point of Control, Vulnerability to Attacks, Operational Delays, Trust Dependencies, and Decentralization Erosion.

```
function deposit(uint _amount, address _onBehalfOf, LockTime _lock)
external {}
function withdraw(uint _amount, address _onBehalfOf) external {}
function addReward(address _rewardToken) external onlyAdmin {}
function notifyReward(address[] calldata _rewardTokens, uint[]
calldata _amounts, uint _rewardsDuration) external onlyAdmin {}
function setTokenAdmin(address _tokenAdmin) external onlyOwner {}
function setFeeReceiver(address _feeReceiver) external onlyOwner {}
function setBurnFee(uint _burnFee) external onlyOwner {}
function setPlatformFee(uint _platformFee) external onlyOwner {}
function setMaxDailyWithdrawal(uint _maxDailyWithdrawal) external
onlyOwner {}
function setMinWithdrawalAmount(uint _minWithdrawalAmount) external
onlyOwner {}
function recoverFees(uint _recoverAmount, address _recipient)
external onlyOwner {}
function burnFees(uint _burnAmount) external onlyOwner {}
function _processFees(uint _amount) internal returns (uint
amountAfterFees) {}
function _authorizeUpgrade(address) internal override onlyOwner {}
function withdrawRewards(
    address _identity,
    uint _amount,
    bytes calldata _data,
    LZSendParam calldata _lzSendParam
) external payable {}
```

Recommendation

To address this finding and mitigate centralization risks, it is recommended to evaluate the feasibility of migrating critical configurations and functionality into the contract's codebase itself. This approach would reduce external dependencies and enhance the contract's self-sufficiency. It is essential to carefully weigh the trade-offs between external configuration flexibility and the risks associated with centralization.

IAC - Inadequate Access Control

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L71
Status	Unresolved

Description

The contract implements the `startEmissions` function that initializes the distribution parameters for the first reward token. Although this function is marked with the external modifier, it should only be callable by the contract's admin. If the `emissions` array is initialized, the function cannot be called again, potentially resulting in the loss of a major functionality of the contract.

```
function startEmissions(EmissionPoint[] memory _emissions) external
{
    require(emissions.length == 0, 'Emissions already started');
    require(_emissions.length > 0, 'No emissions');
    uint256 length = _emissions.length;
    uint256 emissionsSum;
    for (uint256 i = 0; i < length; i++) {
        require(_emissions[i].duration > 0 && _emissions[i].amount
> 0, 'Invalid emission');
        emissionsSum += _emissions[i].amount;
        emissions.push(_emissions[i]);
    }
    emissionsStart = block.timestamp;
    IERC20(rewardTokens[0]).safeTransferFrom(msg.sender,
address(this), emissionsSum);
    _setRewardsDuration(emissions[currentEmissionsIndex].duration);
    Reward storage r = rewardData[rewardTokens[0]];
    r.balance = emissions[currentEmissionsIndex].amount;
    _notifyReward(rewardTokens[0],
emissions[currentEmissionsIndex].amount, rewardsDuration);
}
```

Recommendation

The team is advised to implement the proper access controls to the `startEmissions` function restricting access only to the admin account.

IAI - Inadequate Admin Initialization

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L65,94,117 TokenProxy.sol#L26,37
Status	Unresolved

Description

The TokenEmissionsController contract allows a withdrawingAdmin to execute deposit and withdrawal requests on behalf of a user. Such requests can also be initiated by the TokenProxy contract through its respective functions. If however the TokenProxy contract is not designated as the withdrawingAdmin of the TokenEmissionsController, all such requests will fail.

```
function deposit(uint _amount, address _onBehalfOf, LockTime _lock)
external {
require(msg.sender == _onBehalfOf || msg.sender ==
withdrawingAdmin, 'Not withdrawing admin');
...
}

function withdraw(uint _amount, address _onBehalfOf) external {
require(msg.sender == _onBehalfOf || msg.sender ==
withdrawingAdmin, 'Not withdrawing admin');
...
}
```

```
function deposit(uint _amount, ITokenEmissionsController.LockTime
_lock) external {
proxiedToken.safeTransferFrom(msg.sender, address(this), _amount);
_mint(address(this), _amount);
_approve(address(this), address(controller), _amount);
controller.deposit(_amount, msg.sender, _lock);
}

function withdraw(uint _amount) external {
controller.withdraw(_amount, msg.sender);
_burn(address(this), _amount);
proxiedToken.safeTransfer(msg.sender, _amount);
}
```

Recommendation

The team needs to ensure the TokenProxy contract is set as the withdrawingAdmin of the TokenEmissionsController to guarantee proper execution.

ISV - Inadequate Signature Verification

Criticality	Minor / Informative
Location	RewardDistributorV1LZ.sol#L233
Status	Unresolved

Description

The contract implements a signature verification process within the `withdrawRewards` function, which is designed to authenticate transactions based on digital signatures. The contract's logic validates the signature by comparing the extracted message with an expected message. However, the latter is formed from the data of the signature and the arguments passed by the user when the function is called. Since both elements of the comparison are user dependent variables, this approach introduces a security risk, as it inherently trusts the input of the user without independent verification.

```
(uint totalAmount, bytes32 message, bytes memory signature) =
abi.decode(_data, (uint, bytes32, bytes));
bytes32 expectedMessage = keccak256(abi.encodePacked('\x19Ethereum
Signed Message:\n52', _identity, totalAmount));
require(message == expectedMessage, 'Invalid proof of rewards');
```

Recommendation

To enhance the security of the signature verification process, the expected message should be separated from user input. It is recommended to use additional validation mechanisms to ensure the message's authenticity before performing signature comparison. In this specific implementation, validating that the signer of the message is the tokenAdmin before message validation could prevent counterfeit signatures from bypassing a conditional statement.

MCM - Misleading Comment Messages

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L228 UniV3IncentivesController.sol#L219
Status	Unresolved

Description

The contract is using misleading comment messages. These comment messages do not accurately reflect the actual implementation, making it difficult to understand the source code. As a result, the users will not comprehend the source code's actual implementation.

```
/**
* Add reward tokens for distribution over next 7 days.
```

Recommendation

The team is advised to carefully review the comment in order to reflect the actual implementation. To improve code readability, the team should use more specific and descriptive comment messages.

MEM - Missing Error Messages

Criticality	Minor / Informative
Location	UniV3IncentivesController.sol#L278 TokenEmissionsController.sol#L300
Status	Unresolved

Description

The contract is missing error messages. Specifically, there are no error messages to accurately reflect the problem, making it difficult to identify and fix the issue. As a result, the users will not be able to find the root cause of the error.

```
require(rewardData[_rewardToken].lastUpdateTime == 0);
```

Recommendation

The team is suggested to provide a descriptive message to the errors. This message can be used to provide additional context about the error that occurred or to explain why the contract execution was halted. This can be useful for debugging and for providing more information to users that interact with the contract.

MSC - Missing Sanity Check

Criticality	Minor / Informative
Location	RewardDistributorV1LZ.sol#L330,339
Status	Unresolved

Description

The contract does not properly check for the validity of the addresses provided by the owner. If the addresses are not properly sanitized, the contract will not function as intended.

```
function setTokenAdmin(address _tokenAdmin) external onlyOwner {}

function setFeeReceiver(address _feeReceiver) external onlyOwner {}
```

Recommendation

It is recommended that the contracts implement proper sanity check to ensure that parameters addresses are correct. By adding a verification process, the contract can ensure that the contract will function as intended.

MTLV - Missing Time Lock Validation

Criticality	Minor / Informative
Location	UniV3IncentivesController.sol#L109
Status	Unresolved

Description

The contract implements a staking mechanism that distributes rewards to staked positions based on their liquidity. Currently, the implementation allows new positions to be accepted without a lock-up period, enabling them to be withdrawn immediately after submission, potentially within the same block. This enables attempts to manipulate the internal state of the contract without depositing funds.

```
function deposit(uint[] calldata _nftIds) external {
    updateReward(msg.sender, rewardTokens);
    uint length = _nftIds.length;
    for (uint i = 0; i < length; i++) {
    uint nftId = _nftIds[i];
    (
    ,
    ,
    address _token0,
    address _token1,
    ,
    int24 _tickLower,
    int24 _tickUpper,
    uint128 liquidity,
    ,
    ,
    ,
    ) = INonfungiblePositionManager(address(nft)).positions(nftId);
    require(posConfig.tickLower <= _tickLower, 'Invalid lower
tick');
    require(posConfig.tickUpper >= _tickUpper, 'Invalid upper
tick');
    require(posConfig.token0 == _token0, 'Invalid token0');
    require(posConfig.token1 == _token1, 'Invalid token1');
    require(liquidity > 0, 'Invalid liquidity');
    positions[msg.sender].add(nftId);
    nftLiquidity[nftId] = liquidity;
    userLiquidity[msg.sender] += liquidity;
    totalLiquidity += liquidity;
    nft.safeTransferFrom(msg.sender, address(this), nftId);
    emit Deposited(msg.sender, nftId, liquidity);
    }
}
```

Recommendation

The team is advised to implement a locking period for the deposited positions. This will prevent threads that could target price and parameter manipulation.

MU - Modifiers Usage

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L95,118
Status	Unresolved

Description

The contract is using repetitive statements on some methods to validate some preconditions. In Solidity, the form of preconditions is usually represented by the modifiers. Modifiers allow you to define a piece of code that can be reused across multiple functions within a contract. This can be particularly useful when you have several functions that require the same checks to be performed before executing the logic within the function.

```
require(msg.sender == _onBehalfOf || msg.sender ==
withdrawingAdmin, 'Not withdrawing admin');
```

Recommendation

The team is advised to use modifiers since it is a useful tool for reducing code duplication and improving the readability of smart contracts. By using modifiers to perform these checks, it reduces the amount of code that is needed to write, which can make the smart contract more efficient and easier to maintain.

PLTM - Potential Lock Time Manipulation

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L94
Status	Unresolved

Description

The contract implements a timelock mechanism for new deposits, where the `userLockTime` mapping stores a lock period for each user. Users can withdraw their staked funds and earn rewards only after the specified lock period. The rewards are proportional to the duration the funds are locked, with longer lock periods yielding higher rewards. The contract offers three specific locking periods: 60, 90, and 120 days.

A potential issue arises when a user deposits a large amount of tokens and selects the longest lock period to maximise their rewards. If the user subsequently makes a smaller deposit with the shortest lock period, the lock time for both deposits is reset to the shortest period. This allows the user to withdraw all their tokens at an earlier time. However, the user can claim rewards from the initial deposit until the moment of the second stake, boosted with the largest multiplier. This multiplier was however intended for tokens that remain in the contract for the longest period.

For instance, a user might initially commit a large deposit with a 4-month locking period. At the end of the first month, they make a second deposit with a 2-month locking period. This allows them to withdraw all tokens after just 2 months from the second deposit. Along with these tokens, they also withdraw rewards earned during the first month with the highest multiplier. These rewards were intended for stakes that would remain in the system for at least 4 months, thus contradicting the intended behaviour of the contract.

```
function deposit(uint _amount, address _onBehalfOf, LockTime _lock)
external {
    ...
    userLockTime[_onBehalfOf] = block.timestamp.add(60
days).add(uint256(_lock).mul(30 days));
    stakingToken.safeTransferFrom(msg.sender, address(this),
_amount);
    emit Deposited(_onBehalfOf, _amount, scaled);
}
```

Recommendation

The team is advised to revise the implementation of the deposit and withdraw functions. Specifically, it is suggested to prevent users from resetting the `userLockTime` to a lower time frame than the currently defined.

PTAI - Potential Transfer Amount Inconsistency

Criticality	Minor / Informative
Location	TokenProxy.sol#L26,37
Status	Unresolved

Description

The contract implements the `deposit` and `withdraw` functions that allow external users to interact with the `TokenEmissionsController` through the `TokenProxy` contract. As part of these functions, ERC20 tokens are minted and burned in the same amount as the tokens requested. However, the contract fails to verify whether fees are applied during the transfer. In that case, the `TokenProxy` contract will mistakenly assume an amount different than the one received.

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 deposit(uint _amount, ITokenEmissionsController.LockTime
_lock) external {
    proxiedToken.safeTransferFrom(msg.sender, address(this),
_amount);
    _mint(address(this), _amount);
    _approve(address(this), address(controller), _amount);
    controller.deposit(_amount, msg.sender, _lock);
}

function withdraw(uint _amount) external {
    controller.withdraw(_amount, msg.sender);
    _burn(address(this), _amount);
    proxiedToken.safeTransfer(msg.sender, _amount);
}
```

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`

RFD - Redundant Function Declaration

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L146,165,352
Status	Unresolved

Description

The contract contains functions with no scope or functions that are never executed. Implementing such functions hinders the overall complexity and readability. In particular, the `stakeNFT` and `unstakeNFT` functions have commented-out code and the execution of the `_getMultiplier` function is never reached.

```
function stakeNFT(uint _tokenId) external {}
function unstakeNFT() external {}
function _getMultiplier(uint256 _tokenId) internal view returns
(uint256) {
uint256 level = boosterNFT.getLevelOfTokenById(_tokenId);

        if (level == 0) {
            // Diamond
            return 15; // 1.5 * SCALING_FACTOR
        } else if (level == 1) {
            // Platinum
            return 14; // 1.4 * SCALING_FACTOR
        } else if (level == 2) {
            // Gold
            return 13; // 1.3 * SCALING_FACTOR
        } else if (level == 3) {
            // Silver
            return 12; // 1.2 * SCALING_FACTOR
        } else if (level == 4) {
            // Bronze
            return 11; // 1.1 * SCALING_FACTOR
        } else {
            revert('Invalid token level');
        }
}
```

Recommendation

Functions with no scope or unreachable execution should be removed from the code base to improve the efficiency and readability of the contract.

RSML - Redundant SafeMath Library

Criticality	Minor / Informative
Location	TokenEmissionsController.sol
Status	Unresolved

Description

SafeMath is a popular Solidity library that provides a set of functions for performing common arithmetic operations in a way that is resistant to integer overflows and underflows.

Starting with Solidity versions that are greater than or equal to 0.8.0, the arithmetic operations revert to underflow and overflow. As a result, the native functionality of the Solidity operations replaces the SafeMath library. Hence, the usage of the SafeMath library adds complexity, overhead and increases gas consumption unnecessarily in cases where the explanatory error message is not used.

```
library SafeMath {...}
```

Recommendation

The team is advised to remove the SafeMath library in cases where the revert error message is not used. Since the version of the contract is greater than `0.8.0` then the pure Solidity arithmetic operations produce the same result.

If the previous functionality is required, then the contract could exploit the `unchecked { ... }` statement.

Read more about the breaking change on https://docs.soliditylang.org/en/stable/080-breaking-changes.html#solidity-v0-8-0-breaking-changes.

SVMC - Signature Validation Missing ChainID

Criticality	Minor / Informative
Location	RewardDistributorV1LZ.sol#L233
Status	Unresolved

Description

The contract's `withdrawRewards` function is designed to validate off-chain signatures for operations involving token transfers between addresses. However, the function does not include the `chainId` as part of the parameters in the signature verification process. While the use of a nonce can prevent replay attacks within the same network by ensuring each signature is unique for a particular transaction, it does not safeguard against replay attacks across different networks. Without the inclusion of `chainId`, a legitimate signature on one blockchain could be maliciously reused on another chain, potentially resulting in unintended or unauthorized token transfers, thus exposing the contract to cross-network vulnerabilities.

```
function withdrawRewards(
    address _identity,
    uint _amount,
    bytes calldata _data,
    LZSendParam calldata _lzSendParam
    ) external payable {
    // Validate proof of withdrawal
    (uint totalAmount, bytes32 message, bytes memory signature) =
abi.decode(_data, (uint, bytes32, bytes));
    bytes32 expectedMessage =
keccak256(abi.encodePacked('\x19Ethereum Signed Message:\n52',
_identity, totalAmount));
    require(message == expectedMessage, 'Invalid proof of
rewards');
    require(message.recover(signature) == tokenAdmin, 'Invalid
proof signer');

    ...
}
```

Recommendation

It is recommended to incorporate the `chainId` in the signature verification process by including it in the parameters hashed during the signature construction. By doing so, the signatures will be explicitly tied to a specific network, effectively preventing them from being reused across different chains.

TSI - Tokens Sufficiency Insurance

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L223,232 UniV3IncentivesController.sol#L214,223
Status	Unresolved

Description

The owner can call the `addReward` function to include a new token in the reward mechanism. However, this does not ensure that the contract holds the necessary funds to distribute the rewards. The owner must also call the `notifyReward` function to deposit the rewards. If the rewards for an initialised reward token are not present, it could lead to transaction failures.

```
function addReward(address _rewardToken) external onlyAdmin {
        _addReward(_rewardToken);
}
```

```
function notifyReward(address[] calldata _rewardTokens, uint[]
calldata _amounts, uint _rewardsDuration) external onlyAdmin {
        require(_rewardsDuration > 0, 'Duration is zero');
        require(_rewardTokens.length == _amounts.length, 'Invalid
input');
        _updateReward(address(this), _rewardTokens);
        uint length = _rewardTokens.length;
        for (uint i; i < length; i++) {
            address token = _rewardTokens[i];
            if (token == rewardTokens[0]) continue;
            Reward storage r = rewardData[token];
            require(r.periodFinish > 0, 'Unknown reward token');
            IERC20(token).safeTransferFrom(msg.sender,
address(this), _amounts[i]);
            uint unseen =
IERC20(token).balanceOf(address(this)).sub(r.balance);
            _notifyReward(token, unseen, _rewardsDuration);
            r.balance = r.balance.add(unseen);
        }
}
```

Recommendation

It is recommended to consider implementing a more decentralized and automated approach for handling the contract tokens. One possible solution is to deposit the tokens by calling the notifyReward function at the time of the creation. If the contract guarantees the process it can enhance its reliability, security, and participant trust, ultimately leading to a more successful and efficient process.

L04 - Conformance to Solidity Naming Conventions

Criticality	Minor / Informative
Location	UniV3IncentivesController.sol#L109,142,159,170,185,194,207,214,223 TokenProxy.sol#L26,37,44 TokenEmissionsController.sol#L71,94,117,183,196,204,223,232 RewardDistributorV1LZ.sol#L116,117,118,119,120,121,122,123,156,157,158,159,160,161,162,174,196,197,198,199,200,201,202,203,216,234,235,236,237,293,294,295,330,339,348,358,368,378,387,400
Status	Unresolved

Description

The Solidity style guide is a set of guidelines for writing clean and consistent Solidity code. Adhering to a style guide can help improve the readability and maintainability of the Solidity code, making it easier for others to understand and work with.

The followings are a few key points from the Solidity style guide:

1. Use camelCase for function and variable names, with the first letter in lowercase (e.g., myVariable, updateCounter).
2. Use PascalCase for contract, struct, and enum names, with the first letter in uppercase (e.g., MyContract, UserStruct, ErrorEnum).
3. Use uppercase for constant variables and enums (e.g., MAX_VALUE, ERROR_CODE).
4. Use indentation to improve readability and structure.
5. Use spaces between operators and after commas.
6. Use comments to explain the purpose and behavior of the code.
7. Keep lines short (around 120 characters) to improve readability.

```
uint[] calldata _nftIds
address[] calldata _rewardTokens
address _account
address _rewardsToken
int24 _tickLower
int24 _tickUpper
address _rewardToken
uint _rewardsDuration
uint[] calldata _amounts
ITokenEmissionsController.LockTime _lock
uint _amount
address _controller
EmissionPoint[] memory _emissions
address _onBehalfOf

...
```

Recommendation

By following the Solidity naming convention guidelines, the codebase increased the readability, maintainability, and makes it easier to work with.

Find more information on the Solidity documentation https://docs.soliditylang.org/en/stable/style-guide.html#naming-conventions.

L16 - Validate Variable Setters

Criticality	Minor / Informative
Location	TokenEmissionsController.sol#L65 RewardDistributorV1LZ.sol#L131,132,331,340
Status	Unresolved

Description

The contract performs operations on variables that have been configured on user-supplied input. These variables are missing of proper check for the case where a value is zero. This can lead to problems when the contract is executed, as certain actions may not be properly handled when the value is zero.

```
withdrawingAdmin = _withdrawingAdmin
tokenAdmin = _tokenAdmin
feeReceiver = _feeReceiver
```

Recommendation

By adding the proper check, the contract will not allow the variables to be configured with zero value. This will ensure that the contract can handle all possible input values and avoid unexpected behavior or errors. Hence, it can help to prevent the contract from being exploited or operating unexpectedly.

L19 - Stable Compiler Version

Criticality	Minor / Informative
Location	interfaces/ITokenProxy.sol#L3
Status	Unresolved

Description

The `^` symbol indicates that any version of Solidity that is compatible with the specified version (i.e., any version that is a higher minor or patch version) can be used to compile the contract. The version lock is a mechanism that allows the author to specify a minimum version of the Solidity compiler that must be used to compile the contract code. This is useful because it ensures that the contract will be compiled using a version of the compiler that is known to be compatible with the code.

```
pragma solidity ^0.8.22;
```

Recommendation

The team is advised to lock the pragma to ensure the stability of the codebase. The locked pragma version ensures that the contract will not be deployed with an unexpected version. An unexpected version may produce vulnerabilities and undiscovered bugs. The compiler should be configured to the lowest version that provides all the required functionality for the codebase. As a result, the project will be compiled in a well-tested LTS (Long Term Support) environment.

Functions Analysis

Contract	Type	Bases		
	Function Name	**Visibility**	**Mutability**	**Modifiers**
UniV3IncentivesController	Implementation	ERC721Holder, Adminable		
		Public	✓	Ownable
	deposit	External	✓	-
	withdraw	External	✓	-
	getReward	External	✓	-
	getAllUserNfts	External		-
	lastTimeRewardApplicable	Public		-
	claimableRewards	External		-
	changePositionRanges	External	✓	onlyOwner
	addReward	External	✓	onlyAdmin
	notifyReward	External	✓	onlyAdmin
	_getReward	Internal	✓	
	_rewardPerToken	Internal		
	_earned	Internal		
	_addReward	Internal	✓	
	_notifyReward	Internal	✓	
	_updateReward	Internal	✓	
TokenProxy	Implementation	ERC20, Ownable, ITokenProxy		

		Public	✓	ERC20
	deposit	External	✓	-
	withdraw	External	✓	-
	setController	External	✓	onlyOwner
TokenEmissionsController	Implementation	ITokenEmissionsController, Adminable		
		Public	✓	Adminable Ownable
	startEmissions	External	✓	-
	deposit	External	✓	-
	withdraw	External	✓	-
	stakeNFT	External	✓	-
	unstakeNFT	External	✓	-
	getReward	External	✓	-
	lastTimeRewardApplicable	Public		-
	claimableRewards	External		-
	addReward	External	✓	onlyAdmin
	notifyReward	External	✓	onlyAdmin
	_setRewardsDuration	Internal	✓	
	_getReward	Internal	✓	
	_rewardPerToken	Internal		
	_earned	Internal		
	_addReward	Internal	✓	
	_notifyReward	Internal	✓	
	_updateReward	Internal	✓	

	_getMultiplier	Internal		
RewardableLZ	Implementation	OFT, ERC20Permit, ERC20Burnable		
		Public	✓	OFT ERC20Permit Ownable
IOFTEndpointGetter	Interface			
	endpoint	External		-
RewardDistributorV1LZ	Implementation	UUPSUpgradeable, OwnableUpgradeable		
		Public	✓	-
	initialize	Public	✓	initializer
	createTaskWithPermit	External	✓	-
	createTask	Public	✓	-
	topUpTaskWithPermit	External	✓	-
	topUpTask	Public	✓	-
	withdrawRewards	External	Payable	-
	quoteSend	External		-
	getSameChainLZSendParam	External		-
	setTokenAdmin	External	✓	onlyOwner
	setFeeReceiver	External	✓	onlyOwner
	setBurnFee	External	✓	onlyOwner

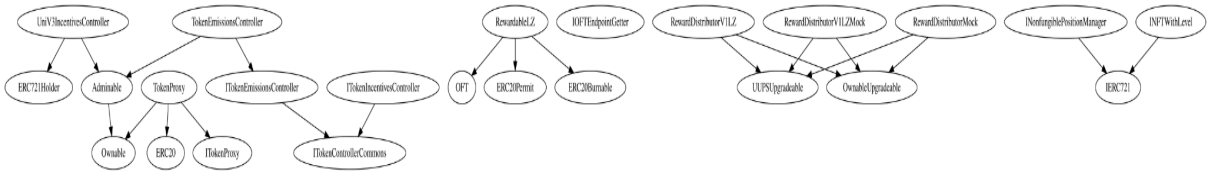
	setPlatformFee	External	✓	onlyOwner
	setMaxDailyWithdrawal	External	✓	onlyOwner
	setMinWithdrawalAmount	External	✓	onlyOwner
	burnFees	External	✓	onlyOwner
	recoverFees	External	✓	onlyOwner
	_processFees	Internal	✓	
	_authorizeUpgrade	Internal	✓	onlyOwner
	_addressToBytes32	Internal		
Adminable	Implementation	Ownable		
	_checkAdmin	Internal		
	addAdmin	External	✓	onlyOwner
	removeAdmin	External	✓	onlyOwner
	isAdmin	External		-
IOFTEndpointGetter	Interface			
	endpoint	External		-
RewardDistributorV1LZMock	Implementation	UUPSUpgradeable, OwnableUpgradeable		
		Public	✓	-
	initialize	Public	✓	initializer
	createTaskWithPermit	External	✓	-
	createTask	Public	✓	-

	topUpTaskWithPermit	External	✓	-
	topUpTask	Public	✓	-
	withdrawRewards	External	Payable	-
	quoteSend	External		-
	getSameChainLZSendParam	External		-
	setTokenAdmin	External	✓	onlyOwner
	setFeeReceiver	External	✓	onlyOwner
	setBurnFee	External	✓	onlyOwner
	setPlatformFee	External	✓	onlyOwner
	setMaxDailyWithdrawal	External	✓	onlyOwner
	addToTest	External	✓	onlyOwner
	setMinWithdrawalAmount	External	✓	onlyOwner
	burnFees	External	✓	onlyOwner
	_processFees	Internal	✓	
	_authorizeUpgrade	Internal	✓	onlyOwner
	_addressToBytes32	Internal		
RewardDistributorMock	Implementation	UUPSUpgradeable, OwnableUpgradeable		
		Public	✓	-
	initialize	Public	✓	initializer
	createTaskWithPermit	External	✓	-
	createTask	Public	✓	-
	topUpTaskWithPermit	External	✓	-
	topUpTask	Public	✓	-

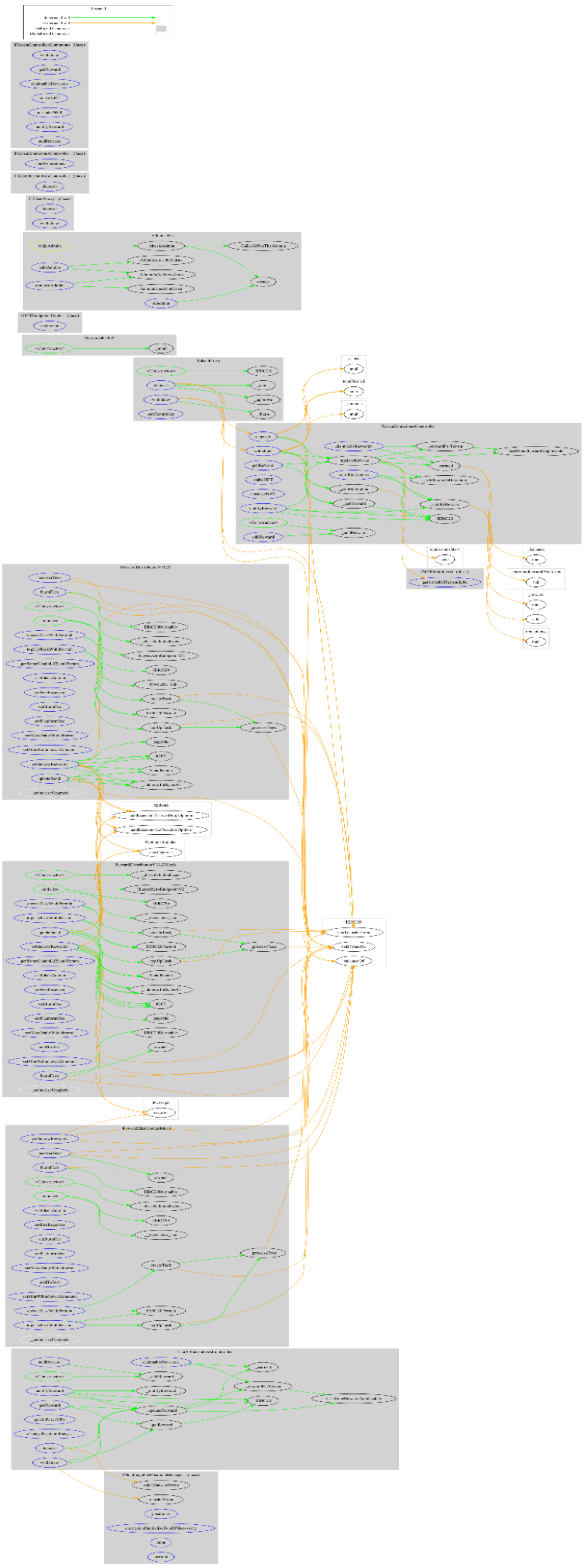
	withdrawRewards	External	✓	-
	setTokenAdmin	External	✓	onlyOwner
	setFeeReceiver	External	✓	onlyOwner
	setBurnFee	External	✓	onlyOwner
	setPlatformFee	External	✓	onlyOwner
	setMaxDailyWithdrawal	External	✓	onlyOwner
	addToTest	External	✓	onlyOwner
	setMinWithdrawalAmount	External	✓	onlyOwner
	burnFees	External	✓	onlyOwner
	recoverFees	External	✓	onlyOwner
	_processFees	Internal	✓	
	_authorizeUpgrade	Internal	✓	onlyOwner
ITokenProxy	Interface			
	deposit	External	✓	-
	withdraw	External	✓	-
ITokenIncentivesController	Interface	ITokenControllerCommons		
	deposit	External	✓	-
ITokenEmissionsController	Interface	ITokenControllerCommons		
	deposit	External	✓	-
	startEmissions	External	✓	-

ITokenControlle rCommons	Interface			
	withdraw	External	✓	-
	getReward	External	✓	-
	claimableRewards	External		-
	stakeNFT	External	✓	-
	unstakeNFT	External	✓	-
	notifyReward	External	✓	-
	addReward	External	✓	-
INonfungiblePo sitionManager	Interface	IERC721		
	positions	External		-
	createAndInitializePoolIfNecessary	External	✓	-
	mint	External	Payable	-
	permit	External	Payable	-
INFTWithLevel	Interface	IERC721		
	getLevelOfTokenById	External		-

Inheritance Graph



Flow Graph



Summary

Rewardable is an interesting project that has a friendly and growing community. Its contracts implement a staking mechanism with automated reward distribution. The Smart Contract analysis reported no compiler error or critical issues. This audit investigates security issues, business logic concerns and potential improvements.

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The Cyberscope team

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