Security Assessment

ShibaSwap

Jul 9th, 2021
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Disclaimer

About
Summary

This report has been prepared for Shiba to discover issues and vulnerabilities in the source code of the ShibaSwap 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 given they are currently missing in the repository;
- Provide more comments per each function for readability, especially contracts are verified in public;
- Provide more transparency on privileged activities once the protocol is live.
Overview

Project Summary

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<tr>
<th>Project Name</th>
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<tr>
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<td>Language</td>
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Audit Summary

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Key Components

Vulnerability Summary

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## Audit Scope

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<th>File</th>
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ShibaSwap Overview

The ShibaSwap Protocol is a part of Shiba token’s decentralized ecosystem. It develops staking, distribution, and swapping features for the ecosystem.

The staking system is mainly implemented by the contracts:

- BoneToken.sol
- BuryBone.sol
- BuryLeash.sol
- BuryShib.sol

A new token, BONE, is introduced in the system. Users can deposit their BONE/LEASH/SHIB tokens to these contracts and get corresponding tBONE/xLEASH/xSHIB.

The distribution system is mainly implemented by the contracts:

- BoneLocker.sol
- DevBoneDistributor.sol
- MultiTokenLocker.sol
- TopDog.sol
- merkleDistributors/XXXMerkleDistributor.sol

Some of the rewards will be sent to the locking contract BoneLocker. These rewards will not be withdrawable until reaching the end of the locking period. Other rewards will be distributed directly to dev and user accounts.

The swapping system is mainly implemented by the contracts:

- Migrator.sol
- ShibaSushiFetch.sol
- ShibaUniFetch.sol
- TreasureFinder.sol
- uniswappv2/UniswapV2ERC20.sol
- uniswappv2/UniswapV2Factory.sol
• uniswapv2/UniswapV2Pair.sol
• uniswapv2/UniswapV2Router02.sol

This system allows users to migrate their LP tokens from their original pairing pools to the pairing pools provided by Shiba. In addition, it allows users to perform regular operations in pairing pools, such as adding/removing liquidity and swapping between different assets.

Shibaswap Architecture & Fee Models

ShibaSwap, a decentralized cryptocurrency exchange where users can exchange tokens. The diagram below illustrates how the unique flagship tokens, fee model, and incentivized mechanism.

Contract Dependencies
In ShibaSwap, the system inherits or uses a few of the depending injection contracts or addresses to fulfill the need of its complex business logic.

- bone for the contract BasicBoneDistributor;
- boneToken for the contract BoneLocker;
- bone for the contract BuryBone;
- LEASH for the contract BuryLeash;
- shib for the contract BuryShib;
- bone for the contract DevBoneDistributor;
- chef, oldFactory, factory for the contract Migrator;
- oldRouter and router for the contract ShibaSushiFetch;
- oldRouter and router for the contract ShibaSushiFetch;
- bone, boneLocker, migrator and poolInfo[].lpToken for the contract TopDog;
- factory, bone, shiba, leash and all other tokens used in swappings for the contract TreasureFinder;
- token for the contract boneMerkleDistributor;
- token for the contract daiMerkleDistributor;
- token for the contract usdcMerkleDistributor;
- token for the contract usdtMerkleDistributor;
- token for the contract wbtcMerkleDistributor;
- token for the contract wethMerkleDistributor;
- token for the contract xLeashBoneMerkleDistributor;
- token for the contract xShibBoneMerkleDistributor;
- factory, token0 and token1 for the contract UniswapV2Pair;
- factory and WETH for the contract UniswapV2Router02.

We assume these contracts or addresses are valid and non-vulnerable actors and implementing proper logic to collaborate with the current project.

**Privileged Roles**
To set up the project correctly, improve overall project quality and preserve upgradability, the following roles are adopted in the codebase:

- `owner` is adopted to withdraw bone in the contract `BasicBoneDistributor`;
- `owner` is adopted to lock token and withdraw all token in the contract `BoneLocker`;
- `owner` is adopted to the mint token in the contract `BoneToken`;
- `owner` is adopted to set wallet addresses and percentage of distributions in the contract `DevBoneDistributor`;
- `owner` is adopted to withdraw tokens in the contract `SwapRewardDistributor`;
- `admin` is adopted to queue, cancel and execute transactions in the contract `Timelock`;
- `owner` is adopted to set up a new pool, update pool configurations, change token distributors, modify distribution percentages, update locking period and withdraw tokens from the locker in the contract `TopDog`;
- `owner` is adopted to update Merkle root and withdraw tokens in the contract `boneMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `daiMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `usdcMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `usdtMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `wbtcMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `wethMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `xLeashBoneMerkleDistributor`;
- `owner` is adopted to freeze/unfreeze the contract, update Merkle root and withdraw tokens in the contract `xShibBoneMerkleDistributor`;
- `feeToSetter` is adopted to set fee recipient, migratory, and fees in the contract `UniswapV2Factory`. 
To improve the trustworthiness of the project, dynamic runtime updates in the project should be notified to the community. Furthermore, any plan to invoke the aforementioned functions should also be considered to move to the execution queue of the Timelock contract.

According to the Shiba Inu Ecosystem Woof Paper, Multisig wallets will be used for privileged roles. The addresses are listed as follows:

- **MULTISIG ADDRESS:** 0x39e1d4314a38c80C6ab3b98b9a89a4411D839d44
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIYRA: 0xBab4F3e701F6d2e009Af3C7f1eF2e7dD88225E96
  - @HYROSHI_KIPA: 0x80e32DEfc16ce8f73d09E6ef7065AfE031bAca7
  - @JUNE_HORLA: 0x6948c6bB8a74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dcE

- **MULTISIG EMERGENCY ADDRESS:** 0x4267A3aD7d20c2395ebb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIYRA: 0xBab4F3e701F6d2e009Af3C7f1eF2e7dD88225E96
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  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dcE
  - @COUNTER_NOMAD: 0x8E1B6A660C14f5CC28727f23fCbc977bd89B6B
  - @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c200D9727fc679a0cCE4
  - @MISS_PHOENIX_SHIB: 0x30145F7b0B164D2Dc38D9Cdd8509b1E580432d04
  - @BURF_DURF: 0x5D471E3a033EaF7eE0ca30340597B8a4c2cdAD33

Multisig, which is used for **devwallet**, requires 3 out of 5 signatures for a transaction to be approved. Emergency Multisig, which is used for all other privileged roles, requires 6 out of 9 signatures for a transaction to be approved.
# Findings

![Circle chart showing 34 total issues with breakdown of severity: 0 Critical (0.00%), 8 Major (23.53%), 1 Medium (2.94%), 11 Minor (32.35%), 14 Informational (41.18%), and 0 Discussion (0.00%).]

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<td>Lack of Input Validation</td>
<td>Volatile Code</td>
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**BBC-01 | Lack Of Input Validation**

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</table>

**Description**

In the contract `BuryBone`, the given constructor input `_bone` is missing a sanity check for ensuring a non-zero address will assign.

**Recommendation**

We recommend adding check for the passed-in value is non-zero to prevent any unexpected error.

Example:

```solidity
require(address(_bone) != address(0), "_bone is a zero address");
```

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
**BBC-02 | Variable Declare as Immutable**

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</table>

**Description**

The variable `bone` assigned in the constructor can be declared as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since `immutable` will not be stored in storage. Still, values will directly insert the values into the runtime code.

**Recommendation**

We recommend using an immutable state variable for `bone`.

```
15 IERC20 public immutable bone;
```

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit

b4e8234b87b1bc52f14c0e5e94115ca3fc8e47bb.
**BBD-01 | Centralization Risk**

<table>
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<tr>
<th>Category</th>
<th>Severity</th>
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</tr>
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<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Minor</td>
<td>projects/shibaswap1/contracts/BasicBoneDistributor.sol: 20-2</td>
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</table>

**Description**

In the contract `Bone`, the role `owner` has authority over the following function:

- `withdrawBone()`: withdraw the ERC20 token `Bone` with the arbitrary amount to any `_destination` address.

Any compromise to the account `owner` may allow the hacker to take advantage of it and transfer the withdrawn tokens to an arbitrary address, the `_destination` address.

As `BasicBoneDistributor` is an abstract contract, it is highly recommended to follow best practices by managing and interacting with any contract inheriting from `BasicBoneDistributor` through a decentralized mechanism.

For example:

- `tBoneBoneDistributor()`
- `xLeashBoneDistributor()`
- `xShibBoneDistributor()`

**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 encourage the centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.
Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., owner role).

The Emergency Multisig members have trusted members of the Community and the DeFi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396ebb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIRYA: 0xBab4F3e701F6d2e009Af3C7f1eF2e7d68225E96
  - @HYROSHI_KIPA: 0x80e32DEfc16ce8f78d09E6ef7065AfE031bAcab7
  - @JUNE_HORLA: 0x6948cBbEa74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cedeE8a5177dcE
  - @COUNTER NOMAD: 0x8E1B6A660C14f5CC28727f23fCcBC977bd89B6B
  - @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c200D9727fc679a0cCE4
  - @MISS_Phoenix_SHIB: 0x30f45F7b08164D2D38D9Cdd8509b1E580432d04
  - @BURF_DURF: 0x5D471E3a033Eaf7eE0cA303405978Da4c2cAD33

You can find more details about the MultiSig Model include the settings and member’s information in the the Shiba Inu Ecosystem Woof Paper Page 24.
BLC-01 | Lack Of Input Validation

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Code</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/BuryLeash.sol: 18</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The given input `LEASH` is missing the sanity check for the non-zero address in the aforementioned line.

Recommendation

We recommend adding check for the passed-in value is non-zero to prevent any unexpected error.

Example:

```solidity
require(address(_LEASH) != address(0), "LEASH is a zero address");
```

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234887b1bc52f14c0e5e94115ca3fc8e47bb.
**BLC-02 | Variable Declare as **immutable**

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Optimization</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/BuryLeash.sol: 15</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The variable `LEASH` assigned in the constructor can be declared as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since `immutable` will not be stored in storage. Still, values will directly insert the values into the runtime code.

**Recommendation**

We recommend using an immutable state variable for `LEASH`.

```solidity
15 IERC20 public immutable LEASH;
```

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234887b1bc52f14c0e5e94115ca3fc8e47bb.
BLK-01 | Potential Edge Case in Claimable Amount

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/BoneLocker.sol: 51–55, 73–76</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

In the aforementioned lines, the claimable amount will be affected when the address's role changes (lockInfoByUser[account][i].isDev). Therefore, the claimable amount could be different from the token amount at their unlocking time.

```solidity
function getClaimableAmount(address _user) public view returns(uint256) {
    LockInfo[] memory lockInfoArrayForUser = lockInfoByUser[_user];
    ...
    uint256 lockingPeriodHere = lockingPeriod;
    if(lockInfoArrayForUser[i].isDev){
        lockingPeriodHere = devLockingPeriod;
    }
    for (i; i<lockInfoArrayForUser.length; i++){
        if(now >= (lockInfoArrayForUser[i].timestamp.add(lockingPeriodHere)){
            totalTransferableAmount =
            totalTransferableAmount.add(lockInfoArrayForUser[i].amount);
        }
    }
    return totalTransferableAmount;
}
```

The following is a potential scenario. Assume that the lockingPeriod is 10 days while devLockingPeriod is 1 day:

- Day 1: A non-dev account receives some locked tokens and expects to unlock them on Day 11. Lock info is stored at lockInfoByUser[account][0].
- Day 2: The account is set as a dev account. It receives some locked tokens and expects to unlock them on Day 3. Lock info is stored at lockInfoByUser[account][1].
- Day 3: The account should be able to unlock tokens received on Day 2. However, when it calls claimAll(), it is still not able to claim these tokens because now < (lockInfoByUser[account][0].timestamp.add(lockingPeriod)) (3 < 1 + 10).

Recommendation
We would like to confirm if the above-mentioned case could be a potential edge case in the real-world scenario.

**Alleviation**

**[Shiba]**: The team acknowledged the finding and disagreed on it. The Shiba team confirmed that the BoneLocker contract’s owner is TopDog, where the boneLocker.lock() function is called in two situations:

- for users making a deposit/withdraw (basically harvest);
- for the devBoneDistributor address, which is a contract, when updatePool is triggered.

The team will ensure never make the dev address (devBoneDistributor) as any user address, and it will always be the devBoneDistributor smart contract address. There will be no such case where any address will be a normal address, then set as a dev address and then gets it token locked as a dev address for less devLockingPeriod than lockingPeriod. Therefore, an address will either be a dev address or will not be a dev address.

**[CertIK]**: We agreed that the issue wouldn’t occur if an address will either be a dev address or will not be a dev address.
BLK-02 | Centralization Risk

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/BoneLocker.sol: 107</td>
<td>☑ Resolved</td>
</tr>
</tbody>
</table>

Description

In the contract `BoneLocker`, the role `owner` has the authority over the following function:

- `emergencyWithdrawOwner()`: withdraw all the ERC20 token `boneToken` to any arbitrary address `_to`.

Any compromise to the `owner` account may allow the hacker to take advantage of this and transfer the withdrawn tokens to an arbitrary address, which is the `_to` address.

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 via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets.

Here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.

Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., `owner` role).

The Emergency Multisig members have trusted members of the Community and the DeFi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396ebb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIRYA: 0xBab4F3e701F6d2e009Af3C7f1eF2e7d688225E96
  - @HYROSHI_KIPA: 0x80a32DEfc16ce8f78d09E6ef7065AfE031bAca7
  - @JUNE_HORLA: 0x6948cBbEa74549062050a164d8fc4cFF27E82084
- @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dCE
- @COUNTER_NOMAD: 0x8E1B6Af660C14f5CC28727f23fCccBC977bd89B6B
- @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c200D9727fc679a0cCE4
- @MISS_PHOENIX_SHIB: 0x30f45F7b08164D2D38D9Cdd8509b1E580432d04
- @BURF_DURF: 0x5D471E3a033EaF7eE0cA303405978Da4c2cdAD33

You can find more details about the MultiSig Model include the settings and member’s information in the Shiba Inu Ecosystem Woof Paper Page 24.
BLK-03 | Lack Of Input Validation

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Code</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/BoneLocker.sol: 113</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The given input `emergencyAddress` is missing the sanity check for the non-zero address in the aforementioned line.

Recommendation

We recommend adding a check that the passed-in value is non-zero to prevent unexpected behavior.

Example:

```solidity
require(_newAddr != address(0), "_newAddr is a zero address");
```

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
**BSC-01 | Lack Of Input Validation**

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Code</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/BuryShib.sol: 18</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The given input `_shib` is missing the sanity check for the non-zero address in the aforementioned line.

**Recommendation**

We recommend adding the check for the passed-in values is non-zero to prevent unexpected error.

Example:

```solidity
require(address(_shib) != address(0), "_shib is a zero address");
```

**Alleviation**

*Shiba:* The team heeded our advice and resolved this issue in the commit  

b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
BSC-02 | Variable Declare as `immutable`

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Optimization</td>
<td>Informational</td>
<td>projects/shibaswap1/contracts/BuryShib.sol: 15</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The variable `shib` assigned in the constructor can declare as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since `immutable` will not be stored in storage. Still, values will directly insert the values into the runtime code.

Recommendation

We recommend using an immutable state variable for `shib`.

```
15 IERC20 public immutable shib;
```

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234887b1bc52f14c0e5e94115ca3fc8e47bb.
BTC-01 | Delegation Should Move Along Fund Transfer

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/BoneToken.sol: 15</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

Given BoneToken is a governance token, any functions that involve the fund operation, such as transfer/mint/burn, should also require come along with the delegate operation. Otherwise, it could lead to an inconsistency in the result of the delegate of each addresses.

For example:

- `transfer()`
- `transferFrom()`
- `burn()`

Recommendation

We advise that `transfer()`, `transferFrom()` and `burn()` functions are properly overridden to also transfer delegates on each invocation from the sender of the funds to the recipient.

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit 58e2df72d15ed8e38074f98053d2281339d11169.
**BTC-02 | Lack of Check for Integer Overflow**

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Operations</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/BoneToken.sol: 232</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The operation in the aforementioned line does not check integer overflow:

```solidity
232           numCheckpoints[delegtee] = nCheckpoints + 1;
```

It might lead to an inaccurate result.

**Recommendation**

We advise the client to check integer overflows in integer operations.

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit 58e2df72d15ed8e38074f9853d2281339d11169.
DBD-01 | Centralization Risk

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/DevBoneDistributor.sol: 41, 45, 49, 53</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The owner of the contract with the `owner` role has the privilege to update the following sensitive variables:

- `devWallet`
- `marketingWallet`
- `adminWallet`
- `devSharePercent`
- `marketingSharePercent`
- `adminSharePercent`

All of these variables decide the source and the percentage of BONE that will be distributed to `devWallet` and `marketingAndGrowthWallet`. Any compromise to the `owner` account may allow the hacker to take advantage of it and potentially transfer all BONE tokens to any arbitrary address.

Recommendation

We recommend the team 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 are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e., 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.

Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., `owner` role).
The Emergency Multisig members have trusted members of the Community and the Defi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396ebb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE0824151212a4C388a76C9d3aB1c00
  - @KAAL_DHAIRYA: 0xBab4F3e701F6d2e009Af3C7f1eF2e7dD68225E96
  - @HYROSHI_KIPA: 0x80e32DEfc16ce8f78d09E6f7055AfE031bAcab7
  - @JUNE_HORLA: 0x6948cBbEa74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dce
  - @COUNTER_NOMAD: 0x8E1B6A660C14f5CC28727f23fCcBC977bd89B6B
  - @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c2009727fc679a0cCE4
  - @MISS_PHOENIX_SHIB: 0x30f45F7b08164D2Dd38D9Cdd8509b1E580432d04
  - @BURF_DURF: 0x5D471E3a033EaF7eE0cA303465978Da4c2cdAD33

You can find more details about the MultiSig Model include the settings and member’s information in the the Shiba Inu Ecosystem Woof Paper Page 24.
DBD-02 | Lack of Event Emission for Significant Transactions

<table>
<thead>
<tr>
<th>Category</th>
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<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding Style</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/DevBoneDistributor.sol: 41, 45, 49, 53</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

Functions that affect the status of sensitive variables should be able to emit events as notifications to customers:

- `setDevWallet()`
- `setMarketingWallet()`
- `setAdminWallet()`
- `setWalletDistribution()`

Recommendation

We advise the client to consider adding events for sensitive actions and emit them in the corresponding functions.

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit `b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb`. The team removed `adminWallet` and merged it into `devWallet` in the commit `22d2f0372a50a7d9e524b447ed9a91fc4e4212e6`. Events are modified and emitted in the updated functions.
MDD-01 | Centralization Risk

<table>
<thead>
<tr>
<th>Category</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Centralization /</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/merkleDistributors/boneMerkleDistributor.sol: 261, 267, 284</td>
</tr>
<tr>
<td>Privilege</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Description

The owner of the contract with the owner role has the privilege to update the merkleRoot by calling function updateMerkleRoot(). Any compromise to the account with owner role may allow the hacker to take advantage of it. For example, if a hacker passes the argument merkleProof when calling function claim(), they bypass the check require(MerkleProof.verify(merkleProof, merkleRoot, node), 'MerkleDistributor: Invalid proof.') in L267. Because of this manipulation of merkleRoot, they could transfer any amount of token to an arbitrary address account.

The same concern exists in all of these contracts as the contract boneMerkleDistributor has almost exactly the same content as:

- daiMerkleDistributor
- usdcMerkleDistributor
- usdtMerkleDistributor
- wbtcMerkleDistributor
- wethMerkleDistributor
- xLeashBoneMerkleDistributor
- xShibBoneMerkleDistributor

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 via smart-contract-based accounts with enhanced security practices, e.g. multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.

**Alleviation**

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., owner role).

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  - HYROSHI_KIPA: 0x80e32DEfc16ce8f78d9E6ef7065AfE031bAcaab7
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  - SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dcE
  - COUNTER_NOMAD: 0x8E1B6A660C14F5CC28727f23fCc9777bd89B6B
  - SHINATO_SAMA: 0x6b1b7bD374Ae0DAC38c200D9727f679a0cCE4
  - MISS_PHOENIX_SHIB: 0x30f45F7b08164D2d3809Cdd8509b1E580432d04
  - BURF_DURF: 0x5D471E3a033EaF7e0cA303405978Da4c2cdAD33

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MTL-01 | Centralization Risk

<table>
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</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/MultiTokenLocker.sol: 41, 56</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

In the contract `MultiTokenLocker`, the role `owner` has authority over the following function:

- `withdrawTheseToken()`: transfer a list of unlocked tokens to a list of accounts.
- `withdrawThisToken()`: transfer an unlocked token to an account.

These two functions have the possibility of being maliciously manipulated by hackers if the account of the `owner` was compromised.

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 encourage the centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g., Multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e., 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.

Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., `owner` role).

The Emergency Multisig members have trusted members of the Community and the Defi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396e6bb0Fe72119984F7073761C
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  - KAAL_DHAIRYA: 0x8ab4F3e701F6d2e009Af3C7f1eF2e7d68225E96
  - HYROSHI_KIPA: 0x80e32DEfc16ce8f78d09E6e7065AfE031bAcab7
- @JUNE_HORLA: 0x6948cBBbEa74549062050a164d8fc4cFF27E82084
- @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dcE
- @COUNTER_NOMAD: 0x8E1B6A660C14f5CC28727f23fCcBC977bd89B6B
- @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c200D9727fd0679a0cCE4
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MTL-02 | Lack of Check for Integer Overflow

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Operations</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/MultiTokenLocker.sol: 59</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The operation in the aforementioned line does not check integer overflow:

```solidity
232    require(block.timestamp >= lockInfoArray[_lockId].timestamp +
lockInfoArray[_lockId].lockingPeriod, "Cannot claim now, still in locking period");
```

It might lead to an inaccurate result.

**Recommendation**

We advise the client to consider using SafeMath library of Openzeppelin library:

```solidity
require(block.timestamp >=
lockInfoArray[_lockId].timestamp.add(lockInfoArray[_lockId].lockingPeriod), "Cannot claim now, still in locking period");
```

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit 6c6fed3662f811cfe95d3b49be730ce53c65fe95.
**MTL-03 | Unrestricted Privilege Function**

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Medium</td>
<td>projects/shibaswapv1/contracts/MultiTokenLocker.sol:31</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The function `MultiTokenLocker.receiveApproval()` transfers tokens from `_distributorContract` to the contract account. It is not restricted, so everyone can call this function. Its safety is guaranteed by the fact that `_distributorContract` needs to approve some allowance for this contract before this function is triggered, or `_distributorContract` does not hold any token until it triggers this function. However, the logic in `_distributorContract` before calling the function `MultiTokenLocker.receiveApproval()` is unknown to us, which means the safety of this function is not guaranteed.

**Recommendation**

We advise the client add restrictions on calling the function `MultiTokenLocker.receiveApproval()`, `onlyOwner` as an example, or review the design of `_distributorContract` to ensure `MultiTokenLocker.receiveApproval()` will not be triggered only when it is necessary.

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit 6c6fed3662f811cfe95d3b49be730ce53c65fe95.
TCK-01 | Incorrect Reference URL In Comment

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding Style</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/Timelock.sol: 3</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

In the aforementioned line, the comment of reference URL to timelock contract is incorrect.

**Recommendation**

We recommend addressing the comment to correct reference URL to https://raw.githubusercontent.com/compound-finance/compound-protocol/master/contracts/Timelock.sol

**Alleviation**

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
TDC-01 | add() Function Not Restricted

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Code</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/TopDog.sol:139</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

When the same LP token is added into a pool more than once in function `add()`, the total amount of
reward in function `updatePool()` will be incorrectly calculated. The current implementation is relying on the
operation correctness to avoid repeatedly adding the same LP token to the pool, as the function will only
be called by the owner.

Recommendation

We recommend adding the check for ensuring whether the given pool for addition is a duplicate of an
existing pool so that the pool addition is only successful when there is no duplicate. This can be done by
using a mapping of addresses -> booleans, which can restrict the same address from being added twice.
In addition, consider not using contract `MasterChef` and to use contract `MasterChefV2` instead, since
`MasterChefV2` has already solved this issue by adding `nonDuplicated` modifier.

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit
b4e8234887b1bc52f14c0e5e94115ca3fc8e47bb.
TDC-02 | Centralization Risk

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 169, 316, 322, 327, 337, 342, 352, 357, 362, 154, 332, 368, 373, 378</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The owner of the contract with the owner role has the privilege to execute the following functions to update the sensitive settings of the project. Any compromise to the owner account may allow the hacker to manipulate the project through these functions.

- updateRewardPerBlock()
- setMigrator()
- setRewardMintPercent()
- setDevRewardMintPercent()
- setLockingPeriod()
- devUpdate()
- tBoneBoneDistributorUpdate()
- xShibBoneDistributorUpdate()
- xLeashBoneDistributorUpdate()
- devPercentUpdate()
- tBonePercentUpdate()
- xShibPercentUpdate()
- xLeashPercentUpdate()

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 via smart-contract-based accounts with enhanced security practices, e.g. multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.
Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., owner role).

The Emergency Multisig members have trusted members of the Community and the Defi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396ebb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIRYA: 0xBab4F3e701F6d2e009Af3C711eF2e7dD68225E96
  - @HYROSHI_KIPA: 0x80e32DEfc16ce8f78d09E6ef7065AfE031bAcab7
  - @JUNE_HORLA: 0x6948cBbEa74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cdeE8a5177dcE
  - @COUNTER_NOMAD: 0x8E1B6Af660C14f5CC28727f23fCcBC977bd89B6B
  - @SHINATO_SAMA: 0xb162Ba637bAAe0DAC38c200D9727f679a0cCE4
  - @MISS_PHOENIX_SHIB: 0x30f45F7b08164D2Dd38D9Cdd8509b1E580432d04
  - @BURF_DURF: 0x5D471E3a033EaF7eE0cA303405978Da4c2cdAD33

You can find more details about the MultiSig Model include the settings and members' information in the Shiba Inu Ecosystem Web Paper Page 24.
TDC-03 | Over Minted Token

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TotDag.sol: 235–243</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The `updatePool()` function minted 100% (boneReward) + 10% (devBoneReward) + 1% (tBONE) + 3% (xSHIB) + 1% (xLEASH) of total rewards.

Recommendation

We advise the client to fix to mint 100% of the block reward instead of 100% + 10% + 1% + 3% + 1% = 115% of the the block reward.

Alleviation

[Shiba]: In the latest whitepaper, rewards for tBONE, xSHIBA and xLEASH are “additionally” minted, which means the percentages are calculated based on the amount of boneReward rather than that of all rewards, so the aforementioned percentages are correct.
TDC-04 | Incompatibility With Deflationary Tokens

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 250, 273</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

When transferring standard ERC20 deflationary tokens, the input amount may not be equal to the received amount due to the charged transaction fee. As a result, an inconsistency in the amount will occur and the transaction may fail due to the validation checks.

Recommendation

We advise the client to regulate the set of LP tokens supported and add necessary mitigation mechanisms to keep track of accurate balances if there is a need to support deflationary tokens.

Alleviation

[Shiba]: The team reviewed the issue and disagreed with the description. The team confirmed that the TopDog contract would not support any external deflationary tokens.

[CertiK]: We agreed that the issue wouldn’t occur if the token contract does not support any deflationary tokens.
TDC-05 | Lack of Event Emission for Significant Transactions

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding Style</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 154, 169, 316, 322, 327, 332, 337, 342, 347, 352, 357, 362, 368, 373, 378</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The function that affects the status of sensitive variables should be able to emit events as notifications to customers.

- `updateRewardPerBlock()`
- `setMigrator()`
- `setRewardMintPercent()`
- `setDevRewardMintPercent()`
- `setLockingPeriod()`
- `devUpdate()`
- `tBoneBoneDistributorUpdate()`
- `xShibBoneDistributorUpdate()`
- `xLeashBoneDistributorUpdate()`
- `devPercentUpdate()`
- `tBonePercentUpdate()`
- `xShibPercentUpdate()`
- `xLeashPercentUpdate()`

Recommendation

We advise the client to consider adding events for the above-mentioned sensitive actions and emit them in the function.

```solidity
1 event SetDev(address indexed user, address indexed _devaddr);
2
3 function devUpdate(address _devaddr) public onlyOwner {
4     _devaddr = _devaddr;
5     emit SetDev(msg.sender, _devaddr);
6 }
```

Alleviation
[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
TDC-06 | Misleading Result of Multiplier Calculation

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 186</td>
<td>☑ Resolved</td>
</tr>
</tbody>
</table>

**Description**

In the function `TopDog.getMultiplier()`, the multiplier should be calculated by the following formula:

\[(\text{number of blocks with bonus}) \times \text{BONUS\_MULTIPLIER} + (\text{number of blocks without bonus})\]

However, `startBlock`, which is set in L121, is not considered in the calculation.

When the function is triggered by `TopDog.pendingBone()` (L205) and `TopDog.updatePool()` (L231), the input variables `_from` and `_to` are always greater than `startBlock`, so it is unnecessary to consider `startBlock`.

Given the `TopDog.getMultiplier()` is a public function, which means it can be called externally, all possibilities of the input need to be fully considered.

For example, if `_from < startBlock` and `_to < startBlock`, the multiplier should be `(_from - startBlock).mul(BONUS\_MULTIPLIER)`, rather than `(_to - _from).mul(BONUS\_MULTIPLIER)` which is calculated in the function.

**Recommendation**

We advise the client to use `startBlock` in the calculation for the multiplier if `_from < startBlock`:

```solidity
function getMultiplier(uint256 _from, uint256 _to) public view returns (uint256)
{
    if (_from < startBlock) {
        _from = startBlock;
    }
    if (_to < bonusEndBlock) {
        return _to.sub(_from).mul(BONUS\_MULTIPLIER);
    } else if (_from >= bonusEndBlock) {
        return _to.sub(_from);
    } else {
        return bonusEndBlock.sub(_from).mul(BONUS\_MULTIPLIER).add(_to.sub(bonusEndBlock));
    }
}
Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
TDC-07 | Inconsistent Checks-effects-interactions Pattern

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 250, 273</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

A reentrancy attack can occur when the contract creates a function that makes an external call to another untrusted contract before resolving any effects. If the attacker can control the untrusted contract, they can make a recursive call back to the original function, repeating interactions that would have otherwise not run after the external call resolved the effects.

The function `deposit()` and `withdraw()` in the `TopDog` contract has state `user.rewardDebt` updated after the external call `pool.lpToken.safeTransferFrom()` and thus are vulnerable to reentrancy attacks.

For example, a user calls `TopDog.deposit()` and claims his reward calculated in L255. If `pool.lpToken.safeTransferFrom()` (L265) allows external calls defined by users, the user can re-enter `TopDog.deposit()` before `user.rewardDebt` is updated (L268). Then the user is able to claim reward again (L255) because `user.rewardDebt` is not updated.

Recommendation

We recommend using the Checks-Effects-Interactions Pattern to avoid the risk of calling unknown contracts or applying OpenZeppelin ReentrancyGuard library - `nonReentrant` modifier for the aforementioned functions to prevent reentrancy attack.

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234887b1bc52f14c0e5e94115ca3fc8e47bb.
TDC-08 | Potential Loss of Pool Rewards

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TopDog.sol: 139, 160</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

```solidity
function add(uint256 _allocPoint,IERC20 _lpToken, bool _withUpdate) public onlyOwner {
    if (_withUpdate) {
        massUpdatePools();
    }
    ...
}
```

In the function `TopDog.add()` and `TopDog.set()`, the flag `_withUpdate` determines if all the pools will be updated. This reliance might lead to significant loss of the reward.

For instance, assume we had only one pool with `pool.allocPoint == 50` and `totalAllocPoint == 50` at the beginning. Now we want to add another pool with `pool.allocPoint == 50`. There will be two scenarios on calculating the pool reward,

**Case 1:** `_withUpdate` is `true` value.

- Step 1, distribute the reward and update the pool.
- Step 2, add or set the given pool information.

(Notes: This is important because the functions update `totalAllocPoint`, which is used in calculation of pool rewards in the function `TopDog.updatePool()` (L232))

**Case 2:** `_withUpdate` is `false` value.

- Step 1, add or set the given pool information.

(Note: the pools update will happens later)

- If we call `TopDog.add()` with `_withUpdate == true`, reward for the first pool is updated and `boneReward` in L232 is `multiplier.mul(bonePerBlock)`.
- If we call `TopDog.add()` with `_withUpdate == false`, reward for the first pool is not updated before the second pool is added. Then we call `TopDog.updatePool()` to update the reward for the first pool. `boneReward` in L232 becomes `multiplier.mul(bonePerBlock).mul(50).div(100)` because...
the second pool is sharing rewards with the first one. The amount of reward becomes half as much as that in the first case.

Recommendation

We advise the client to remove the `__withUpdate` flag and always update pool rewards before updating pool information.

Alleviation

[Shiba]: The team reviewed the issue and disagreed on it. The team confirmed that the flag `__withUpdate` design intended to work well with the Shiba team business flow. The `__withUpdate` flag will operate appropriately:

- The `add()` function is only `onlyOwner` access; the operation will conduct only by authorized people.
- The flag `__withUpdate` can save gas when adding multiple pools successively, such as during the launch. The team believes it’s beneficial to have the option of not updating the pools each time. For instance, when adding, say, 10 pools successively, with the first 9 of them as false, and the last one as true, will enable them to start accruing rewards simultaneously, which won’t be possible if we force update pools each time.
TFC-01 | Centralization Risk

<table>
<thead>
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<th>Location</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TreasureFinder.sol: 327</td>
<td>☑️ Resolved</td>
</tr>
</tbody>
</table>

**Description**

The owner of the contract with the `owner` role has the privilege to update the address of `topCoinDestination`, which will affect the destination where the assets would be sent to. Any compromise to the account `owner` may allow the hacker to take advantage of it and transfer all withdrawn tokens to an arbitrary address/pair address.

**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 via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.

**Alleviation**

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., `owner` role).

The Emergency Multisig members have trusted members of the Community and the DeFi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- MULTISIG EMERGENCY ADDRESS: 0x4267A3ad7d2d20c2396abb0Fe72119984F7073761C
  - @OMEGA_HYPERION: 0x399EC033EE08241512212a4C388a76C9d3aB1c00
  - @KAAL_DHAIRYA: 0x9b44F3e701F6d2e009Af3C7f1eF2e7dD68225E96
  - @HYROSHI_KIPA: 0x80a32DEfc16ce8f78d09E6e7f065AfE031bAcab7
  - @JUNE_HORLA: 0x8948cBbEa74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c98b8aED157575B6792019cedeE8a5177dcE
You can find more details about the MultiSig Model include the settings and members' information in the Shiba Inu Ecosystem Woof Paper Page 24.
TFC-02 | Lack of Event Emission for Significant Transactions

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding Style</td>
<td>informational</td>
<td>projects/shibaswapv1/contracts/TreasureFinder.sol: 327</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The function that affects the status of sensitive variables should be able to emit events as notifications to customers.

Recommendation

Consider adding events for sensitive actions, and emit them in the function like below:

```solidity
1  event SetTopCoinDestination(address indexed user, address indexed _adminAddress);
2
3  function setTopCoinDestination(address _destination) external onlyOwner {
4      topCoinDestination = _destination;
5      emit SetTopCoinDestination(msg.sender, _destination)
6  }
```

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
TFC-03 | Potential Sandwich Attack

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Issue</td>
<td>Minor</td>
<td>projects/shibaswapv1/contracts/TreasureFinder.sol: 310, 315</td>
<td>☑ Partially Resolved</td>
</tr>
</tbody>
</table>

Description

When `pair.swap()` is triggered for a trade of asset `fromToken` for `toToken`, an attacker observing this transaction can manipulate the exchange rate by frontrunning a transaction to purchase one of the assets and make profits by backrunning a transaction to sell the asset.

Here is a possible exploit scenario: A user plans to make a transaction of swapping 100 `fromToken` for 1 `toToken`. The attacker can monitor the mempool and know the transaction detail (i.e., gas) for taking the benefit of frontrunning the victim’s transaction. An attacker could raise the price of `toToken` by swapping `fromToken` for `toToken` before the transaction. As a result, the user might get less `toToken` than he expected. After the transaction, the attacker would be able to swap `toToken` for more `fromToken` than he used in his previous transaction.

Recommendation

We recommend setting a proper maximum slippage when swapping one pair of the assets.

Alleviation

[Shiba]: The team acknowledged this issue and decided to take the following alleviations:

- Set the bridge for low liquidity tokens to be their most liquid pair.
- Swap only highly liquid pairs, where price manipulation (without a flashloan) is not feasible.
UVF-01 | Centralization Risk

<table>
<thead>
<tr>
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<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization / Privilege</td>
<td>Major</td>
<td>projects/shibaswapv1/contracts/uniswapv2/UniswapV2Factory.sol: 8, 6, 91, 96, 101, 109, 117</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

The owner of the contract with the `owner` role has the privilege to control the following sensitive variables and functions beyond the scope of the original version of UniswapV2Factory.sol.

- `migrator` in function `setMigrator()`
- `feeToSetter` in function `setFeeToSetter()`.
- `topCoins` in function `setTopCoin()`.
- `totalFeeTopCoin`, `alphaTopCoin`, and `betaTopCoin` in function `setTopCoinFee()`.
- `totalFeeRegular`, `alphaRegular`, and `betaRegular` in function `setRegularCoinFee()`.
- Function `updatePairFee()`.

Any compromise to the account `owner` may allow the hacker to take advantage of these functions and variables, and eventually manipulate the entire project's economical system.

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 via smart_contract-based accounts with enhanced security practices, e.g. Multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 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.

Alleviation

[Shiba]: The team acknowledges the issue and applied the MultiSig solution in any sensitive privilege access (i.e., `owner` role).
The Emergency Multisig members have trusted members of the Community and the DeFi environment. There must be 6 out of 9 signatures from the below addresses for a transaction to be approved.

- **MULTISIG EMERGENCY ADDRESS: 0x4267A3aD7d20c2396ebb0Fe72119984F7073761C**
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  - @HYROSHI_KIPA: 0x80e32DEfc16ce8f78d09E6ef7065Af031bAcab7
  - @JUNE_HORLA: 0x6948cB6Ea74549062050a164d8fc4cFF27E82084
  - @SISLEY_ARGONAUT: 0xe166c948b8aED157575B6792019cedeE8a5177dcE
  - @COUNTER_NOMAD: 0x8E1B6A660CC14f5CC28727f23fCc977bd89B6B
  - @SHINATO_SAMA: 0x6b162Bc637bAAe0DAC38c200D9727f679a0cCE4
  - @MISS_PHOENIX_SHIB: 0x30f45F7b08164D2D38D9Cdd8509b1E580432d04
  - @BURF_DURF: 0x5D471Ea3a033EaF7eE0cA303405978Da4c2cdAD33

You can find more details about the MultiSig Model include the settings and members' information in the Shiba Inu Ecosystem Woof Paper Page 24.
**UVF-02 | Reusable Code**

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Optimization</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/uniswapv2/UniswapV2Factory.sol: 82, 87, 92, 97, 102, 110, 118</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

**Description**

The `require(msg.sender == feeToSetter, 'UniswapV2: FORBIDDEN');` is frequently used in multiple functions.

**Recommendation**

The frequently used code can be converted into a modifier and be adopted in all these functions:

```solidity
modifier checkFeeToSetter()
{
    require(msg.sender == feeToSetter, 'UniswapV2: FORBIDDEN');
    _;
}
```

**Alleviation**

**[Shiba]**: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
UVF-03 | Lack of Event Emission for Significant Transactions

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding Style</td>
<td>Informational</td>
<td>projects/shibaswapv1/contracts/uniswapv2/UniswapV2Factory.sol: 81, 8, 6, 91, 96, 101, 109</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

Function that affect the status of sensitive variables should be able to emit events as notifications to customers

Recommendation

Consider adding events for sensitive actions, and emit them in the function like below:

```solidity
1  event SetFeeTo(address indexed user, address indexed _adminAddress);
2
3  function setFeeTo(address _feeTo) external override {
4      require(msg.sender == FeeToSetter, 'UniswapV2: FORBIDDEN');
5      feeTo = _feeTo;
6      emit SetFeeTo(msg.sender, _feeTo);
7  }
```

Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit b4e8234087b1bc52f14c0e5e94115ca3fc8e47bb.
UVP-01 | Lack of Input Validation

<table>
<thead>
<tr>
<th>Category</th>
<th>Severity</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Code</td>
<td>Major</td>
<td>projects/shibaswap1/contracts/uniswapv2/UniswapV2Pair.sol: 82<del>84, 89</del>91</td>
<td>Resolved</td>
</tr>
</tbody>
</table>

Description

Currently, the values of \( \alpha \), \( \beta \), and \( \text{totalFee} \) are not validated in the constructor of the contract. All of them should be positive and \( \beta \) should be greater than \( \alpha \).

Moreover, the modification of \( \alpha \) and \( \beta \) may potentially affect the amount of liquidity that could be transferred to address \text{feeTo} and thus break the entire project economy system. The liquidity that could be transferred to address \text{feeTo} in function \_mintFee() can be represented by the following equation:

\[
\text{liquidity} = \frac{1}{((\beta/\alpha) \times \sqrt{k_2})/((\sqrt{k_2} - \sqrt{k_1}) - 1}
\]

where:

- \( k_1 \) is the value of \( k \) before adding liquidity
- \( k_2 \) is the value of \( k \) after adding liquidity
- \( \alpha \) is the parameter \( \alpha \)
- \( \beta \) is the parameter \( \beta \)

Based on above equation, we can see that if and only if the value of \((\beta/\alpha) \times \sqrt{k_2})/((\sqrt{k_2} - \sqrt{k_1})\) tends to 1 on the positive direction (i.e. \( \beta/\alpha \rightarrow ((\sqrt{k_2} - \sqrt{k_1})/\sqrt{k_2})^+ \)), the value of \text{liquidity} will be an extreme large number.

Recommendation

We advise the client to add the following input validators:

```solidity
require(_alpha > 0, "_alpha must be greater than 0");
require(_beta > _alpha, "beta should always be later than alpha");
require(_totalFee > 0, "totalFee should not be 0, which will allow free flash swap");
```

Also, we advise the client to consider the possibility of the aforementioned case before setting new values for \( \alpha \) and \( \beta \).
Alleviation

[Shiba]: The team heeded our advice and resolved this issue in the commit 6c6fed3662f811cfe95d3b49be730ce53c65fe95.
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.

Gas Optimization

Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

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.

Coding Style

Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

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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Blockchain technology and cryptographic assets present a high level of ongoing risk. CertiK’s position is that each company and individual are responsible for their own due diligence and continuous security. CertiK’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.
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