CERTIK

Security Assessment

BitNest

CertiK Assessed on May 29th, 2024

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BitNest

The security assessment was prepared by CertiK, the leader in Web3.0 security.

Project Summary

Project Name	BitNest Network Smart Contract Ecosystem
Description	The smart contract code of the BitNest repository implements a lending protocol with the functions of providing lending and circulation. The ecosystem has smart contracts and decentralized technology, which realizes trustless automated transaction management and solves the high cost, low efficiency and centralized risk problems of traditional transactions.
Core components	Bit Loop Smart Contract: Function: A money market lending protocol based on the BSC network, which has the function of providing lending. All assets lent and borrowed generate interest according to the set parameters.
BitNest Savings Box	Function: A flash exchange protocol based on the BSC network, which can realize a mechanism for quickly exchanging cryptocurrencies. One cryptocurrency can be quickly exchanged for another cryptocurrency through this system, and the exchanged assets are returned according to the set parameters.
BitNest Savings	Function: A savings protocol based on the BSC network, which provides liquidity with the characteristics of automated execution. Both deposited and withdrawn assets have cross-chain interactive verification.

Executive Summary

TYPES	ECOSYSTEM	METHODS
DeFi	Binance Smart Chain (BSC)	Formal Verification, Manual Review, Static Analysis
LANGUAGE	**TIMELINE**	**KEY COMPONENTS**
Solidity	Delivered on 05/29/2024	N/A

CODEBASE

https://bscscan.com/address/0xFCc442275A2620E40F17598F9987F320fB57526e#code

View All in Codebase Page

Vulnerability Summary

4	2	0	0	2	0
Total Findings	Resolved	Mitigated	Partially Resolved	Acknowledged	Declined

0	Critical		Critical risks are those that impact the safe functioning of a platform and must be addressed before launch. Users should not invest in any project with outstanding critical risks.
1	Major	1 Resolved	Major risks can include centralization issues and logical errors. Under specific circumstances, these major risks can lead to loss of funds and/or control of the project.
0	Medium		Medium risks may not pose a direct risk to users' funds, but they can affect the overall functioning of a platform.
2	Minor	1 Resolved, 1 Acknowledged	Minor risks can be any of the above, but on a smaller scale. They generally do not compromise the overall integrity of the project, but they may be less efficient than other solutions.
1	Informational	1 Acknowledged	Informational errors are often recommendations to improve the style of the code or certain operations to fall within industry best practices. They usually do not affect the overall functioning of the code.

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CODEBASE | BITNEST

Repository

https://bscscan.com/address/0xFCc442275A2620E40F17598F9987F320fB57526e#code

AUDIT SCOPE | BITNEST

1 file audited ● 1 file with Acknowledged findings

ID	Repo	File	SHA256 Checksum
● BNC	mainnet	contracts/BitNest.sol	f04bd741314e3c1cec04bd1bf4a64b9fac20e47e39ac6af82a24cd7f4698773b

APPROACH & METHODS | BITNEST

This report has been prepared for BitNest to discover issues and vulnerabilities in the source code of the BitNest 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:

- Testing the smart contracts against both common and uncommon attack vectors;
- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

FINDINGS | BITNEST

4	0	1	0	2	1
Total Findings	Critical	Major	Medium	Minor	Informational

This report has been prepared to discover issues and vulnerabilities for BitNest. Through this audit, we have uncovered 4 issues ranging from different severity levels. Utilizing the techniques of Static Analysis & Manual Review to complement rigorous manual code reviews, we discovered the following findings:

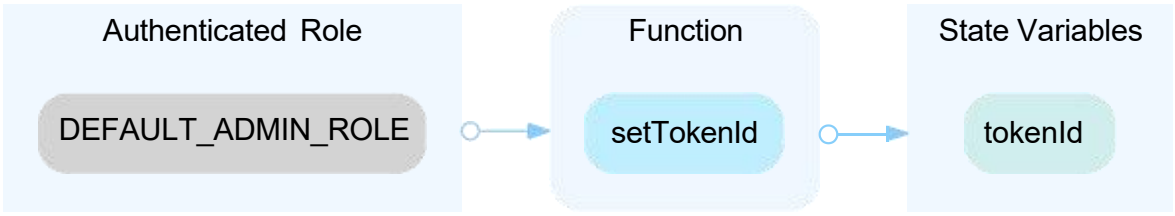
ID	Title	Category	Severity	Status
BNC-01	**Centralization Risks In BitNest.Sol**	**Centralization**	**Major**	**Resolved**
BNC-03	Unused Return Value	Volatile Code	Minor	Resolved
BNC-04	Third-Party Dependency Usage	Design Issue	Minor	Acknowledged
BNC-05	Concerns On Approve Max	Coding Style	Informational	Acknowledged

BNC-01 | CENTRALIZATION RISKS IN BITNEST.SOL

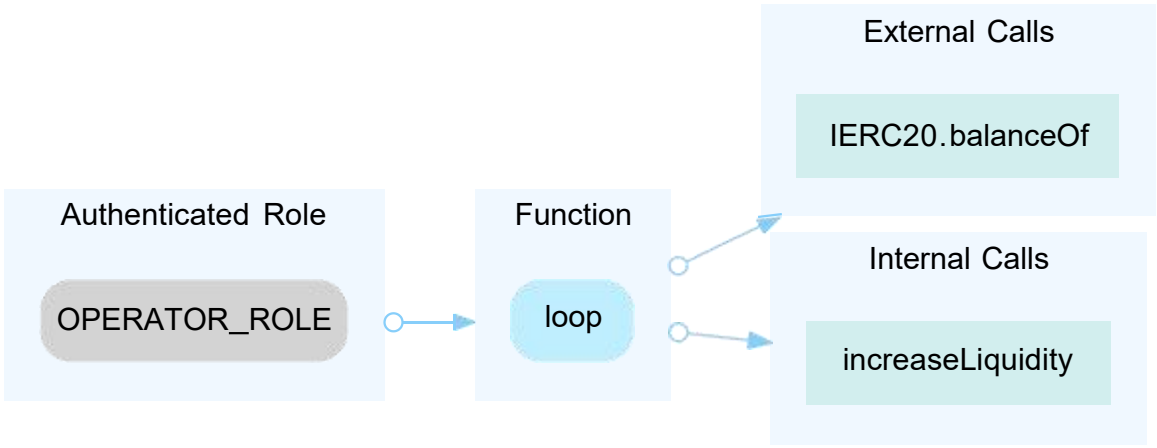
Category	Severity	Location	Status
Centralization	Major	contracts/BitNest.sol: 19, 36	Resolved

Description

In the contract `BitNest` the role `DEFAULT_ADMIN_ROLE` has authority over the functions shown in the diagram below. Any compromise to the `DEFAULT_ADMIN_ROLE` account may allow the hacker to take advantage of this authority and set token id.



In the contract `BitNest` the role `OPERATOR_ROLE` has authority over the functions shown in the diagram below. Any compromise to the `OPERATOR_ROLE` account may allow the hacker to take advantage of this authority and increase liquidity.



Recommendation

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multisignature wallets. Indicatively, here are some feasible suggestions that would also mitigate the potential risk at a different level in terms of short-term, long-term and permanent:

Short Term:

Timelock and Multi sign (⅔ , *) combination *mitigate* by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;

  AND
  - A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, *mitigate* by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
  AND
  - A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered *fully resolved*.

- Renounce the ownership and never claim back the privileged roles.
  OR
- Remove the risky functionality.

Alleviation

The team renounced `DEFAULT_ADMIN_ROLE` role and resolved the issue:
https://bscscan.com/tx/0x378436b7503a0f6d95a5605e1d7735ed1774195d88091fba635c01d342376f6a

BNC-03 | UNUSED RETURN VALUE

Category	Severity	Location	Status
Volatile Code	Minor	contracts/BitNest.sol: 16, 24~33	Resolved

Description

The smart contract does not check or store the return value of an external call in a local or state variable, which may introduce vulnerabilities due to the unhandled outcome.

```
16          IERC20(USDT).approve(address(PositionManager), type(uint256).max);
```

```
24          PositionManager.increaseLiquidity(
25              IncreaseLiquidityParams({
26                  tokenId: tokenId,
27                  amount0Desired: usdtAmount,
28                  amount1Desired: 0,
29                  amount0Min: usdtAmount,
30                  amount1Min: 0,
31                  deadline: block.timestamp
32              })
33          );
```

Recommendation

It is suggested to ensure proper error handling by checking or using the return values of all external function calls, and storing them in appropriate local or state variables if necessary.

Alleviation

[BitNest Team, 05/29/2024]: The return values of externally called contract functions are not used. Contract methods execute atomically, so if an external call fails, the execution of the contract method will rollback. Therefore, there is no need to check the return values.

BNC-04 | THIRD-PARTY DEPENDENCY USAGE

Category	Severity	Location	Status
Design Issue	Minor	contracts/BitNest.sol: 10, 11	Acknowledged

Description

The contract is serving as the underlying entity to interact with one or more third party protocols. The scope of the audit treats third party entities as black boxes and assumes their functional correctness. However, in the real world, third parties can be compromised and this may lead to lost or stolen assets. In addition, upgrades of third parties can possibly create severe impacts, such as increasing fees of third parties, migrating to new LP pools, etc.

```
10      address public constant USDT = 0x55d398326f99059fF775485246999027B3197955;
```

- The contract `BitNest` interacts with third party contract with `IERC20` interface via `USDT`.

```
11      IPositionManager public constant PositionManager = IPositionManager(
0x46A15B0b27311cedF172AB29E4f4766fbE7F4364);
```

- The contract `BitNest` interacts with third party contract with `IPositionManager` interface via `PositionManager`.

Recommendation

The auditors understood that the business logic requires interaction with third parties. It is recommended for the team to constantly monitor the statuses of third parties to mitigate the side effects when unexpected activities are observed.

Alleviation

[BitNest Team, 05/29/2024]: These two contracts have been deployed for many years and carry low risk.

BNC-05 | CONCERNS ON APPROVE MAX

Category	Severity	Location	Status
Coding Style	Informational	contracts/BitNest.sol: 16	Acknowledged

Description

In the auditing codebase, there is an instance where attempting to approve the maximum amount occurs during the contract setup. While this approach may aim to optimize gas usage, it raises concerns about potential fund loss issues if a specific role in the contract is compromised.

```
16          IERC20(USDT).approve(address(PositionManager), type(uint256).max);
```

Recommendation

We recommend approving token expenses based on the tokens required for each operation to enhance security practices.

Alleviation

[BitNest Team, 05/29/2024]: The amount of USDT authorized to the PancakeV3PositionManager contract is 2^256-1. Since PancakeV3PositionManager is essentially risk-free, the large authorization amount will not lead to any risks.

FORMAL VERIFICATION | BITNEST

Formal guarantees about the behavior of smart contracts can be obtained by reasoning about properties relating to the entire contract (e.g. contract invariants) or to specific functions of the contract. Once such properties are proven to be valid, they guarantee that the contract behaves as specified by the property. As part of this audit, we applied formal verification to prove that important functions in the smart contracts adhere to their expected behaviors.

Considered Functions And Scope

In the following, we provide a description of the properties that have been used in this audit. They are grouped according to the type of contract they apply to.

Verification of contracts derived from AccessControl v4.4

We verified properties of the public interface of contracts that provide an AccessControl-v4.4 compatible API. This involves:

- The `hasRole` function, which returns `true` if an account has been granted a specific `role`.
- The `getRoleAdmin` function, which returns the admin role that controls a specific `role`.
- The `grantRole` and `revokeRole` functions, which are used for granting a `role` to an account and revoking a `role` from an `account`, respectively.
- The `renounceRole` function, which allows the calling account to revoke a `role` from itself.

The properties that were considered within the scope of this audit are as follows:

Property Name	Title
accesscontrol-renouncerole-revert-not-sender	`renounceRole` Reverts When Caller Is Not the Confirmation Address
accesscontrol-getroleadmin-change-state	`getRoleAdmin` Function Does Not Change State
accesscontrol-hasrole-succeed-always	`hasRole` Function Always Succeeds
accesscontrol-hasrole-change-state	`hasRole` Function Does Not Change State
accesscontrol-getroleadmin-succeed-always	`getRoleAdmin` Function Always Succeeds
accesscontrol-default-admin-role	AccessControl Default Admin Role Invariance
accesscontrol-renouncerole-succeed-role-renouncing	`renounceRole` Successfully Renounces Role
accesscontrol-grantrole-correct-role-granting	`grantRole` Correctly Grants Role
accesscontrol-revokerole-correct-role-revoking	`revokeRole` Correctly Revokes Role

Verification Results

For the following contracts, formal verification established that each of the properties that were in scope of this audit (see scope) are valid:

Detailed Results For Contract BitNest (contracts/BitNest.sol) In Commit 0xfcc442275a2620e40f17598f9987f320fb57526e

Verification of contracts derived from AccessControl v4.4

Detailed Results for Function `renounceRole`

Property Name	Final Result	Remarks
accesscontrol-renouncerole-revert-not-sender	True	
accesscontrol-renouncerole-succeed-role-renouncing	True	

Detailed Results for Function `getRoleAdmin`

Property Name	Final Result	Remarks
accesscontrol-getroleadmin-change-state	True	
accesscontrol-getroleadmin-succeed-always	True	

Detailed Results for Function `hasRole`

Property Name	Final Result	Remarks
accesscontrol-hasrole-succeed-always	True	
accesscontrol-hasrole-change-state	True	

Detailed Results for Function `DEFAULT_ADMIN_ROLE`

Property Name	Final Result	Remarks
accesscontrol-default-admin-role	True	

Detailed Results for Function `grantRole`

Property Name	Final Result	Remarks
accesscontrol-grantrole-correct-role-granting	True	

Detailed Results for Function `revokeRole`

Property Name	Final Result	Remarks
accesscontrol-revokerole-correct-role-revoking	True	

APPENDIX | BITNEST

Finding Categories

Categories	Description
Coding Style	Coding Style findings may not affect code behavior, but indicate areas where coding practices can be improved to make the code more understandable and maintainable.
Volatile Code	Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases and may result in vulnerabilities.
Centralization	Centralization findings detail the design choices of designating privileged roles or other centralized controls over the code.
Design Issue	Design Issue findings indicate general issues at the design level beyond program logic that are not covered by other finding categories.

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.

Details on Formal Verification

Some Solidity smart contracts from this project have been formally verified. Each such contract was compiled into a mathematical model that reflects all its possible behaviors with respect to the property. The model takes into account the semantics of the Solidity instructions found in the contract. All verification results that we report are based on that model.

The following assumptions and simplifications apply to our model:

- Certain low-level calls and inline assembly are not supported and may lead to a contract not being formally verified.
- We model the semantics of the Solidity source code and not the semantics of the EVM bytecode in a compiled contract.

Formalism for property specifications

All properties are expressed in a behavioral interface specification language that CertiK has developed for Solidity, which allows us to specify the behavior of each function in terms of the contract state and its parameters and return values, as well as contract properties that are maintained by every observable state transition. Observable state transitions occur when the contract's external interface is invoked and the invocation does not revert, and when the contract's Ether balance is changed

by the EVM due to another contract's "self-destruct" invocation. The specification language has the usual Boolean connectives, as well as the operator `\old` (used to denote the state of a variable before a state transition), and several types of specification clause:

Apart from the Boolean connectives and the modal operators "always" (written `[]`) and "eventually" (written `<>`), we use the following predicates to reason about the validity of atomic propositions. They are evaluated on the contract's state whenever a discrete time step occurs:

- `requires [cond]` - the condition `cond`, which refers to a function's parameters, return values, and contract state variables, must hold when a function is invoked in order for it to exhibit a specified behavior.
- `ensures [cond]` - the condition `cond`, which refers to a function's parameters, return values, and both `\old` and current contract state variables, is guaranteed to hold when a function returns if the corresponding requires condition held when it was invoked.
- `invariant [cond]` - the condition `cond`, which refers only to contract state variables, is guaranteed to hold at every observable contract state.
- `constraint [cond]` - the condition `cond`, which refers to both `\old` and current contract state variables, is guaranteed to hold at every observable contract state except for the initial state after construction (because there is no previous state); constraints are used to restrict how contract state can change over time.

Description of the Analyzed AccessControl-v4.4 Properties

Properties related to function `renounceRole`

accesscontrol-renouncerole-revert-not-sender

The `renounceRole` function must revert if the caller is not the same as `account`.

Specification:

```
reverts_when account != msg.sender;
```

accesscontrol-renouncerole-succeed-role-renouncing

After execution, `renounceRole` must ensure the caller no longer has the renounced role.

Specification:

```
ensures !hasRole(role, account);
```

Properties related to function `getRoleAdmin`

accesscontrol-getroleadmin-change-state

The `getRoleAdmin` function must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrol-getroleadmin-succeed-always

The `getRoleAdmin` function must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `hasRole`

accesscontrol-hasrole-change-state

The `hasRole` function must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrol-hasrole-succeed-always

The `hasRole` function must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `DEFAULT_ADMIN_ROLE`

accesscontrol-default-admin-role

The default admin role must be invariant, ensuring consistent access control management.

Specification:

```
invariant DEFAULT_ADMIN_ROLE() == 0x00;
```

Properties related to function `grantRole`

accesscontrol-grantrole-correct-role-granting

After execution, `grantRole` must ensure the specified account has the granted role.

Specification:

```
ensures hasRole(role, account);
```

Properties related to function `revokeRole`

accesscontrol-revokerole-correct-role-revoking

After execution, `revokeRole` must ensure the specified account no longer has the revoked role.

Specification:

```
ensures !hasRole(role, account);
```

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