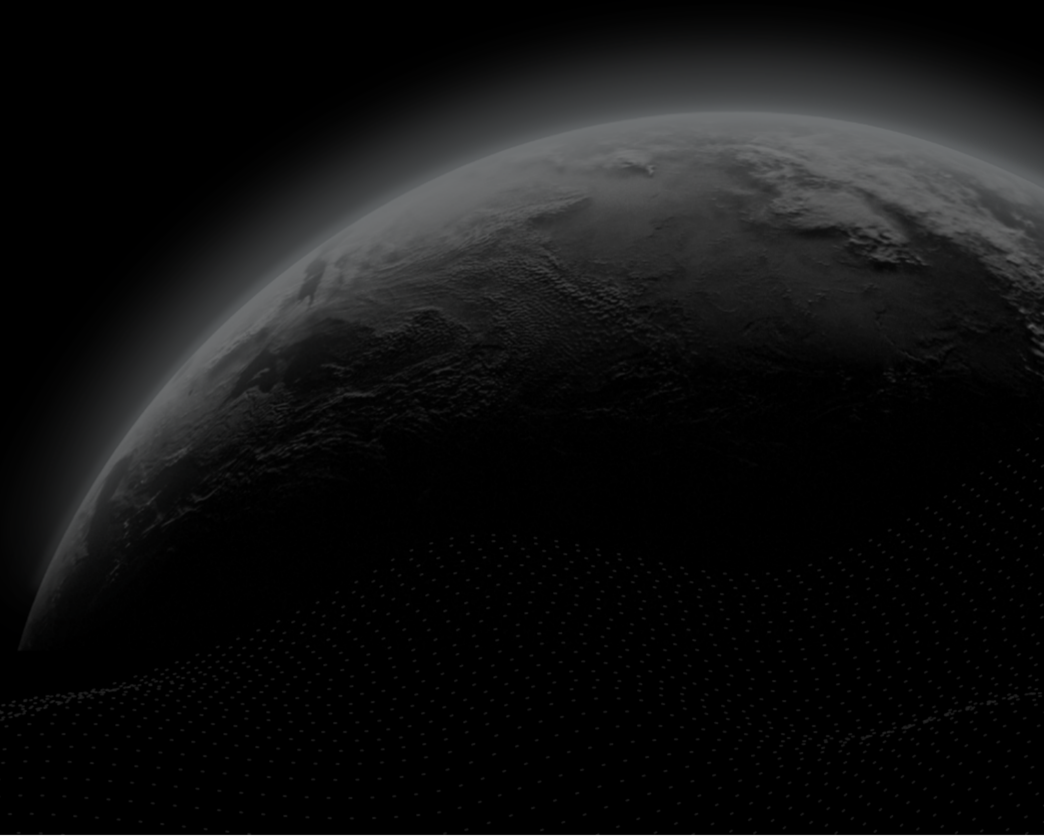
CERTIK

Security Assessment

naws.ai - Audit

CertiK Assessed on Oct 4th, 2024



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naws.ai - Audit

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

Executive Summary

TYPES	ECOSYSTEM	METHODS
ERC-20	Binance Smart Chain (BSC)	Formal Verification, Manual Review, Static Analysis

LANGUAGE	TIMELINE	KEY COMPONENTS
Solidity	Delivered on 10/04/2024	N/A

CODEBASE

NAWS
https://bscscan.com/token/0x726a54e04f394b6e44e58a2d7cb0fec61361d10e#code
View All in Codebase Page

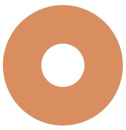
COMMITS

0e9135fbcbfe9ea48ef7727f44caa605d6363d77
View All in Codebase Page

Highlighted Centralization Risks

- Has blacklist/whitelist
- Transfers can be paused

Vulnerability Summary



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

Count	Severity	Status	Description
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.
2	Major	2 Acknowledged	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.
0	Minor		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.

0	Informational	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 | NAWS.AI - AUDIT

Repository

NAWS

https://bscscan.com/token/0x726a54e04f394b6e44e58a2d7cb0fec61361d10e#code

Commit

0e9135fbcbfe9ea48ef7727f44caa605d6363d77

AUDIT SCOPE | NAWS.AI - AUDIT

1 file audited • 1 file without findings

ID	Repo	File	SHA256 Checksum
NAS	naws-ai/NAWS	NAWS.sol	5b21987b871a2f75a4017e06a8bdbc2116e09ed73ba756dfd91f400de0a2868a

APPROACH & METHODS | NAWS.AI - AUDIT

This report has been prepared for naws.ai to discover issues and vulnerabilities in the source code of the naws.ai - Audit 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, Formal Verification, 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 | NAWS.AI - AUDIT

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

This report has been prepared to discover issues and vulnerabilities for naws.ai - Audit. Through this audit, we have uncovered 2 issues ranging from different severity levels. Utilizing the techniques of Static Analysis, Formal Verification & Manual Review to complement rigorous manual code reviews, we discovered the following findings:

ID	Title	Category	Severity	Status
NAS-01	**Initial Token Distribution**	**Centralization**	**Major**	**Acknowledged**
NAS-02	**Centralization Risks In NAWS.Sol**	**Centralization**	**Major**	**Acknowledged**

NAS-01 | INITIAL TOKEN DISTRIBUTION

Category	Severity	Location	Status
Centralization	**Major**	**NAWS.sol: 54~61**	**Acknowledged**

Description

All of the NAWS.AI tokens are equivocally distributed to 5 externally-owned account (EOA) addresses. This is a centralization risk because the owners of the EOAs can distribute tokens without obtaining the consensus of the community. Any compromise to these addresses may allow a hacker to steal and sell tokens on the market, resulting in severe damage to the project.

Recommendation

It is recommended that the team be transparent regarding the initial token distribution process. The token distribution plan should be published in a public location that the community can access. The team should make efforts to restrict access to the private keys of the deployer account or EOAs. A multi-signature (⅔, ⅗) wallet can be used to prevent a single point of failure due to a private key compromise. Additionally, the team can lock up a portion of tokens, release them with a vesting schedule for long-term success, and deanonymize the project team with a third-party KYC provider to create greater accountability.

Alleviation

[NAWS Team, 09/19/2024]: The owner addresses are managed by Cold Wallet as long as they are 'immutable'. These cold wallets are managed with exchange-like procedures. The ledger devices are located in a separate room with procedural documents and CCTV, and are separately stored in a safe for double security. Additionally, the recovery code is managed by the bank by renting a bank vault.

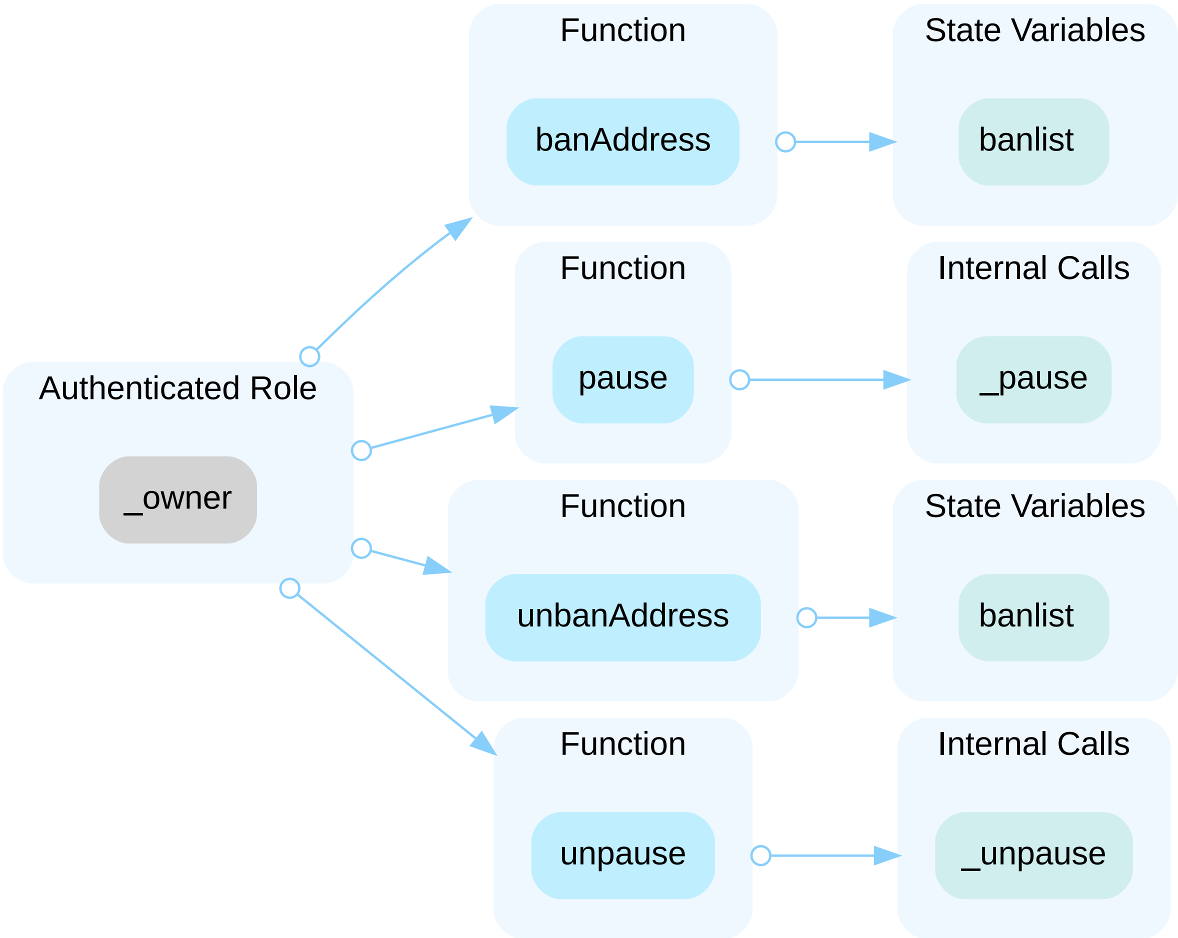
[CertiK, 09/19/2024]: While this strategy has indeed reduced the risk, it's crucial to note that it has not completely eliminated it. CertiK strongly encourages the project team to periodically revisit the private key security management of all above-listed addresses.

NAS-02 | CENTRALIZATION RISKS IN NAWS.SOL

Category	Severity	Location	Status
Centralization	Major	NAWS.sol: 78, 83, 88, 93	Acknowledged

Description

In the contract `NAWS`, the role `_owner` has authority over the functions shown in the diagram below. Any compromise to the `_owner` account may allow the hacker to take advantage of this authority and ban/unban an address, pause/unpause the contract, transfer/renounce ownership.



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, ⅗) 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

[NAWS Team, 09/19/2024]: The owner addresses are managed by Cold Wallet as long as they are 'immutable'. These cold wallets are managed with exchange-like procedures. The ledger devices are located in a separate room with procedural documents and CCTV, and are separately stored in a safe for double security. Additionally, the recovery code is managed by the bank by renting a bank vault.

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FORMAL VERIFICATION | NAWS.AI - AUDIT

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 Pausable ERC-20 Compliance

We verified properties of the public interface of those token contracts that implement the pausable ERC-20 interface. This covers

- Functions `transfer` and `transferFrom` that are widely used for token transfers,
- functions `approve` and `allowance` that enable the owner of an account to delegate a certain subset of her tokens to another account (i.e. to grant an allowance), and
- the functions `balanceOf` and `totalSupply`, which are verified to correctly reflect the internal state of the contract.

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

Property Name	Title
erc20-balanceof-correct-value	`balanceOf` Returns the Correct Value
erc20-totalsupply-correct-value	`totalSupply` Returns the Value of the Corresponding State Variable
erc20-approve-correct-amount	`approve` Updates the Approval Mapping Correctly
erc20-totalsupply-succeed-always	`totalSupply` Always Succeeds
erc20-allowance-change-state	`allowance` Does Not Change the Contract's State
erc20-balanceof-change-state	`balanceOf` Does Not Change the Contract's State
erc20-totalsupply-change-state	`totalSupply` Does Not Change the Contract's State
erc20-approve-revert-zero	`approve` Prevents Approvals For the Zero Address
erc20-balanceof-succeed-always	`balanceOf` Always Succeeds
erc20-approve-never-return-false	`approve` Never Returns `false`

Property Name	Title
erc20-approve-false	If `approve` Returns `false`, the Contract's State Is Unchanged
erc20-allowance-succeed-always	`allowance` Always Succeeds
erc20-allowance-correct-value	`allowance` Returns Correct Value
erc20-approve-succeed-normal	`approve` Succeeds for Valid Inputs

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 NAWS (contracts/NAWS.sol) In Commit 3f45d6b757b5e5ea2467b6d6647be1c1661cd287

Verification of Pausable ERC-20 Compliance

Detailed Results for Function `balanceOf`

Property Name	Final Result	Remarks
erc20-balanceof-correct-value	● True	
erc20-balanceof-change-state	● True	
erc20-balanceof-succeed-always	● True	

Detailed Results for Function `totalSupply`

Property Name	Final Result	Remarks
erc20-totalsupply-correct-value	● True	
erc20-totalsupply-succeed-always	● True	
erc20-totalsupply-change-state	● True	

Detailed Results for Function `approve`

Property Name	Final Result	Remarks
erc20-approve-correct-amount	● True	
erc20-approve-revert-zero	● True	
erc20-approve-never-return-false	● True	
erc20-approve-false	● True	
erc20-approve-succeed-normal	● True	

Detailed Results for Function `allowance`

Property Name	Final Result	Remarks
erc20-allowance-change-state	● True	
erc20-allowance-succeed-always	● True	
erc20-allowance-correct-value	● True	

APPENDIX | NAWS.AI - AUDIT

Finding Categories

Categories	Description
Centralization	Centralization findings detail the design choices of designating privileged roles or other centralized controls over the code.

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 ERC-20-Pausable Properties

Properties related to function `balanceOf`

erc20-balanceof-change-state

Function `balanceOf` must not change any of the contract's state variables.

Specification:

```
assignable \nothing;
```

erc20-balanceof-correct-value

Invocations of `balanceOf(owner)` must return the value that is held in the contract's balance mapping for address `owner`.

Specification:

```
ensures \result == balanceOf(\old(account));
```

erc20-balanceof-succeed-always

Function `balanceOf` must always succeed if it does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `totalSupply`

erc20-totalsupply-change-state

The `totalSupply` function in contract NAWS must not change any state variables.

Specification:

```
assignable \nothing;
```

erc20-totalsupply-correct-value

The `totalSupply` function must return the value that is held in the corresponding state variable of contract NAWS.

Specification:

```
ensures \result == totalSupply();
```

erc20-totalsupply-succeed-always

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

Specification:

```
reverts_only_when false;
```

Properties related to function `approve`

erc20-approve-correct-amount

All non-reverting calls of the form `approve(spender, amount)` that return `true` must correctly update the allowance mapping according to the address `msg.sender` and the values of `spender` and `amount`.

Specification:

```
requires spender != address(0);
ensures \result ==> allowance(msg.sender, \old(spender)) == \old(amount);
```

erc20-approve-false

If function `approve` returns `false` to signal a failure, it must undo all state changes that it incurred before returning to the caller.

Specification:

```
ensures !\result ==> \assigned (\nothing);
```

erc20-approve-never-return-false

The function `approve` must never returns `false`.

Specification:

```
ensures \result;
```

erc20-approve-revert-zero

All calls of the form `approve(spender, amount)` must fail if the address in `spender` is the zero address.

Specification:

```
ensures \old(spender) == address(0) ==> !\result;
```

erc20-approve-succeed-normal

All calls of the form `approve(spender, amount)` must succeed, if

- the address in `spender` is not the zero address and
- the execution does not run out of gas.

Specification:

```
requires spender != address(0);
ensures \result;
reverts_only_when false;
```

Properties related to function `allowance`

erc20-allowance-change-state

Function `allowance` must not change any of the contract's state variables.

Specification:

```
assignable \nothing;
```

erc20-allowance-correct-value

Invocations of `allowance(owner, spender)` must return the allowance that address `spender` has over tokens held by address `owner`.

Specification:

```
ensures \result == allowance(\old(owner), \old(spender));
```

erc20-allowance-succeed-always

Function `allowance` must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

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CertiK | Securing the Web3 World

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