Security Assessment

ZombieWorldZ

Nov 15th, 2021

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Summary

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

Additionally, this audit is based on a premise that all external contracts were implemented safely.

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;
- 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.

Overview

Project Summary

Project Name	ZombieWorldZ
Platform	BSC
Language	Solidity
Codebase	https://github.com/ZombieWorldZ-Game/zwz-tokenimic/tree/main/src
Commit	6946a29eeb1d0738ce5e4d5f46873f1082dc3bb5 7e24550f7062e25f626ea5d39279095ec02f1589

Audit Summary

Delivery Date	Nov 15, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

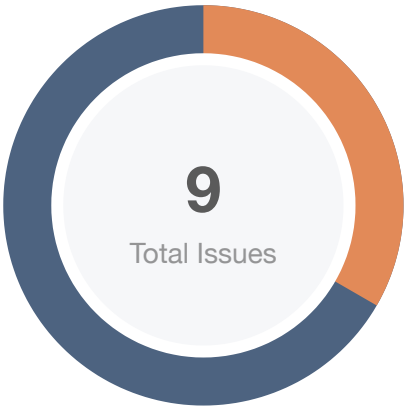
Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	3	0	0	3	0	0
Medium	0	0	0	0	0	0
Minor	0	0	0	0	0	0
Informational	6	0	0	0	0	6
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
ABZ	AntiBot.sol	db77e3119f7f7a7571d2828c689942124aa598ff2527eb255d464956315a8c41
BTZ	BrainToken.sol	12f5b52baf19e836f2d30399ed44fa45d3de12ccae89f556ca599984405e2115
ZZT	ZwZToken.sol	9b1037d5a225240d1285787904115c367418dc559c93f5c581592aac6ff22499

Findings



Critical	**0** (0.00%)
Major	**3** (33.33%)
Medium	**0** (0.00%)
Minor	**0** (0.00%)
Informational	**6** (66.67%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
ABZ-01	Unlocked Compiler Version	Language Specific	Informational	Resolved
BTZ-01	Unlocked Compiler Version	Language Specific	Informational	Resolved
BTZ-02	Token Minted To Centralized Address	Logical Issue	Major	Acknowledged
GLOBAL-01	Centralization Risk	**Centralization / Privilege**	**Major**	Acknowledged
ABZ-02	Function Visibility Optimization	Gas Optimization	Informational	Resolved
ZZT-01	Unlocked Compiler Version	Language Specific	Informational	Resolved
ZZT-02	Token Minted To Centralized Address	Logical Issue	Major	Acknowledged
ZZT-03	Mutability Specifiers Missing	Gas Optimization	Informational	Resolved
ZZT-04	Proper Usage of `require` And `assert` Functions	Coding Style	Informational	Resolved

ABZ-01 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	projects/ZombieWorldZ/contracts/AntiBot.sol (f3e2f47): 3	Resolved

Description

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.8.7` the contract should contain the following line:

```
pragma solidity 0.8.7;
```

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

BTZ-01 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	projects/ZombieWorldZ/contracts/BrainToken.sol (f3e2f47): 3	Resolved

Description

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.8.7` the contract should contain the following line:

```
pragma solidity 0.8.7;
```

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

BTZ-02 | Token Minted To Centralized Address

Category	Severity	Location	Status
Logical Issue	Major	Global	Acknowledged

Description

The amount of tokens that are minted to the centralized address, may raise the community's concerns about the centralization issue.

Recommendation

We advise the client to carefully manage the `owner` account's private key and avoid any potential risks of being hacked. We also advise the client to adopt Multisig, Timelock, and/or DAO in the project to manage this specific account in this case.

Alleviation

The client responded that they have acknowledged this issue.

GLOBAL-01 | Centralization Risk

Category	Severity	Location	Status
Centralization / Privilege	Major	Global	Acknowledged

Description

The role `owner` has the authority over the listed functions:

- `modifyWhiteList()` in `AntiBot.sol`
- `setAntiBot()` in `AntiBot.sol`

The role `MINTER_ROLE` has the authority over the listed functions:

- `mint()` in `BrainToken.sol`, mint any amount of tokens to any address without limitation.

Any compromise to the key role account may allow a potential hacker to take advantage of this and execute malicious acts.

Recommendation

We advise the client to carefully manage the key role 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 suggestions that would also mitigate the potential risk at the different levels in terms of short-term and long-term scenarios:

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

The client responded that they have acknowledged this issue.

ABZ-02 | Function Visibility Optimization

Category	Severity	Location	Status
Gas Optimization	Informational	projects/ZombieWorldZ/contracts/AntiBot.sol (f3e2f47): 14	Resolved

Description

The following functions are declared as `public`, contain array function arguments, and are not invoked in any of the contracts contained within the project's scope. The functions that are never called internally within the contract should have external visibility.

Recommendation

We advise that the functions' visibility specifiers are set to `external` and the array-based arguments change their data location from `memory` to `calldata`, optimizing the gas cost of the function.

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

ZZT-01 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	projects/ZombieWorldZ/contracts/ZwZToken.sol (f3e2f47): 3	Resolved

Description

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.8.7` the contract should contain the following line:

```
pragma solidity 0.8.7;
```

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

ZZT-02 | Token Minted To Centralized Address

Category	Severity	Location	Status
Logical Issue	Major	projects/ZombieWorldZ/contracts/ZwZToken.sol (f3e2f47): 14	Acknowledged

Description

The amount of tokens that are minted to the centralized address, may raise the community's concerns about the centralization issue.

Recommendation

We advise the client to carefully manage the `owner` account's private key and avoid any potential risks of being hacked. We also advise the client to adopt Multisig, Timelock, and/or DAO in the project to manage this specific account in this case.

Alleviation

The client responded that they have acknowledged this issue.

ZZT-03 | Mutability Specifiers Missing

Category	Severity	Location	Status
Gas Optimization	Informational	projects/ZombieWorldZ/contracts/ZwZToken.sol (f3e2f47): 12	Resolved

Description

The linked variables are assigned only once, either during their contract-level declaration or during the `constructor`'s execution.

Recommendation

For the former, we advise that the `constant` keyword is introduced in the variable declaration to greatly optimize the gas cost involved in utilizing the variable. For the latter, we advise that the `immutable` mutability specifier is set at the variable's contract-level declaration to greatly optimize the gas cost of utilizing the variables. Please note that the `immutable` keyword only works in Solidity versions `v0.6.5` and up.

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

ZZT-04 | Proper Usage of `require` And `assert` Functions

Category	Severity	Location	Status
Coding Style	Informational	projects/ZombieWorldZ/contracts/ZwZToken.sol (f3e2f47): 23~25	Resolved

Description

The `assert` function should only be used to test for internal errors, and to check invariants. The `require` function should be used to ensure valid conditions, such as inputs, or contract state variables are met, or to validate return values from calls to external contracts.

Recommendation

We advise the client to use the `require` function, along with a custom error message when the condition fails, instead of the `assert` function.

Alleviation

The development team solved this issue at commit 7e24550f7062e25f626ea5d39279095ec02f1589.

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.

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.

Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

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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