Ether Authority

SMART CONTRACT

Security Audit Report

Project: Axie Infinity Shard
Website: axieinfinity.com
Platform: Ethereum
Language: Solidity
Date: April 16th, 2024

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Introduction

As part of EtherAuthority's community smart contracts audit initiatives, the Axie Infinity Shard smart contract from axieinfinity.com was audited extensively. The audit has been performed using manual analysis as well as using automated software tools. This report presents all the findings regarding the audit performed on April 16th, 2024.

The purpose of this audit was to address the following:

- Ensure that all claimed functions exist and function correctly.
- Identify any security vulnerabilities that may be present in the smart contract.

Project Background

- The AXSToken smart contract, is an ERC20 token. Here's a breakdown of what each part of the code does:
  - **SafeMath.sol:** This library provides functions for safe mathematical operations to prevent overflows and underflows.
  - **IERC20.sol:** This is the interface for the ERC20 standard. It defines the functions and events that an ERC20 token contract must implement.
  - **ERC20.sol:** This contract implements the ERC20 interface. It includes functions for transferring tokens, approving spending, and managing allowances.
  - **IERC20Detailed.sol:** This interface extends the ERC20 interface with additional functions for getting the name, symbol, and decimals of the token.
  - **ERC20Detailed.sol:** This contract implements the detailed ERC20 interface. It adds the name, symbol, and decimal properties to the ERC20 contract.
  - **ERC20GatewayWhitelist.sol:** This contract extends the ERC20 contract and adds functionality to whitelist a mainchain gateway. It allows unlimited allowance for the gateway address and sets a limit for other addresses.
  - **AXSToken.sol:** This is the main contract for the AXS token. It inherits from ERC20Detailed and ERC20GatewayWhitelist contracts. In the constructor, it sets the total supply, assigns all tokens to the contract deployer, and sets the mainchain gateway.

- Overall, this code defines an ERC20 token contract for Axie Infinity Shard (AXS) with additional functionality for whitelisting a mainchain gateway.

Audit scope

Name	Code Review and Security Analysis Report for Axie Infinity Shard Smart Contract
Platform	Ethereum
Language	Solidity
File	AXSToken.sol
Smart Contract Code	0xbb0e17ef65f82ab018d8edd776e8dd940327b28b
Audit Date	April 16th, 2024

Claimed Smart Contract Features

Claimed Feature Detail	Our Observation
Tokenomics: • Name:Axie Infinity Shard • Symbol: AXS • Decimals: 18 • Total Supply: 270 Million	**YES, This is valid.**
Ownership Control: • There are no owner functions, which makes it 100% decentralized.	**YES, This is valid.**
Other Specification:. • The token is without any other custom functionality and without any ownership control, which makes it truly decentralized.	**YES, This is valid.**

Audit Summary

According to the standard audit assessment, the Customer`s solidity-based smart contracts are **"Secured"**. This token contract does not have any ownership control, hence it is **100% decentralized**.

Insecure	Poor secured	Secure	Well-secured

You are here

We used various tools like Slither, Solhint, and Remix IDE. At the same time, this finding is based on a critical analysis of the manual audit.

All issues found during automated analysis were manually reviewed and applicable vulnerabilities are presented in the Audit Overview section. The general overview is presented in the AS-IS section and all identified issues can be found in the Audit overview section.

We found 0 critical, 0 high, 0 medium, 0 low, and 4 very low level issues.

Investor Advice: A technical audit of the smart contract does not guarantee the ethical nature of the project. Any owner-controlled functions should be executed by the owner with responsibility. All investors/users are advised to do their due diligence before investing in the project.

Technical Quick Stats

Main Category	Subcategory	Result
Contract Programming	The solidity version is not specified	Passed
	The solidity version is too old	Passed
	Integer overflow/underflow	Passed
	Function input parameters lack check	Passed
	Function input parameters check bypass	Passed
	Function access control lacks management	Passed
	Critical operation lacks event log	Passed
	Human/contract checks bypass	Passed
	Random number generation/use vulnerability	N/A
	Fallback function misuse	Passed
	Race condition	Passed
	Logical vulnerability	Passed
	Features claimed	Passed
	Other programming issues	Moderated
Code Specification	Function visibility not explicitly declared	Passed
	Var. storage location not explicitly declared	Passed
	Use keywords/functions to be deprecated	Passed
	Unused code	Moderated
Gas Optimization	"Out of Gas" Issue	Passed
	High consumption 'for/while' loop	Passed
	High consumption 'storage' storage	Passed
	Assert() misuse	Passed
Business Risk	The maximum limit for mintage is not set	Passed
	"Short Address" Attack	Passed
	"Double Spend" Attack	Passed

Overall Audit Result: PASSED

Business Risk Analysis

Category	Result
🟢 Buy Tax	0%
🟢 Sell Tax	0%
🟢 Cannot Buy	No
🟢 Cannot Sell	No
🟢 Max Tax	0%
🟢 Modify Tax	No
🟢 Fee Check	Not Detected
🟢 Is Honeypot	Not Detected
🟢 Trading Cooldown	Not Detected
🟢 Can Pause Trade?	Not Detected
🟢 Pause Transfer?	No
🟢 Max Tax?	No
🟢 Is it Anti-whale?	Not Detected
🟢 Is Anti-bot?	Not Detected
🟢 Is it a Blacklist?	No
🟢 Blacklist Check	No
🟢 Can Mint?	No
🟢 Is it a Proxy?	No
🟢 Can Take Ownership?	No
🟢 Hidden Owner?	Not Detected
🟢 Self Destruction?	Not Detected
🟢 Auditor Confidence	High

Overall Audit Result: PASSED

Code Quality

This audit scope has 1 smart contract. Smart contracts contain Libraries, Smart contracts, inherits, and Interfaces. This is a compact and well-written smart contract.

The libraries in Axie Infinity Shard are part of its logical algorithm. A library is a different type of smart contract that contains reusable code. Once deployed on the blockchain (only once), it is assigned a specific address and its properties/methods can be reused many times by other contracts in the Axie Infinity Shard.

The EtherAuthority team has no scenario and unit test scripts, which would have helped to determine the integrity of the code in an automated way.

Code parts are not well commented on in the smart contracts. Ethereum's NatSpec commenting style is recommended.

Documentation

We were given an Axie Infinity Shard smart contract code in the form of an Etherscan web link.

As mentioned above, code parts are not well commented on. but the logic is straightforward. So it is easy to quickly understand the programming flow as well as complex code logic. Comments are very helpful in understanding the overall architecture of the protocol.

Use of Dependencies

As per our observation, the libraries used in this smart contract infrastructure are based on well-known industry standard open-source projects.

Apart from libraries, its functions are not used in external smart contract calls.

AS-IS overview

Functions

Sl.	Functions	Type	Observation	Conclusion
1	constructor	write	Passed	No Issue
2	allowance	read	Passed	No Issue
3	transferFrom	write	Passed	No Issue
4	_setGateway	internal	Passed	No Issue
5	approve	write	Optimization	Refer Audit Findings
6	allowance	read	Passed	No Issue
7	increaseAllowance	write	Optimization	Refer Audit Findings
8	decreaseAllowance	write	Optimization	Refer Audit Findings
9	transfer	write	Passed	No Issue
10	transferFrom	write	Passed	No Issue
11	_approve	internal	Passed	No Issue
12	_transfer	internal	Passed	No Issue

Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to token loss etc.
High	High-level vulnerabilities are difficult to exploit; however, they also have a significant impact on smart contract execution, e.g. public access to crucial
Medium	Medium-level vulnerabilities are important to fix; however, they can't lead to tokens lose
Low	Low-level vulnerabilities are mostly related to outdated, unused etc. code snippets, that can't have a significant impact on execution
Lowest / Code Style / Best Practice	Lowest-level vulnerabilities, code style violations and info statements can't affect smart contract execution and can be ignored.

Audit Findings

Critical Severity

No Critical severity vulnerabilities were found.

High Severity

No High severity vulnerabilities were found.

Medium

No Medium severity vulnerabilities were found.

Low

No Low Severity vulnerabilities were found.

Very Low / Informational / Best practices:

(1) Multiple times pragma solidity version defines:

There are multiple times the same pragma versions defined.

Resolution: We suggest using only one pragma solidity version on top of the code.

(2) Missing SPDX-License-Identifier:

SPDX-License-Identifier is written with the wrong syntax.

Resolution: We suggest adding the correct SPDX license identifier.

(3) Unused interface and functions:

```
interface IERC20Detailed {
  function name() external view returns (string memory _name);    ⛽ - gas
  function symbol() external view returns (string memory _symbol);    ⛽ - gas
  function decimals() external view returns (uint8 _decimals);    ⛽ - gas
}
```

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IERC20Detailed interface defined. ERC20Detailed was inherited from IERC20Detailed but never used.

Resolution: We suggest removing the unused interface and functions in the code.

(4) Optimization:

The public functions that are never called by the contract should be declared external, and their immutable parameters should be located in call data to save gas.

- approve()
- increaseAllowance()
- decreaseAllowance()

Resolution: Use the external attribute for functions never called from the contract, and change the location of immutable parameters to call data to save gas.

Centralization Risk

The Axie Infinity Shard smart contract does not have any ownership control, **hence it is 100% decentralized.**

Therefore, there is **no** centralization risk.

Conclusion

We were given a contract code in the form of [Etherscan](#) web links. And we have used all possible tests based on given objects as files. We observed 4 Informational issues in the smart contracts. but those are not critical. So, **it's good to go for the production**.

Since possible test cases can be unlimited for such smart contracts protocol, we provide no such guarantee of future outcomes. We have used all the latest static tools and manual observations to cover the maximum possible test cases to scan everything.

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools. Smart Contract's high-level description of functionality was presented in the As-is overview section of the report.

The audit report contains all found security vulnerabilities and other issues in the reviewed code.

The security state of the reviewed smart contract, based on standard audit procedure scope, is **"Secured".**

Our Methodology

We like to work with a transparent process and make our reviews a collaborative effort. The goals of our security audits are to improve the quality of systems we review and aim for sufficient remediation to help protect users. The following is the methodology we use in our security audit process.

Manual Code Review:

In manually reviewing all of the code, we look for any potential issues with code logic, error handling, protocol and header parsing, cryptographic errors, and random number generators. We also watch for areas where more defensive programming could reduce the risk of future mistakes and speed up future audits. Although our primary focus is on the in-scope code, we examine dependency code and behavior when it is relevant to a particular line of investigation.

Vulnerability Analysis:

Our audit techniques included manual code analysis, user interface interaction, and whitebox penetration testing. We look at the project's web site to get a high level understanding of what functionality the software under review provides. We then meet with the developers to gain an appreciation of their vision of the software. We install and use the relevant software, exploring the user interactions and roles. While we do this, we brainstorm threat models and attack surfaces. We read design documentation, review other audit results, search for similar projects, examine source code dependencies, skim open issue tickets, and generally investigate details other than the implementation.

Documenting Results:

We follow a conservative, transparent process for analyzing potential security vulnerabilities and seeing them through successful remediation. Whenever a potential issue is discovered, we immediately create an Issue entry for it in this document, even though we have not yet verified the feasibility and impact of the issue. This process is conservative because we document our suspicions early even if they are later shown to not represent exploitable vulnerabilities. We generally follow a process of first documenting the suspicion with unresolved questions, then confirming the issue through code analysis, live experimentation, or automated tests. Code analysis is the most tentative, and we strive to provide test code, log captures, or screenshots demonstrating our confirmation. After this we analyze the feasibility of an attack in a live system.

Suggested Solutions:

We search for immediate mitigations that live deployments can take, and finally we suggest the requirements for remediation engineering for future releases. The mitigation and remediation recommendations should be scrutinized by the developers and deployment engineers, and successful mitigation and remediation is an ongoing collaborative process after we deliver our report, and before the details are made public.

Disclaimers

EtherAuthority.io Disclaimer

EtherAuthority team has analyzed this smart contract in accordance with the best industry practices at the date of this report, in relation to: cybersecurity vulnerabilities and issues in smart contract source code, the details of which are disclosed in this report, (Source Code); the Source Code compilation, deployment and functionality (performing the intended functions).

Due to the fact that the total number of test cases are unlimited, the audit makes no statements or warranties on security of the code. It also cannot be considered as a sufficient assessment regarding the utility and safety of the code, bugfree status or any other statements of the contract. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only. We also suggest conducting a bug bounty program to confirm the high level of security of this smart contract.

Technical Disclaimer

Smart contracts are deployed and executed on the blockchain platform. The platform, its programming language, and other software related to the smart contract can have their own vulnerabilities that can lead to hacks. Thus, the audit can't guarantee explicit security of the audited smart contracts.

Appendix

Code Flow Diagram - Axie Infinity Shard
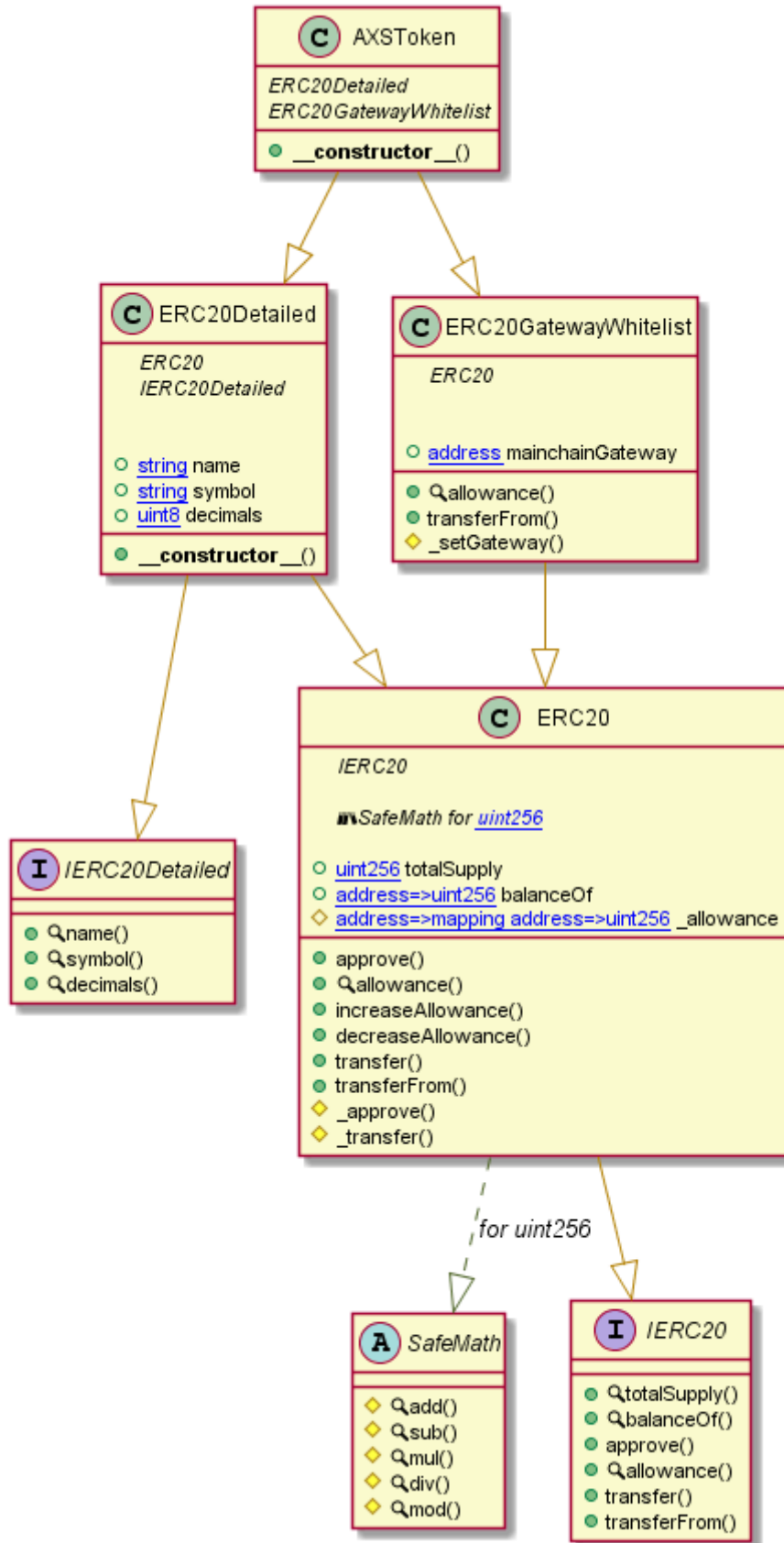
Slither Results Log

Slither is a Solidity static analysis framework that uses vulnerability detectors, displays contract details, and provides an API for writing custom analyses. It helps developers identify vulnerabilities, improve code comprehension, and prototype custom analyses quickly. The analysis includes a report with warnings and errors, allowing developers to quickly prototype and fix issues.

We did the analysis of the project altogether. Below are the results.

Slither Log >> AXSToken.sol

```
INFO:Detectors:
SafeMath.div(uint256,uint256) (AXSToken.sol#30-35) is never used and should be removed
SafeMath.mod(uint256,uint256) (AXSToken.sol#37-41) is never used and should be removed
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#dead-code
INFO:Detectors:
Pragma version0.5.17 (AXSToken.sol#7) allows old versions
Pragma version0.5.17 (AXSToken.sol#46) allows old versions
Pragma version0.5.17 (AXSToken.sol#65) allows old versions
Pragma version0.5.17 (AXSToken.sol#128) allows old versions
Pragma version0.5.17 (AXSToken.sol#139) allows old versions
Pragma version0.5.17 (AXSToken.sol#158) allows old versions
Pragma version0.5.17 (AXSToken.sol#201) allows old versions
solc-0.5.17 is not recommended for deployment
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-versions-of-solidity
```

```
INFO:Detectors:
Parameter ERC20.approve(address,uint256)._spender (AXSToken.sol#77) is not in mixedCase
Parameter ERC20.approve(address,uint256)._value (AXSToken.sol#77) is not in mixedCase
Parameter ERC20.allowance(address,address)._owner (AXSToken.sol#82) is not in mixedCase
Parameter ERC20.allowance(address,address)._spender (AXSToken.sol#82) is not in mixedCase
Parameter ERC20.increaseAllowance(address,uint256)._spender (AXSToken.sol#86) is not in mixedCase
Parameter ERC20.increaseAllowance(address,uint256)._value (AXSToken.sol#86) is not in mixedCase
Parameter ERC20.decreaseAllowance(address,uint256)._spender (AXSToken.sol#91) is not in mixedCase
Parameter ERC20.decreaseAllowance(address,uint256)._value (AXSToken.sol#91) is not in mixedCase
Parameter ERC20.transfer(address,uint256)._to (AXSToken.sol#96) is not in mixedCase
Parameter ERC20.transfer(address,uint256)._value (AXSToken.sol#96) is not in mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._from (AXSToken.sol#101) is not in mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._to (AXSToken.sol#101) is not in mixedCase
Parameter ERC20.transferFrom(address,address,uint256)._value (AXSToken.sol#101) is not in mixedCase
Parameter ERC20GatewayWhitelist.allowance(address,address)._owner (AXSToken.sol#164) is not in mixedCase
Parameter ERC20GatewayWhitelist.allowance(address,address)._spender (AXSToken.sol#164) is not in mixedCase
Parameter ERC20GatewayWhitelist.transferFrom(address,address,uint256)._from (AXSToken.sol#175) is not in mixedCase
Parameter ERC20GatewayWhitelist.transferFrom(address,address,uint256)._to (AXSToken.sol#176) is not in mixedCase
Parameter ERC20GatewayWhitelist.transferFrom(address,address,uint256)._value (AXSToken.sol#177) is not in mixedCase
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#conformance-to-solidity-naming-conventions
```

```
INFO:Detectors:
AXSToken.constructor(address) (AXSToken.sol#207-216) uses literals with too many digits:
        - totalSupply = uint256(270000000).mul(uint256(10) ** 18) (AXSToken.sol#211)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#too-many-digits
INFO:Slither:AXSToken.sol analyzed (7 contracts with 93 detectors), 29 result(s) found
```

Solidity Static Analysis

Static code analysis is used to identify many common coding problems before a program is released. It involves examining the code manually or using tools to automate the process. Static code analysis tools can automatically scan the code without executing it.

AXSToken.sol

Gas costs:

Gas requirement of function AXSToken.transfer is infinite: If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)
Pos: 96:2:

Gas costs:

Gas requirement of function AXSToken.transferFrom is infinite: If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)
Pos: 101:2:

Guard conditions:

Use "assert(x)" if you never ever want x to be false, not in any circumstance (apart from a bug in your code). Use "require(x)" if x can be false, due to e.g. invalid input or a failing external component.
more
Pos: 13:4:

Data truncated:

Division of integer values yields an integer value again. That means e.g. 10 / 100 = 0 instead of 0.1 since the result is an integer again. This does not hold for division of (only) literal values since those yield rational constants.
Pos: 34:11:

Solhint Linter

Linters are the utility tools that analyze the given source code and report programming errors, bugs, and stylistic errors. For the Solidity language, there are some linter tools available that a developer can use to improve the quality of their Solidity contracts.

AXSToken.sol

```
Error message for require is too long
Pos: 5:26
Error message for require is too long
Pos: 5:107
Error message for require is too long
Pos: 5:108
Error message for require is too long
Pos: 5:115
Error message for require is too long
Pos: 5:116
Error message for require is too long
Pos: 5:117
Error message for require is too long
Pos: 5:190
```

Software analysis result:

This software reported many false positive results and some are informational issues. So, those issues can be safely ignored.

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