Smart Contract Audit Report

Connexion Smart Contract

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Numen Cyber Labs - Security Services

Table of Content

1 Executive Summary 2

Methodology 2

2 Findings Overview 6

2.1 Project info and Contract address 6

2.2 Summary 7

2.3 Key Findings 8

3 Detailed Description of Findings 9

3.1 Signer has higher authority 9

3.2 Signer has higher authority 10

3.3 Signer has higher authority 12

3.4 Admin has higher authority 13

4 Conclusion 16

5 Appendix 17

5.1 Basic Coding Assessment 17

5.2 Advanced Code Scrutiny 18

6 Disclaimer 20

References 21

1 EXECUTIVE SUMMARY

Numen Cyber Technology was engaged by Connexion to review smart contract implementation. The assessment was conducted in accordance with our systematic approach to evaluate potential security issues based upon customer requirement. The report provides detailed recommendations to resolve the issue and provide additional suggestions or recommendations for improvement.

Four Medium severities findings are related to owner authority, centralized risk. One Information severities findings are related to logical judgment.

The outcome of the assessment outlined in chapter 3 provides the system's owners a full description of the vulnerabilities identified, the associated risk rating for each vulnerability, and detailed recommendations that will resolve the underlying technical issue.

METHODOLOGY

To standardize the evaluation, we define the following terminology based on OWASP Risk Rating Methodology [10] which is the gold standard in risk assessment using the following risk models:

- Likelihood: represents how likely a particular vulnerability is to be uncovered and exploited in the wild.
- Impact: measures the technical loss and business damage of a successful attack.
- Severity: determine the overall criticality of the risk.

Likelihood and impact are categorized into three ratings: High, Medium and Low. Severity is determined by likelihood and impact and can be classified into four categories accordingly, Critical, High, Medium, Low shown in table 1.1.

Table 1.1: Overall Risk Severity

To evaluate the risk, we will be going through a list of items, and each would be labelled with a severity category. The audit was performed with a systematic approach guided by a comprehensive assessment list carefully designed to identify known and impactful security issues. If our tool or analysis does not identify any issue, the contract can be considered safe regarding the assessed item. For any discovered issue, we might further deploy contracts on our private test environment and run tests to confirm the findings. If necessary, we would additionally build a PoC to demonstrate the possibility of exploitation. The concrete list of check items is shown in Table 1.2.

- Basic Coding Bugs: We first statically analyze given smart contracts with our proprietary static code analyzer for known coding bugs, and then manually verify (reject or confirm) all the issues found by our tool.

- Code and business security testing: We further review business logics, examine system operations, and place DeFi-related aspects under scrutiny to uncover possible pitfalls and/or bugs.

- Additional Recommendations: We also provide additional suggestions regarding the coding and development of smart contracts from the perspective of proven programming practices.

Category	Assessment Item
Basic Coding Assessment	Apply Verification Control
	Authorization Access Control
	Forged Transfer Vulnerability
	Forged Transfer Notification
	Numeric Overflow
	Transaction Rollback Attack
	Transaction Block Stuffing Attack
	Soft fail Attack
	Hard fail Attack
	Abnormal Memo
	Abnormal Resource Consumption
	Secure Random Number
Advanced Source Code Scrutiny	Asset Security
	Cryptography Security
	Business Logic Review
	Source Code Functional Verification
	Account Authorization Control
	Sensitive Information Disclosure

	Circuit Breaker
	Blacklist Control
	System API Call Analysis
	Contract Deployment Consistency Check
Additional Recommendations	Semantic Consistency Checks
	Following Other Best Practices

Table 1.2: The Full List of Assessment Items

To better describe each issue we identified, we categorize the findings with Common Weakness Enumeration (CWE-699) [14], which is a community-developed list of software weakness types to better delineate and organize weaknesses around concepts frequently encountered in software development.

2 Findings Overview

2.1 Project info and Contract address

Project Name: Connexion

Project URL: https://github.com/Connector-Gamefi/ConnectorContract

Audit Time: 2022/12.21 - 2022/12.28

Language: solidity

Commit Hash: 236661f02d66bcf46cd4f6a72a833f5e9bbc581b

Contract Name	Source Code Link
GameLoot.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLoot.sol
GameLootEquipment.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLootEquipment.sol
GameLootGameMinter.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLootGameMinter.sol
GameLootSeller.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLootSeller.sol
GameLootTimelocker.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLootTimelocker.sol
GameLootTreasure.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameLootTreasure.sol
IGameLoot.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/IGameLoot.sol

GameERC721Factory.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameERC721Factory.sol
GameERC721Proxy.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameERC721Proxy.sol
GameERC721Token.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameERC721Token.sol
GameERC721Treasure.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameERC721Treasure.sol
GameERC20Treasure.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameERC20Treasure.sol
GameDaoFixedNFT.sol	https://github.com/Connector-Gamefi/ConnectorContract/blob/main/contracts/GameDaoFixedNFT.sol

2.2 SUMMARY

Severity	Found	
Critical	0	
High	0	
Medium	4	
Low	0	
Informational	0	

2.3 KEY FINDINGS

Four Medium severities findings are related to owner authority, centralized risk.

ID	Severity	Findings Title	Status	Confirm
NVE-001	Medium	Signer has higher authority	Ignore	Confirmed
NVE-002	Medium	Signer has higher authority	Ignore	Confirmed
NVE-003	Medium	Signer has higher authority	Ignore	Confirmed
NVE-004	Medium	Admin has higher authority	Fixed	Confirmed

Table 2.1: Key Audit Findings

3 Detailed Description of Findings

3.1 Signer has higher authority

ID: NVE-001

Location: GameERC20Treasure.sol

Severity: Medium

Category: Authority Issues

Likelihood: Medium

Impact: Medium

Description:

The function of the GameERC20Treasure contract is mainly for users to recharge to the chain and withdraw. upChain is essentially designed for users to withdraw cash, and the data signed by the signer will be verified on the chain, but the signer can call it by itself to withdraw the current contract address Any asset under . So this process involves centralization risk.The specific code segment is shown in the Figure 1.

```
function upChain(
    uint256 _amount,
    uint256 _nonce,
    bytes memory _signature
) public nonceNotUsed(_nonce) whenNotPaused {
    require(verify(msg.sender, address(this), token, _amount, _nonce, this.upChain.selector, _signature), "sign is not correct");
    usedNonce[_nonce] = true;

    IERC20(token).safeTransfer(msg.sender, _amount);
    emit UpChain(msg.sender, _amount, _nonce);
}
```

Figure 1 function upChain

Recommendations:

Numen Cyber Lab recommends proper management of private keys.

Result: Pass

Fix Result:

Ignore (After communicating with the project party, the private key of the signer is stored on the back-end server and stored in segments. If a signature request is required, the private key is calculated by an algorithm and then signed.)

3.2 SIGNER HAS HIGHER AUTHORITY

ID: NVE-002

Location: GameERC721Treasure.sol

Severity: Medium

Category: Authority Issues

Likelihood: Medium

Impact: Medium

Description:

The GameERC721Treasure contract mainly deals with the on-chain and withdrawal of ERC721 assets. Users can use the upChain and upChainBatch functions for single and batch withdrawals, and the submitted data must be signed by the signer and verified on the chain. But the signer can call these two functions to pass the signature verification and withdraw the ERC721 assets under the current contract address. The specific code segment is shown in the Figure 2, Figure 3.

```
function upChain(
    address _token,
    uint256 _tokenID,
    uint256 _nonce,
    bytes memory _signature
) public whenNotPaused nonceNotUsed(_nonce) {
    require(
        verify(
            msg.sender,
            address(this),
            _token,
            _tokenID,
            _nonce,
            _signature
        ),
        "sign is not correct"
    );
    usedNonce[_nonce] = true;

    IERC721(_token).transferFrom(address(this), msg.sender, _tokenID);

    emit UpChain(msg.sender, _token, _tokenID, _nonce);
}
```

Figure 2 function upChain

```
function upChainBatch(
    address[] memory _tokens,
    uint256[] memory _tokenIDs,
    uint256 _nonce,
    bytes memory _signature
) public whenNotPaused nonceNotUsed(_nonce) {
    require(
        verify(
            msg.sender,
            address(this),
            _tokens,
            _tokenIDs,
            _nonce,
            _signature
        ),
        "sign is not correct"
    );
    usedNonce[_nonce] = true;

    for (uint256 i; i < _tokens.length; i++) {
        IERC721(_tokens[i]).transferFrom(
            address(this),
            msg.sender,
            _tokenIDs[i]
        );
    }
    emit UpChainBatch(msg.sender, _tokens, _tokenIDs, _nonce);
}
```

Figure 3 function upChainBatch

Recommendations:

Numen Cyber Lab recommends proper management of private keys.

Result: Pass

Fix Result:

Ignore (After communicating with the project party, the private key of the signer is stored on the back-end server and stored in segments. If a signature request is required, the private key is calculated by an algorithm and then signed.)

3.3 SIGNER HAS HIGHER AUTHORITY

ID: NVE-003 Location: GameLootTreasure.sol

Severity: Medium Category: Authority Issues

Likelihood: Medium

Impact: Medium

Description:

The GameLootTreasure contract is mainly used to handle the deposit and withdrawal of ERC721 assets, uploading to the chain and withdrawing to users. The withdrawal operation is completed by calling upChain and upChainBatch, and then the signer signs and verifies the signature on the chain. Similarly, the signer can call the above function by itself, and can withdraw the ERC721 assets under the current contract address. The specific code segment is shown in the Figure 4, Figure 5.

```
function upChain(
    address _token,
    uint256 _tokenID,
    uint256 _nonce,
    uint128[] memory _attrIDs,
    uint128[] memory _attrValues,
    uint256[] memory _attrIndexesUpdate,
    uint128[] memory _attrValuesUpdate,
    uint256[] memory _attrIndexesRM,
    bytes memory _signature
) public whenNotPaused nonceNotUsed(_nonce) {
    require(verify(msg.sender, address(this), _token, _tokenID, _nonce, _attrIDs, _attrValues, _attrIndexesUpdate, _attrValuesUpdate, _attrIndexesRM, _signature), "sign is not correct");
    usedNonce[_nonce] = true;

    IERC721(_token).transferFrom(address(this), msg.sender, _tokenID);

    if (_attrIDs.length != 0)
        IGameLoot(_token).attachBatch(_tokenID, _attrIDs, _attrValues);

    if (_attrIndexesUpdate.length != 0)
        IGameLoot(_token).updateBatch(_tokenID, _attrIndexesUpdate, _attrValuesUpdate);

    if (_attrIndexesRM.length != 0)
        IGameLoot(_token).removeBatch(_tokenID, _attrIndexesRM);
    emit UpChain(msg.sender, _token, _tokenID, _nonce);
}
```

Figure 4 function upChain

```
function (
    address[] memory _tokens,
    uint256[] memory _tokenIDs,
    uint256 _nonce,
    uint128[][] memory _attrIDs,
    uint128[][] memory _attrValues,
    uint256[][] memory _attrIndexesUpdate,
    uint128[][] memory _attrValuesUpdate,
    uint256[][] memory _attrIndexesRMs,
    bytes memory _signature
) public whenNotPaused nonceNotUsed(_nonce) {
    require(verify(msg.sender, address(this), _tokens, _tokenIDs, _nonce, _attrIDs, _attrValues, _attrIndexesUpdate, _attrValuesUpdate, _attrIndexesRMs, _signature), "sign is not correct");
    usedNonce[_nonce] = true;

    for (uint256 i; i < _tokens.length; i++) {
        IERC721(_tokens[i]).transferFrom(address(this), msg.sender, _tokenIDs[i]);

        if (_attrIDs[i].length != 0)
            IGameLoot(_tokens[i]).attachBatch(_tokenIDs[i], _attrIDs[i], _attrValues[i]);

        if (_attrIndexesUpdate[i].length != 0)
            IGameLoot(_tokens[i]).updateBatch(_tokenIDs[i], _attrIndexesUpdate[i], _attrValuesUpdate[i]);

        if (_attrIndexesRMs[i].length != 0)
            IGameLoot(_tokens[i]).removeBatch(_tokenIDs[i], _attrIndexesRMs[i]);
    }
    emit UpChainBatch(msg.sender, _tokens, _tokenIDs, _nonce);
}
```

Figure 5 function upChainBatch

Recommendations:

Numen Cyber Lab recommends proper management of private keys.

Result: Pass

Fix Result:

Ignore (After communicating with the project party, the private key of the signer is stored on the back-end server and stored in segments. If a signature request is required, the private key is calculated by an algorithm and then signed.)

3.4 ADMIN HAS HIGHER AUTHORITY

ID: NVE-004

Location: GameLootTimelocker.sol

Severity: Medium

Category: Authority Issues

Likelihood: Medium

Impact: Medium

Description:

The GameLootTimelocker contract is a time lock. As a governance role, it manages multiple contracts. The settings of the GameERC20Treasure,GameERC721Treasure, and GameLootTreasure contracts are all authenticated by the signer to determine whether msg.sender is a TimeLock. The essence of time lock is to add a time delay when the project party performs some sensitive operations to give users time to react. However, the admin of the GameLootTimelocker contract can set the delay of the time lock to 0 through setDelay. In this case, the time lock exists but loses its meaning, so there is a risk of centralization. The specific code segment is shown in the Figure 6, Figure 7.

```
function setDelay(uint256 delay_) public {
    require(
        msg.sender == admin,
        "GameLootTimelocker: Call must come from admin."
    );
    require(delaySwitch, "switch is not open");
    delay = delay_;
    emit NewDelay(delay);
}
```

Figure 6 function setDelay

```
function setSigner(address signer, bool isOk) public onlyTimelocker {
    signers[signer] = isOk;
}
```

Figure 7 function setSigner(The three contracts GameERC20Treasure, GameERC721Treasure, and GameLootTreasure set the signer method, and msg.sender needs to be authenticated.)

Recommendations:

Numen Cyber Lab recommends proper management of private keys.

Result: Pass

Fix Result:

Fixed.The project side modified the TimeLcok code, and the delay is passed in through the constructor and cannot be changed.And the admin of Timelock will be controlled by Gnosis multi-signature.The specific code segment is shown in the Figure 8.

Codelink:https://github.com/Connector-Gamefi/ConnexionContract/blob/main/contracts/GameLootTimelocker.sol

Commit Hash:595265c5bb981616f2985d917a5c263e61ddcb75

```
constructor(uint256 delay_) {
    admin = msg.sender;
    delay = delay_;
}
```

Figure 8 function constructor

4 CONCLUSION

In this audit, we thoroughly analyzed Connexion smart contract implementation. The problems found are described and explained in detail in Section 3. The problems found in the audit have been brought up to the project party, ignored issues are in line with the project design, and permissions are only used for the project to properly function. We therefore deem the audit result to be a **PASS.** To improve this report, we greatly appreciate any constructive feedbacks or suggestions, on our methodology, audit findings, or potential gaps in scope/coverage.

5 APPENDIX

5.1 BASIC CODING ASSESSMENT

5.1.1 Apply Verification Control

- Description: The security of apply verification
- Result: Not found
- Severity: Critical

5.1.2 Authorization Access Control

- Description: Permission checks for external integral functions
- Result: Not found
- Severity: Critical

5.1.3 Forged Transfer Vulnerability

- Description: Assess whether there is a forged transfer notification vulnerability in the contract
- Result: Not found
- Severity: Critical

5.1.4 Transaction Rollback Attack

- Description: Assess whether there is transaction rollback attack vulnerability in the contract.
- Result: Not found
- Severity: Critical

5.1.5 Transaction Block Stuffing Attack

- Description: Assess whether there is transaction blocking attack vulnerability.
- Result: Not found
- Severity: Critical

5.1.6 soft fail Attack Assessment

- Description: Assess whether there is soft fail attack vulnerability.
- Result: Not found
- Severity: Critical

5.1.7 hard fail Attack Assessment

- Description: Examine for hard fail attack vulnerability
- Result: Not found
- Severity: Critical

5.1.8 Abnormal Memo Assessment

- Description: Assess whether there is abnormal memo vulnerability in the contract.
- Result: Not found
- Severity: Critical

5.1.9 Abnormal Resource Consumption

- Description: Examine whether abnormal resource consumption in contract processing.
- Result: Not found
- Severity: Critical

5.1.10 Random Number Security

- Description: Examine whether the code uses insecure random number.
- Result: Not found
- Severity: Critical

5.2 Advanced Code Scrutiny

5.2.1 Cryptography Security

- Description: Examine for weakness in cryptograph implementation.
- Results: Not Found
- Severity: High

5.2.2 Account Permission Control

- Description: Examine permission control issue in the contract
- Results: Not Found
- Severity: Medium

5.2.3 Malicious Code Behaviour

- Description: Examine whether sensitive behaviour present in the code
- Results: Not found
- Severity: Medium

5.2.4 Sensitive Information Disclosure

- Description: Examine whether sensitive information disclosure issue present in the code.
- Result: Not found
- Severity: Medium

5.2.5 System API

- Description: Examine whether system API application issue present in the code
- Results: Not found
- Severity: Low

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This report should not be used in any way to make decisions around investment or involvement with any particular project. This report in no way provides investment advice, nor should be leveraged as investment advice of any sort. This report represents an extensive assessing process intending to help our customers increase the quality of their code while reducing the high level of risk presented by cryptographic tokens and blockchain technology.

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