

TENET - LLSD Contracts

Smart Contract Security Assessment

Prepared by: Halborn

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EXECUTIVE OVERVIEW

1.1 INTRODUCTION

Tenet is a PoS blockchain that innovatively allows not only its native token TENET to maintain network security, but also allows the Omni-Chain tLSD token to protect the network. The LLSD contracts allow users to participate in the PoS and earn rewards proportionally to their stake by delegating their stake to the validators.

TENET engaged Halborn to conduct a security assessment on their LLSD smart contracts beginning on July 3rd, 2023 and ending on July 5th, 2023. The security assessment was scoped to the smart contracts provided to the Halborn team.

1.2 ASSESSMENT SUMMARY

The team at Halborn was provided 3 days for the engagement and assigned a full-time security engineer to assessment the security of the smart contract. The security engineer is a blockchain and smart-contract security expert with advanced penetration testing, smart-contract hacking, and deep knowledge of multiple blockchain protocols.

The purpose of this assessment is to:

- Ensure that smart contract functions operate as intended.
- Identify potential security issues with the smart contracts.

In summary, Halborn did not identify any security risk.

1.3 SCOPE

1. IN-SCOPE:

The security assessment was scoped to the following smart contracts:

- contracts/Factory.sol.
- contracts/Interfaces.sol.
- contracts/TLSD.sol.

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1.4 TEST APPROACH & METHODOLOGY

Halborn performed a combination of manual and automated security testing to balance efficiency, timeliness, practicality, and accuracy in regard to the scope of this assessment. While manual testing is recommended to uncover flaws in logic, process, and implementation; automated testing techniques help enhance coverage of the bridge code and can quickly identify items that do not follow security best practices. The following phases and associated tools were used throughout the term of the assessment:

- Research into architecture and purpose.
- Smart contract manual code review and walkthrough.
- Graphing out functionality and contract logic/connectivity/functions. (solgraph)
- Manual assessment of use and safety for the critical Solidity variables and functions in scope to identify any arithmetic related vulnerability classes.
- Manual testing by custom scripts.
- Scanning of solidity files for vulnerabilities, security hotspots or bugs. (MythX)
- Static Analysis of security for scoped contract, and imported functions. (Slither)
- Testnet deployment. (Foundry)

2. RISK METHODOLOGY

Every vulnerability and issue observed by Halborn is ranked based on **two sets** of **Metrics** and a **Severity Coefficient**. This system is inspired by the industry standard Common Vulnerability Scoring System.

The two Metric sets are: Exploitability and Impact. Exploitability captures the ease and technical means by which vulnerabilities can be exploited and Impact describes the consequences of a successful exploit.

The **Severity Coefficients** is designed to further refine the accuracy of the ranking with two factors: **Reversibility** and **Scope**. These capture the impact of the vulnerability on the environment as well as the number of users and smart contracts affected.

The final score is a value between 0-10 rounded up to 1 decimal place and 10 corresponding to the highest security risk. This provides an objective and accurate rating of the severity of security vulnerabilities in smart contracts.

The system is designed to assist in identifying and prioritizing vulnerabilities based on their level of risk to address the most critical issues in a timely manner.

2.1 EXPLOITABILITY

Attack Origin (AO):

Captures whether the attack requires compromising a specific account.

Attack Cost (AC):

Captures the cost of exploiting the vulnerability incurred by the attacker relative to sending a single transaction on the relevant blockchain. Includes but is not limited to financial and computational cost.

Attack Complexity (AX):

Describes the conditions beyond the attacker's control that must exist in order to exploit the vulnerability. Includes but is not limited to macro situation, available third-party liquidity and regulatory challenges.

Metrics:

Exploitability Metric (m_E)	Metric Value	Numerical Value
Attack Origin (AO)	Arbitrary (AO:A)	1
Actack Origin (AO)	Specific (AO:S)	0.2
	Low (AC:L)	1
Attack Cost (AC)	Medium (AC:M)	0.67
	High (AC:H)	0.33
	Low (AX:L)	1
Attack Complexity (AX)	Medium (AX:M)	0.67
	High (AX:H)	0.33

Exploitability ${\it E}$ is calculated using the following formula:

$$E = \prod m_e$$

2.2 IMPACT

Confidentiality (C):

Measures the impact to the confidentiality of the information resources managed by the contract due to a successfully exploited vulnerability. Confidentiality refers to limiting access to authorized users only.

Integrity (I):

Measures the impact to integrity of a successfully exploited vulnerability. Integrity refers to the trustworthiness and veracity of data stored and/or processed on-chain. Integrity impact directly affecting Deposit or Yield records is excluded.

Availability (A):

Measures the impact to the availability of the impacted component resulting from a successfully exploited vulnerability. This metric refers to smart contract features and functionality, not state. Availability impact directly affecting Deposit or Yield is excluded.

Deposit (D):

Measures the impact to the deposits made to the contract by either users or owners.

Yield (Y):

Measures the impact to the yield generated by the contract for either users or owners.

Metrics:

Impact Metric (m_I)	Metric Value	Numerical Value
	None (I:N)	0
	Low (I:L)	0.25
Confidentiality (C)	Medium (I:M)	0.5
	High (I:H)	0.75
	Critical (I:C)	1
	None (I:N)	0
	Low (I:L)	0.25
Integrity (I)	Medium (I:M)	0.5
	High (I:H)	0.75
	Critical (I:C)	1
	None (A:N)	0
	Low (A:L)	0.25
Availability (A)	Medium (A:M)	0.5
	High (A:H)	0.75
	Critical	1
	None (D:N)	0
	Low (D:L)	0.25
Deposit (D)	Medium (D:M)	0.5
	High (D:H)	0.75
	Critical (D:C)	1
	None (Y:N)	0
	Low (Y:L)	0.25
Yield (Y)	Medium: (Y:M)	0.5
	High: (Y:H)	0.75
	Critical (Y:H)	1

Impact ${\it I}$ is calculated using the following formula:

$$I = max(m_I) + \frac{\sum m_I - max(m_I)}{4}$$

2.3 SEVERITY COEFFICIENT

Reversibility (R):

Describes the share of the exploited vulnerability effects that can be reversed. For upgradeable contracts, assume the contract private key is available.

Scope (S):

Captures whether a vulnerability in one vulnerable contract impacts resources in other contracts.

Coefficient (C)	Coefficient Value	Numerical Value
	None (R:N)	1
Reversibility (r)	Partial (R:P)	0.5
	Full (R:F)	0.25
Scope (a)	Changed (S:C)	1.25
Scope (s)	Unchanged (S:U)	1

Severity Coefficient C is obtained by the following product:

C = rs

The Vulnerability Severity Score ${\cal S}$ is obtained by:

S = min(10, EIC * 10)

The score is rounded up to 1 decimal places.

Severity	Score Value Range
Critical	9 - 10
High	7 - 8.9
Medium	4.5 - 6.9
Low	2 - 4.4
Informational	0 - 1.9

3. ASSESSMENT SUMMARY & FINDINGS OVERVIEW

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL
0	0	0	0	0

MANUAL TESTING

The main goal of the manual testing performed during this assessment was to test all the functionalities regarding the TENET LLSD contracts, focusing on the following points/scenarios:

- 1. Testing the critical and basic protocol functionalities (delegate native and non-native tokens, undelegating native and non-native tokens, increasing, and decreasing delegations).
- 2. Tests focused on user's delegation to validators (holder of TENET tokens and holder of LSD tokens participating in the Diversified PoS consensus mechanism and earning a portion of staking rewards).
- 3. Tests focused on user's undelegation from validators (holders of TLSD tokens undelegating completely or a portion of their stake from the network).
- 4. Tests focused on claiming validators rewards (claiming delegation rewards earned by a specific validator using a TLSD token).
- 5. Tests focused on the creation of new TLSD tokens within the contract (issuing new TLSD tokens from the TLSDFactory contract by delegating previously whitelisted assets to the PoS mechanism).
- 6. Tests focused on the difference between issue and issueNative functionalities (using the different Cosmos SDK modules, alliance and staking modules, and analyzing the differences between them at the precompile level).

Test	Result
Issue tLSD tokens using a valid asset for delegation	Pass
Not possible to issue tLSD tokens for an invalid asset not	Pass
whitelisted by governance	
Not possible for the user to undelegate a greater portion than	Pass
previously obtained while delegation	
Issue tLSD tokens using the native token for delegation	Pass
Not possible to reach a DoS when users burning their tLSD tokens	Pass
previously obtained by delegation	
Users are able to change their stake from one validator to another	Pass
using the same valid asset for delegation	
Validators are able to claim their earned delegation rewards	Pass
The storage of assets and validators are properly stored and no	Pass
collision is possible	
The creation of new tLSD tokens within the contract is properly done	Pass
Not possible to exist the same validator for the same asset	Pass
delegated more than once	
Not possible to reach storage collision when assigning new validator	Pass
IDs for new validators within the contract	
The conversion from tLSD token to its validator is properly done	Pass
The conversion from tLSD token to its asset is properly done	Pass
Not possible for users to get tLSD tokens without transferring the	Pass
correct amount of the valid asset linked to that tLSD token	
Only the factory contract can mint and burn tLSD tokens	Pass

AUTOMATED TESTING

5.1 STATIC ANALYSIS REPORT

Description:

Halborn used automated testing techniques to enhance the coverage of certain areas of the scoped contracts. Among the tools used was Slither, a Solidity static analysis framework. After Halborn verified all the contracts in the repository and was able to compile them correctly into their ABI and binary formats, Slither was run on the all-scoped contracts. This tool can statically verify mathematical relationships between Solidity variables to detect invalid or inconsistent usage of the contracts' APIs across the entire code-base.

Slither results:

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Contracts/Factory. sol

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• As a result of the tests carried out with the Slither tool, some results were obtained and reviewed by Halborn. Based on the results reviewed, the vulnerabilities were determined to be false positives.

5.2 AUTOMATED SECURITY SCAN

Description:

Halborn used automated security scanners to assist with detection of well-known security issues, and to identify low-hanging fruits on the targets for this engagement. Among the tools used was MythX, a security analysis service for Ethereum smart contracts. MythX performed a scan on all the contracts and sent the compiled results to the analyzers to locate any vulnerabilities.

MythX results:

Line	SWC Title	Severity	Short Description
135	(SWC-123) Requirement Violation	Low	Requirement violation.
	src/Factory.sol shboard.mythx.io/#/console/analyse	es/4f82bb3a-	re31-469e-be6f-bc4cea628193
Line	SWC Title	Severity	Short Description
3	(SWC-103) Floating Pragma	Low	A floating pragma is set.
11	(SWC-123) Requirement Violation	Low	Requirement violation.
67	(SWC-113) DoS with Failed Call	Hedium	Multiple calls are executed in the same transaction
86	(SWC-113) DoS with Failed Call	Low	Multiple calls are executed in the same transaction
86	(SWC-107) Reentrancy	Low	A call to a user-supplied address is executed.
88	(SWC-187) Reentrancy	Nedium	Read of persistent state following external call
141	(SWC-187) Reentrancy	Low	Read of persistent state following external call.
146	(SWC-113) DoS with Failed Call	Medium	Multiple calls are executed in the same transaction
162	(SWC-107) Reentrancy	Low	Read of persistent state following external call.
164	(SWC-107) Reentrancy	Low	Read of persistent state following external call.
165	(SWC-107) Reentrancy	Low	Read of persistent state following external call.
		Low	Read of persistent state following external call.

Report for src/TLSD.sol https://dashboard.mythx.io/#/console/analyses/1032d400-bd2a-4321-89a7-746b2f5210						
Line	SWC Title	Severity	Short Description			
3	(SWC-103) Floating Pragma	Low	A floating pragma is set.			

• No major issues found by Mythx.

THANK YOU FOR CHOOSING

