SecureDapp

DApp Developers and Smart Contract Auditors

SMART CONTRACT SECURITY AUDIT

of

FILMRARE METAVERSE CONTRACTS

Smart Contract Audit of Filmrare Metaverse

October 25th, 2022 | v. 2.0

TABLE OF CONTENT

AUDIT INTRODUCTION

Auditing Firm	Secure DApp Auditors
Audit Architecture	Secure DApp Auditing Standard
Language	Solidity
Client Firm	Filmrare Metaverse (Decentraland)
Website	https://www.filmrare.com/
Twitter	https://twitter.com/filmrareNFT
Linkedin	https://www.linkedin.com/company/filmrare/
Report Date	August 03, 2022

About Filmrare

Filmrare is the leading metaverse consulting, design, and development company in India and has served global customers. It is located in part of the @sciartlab district in @decentraland.

AUDIT DOCUMENT

Name	Smart Contract Code Review and Security Analysis Report for Filmrare
Approved By	Himanshu Gautam| CTO at SecureDApp
Type	Metaverse - Decentraland Rental NFTs
Platform	EVM
Language	Solidity
Changelog	09.09.2022 – Initial Review | 28.09.2022 - Second Review 08.10.2022 - Third Review

AUDIT SCOPE

The scope of this report is to audit the smart contract source code of Filmrare Metaverse.
Our client provided us with two smart contracts.

- Filmrare.sol
- FilmrarePayments.sol

Both of the contracts were written in Solidity and based on the OpenZeppelin library.
Both of the smart contracts were to be deployed to the Polygon network. The first contract was for rental NFTs based on ERC-721 and ERC-4907 standards and the second contract was for integrating multiple onchain payment options.
After initial research, we agreed to perform the following tests and analyses as part of our well-rounded audit:

- Smart contract behavioral consistency analysis
- Test coverage analysis
- Penetration testing: checking against our database of vulnerabilities and simulating manual attacks against the contracts
- Static analysis
- Manual code review and evaluation of code quality
- Analysis of GAS usage
- Contract analysis with regards to the host network

Initial Review Scope

Repository	https://github.com/himang305/Metaverse_Contracts
Commit	fd98f0c8fb1e753b1ce1c9ebfebd07da59a66a33
Whitepaper	FilmRare Upgradeable Rental NFT Contract
Functional Requirements	Limited documentation provided. README.md
Technical Requirements	Partial documentation provided. README.md
Contracts Addresses	Not Yet Deployed
Contracts	File: ./contracts/Filmrare.sol SHA3: aead98c060fac03f407008573b1720cc2783f5ff6d0355918ed3bb4db0ed60c3 File: ./contracts/FilmrarePayments.sol SHA3: c51c85c7d583a45c75793f9dcc06bbf2dc8936652c9f3540671bc8566e2c12e8

Second Review Scope

Repository	https://github.com/himang305/Metaverse_Contracts
Commit	fd98f0c8fb1e753b1ce1c9ebfebd07da59a66a33
Whitepaper	FilmRare Upgradeable Rental NFT Contract
Functional Requirements	Limited documentation provided. README.md
Technical Requirements	Partial documentation provided. README.md
Contracts Addresses	Not Yet Deployed
Contracts	File: ./contracts/Filmrare.sol SHA3: aead98c060fac03f407008573b1720cc2783f5ff6d0355918ed3bb4db0ed60c3 File: ./contracts/FilmrarePayments.sol SHA3: c51c85c7d583a45c75793f9dcc06bbf2dc8936652c9f3540671bc8566e2c12e8

Third Review Scope

Repository	https://github.com/himang305/Metaverse_Contracts
Commit	fd98f0c8fb1e753b1ce1c9ebfebd07da59a66a33
Whitepaper	FilmRare Upgradeable Rental NFT Contract
Functional Requirements	Limited documentation provided. README.md
Technical Requirements	Partial documentation provided. README.md
Contracts Addresses(Polygon)	Filmrare Implementation Contract: 0xcedC1EeA73119C780E49cDdB0264f7A085C9f70C Filmrare Proxy Contract: 0xd349538ED22618a232204f0c9751A21977614FbE
Contracts	File: ./contracts/Filmrare.sol SHA3: aead98c060fac03f407008573b1720cc2783f5ff6d0355918ed3bb4db0ed60c3 File: ./contracts/FilmrarePayment.sol SHA3: c51c85c7d583a45c75793f9dcc06bbf2dc8936652c9f3540671bc8566e2c12e8

Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to asset loss or data manipulations.
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 functions.
Medium	Medium-level vulnerabilities are important to fix; however, they cannot lead to asset loss or data manipulations.
Low	Low-level vulnerabilities are mostly related to outdated, unused, etc. code snippets that cannot have a significant impact on execution.
Informational	Issue listed to improve understanding, readability and quality of code

All statuses which are identified in the audit report are categorized here for the reader to review:

Status Type	Definition
Open	Risks are open.
Acknowledged	Risks are acknowledged, but not fixed.
Resolved	Risks are acknowledged and fixed.

AUDIT SUMMARY

The Secure DApp team has performed a line-by-line manual analysis and automated review of smart contracts. Smart contracts were analyzed mainly for common contract vulnerabilities, exploits, and manipulation hacks. According to the audit:

Status	Critical	High	Medium	Low	Informative
Open	0	0	0	0	0
Acknowledged	1	1	0	0	0
Resolved	0	0	0	3	8

AUDIT METHODOLOGY

SecureDApp scans contracts and reviews codes for common vulnerabilities, exploits, hacks and back- doors. Mentioned are the steps used by SecureDApp to audit smart contracts:

a. Smart contract source code reviewal:
    i. Review of the specifications, sources, and instructions provided to SecureDApp to make sure we understand the audit scope, intended business behavior, overall architecture, and project's goal.
    ii. Manual review of code, which is the process of reading source code line-by-line to identify potential vulnerabilities.
b. Test coverage analysis: (Unit testing)
    i. Test coverage analysis is the process of determining whether the test cases are covering the code and how much code is exercised when we run those test cases.
c. Static analysis:
    i. Run a suite of vulnerability detectors to find security concerns in smart contracts with different impact levels.
d. Symbolically executed tests: (SMTChecker testing) (Taint analysis)
    i. Symbolic execution is analyzing a program to determine what inputs cause each part of a program to execute.
    ii. Check for security vulnerabilities using static and dynamic analysis
e. Property based analysis (Fuzz tests)(Invariant testing)
    i. Run the execution flow multiple times by generating random sequences of calls to the contract.
    ii. Asserts that all the invariants hold true for all scenarios.
f. Best practices review, which is a review of the smart contracts to improve efficiency, effectiveness, clarify, maintainability, security, and control based on the established industry and academic practices, recommendations, and research.
g. Specific, itemized, actionable recommendations to help you take steps to secure your smart contracts.

Automated 5S frameworks used to assess the smart contract vulnerabilities

- Consensys Tools
- SWC Registry
- Solidity Coverage
- Open Zeppelin Code Analyzer
- Solidity Code Compiler

We have audited the smart contracts for commonly known and more specific vulnerabilities.
Below is the list of smart contract tests, vulnerabilities, exploits, and hacks:

ID	Description	Status
EEA 3.3	Oracle Manipulation	Passed
EEA 3.3	Bad Randomness - VRF	N/A
S60	Assembly Usage	Passed
S59	Dangerous usage of block.timestamp	Passed
EEA 3.7	Front-Running Attacks	N/A
EEA 3.7	Back-Running Attacks	N/A
EEA 3.7	Sandwich Attacks	N/A
DASP	Gas Griefing Attacks	Passed
DASP	Force Feeding	Passed
SCSVS V2	Access Control	Passed
DASP	Short Address Attack	Passed
DASP	Checks Effects Interactions	Passed
EEA 4.1	No Self-destruct	Passed
SCSVS V14	Decentralized Finance Checks	Passed

Slither Tests	Checks for ERC's conformance	Passed
Coverage	Unit tests with 100% coverage	Passed
Gas Reporter	Gas usage & limitations	Passed
Echidna Tests	Malicious input handling	Passed
SWC-101	Integer Overflow and Underflow	Passed
SWC-102	Outdated Compiler Version	Passed
SWC-103	Floating Pragma	Passed
SWC-104	Unchecked Call Return Value	Passed
SWC-105	Unprotected Ether Withdrawal	Passed
SWC-106	Unprotected SELF-DESTRUCT Instruction	Passed
SWC-107	Re-entrancy	Passed
SWC-108	State Variable Default Visibility	Passed
SWC-109	Uninitialized Storage Pointer	Passed
SWC-110	Assert Violation	Passed
SWC-111	Use of Deprecated Solidity Functions	Passed
SWC-112	Delegate Call to Untrusted Callee	Passed

SWC-113	DoS with Failed Call	Passed
SWC-114	Transaction Order Dependence	Passed
SWC-115	Authorization through tx.origin	Passed
SWC-116	Block values as a proxy for time	Passed
SWC-117	Signature Malleability	Passed
SWC-134	Message call with the hardcoded gas amount	Passed
SWC-135	Code With No Effects (Irrelevant/Dead Code)	Informational
SWC-136/SCSVS V3	Unencrypted Private Data On-Chain	Passed

SYSTEM OVERVIEW

Filmrare is a Metaverse Cineplex, part of the @sciartlab district in @decentraland Metaverse.
System architect uses two core contracts. Filmrare contract is a Rental NFT UUPS Upgradeable Contract. It is based on the IERC4907 Rental NFT standard that allows users to rent spaces inside Filmrare properties in Decentraland for purposes such as Metaverse Cineplex.

FilmrarePayment contract allows users to rent out Filmrare NFTs (FRM) using various ERC-20 tokens - USDT, USDC, MATIC, BNB etc. It uses chainlink feed to get the real time prices for determining the payments. The scope of the audit is Filmrare.sol and FilmrarePayments.sol.

Privileged roles

1. DEFAULT_ADMIN_ROLE:
    a. UUPS Upgrade Strategy
2. ORACLE_ROLE:
    a. Providing real time prices of Onchain Payment Tokens (USDC, USDT, MATIC, BNB)
3. PLATFORM_ADMIN:
    a. Mint and Burn : FRM_NFTs

Risk

1. The impact of ORACLE_ROLE being compromised would have a huge impact on the protocol.
2. Centralization risk is the most common cause of cryptography asset loss
3. Compromising the DEFAULT_ADMIN_ROLE may lead to all user's asset loss.
4. Contract upgradeability allows privileged roles to change current contract implementation which negatively elevates centralization risk.

FINDINGS

Centralization Risk

Centralization risk is the most common cause of dapp's hacks. When a smart contract has an active contract ownership, the risk related to centralization is elevated. There are some well-intended reasons to be an active contract owner, such as:

- Contract owners can be granted the power to pause() or lock() the contract in case of an external attack.
- Contract owners can use functions like, include(), and exclude() to add or remove wallets from fees, swap checks, and transaction limits. This is useful to run a presale, and to list on an exchange.

Authorizing a full centralized power to a single body can be dangerous. Unfortunately, centralization related risks are higher than common smart contract vulnerabilities. Centralization of ownership creates a risk of rug pull scams, where owners cash out tokens in such quantities that they become valueless. Most important question to ask here is, how to mitigate centralization risk? Here's SecureDApp's recommendation to lower the risks related to centralization hacks:

- Smart contract owner's private key must be carefully secured to avoid any potential hack.
- Smart contract ownership should be shared by multi-signature (multi-sig) wallets.
- Smart contract ownership can be locked in a contract, user voting, or community DAO can be introduced to unlock the ownership.

Filmrare's Centralization Status

- Filmrare's smart contract has DEFAULT_ADMIN_ROLE and PLATFORM_ADMIN roles.
- Smart contract ownership is set to 0xaEE653F4DC905Df377015f4bd3E1854Fe439BB41 at the time of the audit.

STATIC ANALYSIS REPORT

| Symbol | Meaning |

|:--------:|-----------|

| 🛑 | Function can modify state |

| 💵 | Function is payable |

| Contract | Type | Bases |

Filmrare | Implementation | Initializable, UUPSUpgradeable, ERC721Upgradeable, ERC721URIStorageUpgradeable, ERC721BurnableUpgradeable, AccessControlUpgradeable |||

Function Name | **Visibility** | **Mutability** | **Modifiers** |

| └ | _initializer | External ❗ | 🛑 | initializer |

| └ | changeAdmin | External ❗ | 🛑 |NO ❗ |

| └ | rentNFT | External ❗ | 🛑 | onlyRole |

| └ | _burn | Internal 🔒 | 🛑 | |

| └ | tokenURI | Public ❗ | | NO ❗ |

| └ | setTokenURI | External ❗ | 🛑 | NO ❗ |

| └ | batchMint | External ❗ | 🛑 | onlyRole |

| └ | safeMint | Public ❗ | 🛑 | onlyRole |

| └ | updatePrices | Public ❗ | 🛑 | onlyRole |

| └ | safeTransferFrom | Public ❗ | 🛑 | onlyRole |

| └ | transferFrom | Public ❗ | 🛑 | NO ❗ |

| └ | supportsInterface | Public ❗ | | NO ❗ |

| └ | _authorizeUpgrade | Internal 🔒 | 🛑 | onlyRole |

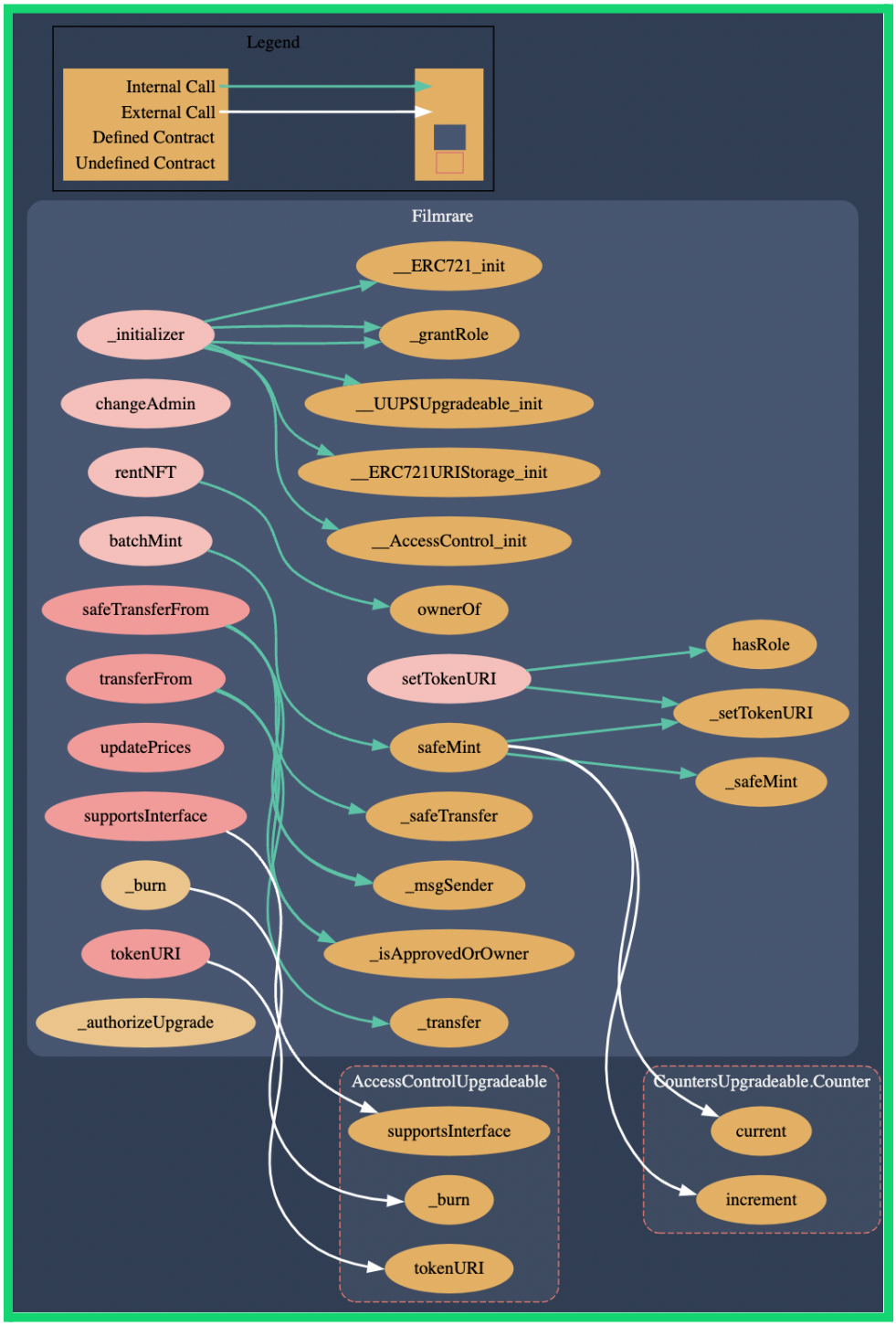
||||||

DYNAMIC TEST REPORT

TRANSACTION GAS CHART

Solc version: 0.8.13	Optimizer enabled: false	Runs: 200	Block limit: 30000000 gas			
Methods		1 gwei/gas			1463.24 usd/eth	
Contract	**Method**	Min	Max	Avg	# calls	usd (avg)
ERC721Upgradeable	transferFrom	–	–	70339	2	0.10
Filmrare	batchMint	–	–	562098	1	0.82
Filmrare	burn	–	–	40064	2	0.06
Filmrare	changeAdmin	–	–	32109	2	0.05
Filmrare	grantRole	–	–	56927	2	0.08
Filmrare	rentNFT	–	–	81216	1	0.12
Filmrare	safeMint	–	–	160459	1	0.23
Filmrare	upgradeTo	–	–	40174	7	0.06
Deployments					**% of limit**	
Filmrare		–	–	5021971	16.7 %	7.35
Filmrare2		–	–	5035381	16.8 %	7.37

INHERITANCE GRAPH - CALL GRAPH



MANUAL REVIEW

Identifier	Definition	Severity
CEN-01	Centralization privileges of Filmrare Admins	High

Centralized privileges are listed below:

AuthorizeUpgrade()
BatchMinting()
BurnNFTs()
grantRole()
changeAdmin()

RECOMMENDATION

Deployer, contract owner, role, and access control privileges must be authenticated and their private keys should be secured carefully. Please refer to CENTRALIZED PRIVILEGES for a detailed understanding.

Status: Acknowledged

According to the project team, Multi-sig wallet plans are on the roadmap to lower centralization related risks.

Identifier	Definition	Severity
CEN-02	Use of proxy and upgradeable contracts	Critical

Privileged roles can initiate contract implementation. Contract upgradeability allows privileged roles to change current contract implementation.

RECOMMENDATION

Test and validate the current contract thoroughly before deployment. Future contract upgradeability negatively elevates centralization risk.

Status: ACKNOWLEDGEMENT

According to the project team, Filmrare is currently in the development phase, hence contract upgradeability is required for future development.

Identifier	Definition	Severity
OPT-01	Filmrare.updatePrices(uint256,uint256,uint256,uint256) should be declared external (Gas Optimization)	Optimization

RECOMMENDATION

Declare Filmrare.updatePrices external

Status: Resolved

Revised commit: 099142e81032c0345673d4dad6b5520803141a99

Identifier	Definition	Severity
LOW-01	Reentrancy in Filmrare.safeMint	Low

State variables written after the external call(s):

- _setTokenURI(tokenId,uri) (projects/test1/contracts/token.sol#2320)
- _tokenURIs[tokenId] = _tokenURI (projects/test1/contracts/token.sol#1812)
- nft.mnPrice = _mnPrice (projects/test1/contracts/token.sol#2323)
- nft.yrPrice = _yrPrice (projects/test1/contracts/token.sol#2324)
- nft.price = _price (projects/test1/contracts/token.sol#2325)

RECOMMENDATION

Apply the check-effects-interactions pattern

Status: Resolved

Revised commit: 099142e81032c0345673d4dad6b5520803141a99

Identifier	Definition	Severity
LOW-02	Unclear error messages	Low

RECOMMENDATION

Provide accurate information strings for require related errors.

Status: Resolved

Revised commit: 099142e81032c0345673d4dad6b5520803141a99

Identifier	Definition	Severity
LOW-03	Timestamp manipulation via block.timestamp	Low

Be aware that the timestamp of the block can be manipulated by a miner. When the contract uses the timestamp to seed a random number, the miner can actually post a timestamp within 15 seconds of the block being validated, effectively allowing the miner to precompute an option more favorable to their chances, this is a critical exploit for contracts calculating random numbers, e.g., lottery.

RECOMMENDATION

To maintain block integrity, follow the 15 seconds rule, and scale time dependent events accordingly.

Status: Acknowledged

block.timestamp is required and kept as-is by the project team.

Identifier	Definition	Severity
INF-01	Invalid Solidity Naming Conventions	Informational

- Struct Filmrare.nftDetailStruct is not in CapWords
- Function/Parameters not in mixedCase
    - Filmrare._initializer(string,string)
    - Filmrare.changeAdmin(address)._newAdmin
    - Filmrare.setTokenURI(uint256,string)._tokenURI
    - Filmrare.batchMint(string[],uint256[],uint256[],uint256[])._tokenURI
    - Filmrare.batchMint(string[],uint256[],uint256[],uint256[])._mnPrice
    - Filmrare.batchMint(string[],uint256[],uint256[],uint256[])._yrPrice
    - Filmrare.batchMint(string[],uint256[],uint256[],uint256[])._price

RECOMMENDATION

Apply the Solidity Naming Conventions

Status: Resolved

Revised commit: 099142e81032c0345673d4dad6b5520803141a99

UNIT TEST REPORT

```
 Filmrare_NFT_Testing
Active Address:0xf39Fd6e51aad88F6F4ce6aB8827279cffFb92266
Duplicate definition of AdminChanged (AdminChanged(address), AdminChanged(address,address))
Duplicate definition of AdminChanged (AdminChanged(address), AdminChanged(address,address))
0xe7f1725E7734CE288F8367e1Bb143E90bb3F0512  Rental(proxy) address
0x5FbDB2315678afecb367f032d93F642f64180aa3  getImplementationAddress
   ✔ Deployed Successfully
   ✔ Minting NFTs
   ✔ Bulk Minting NFTs
   ✔ Renting NFTs by Admin
   ✔ Renting NFTs by Users
   ✔ Token URI changing
   ✔ Transferring Rented NFTs
   ✔ Rerent NFTs
   ✔ Burn NFTs
   ✔ Change Admin
   ✔ Grant Role
   ✔ Upgrade Implementation
   ✔ Verify Proxy Switch to New Implementation


 13 passing (1s)
```

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SecureDApp Auditors provides the easy-to-understand audit of solidity source codes (commonly known as smart contracts).

The smart contract for this particular audit was analyzed for common contract vulnerabilities, and centralization exploits. This audit report makes no statements or warranties on the security of the code. This audit report does not provide any warranty or guarantee regarding the absolute bug-free nature of the smart contract analyzed, nor do they provide any indication of the client's business, business model or legal compliance. This audit report does not extend to the compiler layer, any other areas beyond the programming language, or other programming aspects that could present security risks. Cryptographic tokens are emergent technologies, they carry high levels of technical risks and uncertainty. You agree that your access and/or use, including but not limited to any services, reports, and materials, will be at your sole risk on an as-is, where-is, and as-available basis. This audit report could include false positives, false negatives, and other unpredictable results.

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SecureDApp is built by a decentralized team of UI experts, contributors, engineers, and enthusiasts from all over the world. Our team currently consists of 6+ core team members, and 10+ casual contributors. SecureDApp provides manual, static, and automatic smart contract analysis, to ensure that the project is checked against known attacks and potential vulnerabilities.

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