



Matrix Chain

Security Assessment

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Prepared for: Matrix Chain

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WE SECURE YOUR  
SMART CONTRACTS



## About Truscova

Founded in last quarter of 2022 and headquartered in Bremen, Germany, Truscova aims to secure Web 3.0 by providing security assessment, audit, advisory and training services using formal verification and other leading technologies. Truscova founders include eminent scientists with more than 35 books, several patents, and more than 20,000 google scholar citations in the areas of verification, testing, security, and machine learning.

We focus on smart contracts testing and code review projects in Ethereum ecosystem, supporting client organizations in technology, defense, and finance industries, as well as government entities. We specialize in applying formal verification, dynamic analysis, fuzz testing, metamorphic testing, advanced coverage metrics, and static analysis to secure Web 3.0 projects.

We maintain an exhaustive list of publications at <https://github.com/Truscova>, with links to papers, presentations, public audit reports, and blog articles.

To explore our latest news and developments, please follow @truscova on [Twitter](#) or [LinkedIn](#). You can also explore our repository at <https://github.com/Truscova> or blog articles at <https://truscova.com/blog.php>. To engage us directly, visit our “Contact” page at <https://www.truscova.com/>.

## Notices and Remarks

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### Test Coverage Disclaimer

All activities undertaken by Truscova in this project were performed in accordance with terms of the project agreement.

Truscova uses a combination of automated testing techniques and manual inspection to conduct security assessments and identify security flaws of the target system. Each method carries its own limitations.

Security assessments are time bound (hence not exhaustive) and are reliant on information provided by the client. As a result, the findings documented in this report should not be considered a comprehensive list of security issues, flaws, or defects in the target system or codebase.

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## Executive Summary

### Engagement Overview and Scope

Matrix Chain engaged Truscova GmbH from 24<sup>th</sup> November 2023 till 8<sup>th</sup> December 2023 to review and audit the code base provided via online deployed contract available at following address:

[0x67009eB16ff64d06b4F782b3c552b924B1D1bb93](https://matrixchain.com/contracts/0x67009eB16ff64d06b4F782b3c552b924B1D1bb93)

The scope of audit is limited to the following:

- MTCToken

One security expert at Truscova audited the above code base using static analysis, fuzzing, proprietary Truscova Tools, and manual inspection. A summary of findings is discussed in the next subsection.

### Summary of Findings

The uncovered vulnerabilities in codebase during the course of the audit are summarized in the following table:

Vulnerability Classification		Vulnerability Categorization	
Classification	Count	Category	Count
High	1	Arithmetic	1
Informational	1	Dead code	1

## Project Summary

### Contact Information

Following officials from Truscova participated in this project.

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Project Coordination

Security Assessment Expert

### Project Timeline

The significant project events and milestones are as follows:

Date	Event
23 <sup>rd</sup> November, 2023	First Contact
24 <sup>th</sup> November, 2023	Contract Agreement
24 <sup>th</sup> November, 2023	Assessment Start
05 <sup>th</sup> December, 2023	Assessment Complete
07 <sup>th</sup> December, 2023	Final Audit Report Submitted



## Project Goals

The engagement was scoped to assess the security of Matrix Chain token MTC contracts. Specifically, we focused to answer the following non-exhaustive list of questions:

- Are there appropriate access controls in place?
- Are user-provided parameters sufficiently validated?
- Are the arithmetic calculations and state changes performed during token purchases, correct?
- Could an attacker steal funds from the system?
- Could an attacker take over the contract's ownership?
- How does the minting of tokens work?
- Are there any centralization risks?

## Project Targets

The engagement involved a review and testing of the following targets:

Matrix Chain MTC Token

1. Contract [0x67009eB16ff64d06b4F782b3c552b924B1D1bb93](#)

Codebase Type: Solidity

Platform: BNB Smart Chain



## Project Coverage

This section provides an overview of the analysis coverage of the review, as determined by our high-level engagement goals. Our approaches and their results include the following:

### MTC Token

MTC token is a standard token, which is ERC-20 compliant, and is designed to be deployed on the BNB smart chain. ERC-20 is a technical standard for tokens on the Ethereum blockchain that defines a common set of rules for tokens to follow. This standard ensures interoperability between different tokens and enables developers to create decentralized applications that can work with a wide range of tokens.

The contract has the following state variables:

1. **IUniswapV2Router02 public immutable uniswapV2Router:**
  - A reference to the Uniswap V2 Router, used for interacting with the Uniswap protocol.
2. **address public immutable uniswapV2Pair:**
  - The address of the Uniswap liquidity pair for the MTCToken.
3. **uint256 public buyFee:**
  - A variable to store the fee percentage for buy transactions.
4. **uint256 public sellFee:**
  - A variable to store the fee percentage for sell transactions.
5. **address public feeWallet:**
  - The address where transaction fees collected by the contract are sent.
6. **IERC20 public oldToken:**
  - A reference to an older version of token contract,.
7. **mapping(address => bool) private \_isExcludedFromFees:**
  - A mapping to keep track of addresses that are excluded from transaction fees.
8. **mapping(address => bool) public automatedMarketMakerPairs:**
  - A mapping to manage addresses marked as Automated Market Maker (AMM) pairs.

The contract has a constructor that takes the following parameters:

1. **uint256 initialSupply:**
  - Specifies the initial amount of MTCToken to be minted at contract deployment.
2. **address \_feeWallet:**
  - The address where transaction fees collected by the contract will be sent. At deployment, the following address is used:  
[0x8cBf82f6243e006aA675A406638cf08d35F3080f](#)
3. **address \_usdt:**
  - The address of the [BUSD-T](#) token, used to create a Uniswap pair with the MTCToken.
4. **IERC20 \_oldToken:**
  - A reference to an older token contract -  
[0xeD8EfEDf6f3896c8629495e1Deb97B1D951ad900.](#)

The constructor of the **MTCToken** smart contract, upon deployment, performs several critical initialization tasks. It sets up the contract's interaction with the Uniswap decentralized exchange by initializing the Uniswap V2 Router and creating a Uniswap pair with [BUSD-T](#) for liquidity purposes. Simultaneously, it establishes an initial fee structure, setting buy fees to 0% and sell fees to 3%, and designates a specific address ([\\_feeWallet](#)) to collect these transaction fees. In addition, the constructor mints the initial supply of MTCTokens, allocating them to the contract deployer's address. It also provides functionality for token migration by storing a reference to an 'old token' ([\\_oldToken](#)). Key addresses, including the contract itself, the deployer, and a burn address (**0xdead**), are excluded from fee mechanisms, allowing certain transactions to bypass fee deductions.

The contract has the following public functions:

- **convert(uint amount):**
  - Allows users to exchange a specified amount of an old token for an equivalent amount of MTCToken.
- **burn(uint256 value):**
  - Enables users to permanently destroy a specified amount of their own MTCToken.
- **burnFrom(address account, uint256 value):**
  - Allows a user to burn a specified amount of MTCToken from another user's account, given that they have an allowance to do so.
- **updateFeeWallet(address \_feeWallet):**
  - Lets the contract owner update the address of the wallet where transaction fees are collected.

- **updateFees(uint256 \_buyFee, uint256 \_sellFee):**
  - Used by the contract owner to set the percentages for buy and sell transaction fees.
- **excludeFromFees(address account, bool excluded):**
  - Enables the contract owner to exclude a specific account from paying transaction fees.
- **setAutomatedMarketMakerPair(address pair, bool value):**
  - Allows the contract owner to designate or remove a pair as an Automated Market Maker (AMM) pair, affecting how fees are applied.
- **isExcludedFromFees(address account):**
  - Public view function to check if a specific account is excluded from transaction fees.
- **withdrawStuck():**
  - A function for the contract owner to withdraw any MTCToken or ERC20 tokens stuck in the contract.
- **withdrawStuckEth(address toAddr):**
  - Allows the contract owner to withdraw any Ether/BNB stuck in the contract to a specified address.

We conducted a review of the contract and investigated the following:

- We reviewed if an attacker could bypass the access control on minting and burning functions.
- We checked the arithmetic operations.
- We checked if roles could be updated or not.
- We checked if a user can buy tokens for free or sell tokens for free.

## Automated Testing

In this evaluation, Echidna, a smart contract fuzzer, was utilized to swiftly examine various system states and verify security properties through malicious, coverage-guided test case generation. Automated testing techniques were employed to supplement manual security reviews rather than replace them. However, each technique has limitations, such as Echidna's inability to randomly generate an edge case that violates a property. To maximize the effectiveness of security testing, a consistent process is followed. In the case of Echidna, 100,000 test cases are generated per property.

The focus of our automated testing and verification efforts was on the essential properties and elements of the MTC Token. Our aim was to ensure that the critical system properties are maintained to ensure correct protocol behavior.

### Basic properties for standard functions

Property	Result
Total supply should be constant for non-mintable and non-burnable tokens.	Passed
No user balance should be greater than the token's total supply.	Passed
The sum of users balances should not be greater than the token's total supply.	Passed
Token balance for address zero should be zero.	Passed
transfers to zero address should not be allowed.	Passed
transferFroms to zero address should not be allowed.	Passed
Self transfers should not break accounting.	Passed
Self transferFroms should not break accounting.	Passed
transfers for more than account balance should not be allowed.	Passed
transferFroms for more than account balance should not be allowed.	Passed
transfers for zero amount should not break accounting.	Passed
transferFroms for zero amount should not break accounting.	Passed
Valid transfers should update accounting correctly.	Passed
Valid transferFroms should update accounting correctly.	Passed
Allowances should be set correctly when approve is called.	Passed
Allowances should be updated correctly when approve is called twice.	Passed
After transferFrom, allowances should be updated correctly.	Passed

### Tests for burnable tokens

Property	Result
User balance and total supply should be updated correctly when burn is called.	Passed
User balance and total supply should be updated correctly when burnFrom is called.	Passed
Allowances should be updated correctly when burnFrom is called.	Passed

## Tests for mintable tokens

Property	Result
User balance and total supply should be updated correctly after minting.	Passed

## Summary of Findings

The table below summarizes the findings of the review, including type and severity details.

ID	Title	Type	Severity
1	<a href="#">Internal function “_update” is never used</a>	Dead code	Informational
2	<a href="#">Internal function “_update” can result in users buying/selling free MTC Tokens</a>	Arithmetic	High
3	<a href="#">Unhandled return value of transferFrom in function “convert” could lead to fund loss for recipients</a>	Medium	-

## Detailed Findings

### 1. Internal function “\_update” is never used

Severity: Informational	Difficulty: -
Type: Dead code	Finding ID: TCV-NK-1
Target: MTCToken	

#### Description

The MTC Token has defined an internal “\_update” function which is never called /used. This should be removed to not create confusion in future.



## 2. Internal function “\_update” can result in users buying/selling free MTC Tokens

Severity: High	Difficulty: Low
Type: Arithmetic	Finding ID: TCV-NK-2
Target: MTCToken	

### Description

The MTC Token has defined an internal “\_update” function which is never called /used. However, if it is used in future, it has to be used with very well defined parameters, i.e., buyFee, sellFee, and amount. The code excerpt for function “\_update” is shown below:

```

if (takeFee) {
    // on sell
    if (automatedMarketMakerPairs[to] && sellFee > 0) {
        fee = (amount * sellFee) / 10_000; // @audit - the minimum amount of sell-fee and
        amount should be greater than or equal to 10_000, otherwise it rounds down. Someone can
        sell tokens for free.
    }
    // on buy
    else if (automatedMarketMakerPairs[from] && buyFee > 0) {
        fee = (amount * buyFee) / 10_000; // @audit - the minimum amount of buyFee and
        amount should be greater than or equal to 10_000, otherwise it rounds down. Someone can
        buy tokens for free.
    }
    if (fee > 0) {
        super._update(from, feeWallet, fee);
    }

    amount -= fee;
}

```

Figure 1: Code excerpt of function \_update

Consider a scenario where the “\_update” function is called with amount 30 and buyFee of 300. The corresponding fee will be 0.9 (9000 / 10000). However, solidity does not take care of decimals, hence, the division operation will round down 0.9 to 0. As a consequence, the fee will be 0 and the attacker can buy 30 MTC Tokens without paying any fee.

This highlights one of the scenarios, but more of such scenarios exist.

## Recommendation

Please set a minimum amount a user should buy or sell and also the minimum percentage of buyFee or sellFee that the user should pay. Otherwise, a combination of both amount and fee percentage will result in users getting MTC tokens without any paying any fee.

### 3. Unhandled return value of transferFrom in function “convert” could lead to fund loss for recipients

Severity: Medium	Difficulty: -
Type: ERC20	Finding ID: TCV-NK-2
Target: MTCToken	

#### Description

ERC20 implementations are not always consistent. Some implementations of transfer and transferFrom could return ‘false’ on failure instead of reverting. It is safer to wrap such calls into require() statements or use safe wrapper functions implementing return value/data checks to handle these failures

```
function convert(uint amount) public {
    oldToken.transferFrom(msg.sender, address(this), amount);
    _transfer(address(this), msg.sender, amount);
}
```

Figure 2: function convert from MTCToken smart contract.

#### Recommendation

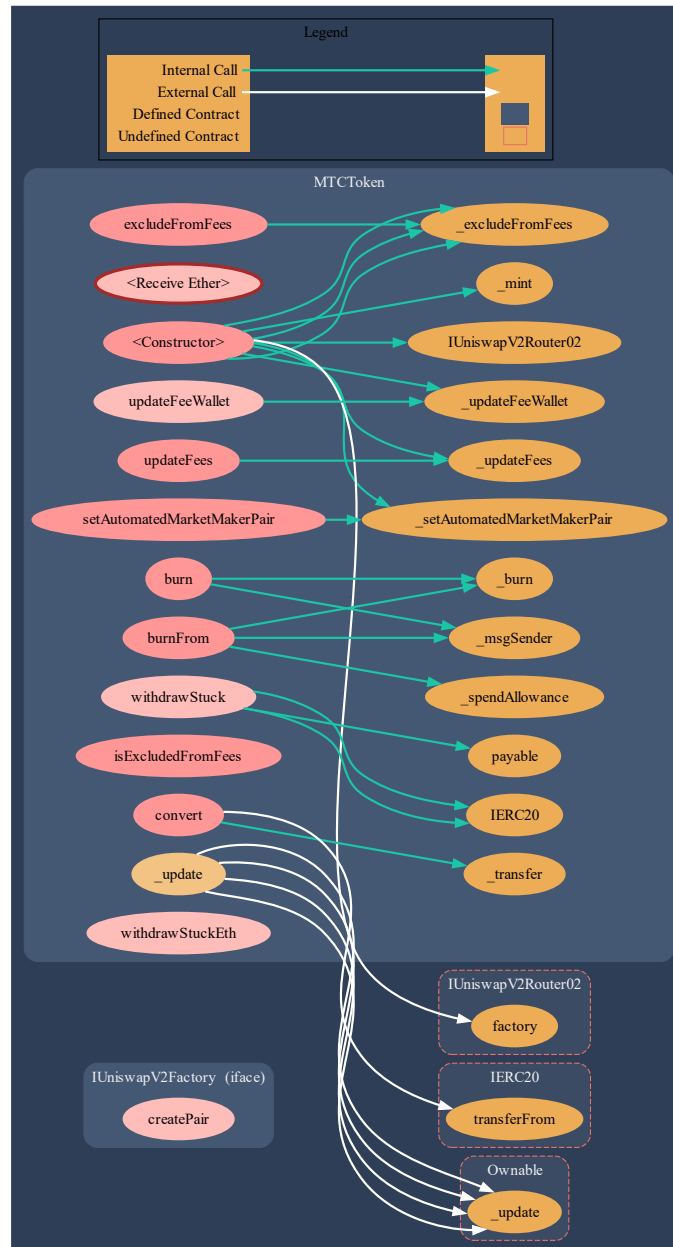
Replace use of oldToken.transferFrom(msg.sender, address(this), amount); with

TransferHelper.safeTransferFrom(token, msg.sender, address(this), amount);

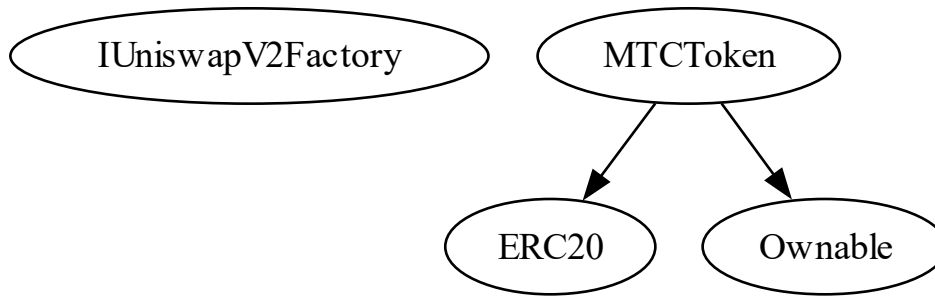
See the following link for reference: [TransferHelper](#)

This will revert on transfer failure for e.g. if msg.sender does not have a token balance >= amount.

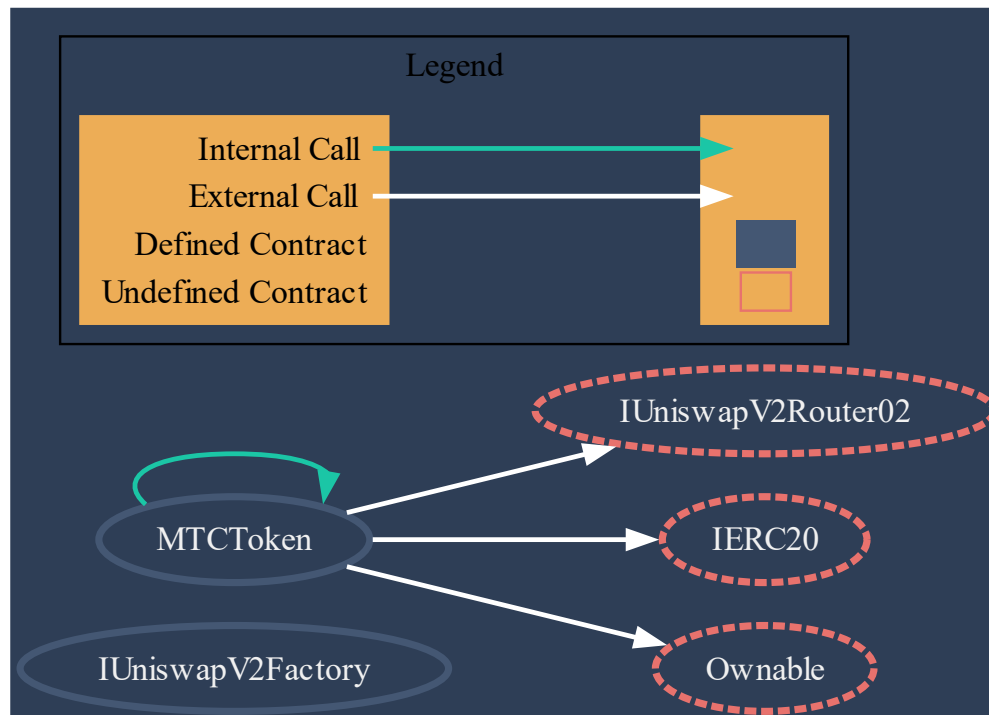
## Call Graph for MTC Token



## Inheritance Graph for MTC Token



## Interaction Graph for MTC Token



## Summary of Recommendations

The Matrix Chain's MTC Token is an ERC20 token and it satisfies the necessary properties of ERC20 tokens. These include constant total supply, correct user balances, the ability to set allowances, the prevention of transfers to the zero address, and the ability to burn tokens. The fulfillment of these properties ensures the token's security and functionality. Truscova recommends that Matrix Chain team address the following for future iterations:

- Develop a detailed incident response plan to ensure that any issues that arise can be addressed promptly and without confusion.
- Create good documentation.