REALITY CARDS SMART CONTRACT AUDIT

March 23, 2021

CONTENTS

1.	INTRODUCTION	. 1
	DISCLAIMER	1
	PROJECT OVERVIEW	1
	SECURITY ASSESSMENT METHODOLOGY	2
	EXECUTIVE SUMMARY	4
	PROJECT DASHBOARD	4
2.	FINDINGS REPORT	. 7
	2.1.CRITICAL	7
	2.2.MAJOR	7
	MJR-1 Use msgSender instead of msg.sender in Event param	7
	2.3.WARNING	8
	WRN-1 Check that the address is not zero	8
	WRN-2 Use general safeTransferFrom	9
	2.4.COMMENTS	10
	CMT-1 Missing the check whether _timestamps has an appropriate length	10
	CMT-2 Incorrect function name	11
	CMT-3 Difficult calculation of uint max	12
	CMT-4 Self-explainable naming	13
	CMT-5 Not optimal data type	15
	CMT-6 No magic numbers	16
	CMT-7 The requirement will never work	17
	CMT-8 Save time cache values	18
	CMT-9 Explain tricky places	19
	CMT-10 One value is always returned	20
	CMT-11 Do not hardcode addresses in constructor	21
	CMT-12 Use msgSender instead of msg.sender	22
	CMT-13 Use SafeMath	23
_	ADOLUE MENON/EEG	2.4

1. INTRODUCTION

1.1 DISCLAIMER

The audit makes no statements or warranties about utility of the code, safety of the code, suitability of the business model, investment advice, endorsement of the platform or its products, regulatory regime for the business model, or any other statements about fitness of the contracts to purpose, or their bug free status. The audit documentation is for discussion purposes only. The information presented in this report is confidential and privileged. If you are reading this report, you agree to keep it confidential, not to copy, disclose or disseminate without the agreement of RealityCards. If you are not the intended recipient(s) of this document, please note that any disclosure, copying or dissemination of its content is strictly forbidden.

1.2 PROJECT OVERVIEW

Reality Cards is the world's first NFT-based prediction market, where instead of betting on an outcome, you own it. Concepts such as shares, bids, asks do not exist- even 'odds' are abstracted away, replaced by a 'daily rental price'.

1.3 SECURITY ASSESSMENT METHODOLOGY

At least 2 auditors are involved in the work on the audit who check the provided source code independently of each other in accordance with the methodology described below:

- 01 "Blind" audit includes:
 - > Manual code study
 - > "Reverse" research and study of the architecture of the code based on the source code only

Stage goal:

Building an independent view of the project's architecture Finding logical flaws

- 02 Checking the code against the checklist of known vulnerabilities includes:
 - > Manual code check for vulnerabilities from the company's internal checklist
 - > The company's checklist is constantly updated based on the analysis of hacks, research and audit of the clients' code

Stage goal:

Eliminate typical vulnerabilities (e.g. reentrancy, gas limit, flashloan attacks, etc.)

- O3 Checking the logic, architecture of the security model for compliance with the desired model, which includes:
 - > Detailed study of the project documentation
 - > Examining contracts tests
 - > Examining comments in code
 - > Comparison of the desired model obtained during the study with the reversed view obtained during the blind audit

Stage goal:

Detection of inconsistencies with the desired model

- O4 Consolidation of the reports from all auditors into one common interim report document
 - > Cross check: each auditor reviews the reports of the others
 - > Discussion of the found issues by the auditors
 - > Formation of a general (merged) report

Stage goal:

Re-check all the problems for relevance and correctness of the threat level Provide the client with an interim report

- 05 Bug fixing & re-check.
 - > Client fixes or comments on every issue
 - > Upon completion of the bug fixing, the auditors double-check each fix and set the statuses with a link to the fix

Stage goal:

Preparation of the final code version with all the fixes

06 Preparation of the final audit report and delivery to the customer.

Findings discovered during the audit are classified as follows:

FINDINGS SEVERITY BREAKDOWN

Level	Description	Required action
Critical	Bugs leading to assets theft, fund access locking, or any other loss funds to be transferred to any party	Immediate action to fix issue
Major	Bugs that can trigger a contract failure. Further recovery is possible only by manual modification of the contract state or replacement.	Implement fix as soon as possible
Warning	Bugs that can break the intended contract logic or expose it to DoS attacks	Take into consideration and implement fix in certain period
Comment	Other issues and recommendations reported to/acknowledged by the team	Take into consideration

Based on the feedback received from the Customer's team regarding the list of findings discovered by the Contractor, they are assigned the following statuses:

Status	Description
Fixed	Recommended fixes have been made to the project code and no longer affect its security.
Acknowledged	The project team is aware of this finding. Recommendations for this finding are planned to be resolved in the future. This finding does not affect the overall safety of the project.
No issue	Finding does not affect the overall safety of the project and does not violate the logic of its work.

1.4 EXECUTIVE SUMMARY

The audited scope implements custom predictions market with a feature of renting tokens to claim reward instead of having them.

The project have several logical modules: proxies to xDai and ETH mainnet, NFT hubs to manage NFT, RCMarket to mange prediction market, RCFactory to create new RCMarkets, RCTreasury to store deposits and manage rewards.

Usage of xDai makes gas very cheap.

Such project could be used to create robust predictions markets.

1.5 PROJECT DASHBOARD

Client	RealityCards
Audit name	RealityCards
Initial version	8c0b05b25a7deef25f98532ae2f8afd4f9a84360
Final version	a860b714944341eeda9b26a9e3d1f8f0747b6cbd
SLOC	1457
Date	2021-02-01 - 2021-03-23
Auditors engaged	2 auditors

FILES LISTING

RCFactory.sol	RCFactory.sol
RCMarket.sol	RCMarket.sol
RCTreasury.sol	RCTreasury.sol
RCNftHubXdai.sol	RCNftHubXdai.sol
RCNftHubMainnet.sol	RCNftHubMainnet.sol
RCProxyMainnet.sol	RCProxyMainnet.sol
RCProxyXdai.sol	RCProxyXdai.sol
IAlternateReceiverBridge.sol	IAlternateReceiverBri
IRCProxyMainnet.sol	IRCProxyMainnet.sol
IRCProxyXdai.sol	IRCProxyXdai.sol
IRCNftHubXdai.sol	IRCNftHubXdai.sol
IRealitio.sol	IRealitio.sol
IERC20Dai.sol	IERC20Dai.sol
IERC721.sol	IERC721.sol
IRCMarket.sol	IRCMarket.sol
IFactory.sol	IFactory.sol
ITreasury.sol	ITreasury.sol
IBridgeContract.sol	IBridgeContract.sol
RCTreasury.sol	RCTreasury.sol
EIP712Base.sol	EIP712Base.sol
NativeMetaTransaction.sol	NativeMetaTransaction.sol
CloneFactory.sol	CloneFactory.sol

FINDINGS SUMMARY

Level	Amount
Critical	0
Major	1
Warning	2
Comment	13

CONCLUSION

Smart contracts have been audited and several suspicious places have been spotted. During the audit no critical issues were spotted. One issue was marked major as it might cause the undesirable behavior. Several warnings and comments were found and discussed with the client. After working on the reported findings some of them were fixed or acknowledged (if the problem was not critical). So, the contracts are assumed as secure to use according to our security criteria. Final commit identifier with all fixes: a860b714944341eeda9b26a9e3d1f8f0747b6cbd

2. FINDINGS REPORT

2.1 CRITICAL

Not Found

2.2 MAJOR

MJR-1	Use msgSender instead of msg.sender in Event param
File RCMarket.sol NativeMetaTransaction.sol	
Severity	Major
Status	Acknowledged

DESCRIPTION

Since the contract uses metatransactions everywhere (and uses NativeMetaTransaction), you should always use msgSender()

• RCMarket.sol#L584

otherwise the event parameter maybe not correct

look at the logic at NativeMetaTransaction.sol#L105

But at RCMarket.sol#L579 the msgSender(), so it is used what is not consistent.

RECOMMENDATION

It is recommended to use <code>msgSender()</code> in all of <code>msg.sender</code> usages (see also: https://medium.com/biconomy/biconomy-supports-native-meta-transactions-243ce52a2a2b).

CLIENT'S COMMENTARY

The instances of msg.sender left are in functions that are only for the market contract (doesn't use meta-Tx), or the sponsor function where the sponsor is expected to have funds and not use meta-Tx. But we've decided that yes we will do a blanket change to msgSender() everywhere, so this will be fixed.

2.3 WARNING

WRN-1	Check that the address is not zero
File	RCTreasury.sol RCProxyMainnet.sol RCProxyMainnet.sol RCProxyXdai.sol RCNftHubMainnet.sol
Severity	Warning
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

DESCRIPTION

The following lines use address variables. But if the value turns out to be zero, funds will be lost:

- RCTreasury.sol#L163
- RCProxyMainnet.sol#L70
- RCProxyMainnet.sol#L75
- RCProxyMainnet.sol#L80
- RCProxyMainnet.sol#L85
- RCProxyMainnet.sol#L90
- RCProxyMainnet.sol#L100
- RCProxyMainnet.sol#L104
- RCProxyXdai.sol#L95
- RCProxyXdai.sol#L100
- RCProxyXdai.sol#L105
- RCProxyXdai.sol#L110
- RCProxyXdai.sol#L120
- RCProxyXdai.sol#L142-L149
- RCProxyXdai.sol#L182
- RCNftHubMainnet.sol#L29

RECOMMENDATION

It is recommended to add a check that address is valid.

WRN-2	Use general safeTransfe	
File	RCNftHubXdai.sol	
Severity	Warning	
Status	No issue	

It is required to check success of transfer. So it is should be handled as in ERC20:

• RCNftHubXdai.sol#L69

RECOMMENDATION

It is recommended to use the safeTransferFrom() method from the ERC20 safe library.

CLIENT'S COMMENTARY

The intention is for the market to move the NFTs as and when the highest bidder changes, this means forcefully moving the NFTs without prior approval of the owner, which is why we are calling the internal function _transfer() and bypassing the usual ownership checks in transferFrom(), because of this it doesn't matter if the owner is a contract not implementing ERC721. If a non-implementer owns it during the event the market will forcefully move the NFT anyway, if they end up being the owner after the event has completed then it's assumed that was the intention of the winning bidder (the non-ERC721 contract creator) and the NFT is now locked. This will not be amended.

2.4 COMMENTS

CMT-1	Missing the check whether _timestamps has an appropriate length	
File	RCFactory.sol	
Severity	Comment	
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd	

DESCRIPTION

At the lines

- RCFactory.sol#L312-L313
- RCFactory.sol#L317
- RCFactory.sol#L320
- RCFactory.sol#L352

have operations with elements of the _timestamps array. It is possible that the number of transferred elements of the _timestamps array will be less than 3. In this case, a reference will be made to a nonexistent array element. For clean code, it is better to avoid this situation and check the length of the array.

RECOMMENDATION

It is recommended to check the number of array elements:
 require(_timestamps.length < 3, "Incorrect number of array elements");</pre>

CMT-2	Incorrect function name
File	RCFactory.sol RCFactory.sol RCTreasury.sol RCProxyMainnet.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

In some function <code>setSomeValue()</code> the value of boolean variable <code>someValue</code> is reversed. But by setting it means setting any value and the value may not even change. It would be more correct to call not "Set", but "Change". This can be seen on the following lines:

- RCFactory.sol#L187
- RCFactory.sol#L197
- RCFactory.sol#L216
- RCFactory.sol#L226
- RCFactory.sol#L232
- RCFactory.sol#L237
- RCFactory.sol#L242
- RCTreasury.sol#L125
- RCTreasury.sol#L130
- RCProxyMainnet.sol#L137

RECOMMENDATION

It is recommended to rename a setSomeValue() function to changeSomeValue().

CLIENT'S COMMENTARY

setMarketCreationGovernorsOnly to changeMarketCreationGovernorsOnly setTrapCardsIfUnapproved to changeTrapCardsIfUnapproved addOrRemoveGovernor to changeGovernorApproval approveOrUnapproveMarket to changeMarketApproval addOrRemoveArtist to changeArtistApproval addOrRemoveAffiliate to changeAffiliateApproval addOrRemoveCardAffiliate to changeCardAffiliateApproval setGlobalPause to changeGlobalPause setPauseMarket to changePauseMarket enableOrDisableDeposits to changeDepositsEnabled

CMT-3	Difficult calculation of uint max
File	RCMarket.sol RCProxyMainnet.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

See these lines:

- RCMarket.sol#L29
- RCMarket.sol#L30
- RCProxyMainnet.sol#L91

Both of this values are worked out by strange way. E.g. 2**256 for uint256 will get 0.

But there are simpler ways to calculate the maximum value. For example:

- uint256 public constant MAX_UINT256 = uint256(-1);
- uint256 public constant MAX_UINT256 = type(uint256).max;

RECOMMENDATION

It is recommended to make it clearer.

CLIENT'S COMMENTARY

The recommended solution was not available in the project solidity version, after update the recommendations were applied.

CMT-4	Self-explainable naming
File	RCFactory.sol RCMarket.sol RCTreasury.sol RCProxyXdai.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

It's good if the name of the variable is absolutely self-explainable. For primitive types (integers) it's good to know what exactly the variable is. For mappings it's better to add key to the name (e.g. userDeposits not just deposits)

- key and value of struct is unclear RCFactory.sol#L38 - mappingOfMarkets RCMarket.sol#L49 - price
- add Percent postfix
 RCFactory.sol#L46 minimumPriceIncrease
 RCMarket.sol#L62 minimumPriceIncrease
- add DayDivisor postfix
 RCMarket.sol#L64 minRentalDivisor
- add weekDivisor postfix
 RCMarket.sol#L66 hotPotatoDivisor
- rentCollected postfix RCMarket.sol#L51 RCMarket.sol#L53 RCMarket.sol#L55
- deposit RCTreasury.sol#L23 what is the key?
- RCProxyXdai.sol#L37 what is the key?
- RCProxyXdai.sol#L38 what is the key?
- RCProxyXdai.sol#L39 must be upper-cased
- RCProxyXdai.sol#L47 what is the key?

- RCProxyXdai.sol#L48 what is the key?
- RCProxyXdai.sol#L118 change amicable to some common word
- RCProxyXdai.sol#L50 the purpose of the value is not clear from the name

RECOMMENDATION

It is recommended to rename variables.

floatSize, not changed, it is the size of the float.

CLIENT'S COMMENTARY

mappingOfMarkets not changed, variable unused for now, a better name will be chosen if it's used otherwise it will be removed. price to tokenPrice minimumPriceIncrease to minimumPriceIncreasePercent minRentalDivisor to minRentalDayDivisor hotPotatoDivisor to hotPotatioWeekDivisor collectedPerUser to rentCollectedPerUser collectedPerToken to rentCollectedPerToken totalCollected to totalRentCollected deposit to userDeposit isMarket not changed, where used it offers a simple readable name, also used in external bot upgradedNfts to upgradedNftId nft to NFT deposits not changed, used in external bot hasConfirmedDeposit not changed, used in external bot setAmicableResolution not changed

CMT-5	Not optimal data type
File	RCFactory.sol RCMarket.sol RCNftHubXdai.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

At the line RCFactory.sol#L42 uses an array. But with the use of structure, the code will become clearer.

The following lines use variables and numbers:

- RCMarket.sol#L34
- RCNftHubXdai.sol#L80
- RCNftHubXdai.sol#L87
 This makes the code hard to read.

RECOMMENDATION

It is recommended to make a structure.

It is recommended to create constants or enum:

MODE_CLASSIC
MODE_WINNER_TAKES_ALL
MODE_HOT_POTATO

CLIENT'S COMMENTARY

Not changed, using an array offers easier integration with certain external services that already have an array as a data type.

6. Named constants or enum

Mode changed to enum

Market state checks have been updated.

CMT-6	No magic numbers
File	RCMarket.sol RCProxyMainnet.sol RCProxyXdai.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

```
• RCMarket.sol#L487 (fixed)
```

- RCMarket.sol#L675
- RCMarket.sol#L687
- RCMarket.sol#L721 (fixed)
- RCProxyMainnet.sol#L117 (what is 2 and 0)
- RCProxyMainnet.sol#L149 (what is 2 and 0)
- RCProxyMainnet.sol#L169 (what is 400000) (fixed)
- RCProxyXdai.sol#L173 (what is 200000) (fixed)
- RCProxyXdai.sol#L206 (what is 200000) (fixed)

RECOMMENDATION

It is recommended to create named constants with required explanation about choicing the value

CLIENT'S COMMENTARY

```
Changed to MIN_RENTAL_VALUE

100 is not considered a magic number here because alternatives such as "HUNDRED",
"PERCENT" or "CENTUM" wouldn't clarify the basic arithmetic formula being
performed.

As above

Issue derived from 6.3
```

Issue derived from 6.a.
Updated to REALITIO_TEMPLATE_ID and REALITIO_NONCE
As above
Updated to XDAI_BRIDGE_GAS_COST
Updated to MAINNET_BRIDGE_GAS_COST
As above

CMT-7	The requirement will never work
File	RCMarket.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

At the line RCMarket.sol#L684 has the value for the requirement always False.

RECOMMENDATION

It is recommended to make a variable or condition instead of False. Or remove this requirement.

CLIENT'S COMMENTARY

Require statement amended and moved to a more appropriate place

CMT-8	Save time cache values
File	RCMarket.sol RCTreasury.sol
Severity	Comment
Status	No issue

At the lines:

- RCMarket.sol#L774-L777
- RCTreasury.sol#L176-L186

msgSender() is used in a lot of places. It is better to cache it to avoid multi
calls.

RECOMMENDATION

It is recommended to cache the value.

CLIENT'S COMMENTARY

msgSender() is now cached in several functions, although minimal benefit to be had when compiling with the optimizer.

CMT-9	Explain tricky places
File	RCTreasury.sol RCProxyXdai.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

Let's take a look at the following lines:

- RCTreasury.sol#L73
- RCProxyXdai.sol#L215

It is not clear why 24*6 = 10 minutes. It is not clear floatSize.

RECOMMENDATION

It is recommended to add explanations as comments.

CLIENT'S COMMENTARY

Added explanation about min rental divisor floatSize, not changed, it is the size of the float

CMT-10	One value is always returned
File	RCTreasury.sol RCProxyXdai.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

Here the function always returns True and never returns False:

- RCTreasury.sol#L100
- RCProxyXdai.sol#L85

RECOMMENDATION

It is recommended to remove the return statement.

CLIENT'S COMMENTARY

Removed the return value

CMT-11	Do not hardcode addresses in constructor
File	RCProxyMainnet.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-

The address could be changed if deployed to testnet for example RCProxyMainnet.sol#L52

RECOMMENDATION

It is recommended to set the address as an argument.

CLIENT'S COMMENTARY

 $\label{prop:constructor} \mbox{Address is now passed into the constructor} \\$

CMT-12	Use msgSender instead of msg.sender
File	RCMarket.sol RCTreasury.sol NativeMetaTransaction.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

Since the contract uses metatransactions everywhere (and uses NativeMetaTransaction), you should always use msgSender

- RCMarket.sol#L332
- RCTreasury.sol#L200
- RCTreasury.sol#L211

look at the logic at NativeMetaTransaction.sol#L105

In above examples the code is correct but not robust, the method cannot be called via metaTransaction by the market contract. If the part of logic will be inaccurate copy-pasted to some other place it's easy to make a mistake forgetting about switching to msgSender().

RECOMMENDATION

It is recommended to use <code>msgSender()</code> in all of <code>msg.sender</code> usages (see also: https://medium.com/biconomy/biconomy-supports-native-meta-transactions-243ce52a2a2b).

CLIENT'S COMMENTARY

Changed all occurrences of msg.sender to msgSender.

CMT-13	Use SafeMath
File	RCTreasury.sol
Severity	Comment
Status	Fixed at https://github.com/RealityCards/RealityCards-Contracts/blob/a860b714944341eeda9b26a9e3d1f8f0747b6cbd

The uint256 overflow is possible at RCTreasury.sol#L84

RECOMMENDATION

It is recommended to use SafeMath.

3.ABOUT MIXBYTES

MixBytes is a team of blockchain developers, auditors and analysts keen on decentralized systems. We build open-source solutions, smart contracts and blockchain protocols, perform security audits, work on benchmarking and software testing solutions, do research and tech consultancy.

BLOCKCHAINS

TECH STACK



Ethereum



Cosmos



Python



Solidity



EOS



Substrate





CONTACTS

https://github.com/mixbytes/audits_public



www https://mixbytes.io/



hello@mixbytes.io



https://t.me/MixBytes



https://twitter.com/mixbytes