

# 4RX

FourRXFinance.sol

## Smart Contract Audit Final Report



**May 31, 2021**

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This audit does not provide a security or correctness guarantee of the audited smart contract. Securing smart contracts is a multistep process, therefore running a bug bounty program as a complement to this audit is strongly recommended.

## Introduction

### 1. About 4RX

The purpose of the 4RX project is to build one token that reflects a wide range of crypto assets with a high potential growing curve.

4RX is the very first base price index utility token, used as an indicator that indicates the market volatility in real-time with 15-20% of total all tokens market cap valued as \$360B as of April 1<sup>st</sup> 2021.

4RX indices 65 crypto assets, mostly defi projects with high potential curve for the next coming years. This enables the 4RX community to passively stake a long list of coins with one token and save a tremendous volume of money on trading and gas fees.

### 2. About ImmuneBytes

ImmuneBytes is a security start-up to provide professional services in the blockchain space. The team has hands-on experience in conducting smart contract audits, penetration testing, and security consulting. ImmuneBytes's security auditors have worked on various A-league projects and have a great understanding of DeFi projects like AAVE, Compound, 0x Protocol, Uniswap, dydx.

The team has been able to secure 15+ blockchain projects by providing security services on different frameworks. ImmuneBytes team helps start-up with a detailed analysis of the system ensuring security and managing the overall project.

Visit <http://immunebytes.com/> to know more about the services.

## Documentation Details

The 4RX team has provided documentation for the purpose of conducting the audit. The documents are:

1. 4RX Staking Auditing.docx

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## Audit Process & Methodology

ImmuneBytes team has performed thorough testing of the project starting with analyzing the code design patterns in which we reviewed the smart contract architecture to ensure it is structured and safe use of third-party smart contracts and libraries.

Our team then performed a formal line-by-line inspection of the Smart Contract in order to find any potential issues like Signature Replay Attacks, Unchecked External Calls, External Contract Referencing, Variable Shadowing, Race conditions, Transaction-ordering dependence, timestamp dependence, DoS attacks, and others.

In the Unit testing phase, we run unit tests written by the developer in order to verify the functions work as intended. In Automated Testing, we tested the Smart Contract with our in-house developed tools to identify vulnerabilities and security flaws.

The code was audited by a team of independent auditors which includes -

1. Testing the functionality of the Smart Contract to determine proper logic has been followed throughout.
2. Analyzing the complexity of the code by thorough, manual review of the code, line-by-line.
3. Deploying the code on testnet using multiple clients to run live tests.
4. Analyzing failure preparations to check how the Smart Contract performs in case of bugs and vulnerabilities.
5. Checking whether all the libraries used in the code are on the latest version.
6. Analyzing the security of the on-chain data.

## Audit Details

- Project Name: 4RX
- Contract Name(s): *FourRXFinance, RewardsAndPenalties, Insurance, Pools, ReferralPool, SponsorPool, PercentageCalculator, InterestCalculator, SharedVariables*
- Languages: Solidity(Smart contract)
- Github commit hash for audit: **f7d395e86028056ba5e88ee50ddbd933a1a0779d**
- Github commit hash for final udit: **3251ace050d3794d0730c15439f395e2bde6ce79**
- Git Hub Link: <https://github.com/FourRX/4rx/blob/master/contracts/FourRXFinance.sol>
- Platforms and Tools: Remix IDE, Truffle, Truffle Team, Ganache, Solhint, VScode, Contract Library, Slither, SmartCheck

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## Audit Goals

The focus of the audit was to verify that the smart contract system is secure, resilient, and working according to its specifications. The audit activities can be grouped into the following three categories:

1. Security: Identifying security-related issues within each contract and within the system of contracts.
2. Sound Architecture: Evaluation of the architecture of this system through the lens of established smart contract best practices and general software best practices.
3. Code Correctness and Quality: A full review of the contract source code. The primary areas of focus include:
  - a. Correctness
  - b. Readability
  - c. Sections of code with high complexity
  - d. Quantity and quality of test coverage

## Security Level References

Every issue in this report was assigned a severity level from the following:

**High severity issues** will bring problems and should be fixed.

**Medium severity issues** could potentially bring problems and should eventually be fixed.

**Low severity issues** are minor details and warnings that can remain unfixed but would be better fixed at some point in the future.

Issues	<u>High</u>	<u>Medium</u>	<u>Low</u>
Open	-	-	-
Closed	1	3	4

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## Contract Name: FourRX Finance

### Medium Severity Issues

#### 1. State Variables Updated After External Call. Violation of Check\_Effects\_Interaction Pattern

##### Explanation:

As per the Check\_Effects\_Interaction Pattern in Solidity, external calls should be made at the very end of the function.

Event emission as well as any state variable modification must be done before the external call is made.

However, during the automated testing, it was found that some of the functions in the FourRXFinance contract violate this **Check-Effects-Interaction** pattern as they update state variables after making the external call.

Such functions are mentioned below along with the specific line number of the external calls:

- **deposit at Line 102**
- **withdraw at Line 185**
- **withdrawDevFee at Line 246**

##### Recommendation:

Modification of any State Variables must be performed before making an external call.

[Check Effects Interaction Pattern](#) must be followed while implementing external calls in a function.

**Amended (May 26th 2021):** Issue was fixed by 4RX team and is no longer present in the code.

### Low Severity Issues

#### 1. Return Value of an External Call is never used Effectively

Line no -185, 215, 246

##### Explanation:

The external calls made in the above-mentioned lines do return a boolean value that indicates whether or not the external call made was successful.

These boolean return values can be used in the function as a check to ensure that the further execution of the function is only allowed if the external is successfully made. However, the FourRXFinance contract never uses these return values throughout the contract.

```
214  
215  
216  
fourRXToken.transfer(user.wallet, availableAmount);
```

**Recommendation:**

Effective use of all the return values from external calls must be ensured within the contract.

**Acknowledged(May 26th 2021):** 4RX team has acknowledged the issue. This is an intentional functionality by the dev team.

**2. updateDevAddress function does not include Zero Address Validation**

Line no: 250-253

**Explanation:**

The **updateDevAddress** function initializes one of the most imperative state variables, i.e., **devAddress** in the FourRXFinance contract.

```
250    function updateDevAddress(address newDevAddress) external {  
251        require(msg.sender == devAddress);  
252        devAddress = newDevAddress;  
253    }
```

However, during the automated testing of the contract, it was found that the function doesn't implement any Zero Address Validation Check to ensure that no zero address is passed while calling this function.

**Recommendation:**

Since the **updateDevAddress** initializes a crucial address in the contract, it is quite important to implement zero address checks and ensure that only valid addresses are updated while calling this function.

**Acknowledged(May 26th 2021):** 4RX team has acknowledged the issue. This is an intentional functionality by the dev team.

## Informational

### 1. NatSpec Annotations must be included

**Explanation:**

The smart contracts do not include the NatSpec annotations adequately.

**Recommendation:**

Cover by NatSpec all Contract methods.

### 2. Absence of Error messages in Require Statements

**Explanation:**

The **require** statements in the FourRXFinance contract do not include any error message.

While this makes it troublesome to detect the reason behind a particular function revert, it also reduces the readability of the code.

**Recommendation:**

Error Messages must be included in every **require** statement in the contract.



## Contract Names: Pool, ReferralPool, SponsorPool, PercentageCalculator, InterestCalculator

### High Severity Issues

1. **calcPercentage** allows passing ZERO as its second argument

**Contract Name - PercentageCalculator**

Line no - 13

#### Explanation:

The **calcPercentage** function includes a **require** statement at Line 13 that allows the **basisPoints** arguments to be **equal to ZERO**.

```
12     function _calcPercentage(uint amount, uint basisPoints) internal pure returns (uint) {
13         require(basisPoints >= 0);
14         return amount.mul(basisPoints).div(PERCENT_MULTIPLIER);
15     }
```

Since **basisPoints** is an imperative argument and is being used in the calculation of percentage value in multiple instances in the contract, this **require** statement can lead to unwanted scenarios.

During the automated testing of the contract, a similar warning was found as well:

```
PercentageCalculator._calcPercentage(uint256,uint256) (Pool_FLAT.sol#653-656) contains a tautology or contradiction:
- require(bool)(basisPoints >= 0) (Pool_FLAT.sol#654)
```

#### Recommendation:

If the above-mentioned function design is not intended, **require** statement of the **calcPercentage** should be updated as follows:

**require(basisPoints > 0, "Basis Point cannot be ZERO")**

**Acknowledged(May 26th 2021):** 4RX team has acknowledged the issue. This is an intentional functionality by the dev team.

### Medium Severity Issues

1. Function design of **\_addSponsorPoolRecord** does not match to **\_addRefPoolRecord**.

**Contract: ReferralPool, SponsorPool**

Line no - 11-17, 9-11

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**Explanation:**

The function `_addRefPoolRecord`, in the `ReferralPool` contract, includes a **IF\_ELSE** mechanism to check whether or not the provided information is already present in the list (using `SortedLinkedList.isInList` function). It only uses the **addNode** function if the information is not present already. Otherwise, it uses the `updateNode` function to store the data.

```
11     function _addRefPoolRecord(address user, uint amount, uint8 stakeId) public {
12         if (!SortedLinkedList.isInList(refPoolUsers, user, stakeId)) {
13             SortedLinkedList.addNode(refPoolUsers, user, amount, stakeId);
14         } else {
15             SortedLinkedList.updateNode(refPoolUsers, user, amount, stakeId);
16         }
17     }
```

However, no such **IF\_ELSE** mechanism was found in the `_addSponsorPoolRecord` function in the **SponsorPool** contract despite the fact that both the functions perform almost similar tasks of adding records to their respective pools.

```
9     function _addSponsorPoolRecord(address user, uint amount, uint8 stakeId) interna
10         SortedLinkedList.addNode(sponsorPoolUsers, user, amount, stakeId);
11     }
```

**IS THIS INTENDED?****Recommendation:**

If the above mentioned scenario is not intended, then the `_addSponsorPoolRecord` function in `SponsorPool` contract should also include **IF\_ELSE** mechanism and use `updateNode` function to store already available information.

**Acknowledged(May 26th 2021):** 4RX team has acknowledged the issue. This is an intentional functionality by the dev team.

## Informational

### 1. Coding Style Issues in the Contract

**Explanation:**

Code readability of a Smart Contract is largely influenced by the Coding Style issues and in some specific scenarios may lead to bugs in the future.

During the automated testing, it was found that the `ReferralPool` contract had quite a few code style issues.

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```
Function ReferralPool._addRefPoolRecord(address,uint256,uint8) (Pool_FLAT.sol#881-887) is not in mixedCase  
Function ReferralPool._cleanRefPoolUsers() (Pool_FLAT.sol#889-892) is not in mixedCase
```

**Recommendation:**

Therefore, it is highly recommended to fix the issues like naming convention, indentation, and code layout issues in a smart contract.

**2. NatSpec Annotations must be included****Explanation:**

The smart contracts do not include the NatSpec annotations adequately.

**Recommendation:**

Cover by NatSpec all Contract methods.

**3. Absence of Error messages in Require Statements****Contract Name: InterestCalculator**

Line no: 383

**Explanation:**

The **require** statement in the InterestCalculator contract does not include any error message.

```
382     function _getInterestTillDays(uint _day) internal pure  
383         require(_day <= MAX_DAYS);  
384  
385         return _initCumulativeInterestForDays()[_day];  
386     }
```

While this makes it troublesome to detect the reason behind a particular function revert, it also reduces the readability of the code.

**Recommendation:**

Error Messages must be included in every **require** statement in the contract.

## Contract Name - RewardsAndPenalties, SharedVariables

### Medium Severity Issues

#### 1. Multiplication is being performed on the result of Division

##### Explanation:

During the automated testing of the RewardsAndPenalties.sol contract, it was found that some of the functions in the contract are performing multiplication on the result of a Division.

Integer Divisions in Solidity might truncate. Moreover, this performing division before multiplication might lead to loss of precision.

The following functions involve division before multiplication in the mentioned lines:

- **\_calcContractBonus** at 52-53
- **\_calcHoldRewards** at 63-64

```
50
51     function calcContractBonus(Stake memory stake) internal view returns (uint) {
52         uint contractBonusPercent = fourRXToken.balanceOf(address(this)).
53         div(10**fourRXTokenDecimals).mul(CONTRACT_BONUS_PER_UNIT_BP).div(CONTRACT_BONUS_UNIT);
54     }
```

##### Recommendation:

Solidity doesn't encourage arithmetic operations that involve division before multiplication. Therefore the above-mentioned function should be checked once and redesigned if they do not lead to expected results.

**Amended (May 26th 2021):** Issue was fixed by 4RX team and is no longer present in the code.

## Low Severity Issues

### 1. Constant declaration should be preferred

**Contract:** SharedVariables

Line no: 15

**Explanation:**

State variables that are not supposed to change throughout the contract should be declared as **constant**.

**Recommendation:**

The following state variables need to be declared as **constant**, unless the current contract design is intended.

- fourRXTokenDecimals

**Amended (May 26th 2021):** Issue was fixed by 4RX team and is no longer present in the code.

### 2. Contract includes Hardcoded Addresses

**Contract:** SharedVariables

Line no - 17

**Explanation:**

Keeping in mind the immutable nature of smart contracts, it is not considered a better practise to hardcode any address in the contract before deployment.

Most importantly, when that particular address is involved in token transfers.

```
16  
17     address public devAddress = 0x64B8cb4C04Ba902010856d913B4e5DF940748Bf2;  
18
```

**Recommendation:**

Instead of including hardcoded addresses in the contract, initialize those addresses within the constructors at the time of deployment.

**Amended (May 26th 2021):** Issue was fixed by 4RX team and is no longer present in the code.

## FourRXFinance.sol

### Audit Categories and Results:

No.	Categories	Subitems	Results
1	Coding Conventions	ERC20 Token Standards	Pass
		Compiler Version Security	Pass
		Visibility Specifiers	Pass
		Gas Consumption	Pass
		SafeMath Features	Pass
		Fallback Usage	Pass
		tx.origin Usage	Pass
		Deprecated Items	Pass
		Redundant Code	Pass
		Overriding Variables	Pass
2	Function Call Audit	Authorization of Function Call	Pass
		Low-level Function (call/delegate call) Security	Pass
		Returned Value Security	Pass
		selfdestruct Function Security	Pass
3	Business Security	Access Control of Owner	Pass
		Business Logics	Pass
		Business Implementations	Pass
4	Integer Overflow/underflow	-	Pass
5	Reentrancy	-	Pass

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6	Exceptional Reachable state	-	Pass
7	Transaction-Ordering Dependence	-	Pass
8	Block Properties Dependence	-	Pass
9	Pseudo-random Number Generator (PRNG)	-	Pass
10	DoS (Denial of Service)	-	Pass
11	Token Vesting Implementation	-	N/A
12	Fake Deposit	-	Pass
13	Event security	-	Pass

### Business Logic:

No.	Categories	Subitems	Results
1	<b>User Interest</b>	-	Pass
2	<b>3% Max and Min Withdrawal</b>	-	Pass
3	<b>35% Liquidity Insurance</b>	-	Pass
4	<b>Penalties</b>	-	Pass
5	<b>Liquidity Protection</b>	-	Pass
6	<b>Rewards and Bonus</b>	-	Pass
7	<b>Rug Pull Testing</b>	-	Pass
8	<b>Security Holes</b>	-	Pass
9	<b>Affiliate Commission Rate - 8%</b>	-	Pass
10	<b>Exit Plenty 50%</b>	-	Pass

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## Automated Test Results

```

FourRXFinance.deposit(uint256,address,uint8).stake (Flat_Finance.sol#1211) is a local variable never initialized
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#uninitialized-local-variables
INFO:Detectors:
FourRXFinance.withdraw(uint256) (Flat_Finance.sol#1259-1303) ignores return value by fourRXToken.transfer(user.wallet,availableAmount) (Flat_Finance.sol#1288)
FourRXFinance.exitProgram(uint256) (Flat_Finance.sol#1305-1327) ignores return value by fourRXToken.transfer(user.wallet,availableAmount) (Flat_Finance.sol#1318)
FourRXFinance.withdrawDevFee(address,uint256) (Flat_Finance.sol#1346-1351) ignores return value by fourRXToken.transfer(withdrawingAddress,amount) (Flat_Finance)

Pragma version^0.6.12 (Flat_Finance.sol#4) necessitates a version too recent to be trusted. Consider deploying with 0.6.11
solc-0.6.12 is not recommended for deployment
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-versions-of-solidity
INFO:Detectors:
Function ReferralPool._addRefPoolRecord(address,uint256,uint8) (Flat_Finance.sol#884-890) is not in mixedCase
Function ReferralPool._cleanRefPoolUsers() (Flat_Finance.sol#892-895) is not in mixedCase
Parameter FourRXFinance.balanceOf(address,uint256)._userAddress (Flat_Finance.sol#1252) is not in mixedCase
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#conformance-to-solidity-naming-conventions

Pools.drawPool() (Flat_Finance.sol#927-952) uses timestamp for comparisons
Dangerous comparisons:
- block.timestamp > poolDrewAt + 86400 (Flat_Finance.sol#928)
RewardsAndPenalties._calcHoldRewards(SharedVariables.Stake) (Flat_Finance.sol#1055-1064) uses timestamp for comparisons
Dangerous comparisons:
- holdBonusPercent > MAX_HOLD_BONUS_BP (Flat_Finance.sol#1059)
RewardsAndPenalties._calcRewards(SharedVariables.Stake) (Flat_Finance.sol#1076-1090) uses timestamp for comparisons
Dangerous comparisons:
- _calcBasisPoints(stake.deposit,rewards) >= REWARD_THRESHOLD_BP (Flat_Finance.sol#1079)
- rewards > maxRewards (Flat_Finance.sol#1085)
RewardsAndPenalties._calcPenalty(SharedVariables.Stake,uint256) (Flat_Finance.sol#1092-1100) uses timestamp for comparisons
Dangerous comparisons:
- basisPoints >= REWARD_THRESHOLD_BP (Flat_Finance.sol#1095)
Insurance._checkForBaseInsuranceTrigger() (Flat_Finance.sol#1112-1118) uses timestamp for comparisons
Dangerous comparisons:
- fourRXToken.balanceOf(address(this)) <= _calcPercentage(maxContractBalance,BASE_INSURANCE_FOR_BP) (Flat_Finance.sol#1113)
Insurance._getInsuredAvailableAmount(SharedVariables.Stake,uint256) (Flat_Finance.sol#1120-1138) uses timestamp for comparisons
Dangerous comparisons:

PercentageCalculator._calcPercentage(uint256,uint256) (Flat_Finance.sol#654-657) contains a tautology or contradiction:
- require(bool)(basisPoints >= 0) (Flat_Finance.sol#655)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#tautology-or-contradiction

```

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## Concluding Remarks

While conducting the audits of 4RX smart contract - FourRXFinance.sol, it was observed that the contracts contain High, Medium, and Low severity issues, along with a few areas of recommendations.

Our auditors suggest that High, Medium, Low severity issues should be resolved by the developers. Resolving the areas of recommendations are up to the team's discretion. The recommendations given will improve the operations of the smart contract.

## Disclaimer

ImmuneBytes's audit does not provide a security or correctness guarantee of the audited smart contract. Securing smart contracts is a multistep process, therefore running a bug bounty program as a complement to this audit is strongly recommended.

Our team does not endorse the 4RX platform or its product neither this audit is investment advice.

Notes:

- Please make sure contracts deployed on the mainnet are the ones audited.
- Check for the code refactor by the team on critical issues.

***ImmuneBytes Pvt Ltd.***