Code Security Assessment

FST SWAP

Jan 16th, 2022

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Summary

This report has been prepared for FST SWAP to discover issues and vulnerabilities in the source code of the FST SWAP project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

Overview

Project Summary

Project Name	FST SWAP
Platform	BSC
Language	Solidity
Codebase	https://bscscan.com/address/0xC9882dEF23bc42D53895b8361D0b1EDC7570Bc6A https://bscscan.com/address/0x9A272d734c5a0d7d84E0a892e891a553e8066dce https://bscscan.com/address/0x1B6C9c20693afDE803B27F8782156c0f892ABC2d
Commit	

Audit Summary

Delivery Date	Jan 16, 2022
Audit Methodology	Static Analysis, Manual Review

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	2	0	0	1	0	1
Medium	0	0	0	0	0	0
Minor	2	0	0	2	0	0
Informational	5	0	0	5	0	0
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
FSC	FistStandard.sol	92154da3d4bfbecd487725ca34491bed3556e210b8686e9a2b3fd19ee817817d
FFC	FstswapFactory.sol	c5788a11c532fc919cc935795b358172d615ccff63a6db48be62d7a2ff4032c7
FRC	FstswapRouter02.sol	a3b1db17fbf769d76efeeadf9e3abe67503920408dbf8f56e1a9ccf5c7854710

Understandings

Overview

FSTSwap is an automated liquidity protocol powered by a constant product formula. Each smart contract, or pair, manages a liquidity pool made up of reserves of two ERC-20 tokens. Anyone can become a liquidity provider (LP) for a pool by depositing an equivalent value of each underlying token in return for pool tokens. These tokens track pro-rata LP shares of the total reserves, and can be redeemed for the underlying assets at any time.

Pairs act as automated market makers, standing ready to accept one token for the other as long as the `constant product` formula is preserved. This formula, most simply expressed as x * y = k(In practice, contract applies a 0.30% fee to trades), states that trades must not change the product (k) of a pair’ s reserve balances (x and y).When adding or removing liquidity and if `fee` is on, mint liquidity equivalent to 1/4th of the growth in sqrt(k).

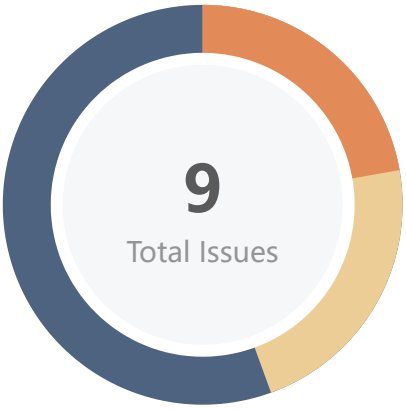
Privileged Functions

The contract contains the following privileged functions that are used to modify the contract configurations and address attributes. We list these functions below:

Contract `factory`:

- setFeeTo(address _feeTo)
- setFeeToSetter(address _feeToSetter)

Findings



Critical	**0** (0.00%)
Major	**2** (22.22%)
Medium	**0** (0.00%)
Minor	**2** (22.22%)
Informational	**5** (55.56%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
FFC-01	Divide by Zero	Logical Issue	Minor	Acknowledged
FFC-02	Missing Input Validation	Logical Issue	Informational	Acknowledged
FFC-03	Centralization Related Risks	**Centralization / Privilege**	**Major**	Resolved
FFC-04	Unnecessary Array as Counter	Gas Optimization	Informational	Acknowledged
FFC-05	Proper Usage Of `require()` And `assert()`	Coding Style	Informational	Acknowledged
FRC-01	Incompatibility With Deflationary Tokens	Logical Issue	Minor	Acknowledged
FSC-01	Too Many Digits	Coding Style	Informational	Acknowledged
FSC-02	Function Visibility Optimization	Gas Optimization	Informational	Acknowledged
FSC-03	Token Minted To Centralized Address	**Centralization / Privilege**	**Major**	Acknowledged

FFC-01 | Divide by Zero

Category	Severity	Location	Status
Logical Issue	Minor	FstswapFactory.sol: 547	Acknowledged

Description

The call to `burn()` function will fail if the value of `totalSupply` is 0.

Recommendation

We advise the client to add the following validation in the function `burn()`:

```
547  require(totalSupply != 0, "The value of totalSupply must not be 0");
```

Alleviation

The client has already acknowledged.

FFC-02 | Missing Input Validation

Category	Severity	Location	Status
Logical Issue	Informational	FstswapFactory.sol: 762	Acknowledged

Description

The given input is missing the check for the non-zero value.

Recommendation

We advise adding the check for the passed-in values to prevent unexpected error as below:

```
762    function uqdiv(uint224 x, uint112 y) internal pure returns (uint224 z) {
763          require(y !=0, "y can not be 0!");
764          z = x / uint224(y);
765      }
```

Alleviation

The client has already acknowledged.

FFC-03 | Centralization Related Risks

Category	Severity	Location	Status
Centralization / Privilege	**Major**	FstswapFactory.sol: 699, 704	Resolved

Description

In the contract `FstswapFactory`, the role `feeToSetter` has authority over the following functions:

- function setFeeTo()
- function setFeeToSetter()

Any compromise to the `feeToSetter` account may allow a hacker to take advantage of this authority.

Recommendation

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multi-signature wallets.

Indicatively, here are some feasible suggestions that would also mitigate the potential risk at a different level in terms of short-term, long-term and permanent:

Short Term:

Timelock and Multi sign (⅔, ⅗) combination mitigate by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;
  AND
- A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, mitigate by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
  AND
- A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered fully resolved.

- Renounce the ownership and never claim back the privileged roles.
  OR
- Remove the risky functionality.

Alleviation

The client has renounced the ownership of `FistStandard` contract, the ownership of `FistStandard` contract is address(0).

FFC-04 | Unnecessary Array as Counter

Category	Severity	Location	Status
Gas Optimization	Informational	FstswapFactory.sol: 660	Acknowledged

Description

The usage of `allPairs` array is as a counter to maintain the number of created pairs.

Recommendation

We advise the client to replace the `allPairs` with a simple uint type counter to store the number of pairs created.

Alleviation

The client has already acknowledged.

FFC-05 | Proper Usage Of `require()` And `assert()`

Category	Severity	Location	Status
Coding Style	Informational	FstswapRouter02.sol: 411, 452, 526, 821, 910, 992	Acknowledged

Description

The `assert()` function should only be used to test for internal errors, and to check invariants. The `require()` function should be used to ensure valid conditions, such as inputs, or contract state variables are met, or to validate return values from calls to external contracts.

Recommendation

We advise the client using the `require()` function, along with a custom error message when the condition fails, instead of the `assert()` function

Alleviation

The client has already acknowledged.

FRC-01 | Incompatibility With Deflationary Tokens

Category	Severity	Location	Status
Logical Issue	Minor	FstswapRouter02.sol: 491, 492, 551, 583	Acknowledged

Description

When users add or remove LP tokens into the router, and the `mint` and `burn` operations are performed. When transferring standard ERC20 deflationary tokens, the input amount may not be equal to the received amount due to the charged transaction fee. As a result, the amount inconsistency will occur and the transaction may fail due to the validation checks.

Recommendation

We advise the client to regulate the set of LP tokens supported and add necessary mitigation mechanisms to keep track of accurate balances if there is a need to support deflationary tokens.

Alleviation

The client response:
FistSwap will not be specially compatible with deflationary tokens.

FSC-01 | Too Many Digits

Category	Severity	Location	Status
Coding Style	Informational	FistStandard.sol: 359	Acknowledged

Description

Literals with many digits are difficult to read and review.

Recommendation

We advise the client to use the scientific notation to improve readability. For example:

```
359    _totalSupply = 2 * 10**8 * 10**6;
```

Alleviation

The client has already acknowledged.

FSC-02 | Function Visibility Optimization

Category	Severity	Location	Status
Gas Optimization	Informational	FistStandard.sol: 469, 488	Acknowledged

Description

The following functions are declared as `public`, contain array function arguments, and are not invoked in any of the contracts contained within the project's scope. The functions that are never called internally within the contract should have external visibility.

Recommendation

We advise that the functions' visibility specifiers are set to `external` and the array-based arguments change their data location from `memory` to `calldata`, optimizing the gas cost of the function.

Alleviation

The client has already acknowledged.

FSC-03 | Token Minted To Centralized Address

Category	Severity	Location	Status
Centralization / Privilege	**Major**	FistStandard.sol: 360	Acknowledged

Description

The amount of `_totalSupply` tokens that are minted to the centralized address `msg.sender` who is `owner`, may raise the community's concerns about the centralization issue.

Recommendation

We advise the client to carefully manage the `owner` account's private key and avoid any potential risks of being hacked. We also advise the client to adopt Multisig, Timelock, and/or DAO in the project to manage this specific account in this case.

Alleviation

The client has already acknowledged.

Appendix

Finding Categories

Centralization / Privilege

Centralization / Privilege findings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.

Gas Optimization

Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

Logical Issue

Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.

Coding Style

Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

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