



Audit Report for Clipper - July 12, 2021

Summary

Audit Report prepared by Solidified covering the Clipper (formerly known as Galleon) DEX smart contracts.

Process and Delivery

Three (3) independent Solidified experts performed an unbiased and isolated audit of the code in several rounds. The debrief of round 1 took place on 29 March 2021.

The debrief of round 2 took place on 27 April 2021.

The rounds of fixes and small changes were concluded on 17 May 2021.

Audited Files

The source code has been supplied in the form of a GitHub repository:

<https://github.com/shipyard-software/galleon-dex>

Final Commit number: **ef34ae95005c5b9d7b003fe4fa84f72bb561ba79**

The scope of the audit was limited to the following files:

```
contracts
├─ BlacklistAndTimeFilter.sol
├─ GalleonDeposit.sol
├─ GalleonEscapeContract.sol
├─ GalleonExchangeInterface.sol
├─ GalleonPool.sol
├─ libraries
│   └─ AggregatorInterface.sol
│   └─ ApprovalInterface.sol
│   └─ Sqrt.sol
└─ UniERC20.sol
```

Intended Behavior

The smart contracts implement an automated market maker aimed at providing a decentralized exchange.

Code Complexity and Test Coverage

Smart contract audits are an important step to improve the security of smart contracts and can find many issues. However, auditing complex codebases has its limits and a remaining risk is present (see disclaimer).

Users of a smart contract system should exercise caution. In order to help with the evaluation of the remaining risk, we provide a measure of the following key indicators: **code complexity**, **code readability**, **level of documentation**, and **test coverage**.

Note, that high complexity or lower test coverage does equate to a higher risk. Certain bugs are more easily detected in unit testing than a security audit and vice versa. It is, therefore, more likely that undetected issues remain if the test coverage is low or non-existent.

| Criteria | Status | Comment |
|------------------------------|-------------|---------|
| Code complexity | Medium-High | - |
| Code readability and clarity | High | - |
| Level of Documentation | High | - |
| Test Coverage | Medium | - |

Test coverage report:

| File | % Stmts | % Branch | % Funcs | % Lines | Uncovered Lines |
|------------------------------|---------|----------|---------|---------|-----------------|
| contracts/ | 81.73 | 45.45 | 61.76 | 80 | |
| BlacklistAndTimeFilter.sol | 41.18 | 0 | 23.08 | 35 | ... 65,69,73,77 |
| GalleonDeposit.sol | 100 | 70 | 100 | 100 | |
| GalleonEscapeContract.sol | 33.33 | 0 | 50 | 33.33 | 19,20 |
| GalleonExchangeInterface.sol | 93.9 | 55 | 85.71 | 94.05 | 61,62,66,67,68 |
| GalleonPool.sol | 73.97 | 40 | 62.86 | 72.5 | ... 306,310,313 |
| contracts/libraries/ | 92.31 | 83.33 | 100 | 92.86 | |
| AggregatorInterface.sol | 100 | 100 | 100 | 100 | |
| ApprovalInterface.sol | 100 | 100 | 100 | 100 | |
| Sqrt.sol | 100 | 100 | 100 | 100 | |
| UniERC20.sol | 92.31 | 83.33 | 100 | 92.31 | 39 |
| contracts/mocks/ | 75 | 100 | 71.43 | 75 | |
| MockOracle.sol | 66.67 | 100 | 50 | 66.67 | 20 |
| MockToken.sol | 75 | 100 | 75 | 75 | 29 |
| SqrtMock.sol | 100 | 100 | 100 | 100 | |
| All files | 82.11 | 51.28 | 65 | 80.6 | |

Issues Found

Solidified found that the Clipper smart contracts contain no critical issues, 2 major issues, 3 minor issues, in addition to 7 informational notes.

We recommend all issues are amended, while the notes are up to the team's discretion, as they refer to best practices.

| Issue # | Description | Severity | Status |
|---------|--|----------|--------------|
| 1 | Iterations over variable-sized data structure may cause critical functions to fail if too many tokens registered | Major | Acknowledged |
| 2 | GalleonExchangeInterface.sol: some functions can be blocked by a denial of service attack or malfunctioning token | Major | Acknowledged |
| 3 | GalleonPool.sol: Non-enforcement of ETH as last element in the linked list may break escape protection | Minor | Resolved |
| 4 | GalleonPool.sol: Missing zero-checks | Minor | Acknowledged |
| 5 | UniERC20.sol: Functions uniTransfer()/uniTransferFromSender() can potentially fail when transferring ETH to a smart contract | Minor | Resolved |
| 6 | Consider using additional events | Note | Resolved |
| 7 | Use constants instead of magic numbers | Note | Resolved |
| 8 | Use modifier instead of copying require constraints | Note | Resolved |
| 9 | GalleonPool.sol: _escapeContract doesn't need owner restriction | Note | Resolved |
| 10 | GalleonExchangeInterface.sol: potential gas optimization | Note | Resolved |



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| | | | |
|----|---|------|--------------|
| 11 | GalleonExchangeInterface.sol: add check for tradeability in _sync() | Note | Acknowledged |
| 12 | GalleonDeposit.sol: Unnecessary gas expenditure by declaring myDeposit as memory instead of storage | Note | Resolved |

Critical Issues

No critical issues have been found.

Major Issues

1. Iterations over variable-sized data structure may cause critical functions to fail if too many tokens registered

The `GalleonPool` contract stores `asset` in a linked list. There are several functions that iterate over these data structures:

`GalleonPool.sol`:

- `removeToken()`
- `syncAll()`

`GalleonExchangeInterface.sol`:

- `withdraw()`
- `invariant()`

If this data structure grows too large, due to many tokens being registered with the pool, these iterations may hit the block gas limit, leading to the transactions always reverting.

Recommendation

Consider using a data model that does not require looping over variable-sized data structures. It seems the linked list implementation is not really required to keep track of all tokens and removing it would also provide significant gas savings.

Round Two Update

The team acknowledges this property. In this particular case, the iteration is considered acceptable, since the smart contract will only be used for a limited number of assets. The addition and removal of assets are operator-controlled.

Solidified recommends coding a maximum limit into the smart contract, in order to avoid exceeding the safe limit accidentally.

2. **GalleonExchangeInterface.sol**: some functions can be blocked by a denial of service attack or malfunctioning token

Throughout the code, external calls are performed to registered tokens, for instance in `withdraw()` and `syncAndTransfer()`. If an external token misbehaves by reverting, the whole transaction will fail. This can be exploited by malicious tokens that revert to perform a denial of service attack.

Recommendation

Consider token withdrawals to be performed individually and/or use `try` and `catch` clauses to prevent transactions from failing completely.

Round Two Update

The team acknowledges this property. All tokens will be vetted by the operators before adding them.

Minor Issues

3. **GalleonPool.sol**: Non-enforcement of ETH as the last element in the linked list may break escape protection

The `escape()` function protection relies on assuming the ETH token entry will be inserted first. However, there is nothing to enforce in the codebase that really is placed at this point in the data structure by the admin team. If this assumption is violated accidentally or on purpose, the protection mechanism in the `escape()` function will not work.

Recommendation

Consider including checks to ensure that ETH is inserted as the first element.

Round Two Update

This issue has been resolved through refactoring.

4. GalleonPool.sol: Missing zero-checks

The functions `modifyDepositContract()`, `modifyApprovalContract()` and `modifyExchangeInterfaceContract()` do not check for `address(0)`. This may cause protocol malfunctioning if these functions are called with zero arguments.

Recommendation

Consider adding zero-checks.

Update

Team Response: “Acknowledged that calls with zero values could cause disruption. These functions are only to be called by admin users. We assume that admins will not be malicious in their calls.”

5. UniERC20.sol: Functions

`uniTransfer()/uniTransferFromSender()` can potentially fail when transferring ETH to a smart contract

Function `uniTransfer()` & `uniTransferFromSender()` call `transfer()` when sending ETH to `to/sendTo`, which only forwards 2300 gas. In cases where `sendTo` address is a smart contract whose fallback function consumes more than 2300 gas, the call will always fail. This will have the side effect of potentially preventing smart contracts (e.g. DAOs) from receiving transfers.

For a more in-depth discussion of issues with `transfer()` and smart contracts, please refer to <https://diligence.consensys.net/blog/2019/09/stop-using-soliditys-transfer-now/>

Recommendation

Replace instances of `transfer()` with `call()`.

Update

Resolved

Informational Notes

6. Consider using additional events

It is good practice to emit an event when updating key protocol parameters or adding an asset. The current implementation does not use many event types. For instance, no events are emitted when the fees are changed or a new asset is added.

Recommendation

Consider adding event types

Update

Resolved

7. Use constants instead of magic numbers

Much of the code has hard-coded numbers instead of declared constants. For example, the multiplier value, the token decimals, and the number of seconds in `ActivateRemoval`.

Recommendation

Consider using declared top-level constants to replace the magic numbers.

Update

Resolved

8. Use modifier instead of copying require constraints

In many places, the code repeats certain access constraints as pre-conditions for functions. It would be cleaner to use modifiers for this instead of copying the constraint.

For instance in the following functions:

- `recordDeposit`
- `recordUnlockedDeposit`
- `syncAll`
- `sync`

- `transfer`
- `syncAndTransfer`
- `swapAndBurn`

Recommendation

Consider using modifiers.

Update

Resolved

9. `GalleonPool.sol`: `_escapeContract()` doesn't need owner restriction

This function is just a view function so it does not require a calling restriction, since it changes no state.

Recommendation

Consider removing the restriction.

Update

Resolved

10. `GalleonExchangeInterface.sol`: potential gas optimization

The function `invariant()` could benefit from CALL reduction

Creating a `getTokenDetails(address token)` function that returns a tuple of `(oracle, marketShare, lastBalance)` for a token would reduce the CALL and stack overhead costs incurred each time the contract calls out to GalleonPool.

Recommendation

Consider adding this function to optimize gas.

Update

Resolved

11. GalleonExchangeInterface.sol: add check for tradeability in `_sync()`

The function `_sync()` relies on a nested check in function `balancesAndMultipliers()` to validate input parameters:

```
require(isTradable(inputToken) && isTradable(outputToken), "Galleon: Untradable asset(s)");
```

This does not favor the readability and maintainability of the code.

Recommendation

Consider placing this check in `_sync()`

Update

Team Response: *"Acknowledged. Deemed not worth gas expenditure for a "double check" (swaps need to start with a tradability check)"*

12. GalleonDeposit.sol: Unnecessary gas expenditure by declaring `myDeposit` as memory instead of storage

Function `unlockVestedDeposit()` assigns `deposits[msg.sender]` to a `memory` variable, which results in the value being copied from the contract's storage to memory, wasting unnecessary gas.

Function `deposit()` also has the same issue with `curDeposit`.

Recommendation

Declare `myDeposit` as a `storage` variable so that no unnecessary copying takes place.

Update

Resolved



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Disclaimer

Solidified audit is not a security warranty, investment advice, or an endorsement of Clipper or its products. 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.

The individual audit reports are anonymized and combined during a debrief process, in order to provide an unbiased delivery and protect the auditors of Solidified platform from legal and financial liability.

Solidified Technologies Inc.