CERTIK

Security Assessment

Good Protocol Governance

Sept 13th, 2021

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Disclaimer

About

Summary

This report has been prepared for GoodDollar to discover issues and vulnerabilities in the source code of the Good Protocol Governance 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	Good Protocol Governance
Platform	Ethereum
Language	Solidity
Codebase	https://github.com/GoodDollar/GoodProtocol/tree/master/contracts/governance
Commit	7f743a54dae557d30351ee2fd4d2989864b04b99

Audit Summary

Delivery Date	Sept 13, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	2	0	0	0	0	2
Major	0	0	0	0	0	0
Medium	2	0	0	0	0	2
Minor	0	0	0	0	0	0
Informational	3	0	0	0	0	3
Discussion	0	0	0	0	0	0

Audit Scope

ID			File	SHA256 Checksum

Understandings

Overview

The GoodProtocol Governance contracts implement the governance reputation system and the voting system for the GoodProtocal project.

The governance reputation system is implemented by the contracts:

- ClaimersDistribution.sol
- GReputation.sol
- GovarnanceStaking.sol
- MultiBaseGovernanceShareField.sol
- Reputation.sol
- StakersDistribution.sol

The system mints reputation for users who staked their token or claimed the reputation in the Universal Basic Income (UBI) system. The reputation determines users' voting powers. Users can also delegate their voting powers to other accounts.

The voting system is implemented by

- CompoundVotingMachine.sol

It allows users to submit proposals, vote for proposals, cancel proposals, and execute succeeded proposals.

Dependencies

There are a few dependency injection contracts/addresses in the current project. We assume the contracts/addresses provided by `nameService` are valid and non-vulnerable actors, and they are implementing proper logic to collaborate with the current project.

Privilledged Functions

The restriction modifier `_onlyAvatar()` is applied in ClaimersDistribution.sol, GReputation.sol, GovernanceStaking.sol and StakersDistribution.sol, setting up the Avatar-Only writing access to modify system parameters or update crucial states of the contracts:

- `ClaimersDistribution.setMonthlyReputationDistribution()` to set monthly claimer reputation distributions;
- `GReputation. setBlockchainStateHash()` to set blockchain state hashes;

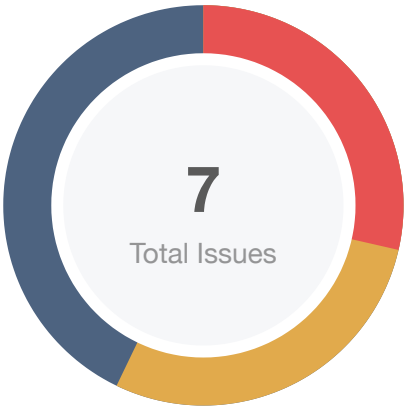
- `GovernanceStaking.setMonthlyRewards()` to set monthly rewards;
- `StakersDistribution.setMonthlyReputationDistribution ()` to set monthly staker reputation distributions.

The role `guardian` is introduced in the contract CompoundVotingMachine.sol to cancel proposals by calling `CompoundVotingMachine.cancel()`.

The restriction `_canMint()` is applied in the contract `GReputation` and `Reputation` to allow certain roles to mint reputation by calling `Reputation.mint()`.

To improve the trustworthiness of the project, any dynamic runtime updates in the project should be notified to the community. Any plan to invoke the aforementioned functions should be also considered to move to the execution queue of the `CompoundVotingMachine` contract.

Findings



Critical	2 (28.57%)
Major	0 (0.00%)
Medium	2 (28.57%)
Minor	0 (0.00%)
Informational	3 (42.86%)
Discussion	0 (0.00%)

ID	Title	Category	Severity	Status
BGS-01	Potential Reward Overminting	Logical Issue	Critical	Resolved
BGS-02	Inconsistent Reward Calculations	Logical Issue	Medium	Resolved
CDG-01	Lack of Event Emissions for Significant Transactions	Logical Issue	Informational	Resolved
CVM-01	Should Declare as `memory` for Read Only Object	Gas Optimization	Informational	Resolved
CVM-02	Lack of Event Emissions for Significant Transactions	Logical Issue	Informational	Resolved
MBG-01	Potential Reward Overminting	Logical Issue	Critical	Resolved
MBG-02	Inconsistent Reward Calculations	Logical Issue	Medium	Resolved

BGS-01 | Potential Reward Overminting

Category	Severity	Location	Status
Logical Issue	Critical	BaseGovernanceShareField.sol: 157	Resolved

Description

The function `BaseGovernanceShareField._issueEarnedRewards()` in L157 returns the amount of a user's pending reward. However, in this function, `userInfo.rewardDebt` is not updated after the update of pending reward (i.e. `userInfo.rewardEarn`) in L159 (`_audit(user)`). Considering the pending reward is calculated logically as

```
    uint256 pending = (userInfo.amount * accAmountPerShare[_contract]) / 1e27 -
userInfo.rewardDebt;
```

If `userInfo.rewardDebt` is not updated, the pending reward will still be positive in the next call of `BaseGovernanceShareField._issueEarnedRewards()`. Although `userInfo.rewardEarn` is set as zero in L162, when the same user calls the function again right away, `userInfo.rewardEarn` could be updated as some non-zero value in L159 (`BaseGovernanceShareField._audit(user)`) and behave as the return value of the function.

Recommendation

We recommend adding proper `userInfo.rewardDebt` update logic in the function `BaseGovernanceShareField._issueEarnedRewards()` after executing `BaseGovernanceShareField._audit()`. Moreover, we advice encapsulating the logic of `userInfo.rewardDebt` update into the function `BaseGovernanceShareField._audit()` instead of doing it outside for better code readability and maintainability.

Alleviation

The development team removed this file in the commit 7c2ade00694466bb7e87e7e33cf689d4e79cd106.

BGS-02 | Inconsistent Reward Calculations

Category	Severity	Location	Status
Logical Issue	Medium	BaseGovernanceShareField.sol: 59, 141	Resolved

Description

When calculating the reward, the current code implementation applies `rounding` logic (via `DSMath.rdiv()`) instead of `flooring` logic, for instance,

```
57      accAmountPerShare =
58          accAmountPerShare +
59          rdiv(reward, totalProductivity * 1e16);
```

If a float number is rounded to a larger integer, it might lead to some unexpected behaviors. For example, assuming the contract sets 5 as monthly reward amount, meaning at most 5 rewards can be minted this month; and contains X (an even number) shares in total,

- Case 1: user A has X shares and could earn 5 rewards. In this case at most 5 rewards could be minted this month, which is as expected;
- Case 2: user A has X/2 shares and could earn 3 rewards (2.5, rounding to 3), and user B has X/2 shares and could earn 3 rewards (2.5, rounding to 3) as well. In this case, at most 6 rewards could be minted, which is larger than 5, the expected upper bound of rewards to be minted this month.

Ideally the expected behavior is, once the monthly reward amount is set as 5, the maximum amount of the reward that could be minted is always 5, regardless of the shares distribution. According to our observation, unless there is any specific design requirement, most projects will make use of `flooring` instead of `rounding` to avoid any potential project loss.

We hope to learn more about any specific reason to apply rounding instead of flooring. Is it an intended design?

Alleviation

The development team removed this file in the commit 7c2ade00694466bb7e87e7e33cf689d4e79cd106.

CDG-01 | Lack of Event Emissions for Significant Transactions

Category	Severity	Location	Status
Logical Issue	Informational	ClaimersDistribution.sol: 46	Resolved

Description

Event should be emitted for significant contract state(s) update. For example, in the function `ClaimerDistribution.setMonthlyReputationDistribution()`, it updates the an important state `monthlyReputationDistribution`.

Recommendation

We recommend emitting an event at the end of the aforementioned function.

Alleviation

The development team heeded our advice and fixed the issue in the commit bf5031f8a3372924227b9a84beec64446ea62772.

CVM-01 | Should Declare as `memory` for Read Only Object

Category	Severity	Location	Status
Gas Optimization	Informational	CompoundVotingMachine.sol: 327	Resolved

Description

In the function `CompoundVotingMachine.execute()`, `proposal` in L327 should be better declared as `memory` instead of `storage` for execution gas saving.
In general, when the variable is declared as `memory`, extra gas for reserving the memory would be paid in execution. From this perspective, using `storage` would be more efficient than using `memory`. However, reading from a `memory` variable is much more cost-efficient than reading from a `storage` variable. As a result, the more the reading happens later, the more the `EFFICIENCY` balance would be tilted towards `memory` variable.

In the loop in L329-L338, it iterates through a few array fields. The larger the array size is, the more gas would be saved if it reads from a `memory` variable.

Recommendation

We recommend updating L327 as

```
327     Proposal memory proposal = proposals[proposalId];
```

Alleviation

The development team heeded our advice and fixed the issue by loading the status into memory in the commit 97836ab191f57f7809f802a966350252bd49d8ac.

CVM-02 | Lack of Event Emissions for Significant Transactions

Category	Severity	Location	Status
Logical Issue	Informational	CompoundVotingMachine.sol: 655, 664	Resolved

Description

Event should be emitted for significant contract state(s) update. For example,
in the function `CompoundVotingMachine.renounceGuardian()`, it updates the important states: `guardian` and `foundationGuardianRelease`;
in the function `CompoundVotingMachine.setGuardian()`, it updates the important state `guardian`.

Recommendation

We recommend emitting corresponding events at the end of the aforementioned functions to log the state(s) update.

Alleviation

The development team heeded our advice and fixed the issue in the commit 97836ab191f57f7809f802a966350252bd49d8ac.

MBG-01 | Potential Reward Overminting

Category	Severity	Location	Status
Logical Issue	Critical	MultiBaseGovernanceShareField.sol: 199	Resolved

Description

The function `MultiBaseGovernanceShareField._issueEarnedRewards()` returns the amount of a user's pending reward which will be used in `GovernanceStaking._mintRewards()` and `StakersDistribution._claimReputation()` to mint reputation for the user.

However, in this function, `userInfo.rewardDebt` is not updated after the update of pending reward (`userInfo.rewardEarn`) in L206 (`_audit(_contract, _user)`). Considering the pending reward is calculated by

```
    uint256 pending = (userInfo.amount * accAmountPerShare[_contract]) / 1e27 -
userInfo.rewardDebt;
```

If `userInfo.rewardDebt` is not updated, the pending reward will still be positive in the next call of `MultiBaseGovernanceShareField._issueEarnedRewards()`, which means users can infinitely gain reward by calling the function `GovernanceStaking.withdrawRewards()` repeatedly (the calling routine is `GovernanceStaking.withdrawRewards()` => `GovernanceStaking._mintRewards()` => `MultiBaseGovernanceShareField._issueEarnedRewards()`). Although `userInfo.rewardEarn` is set as zero in L209, when the same user calls the function again right away, `userInfo.rewardEarn` could be updated as some non-zero value in L206 (`MultiBaseGovernanceShareField._audit(_contract, _user)`) and behave as the return value of the function. As a result, the amount of tokens would be minted for the user for another time.

Recommendation

We recommend adding proper `userInfo.rewardDebt` update logic in the function `MultiBaseGovernanceShareField._issueEarnedRewards()` after executing `MultiBaseGovernanceShareField._audit()`. Moreover, we advice encapsulating the logic of `userInfo.rewardDebt` update into the function `MultiBaseGovernanceShareField._audit()` instead of doing it outside for better code readability and maintainability.

Alleviation

The development team heeded our advice and fixed the issue in the commit 7792b1fedb72ad7b5ed1d7c8b5f46b2d04cfd147.

MBG-02 | Inconsistent Reward Calculations

Category	Severity	Location	Status
Logical Issue	Medium	MultiBaseGovernanceShareField.sol: 90	Resolved

Description

When calculating the reward, the current code implementation applies `rounding` logic (via `DSMath.rdiv()`) instead of `flooring` logic, for instance,

```
90      _accAmountPerShare += rdiv(reward, totalProductivity[_contract]);
```

If a float number is rounded to a larger integer, it might lead to some unexpected behaviors. For example, assuming the contract sets 5 as monthly reward amount, meaning at most 5 rewards can be minted this month; and contains X (an even number) shares in total,

- Case 1: user A has X shares and could earn 5 rewards. In this case at most 5 rewards could be minted this month, which is as expected;
- Case 2: user A has X/2 shares and could earn 3 rewards (2.5, rounding to 3), and user B has X/2 shares and could earn 3 rewards (2.5, rounding to 3) as well. In this case, at most 6 rewards could be minted, which is larger than 5, the expected upper bound of rewards to be minted this month.

Ideally the expected behavior is, once the monthly reward amount is set as 5, the maximum amount of the reward that could be minted is always 5, regardless of the shares distribution. According to our observation, unless there is any specific design requirement, most projects will make use of `flooring` instead of `rounding` to avoid any potential project loss.

We hope to learn more about any specific reason to apply rounding instead of flooring. Is it an intended design?

Alleviation

The development team heeded our advice and fixed the issue in the commit 3d59716b27dd5d55292792fbf41cd123c7eb6262.

Appendix

Finding Categories

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.

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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