Security Assessment

Quadrata Audit (Passport)

Jul 15th, 2022

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Summary

This report has been prepared for Quadrata to discover issues and vulnerabilities in the source code of the Quadrata Audit (Passport) 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	Quadrata Audit (Passport)
Platform	EVM Compatible
Language	Solidity
Codebase	https://github.com/QuadrataNetwork/passport-contracts
Commit	ad7c3d96dc04dd7907be4062f23a08a201676a6f

Audit Summary

Delivery Date	Jul 15, 2022 UTC
Audit Methodology	Static Analysis, Manual Review

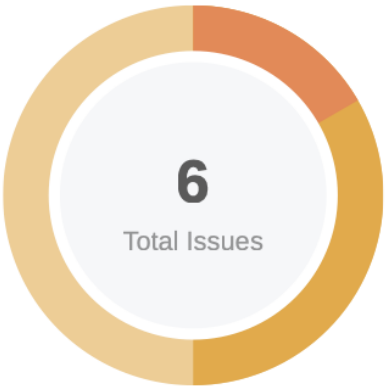
Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Mitigated	Partially Resolved	Resolved
Critical	0	0	0	0	0	0	0
Major	1	0	0	0	1	0	0
Medium	2	0	0	2	0	0	0
Minor	3	0	0	1	0	0	2
Optimization	3	0	0	1	0	0	2
Informational	0	0	0	0	0	0	0
Discussion	0	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
QGS	contracts/storage/QuadGovernanceStore.sol	2e8cfbebed3797b36822967fdb32dce605151d729bdb2f8b81b5898f8d9c2833
QPS	contracts/storage/QuadPassportStore.sol	db3de5deb7ef4e300cb4f3fedb70aadf17e3b2757a0448d71e1e07625f49ad27
QRS	contracts/storage/QuadReaderStore.sol	93359dde94b7f1fd0ac5e33bb50b99d6ae945758bd15c7cf9d99844e195cd407
QGQ	contracts/QuadGovernance.sol	a2658628ded7456c38dc4b31078385ee8c5791d6e499aa76de56494aa391e32f
QPQ	contracts/QuadPassport.sol	30d9a156aec902c5e062302b0ff6c389207e50ce1d138d1d50a40b2ac16b45e6
QRQ	contracts/QuadReader.sol	52fd9377dd2fb630d7c61b84cf80f30caea75a6b6f33e205c0dd6d2bc7c192a1

Findings



Critical	**0** (0.00%)
Major	**1** (16.67%)
Medium	**2** (33.33%)
Minor	**3** (50.00%)
Informational	**0** (0.00%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
QGQ-01	No Empty Initializer Constructor For UUPS Upgradable Contracts	Language Specific	Minor	Resolved
QNB-01	Centralization Risks In Passport Contract	**Centralization / Privilege**	**Major**	Mitigated
QNB-02	Lack Of Storage Gap	Language Specific	Medium	Acknowledged
QPQ-01	No Empty Initializer Constructor For UUPS Upgradable Contracts	Language Specific	Minor	Resolved
QRQ-01	Locked Ether And Token	Logical Issue	Medium	Acknowledged
QRQ-02	Incompatibility With Deflationary Tokens	Logical Issue	Minor	Acknowledged

QGQ-01 | No Empty Initializer Constructor For UUPS Upgradable Contracts

Category	Severity	Location	Status
Language Specific	Minor	contracts/QuadGovernance.sol (v1): 32	Resolved

Description

It's recommended the team verify the UUPS implementation contract is initialized correctly. Besides initializing the contract, another way to prevent the implementation contract from being used is to invoke the "_disableInitializers" function in the constructor to automatically lock it when it is deployed. For more information, please refer to: https://docs.openzeppelin.com/upgrades-plugins/1.x/writing-upgradeable#initializing_the_implementation_contract

Recommendation

We advise the client to add an empty initializer constructor to the linked contract.

```
1   constructor() initializer {}
```

Alleviation

The client revised the code and resolved the issue in this commit.

QNB-01 | Centralization Risks In Passport Contract

Category	Severity	Location	Status
Centralization / Privilege	**Major**	contracts/QuadGovernance.sol (v1): 76, 88, 101, 112, 124, 137, 149, 173, 185, 198, 212, 224, 239, 254, 273, 293, 315, 340; contracts/QuadPassport.sol (v1): 62, 91, 177, 304, 319, 335, 349, 369; contracts/QuadReader.sol (v1): 34	Mitigated

Description

In the contract `QuadGovernance` the role `GOVERNANCE_ROLE` has authority over the functions. Any compromise to the `GOVERNANCE_ROLE` account may allow the hacker to take advantage of this authority and

- set QuadPassport treasury wallet to withdraw the protocol fees through `setTreasury()`
- set QuadPassport contract address through `setPassportContractAddress()`
- set the QuadGovernance address in the QuadPassport contract through `updateGovernanceInPassport()`
- set the QuadPassport deployed version through `setPassportVersion()`
- set the price for minting the QuadPassport through `setMintPrice()`
- Set the eligibility status for a tokenId passport through `setEligibleTokenId()`
- set the eligibility status for an attribute type through `setEligibleAttribute()`
- set the eligibility status for an attribute type grouped by DID through `setEligibleAttributeByDID()`
- set the price to update/set a single attribute after owning a passport through `setAttributePrice()`
- set the price to update/set a single business attribute after owning a passport through `setBusinessAttributePrice()`
- set the min price to update/set a single attribute after owning a passport through `setAttributeMintPrice()`
- set the `UniswapAnchorView` oracle through `setOracle()`
- set the revenue split percentage between Issuers and Quadrata Protocol through `setRevSplitIssuer()`
- add a new issuer or update treasury through `setIssuer()`
- delete issuer through `deleteIssuer()`
- deactivate issuer through `setIssuerStatus()`
- authorize or denied a payment to be received in Toke through `allowTokenPayment()`
- authorize to upgrade through `_authorizeUpgrade()`

In the contract `QuadPassport` the role `GOVERNANCE_ROLE` has authority over the functions. Any compromise to the `GOVERNANCE_ROLE` account may allow the hacker to take advantage of this authority and

- authorize to upgrade through `_authorizeUpgrade()`

In the contract `QuadPassport` the role `READER_ROLE` has authority over the functions. Any compromise to the `READER_ROLE` account may allow the hacker to take advantage of this authority and

- increase ETH balance of account through `increaseAccountBalanceETH()`
- increase balance of account through `increaseAccountBalance()`
- allow an authorized readers to get attribute information about a passport holder for a specific issuer through `attributes()`

In the contract `QuadPassport` the role `ISSUER_ROLE` has authority over the functions. Any compromise to the `ISSUER_ROLE` account may allow the hacker to take advantage of this authority and

- issuer can burn an account's Quadrata passport when requested through `burnPassportIssuer()`
- update or set a new attribute for your existing passport through `setAttribute()`
- claim and mint a wallet account Quadrata Passport through `mintPassport()`

In the contract `QuadReader` the role `GOVERNANCE_ROLE` has authority over the functions. Any compromise to the `GOVERNANCE_ROLE` account may allow the hacker to take advantage of this authority and

- authorize to upgrade through `_authorizeUpgrade()`

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., multisignature 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

[Quadrata Team]:

The team has switched to a 4/6 Multi-Sign wallet for timelock operation.

The team has revoked the roles of the deployer.

Transaction proof:
https://etherscan.io/tx/0x528687cb1db9d8eca2c38675537e6429ac263a271944e85d52a6d70b2748857f

QNB-02 | Lack Of Storage Gap

Category	Severity	Location	Status
Language Specific	Medium	contracts/QuadGovernance.sol (v1): 15; contracts/QuadPassport.sol (v1): 24; contracts/QuadReader.sol (v1): 23	Acknowledged

Description

The code base contains a transparent_proxy folder, implying the potential to upgrade implementation contracts in the future.

For upgradeable contracts, there must be storage gap to "allow developers to freely add new state variables in the future without compromising the storage compatibility with existing deployments". Otherwise it may be very difficult to write new implementation code. Without storage gap, the variable in child contract might be overwritten by the upgraded base contract if new variables are added to the base contract.

Refer to https://docs.openzeppelin.com/upgrades-plugins/1.x/writing-upgradeable

Recommendation

We advise the client to add appropriate storage gap at the end of upgradeable contracts.

Alleviation

[Quadrata Team]:

The team will not be leaving gaps in our Storage contracts. These storage contracts will always be declared as the rightmost base contract, thereby making them the least base contract. That means so as long as no variables are declared in the child contract, there should be no problem updating the storage contract. The child contracts will not have any state variables and will follow a storage variable scheme similar to Compound.

QPQ-01 | No Empty Initializer Constructor For UUPS Upgradable Contracts

Category	Severity	Location	Status
Language Specific	Minor	contracts/QuadPassport.sol (v1): 20	Resolved

Description

It's recommended the team verify the UUPS implementation contract is initialized correctly. Besides initializing the contract, another way to prevent the implementation contract from being used is to invoke the "_disableInitializers" function in the constructor to automatically lock it when it is deployed. For more information, please refer to: https://docs.openzeppelin.com/upgrades-plugins/1.x/writing-upgradeable#initializing_the_implementation_contract

Recommendation

We advise the client to add an empty initializer constructor to the linked contract.

```
1   constructor() initializer {}
```

Alleviation

The client revised the code and resolved the issue in this commit.

QRQ-01 | Locked Ether And Token

Category	Severity	Location	Status
Logical Issue	Medium	contracts/QuadReader.sol (v1): 405, 433	ⓘ Acknowledged

Description

Due to the existence of division when adding balance to the issuers will result in a small amount of ETHs or Tokens stranded in the contract `QuadPassport`, but the contract `QuadPassport` does not provide any extraction function.

Recommendation

We advise the client to add a function to extract ETHs and tokens from this contract in the contract `QuadPassport`.

Alleviation

[Quadrata Team]:

Issue acknowledged. I won't make any changes for the current version.

The team chose not to handle dust in this current version to optimize gas cost, with any dust amount being negligible. The team will decide at a later stage if it'll be worth adding a dust-sweeping functionality.

QRQ-02 | Incompatibility With Deflationary Tokens

Category	Severity	Location	Status
Logical Issue	Minor	contracts/QuadReader.sol (v1): 417	Acknowledged

Description

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, an inconsistency in the amount will occur and the transaction may fail due to the validation checks.

Recommendation

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

Alleviation

[Quadrata Team]:

Issue acknowledged. I won't make any changes for the current version.

The limitation regarding deflationary tokens as payment methods is understood. Quadrata Governance will not allow deflationary tokens to be allowed as eligible payment tokens.

Optimizations

ID	Title	Category	Severity	Status
QGQ-02	Costly Operation Inside Loop	Gas Optimization	Optimization	Acknowledged
QGQ-03	Not All Parent Contract Initializing Functions Are Called	Logical Issue	Optimization	Resolved
QPQ-02	Gas Optimization	Gas Optimization	Optimization	Resolved

QGQ-02 | Costly Operation Inside Loop

Category	Severity	Location	Status
Gas Optimization	Optimization	contracts/QuadGovernance.sol (v1): 160	Acknowledged

Description

Accessing storage variables in a loop can be costly in terms of gas consumption.

File: contracts/QuadGovernance.sol (Line 160, Function `QuadGovernance.setEligibleAttribute`)

```
                    eligibleAttributesArray.pop();
```

Recommendation

We recommend using a local variable to hold the intermediate result.

Alleviation

[Quadrata Team]:

Issue acknowledged. I won't make any changes for the current version.

This function is only executed as an admin operation. Quadrata is aware of the linear gas cost of looping through a list. however, the gas/cost risk is mitigated due to our use case only requiring a small array of 7 or so attributes. This set of attributes will only be expanded should the Quadrata Governance agree.

QGQ-03 | Not All Parent Contract Initializing Functions Are Called

Category	Severity	Location	Status
Logical Issue	Optimization	contracts/QuadGovernance.sol (v1): 35	Resolved

Description

Contract QuadGoverance extends AccessControlUpgradable, while `__AccessControl_init_unchained()` is not called in the initialize function. Generally the initializer function of an upgradeable contract should always call all the initializer functions of the contracts that it extends.

Recommendation

We advise the client to call `__AccessControl_init_unchained()` in the linked contract.

Alleviation

The client revised the code and resolved the issue in this commit.

QPQ-02 | Gas Optimization

Category	Severity	Location	Status
Gas Optimization	Optimization	contracts/QuadPassport.sol (v1): 167	Resolved

Description

The fetching of `attributeType` can be placed in the first loop to save gas.

Recommendation

We advise the client to move the `attributeType` to the first loop.

Alleviation

The client revised the code and resolved the issue in this commit.

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.

Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

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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