CERTIK

Security Assessment

Panther ZKP Token

Nov 16th, 2021

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Summary

This report has been prepared for Panther Protocol to discover issues and vulnerabilities in the source code of the Panther ZKP Token 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	Panther ZKP Token
Platform	other
Language	Solidity
Codebase	https://github.com/pantherprotocol/zkp-token/tree/master/contracts
Commit	• f1e9d857dbd1660d90f1f029511f93417896d792 • ed7262b28e35f561cf35c66b4ac1bf60690d87a4

Audit Summary

Delivery Date	Nov 16, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

Vulnerability Summary

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

Audit Scope

ID	File	SHA256 Checksum
CCK	interfaces/Constants.sol	262cddb01adf7bff3c3f582e0fb1ef33d8989786cd5c4ad60688bb2a8bb93e8a
ZKP	ZKPToken.sol	dae1edcf593ba4e946cce0d860bbd2663b6b65b12865bf6a22af670693bbac89

Understandings

Overview

The Panther Protocol is a blockchain network with a focus on privacy while also providing compliance tools through zero-knowledge proofs. In this report, we looked at the Panther Protocol's ZKP token as well as their implementation of vesting pools. This includes how stakeholders interact with the vesting pool and the implementation of a vesting pool's wallet.

Dependencies

We assume the contracts `PoolStakes`, `VestingPools`, `ZKPToken`, `Constants`, `Claimable`, `DefaultOwnable`, `TokenAddress`, `VestingPoolsAddress`, `DefaultOwnerAddress`, `ProxyFactory`, and `SafeUints` are deployed successfully and triggered correctly within the protocol.

There are a few depending injection contracts or addresses in the current project:

- `DefaultOwnerAddress`, `TokenAddress`, and `VestingPoolsAddress` for the contract `PoolStakes`;
- `TokenAddress` for the contract `VestingPools`;
- `_minter` for the contract `ZKPToken`.

We assume these contracts or addresses are valid and non-vulnerable actors and implementing proper logic to collaborate with the current project.

Privileged Functions

In the contract `PoolStakes`, the roles `_owner` and `_defaultOwner` have the authority over the following functions:

- `PoolStakes.addStakes()`, which adds stakeholders along with their allocations to a proxy;
- `PoolStakes.massWithdraw()`, which sends tokens to stakeholders;
- `PoolStakes.claimErc20()`, which sends the contract's extra tokens to an address;
- `PoolStakes.removeContract()`, which destroys a proxy version of the contract under the conditions that all stakes have been paid and the contract does not contain any vested Tokens;
- `DefaultOwnable.transferOwnership()`, which transfers the `_owner` role to a designated address.

In the contract `VestingPools`, the role `_owner` has the authority over the following functions:

- `VestingPools.addVestingPools()`, which adds a vesting pool and its associated wallet;
- `VestingPools.updatePoolTime()`, which changes the start time and vesting duration of a vesting pool;
- `VestingPools.claimErc20()`, which sends ERC20 tokens or unvested tokens to an address;

- `VestingPools.removeContract()`, which destroys the `VestingPools` contract under the condition that all allocated tokens have been vested;
- `Ownable.renounceOwnership()`, which disables all functions with the `onlyOwner` modifier;
- `Ownable.transferOwnership()`, which transfers the `_owner` role to a different address.

In addition, the wallet associated to the vesting pool has the authority over the following functions:

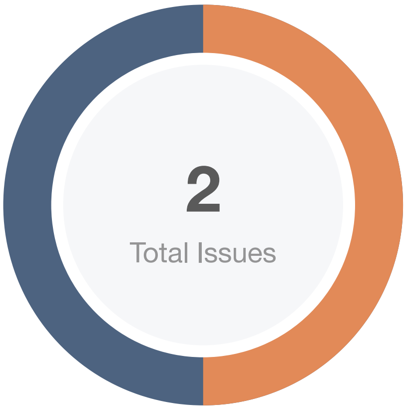
- `VestingPools.release()`, which sends tokens allocated in the vesting pool to the wallet;
- `VestingPools.releaseTo()`, which sends tokens allocated in the vesting pool to a chosen address;
- `VestingPools.updatePoolWallet()`, which changes the address of the wallet for that vesting pool.

In the contract `ZKPToken`, the role `minter` has the authority over the following functions:

- `ZKPToken.mint()`, which mints new ZKP tokens;
- `ZKPToken.setMinter()`, which sets the address for the `minter` role.

To improve the trustworthiness of the project, 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 `Timelock` contract.

Findings



- **Critical** **0** (0.00%)
- **Major** **1** (50.00%)
- **Medium** **0** (0.00%)
- **Minor** **0** (0.00%)
- **Informational** **1** (50.00%)
- **Discussion** **0** (0.00%)

ID	Title	Category	Severity	Status
GLOBAL-01	Unlocked Compiler Version	Language Specific	● Informational	✓ Resolved
ZKP-01	Centralization Risk	**Centralization / Privilege**	● **Major**	ⓘ Acknowledged

GLOBAL-01 | Unlocked Compiler Version

Category	Severity	Location	Status
Language Specific	Informational	Global	Resolved

Description

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation

[Panther Team]: Exact compiler version (8.4) is fixed in the hardhat.config.ts.

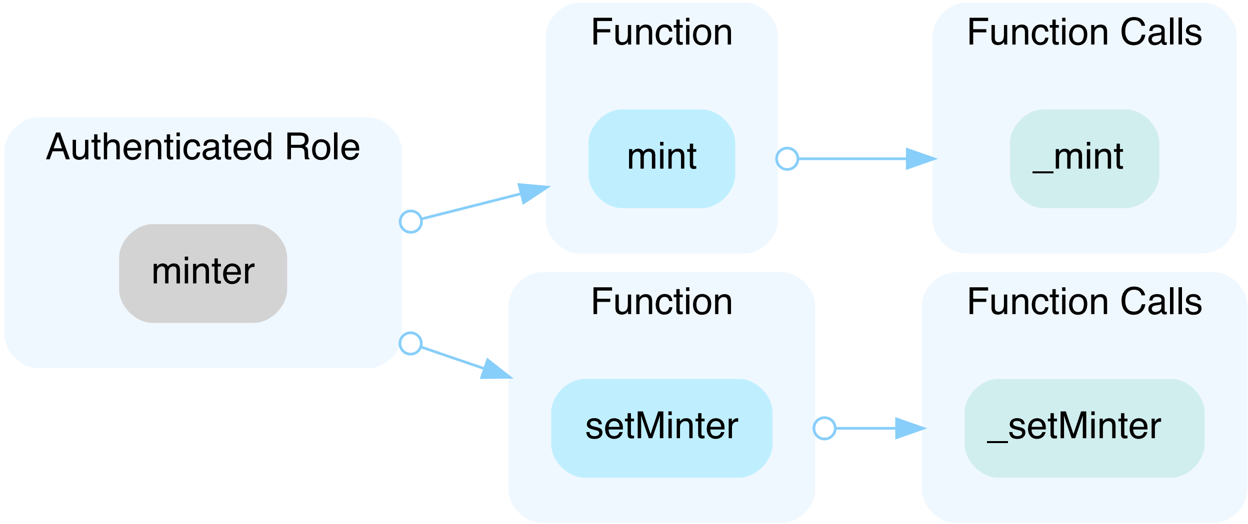
ZKP-01 | Centralization Risk

Category	Severity	Location	Status
Centralization / Privilege	Major	projects/panther/contracts/ZKPToken.sol (9a05001): 24, 33	Acknowledged

Description

In the contract `ZKPToken`, the role `minter` has the authority over the following functions:

- `ZKPToken.mint()`, the minter can mints arbitrary amount of ZKP tokens;
- `ZKPToken.setMinter()`, the minter can assign arbitrary the address as the `minter` role.



Any compromise to the `minter` account may allow the hacker to take advantage of this and arbitrarily mint new tokens or prevent new tokens from being minted.

Recommendation

We advise the client to carefully manage the `minter` account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., Multisignature wallets.

Here are some feasible suggestions that would also mitigate this risk in the short-term and long-term:

- A time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;

- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

[Panther Team]: Contracts logic (ZKPToken has a single minter, VestingPools contract mints $ZKP), the Deployment Plan (./deploymentPlan.README.md), and the Contracts Hierarchy diagram (docs/ZKP-contracts-hierarchy.png) provides for the VestingPools contract being the only ZPToken.minter.

[Certik]: The auditors agree that, if the `minter` is the `VestingPool` contract, there will not be risks on the `minter` account's private key. However, considering the auditors do not know if the deployment will proceed correctly, the status of this issue will be updated after contract deployment upon request.

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.

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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