CERTIK

Certik Report for VSYS

Contents

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About CertiK

CertiK is a technology-led blockchain security company founded by Computer Science professors from Yale University and Columbia University built to prove the security and correctness of smart contracts and blockchain protocols.

CertiK, in partnership with grants from IBM and the Ethereum Foundation, has developed a proprietary Formal Verification technology to apply rigorous and complete mathematical reasoning against code. This process ensures algorithms, protocols, and business functionalities are secured and working as intended across all platforms.

CertiK differs from traditional testing approaches by employing Formal Verification to mathematically prove blockchain ecosystem and smart contracts are hacker-resistant and bug-free. CertiK uses this industry-leading technology together with standardized test suites, static analysis, and expert manual review to create a full-stack solution for our partners across the blockchain world to secure 6.2B in assets. For more information: https://certik.org.

Executive Summary

V SYSTEMS, a distributed database project using cutting edge blockchain technology that allows all economic systems to build their app on top of the platform.

CertiK is invited by VSYSTEMS team for reviewing the Non-Turing-Complete, smart contract technology development. The development is planned into three phrase:

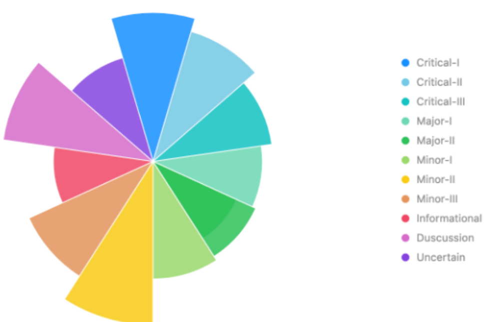
1. Token creation, distribution, and issuance
2. Token trading and management

3. Optimize the performance

Testing Summary

SECURITY LEVEL

VULNERABILITY OVERVIEW



This report has been prepared as a product of the Audit request by VSYS.

TYPE	Chain
SOURCE CODE	https://github.com/virtualeconomy/v-systems
PLATFORM	Custom
LANGUAGE	Scala
REQUEST DATE	June, 2020
REVISION DATE	June, 2020
METHODS	Static Analysis, and Manual Review, a comprehensive examination has been performed.

Source Of Truth

From vsys smart contract document:

Considering the technology development and industrial needs for smart contracts, V SYSTEMS will temporarily adopt the non-Turing-complete scripting language, so that smart contracts can be secure, resource-efficient, and easy to use and manage. In the near future, a Turing-complete model will eventually be adopted by V SYSTEMS.

- Smart contract ownership cannot be transferred, but the token issue right can be transferred. The contract creator has the final right to interpret the token issue right.
- The smart contract itself cannot be modified. It is a simple consensus and cannot be modified at will, but the parameters of some contracts can be changed. The contracts with modifiable parameters are relatively weak in consensus. These parameter revisions will provide choices and an advanced notice.

Scope Of Audit

CertiK was chosen by V Systems to audit the design and implementation of its smart contract technology based on VSYS chain. To ensure comprehensive protection,the source code has been analyzed by the proprietary CertiK formal verification engine and manually reviewed by our smart contract experts and engineers. That end-to-end process ensures proof of stability as well as a hands-on, engineering-focused process to close potential loopholes and recommend design changes in accordance with the best practices in the space.

Source Code SHA-256 Checksum

Contract

- **CallType.scala**

  c0749ca4dfb68a6d7e4501ca2188586215e7038f566bba5e75e2b9b523839b06

- **Contract.scala**

  901846cd2107b6dc7be69939ea6be4e91355e8bf0533f75fcc57ae6c8e7033b9

- **ContractDepositWithdraw.scala**

  e0976d56bb01152ab4a21c549300bd1a36f2fb6f3bacbb5a5deef762480958e5

- **ContractDepositWithdrawProductive.scala**

  d0c0854dc253ab0c89874fef922b00374e5bdf8b7d32633d7ade4a29df0148e8

- **ContractGen.scala**

  0c11a58f93edfbfbbb840d843cec73cd8a793066150d8036c72e9f4b15d7ed32

- **ContractPermitted.scala**

  e9ff852b4ad82e0a25ae0f5c0bda94f55b31f6eb79360a208d799a02ac14bd27

- **ContractSystem.scala**

  1ee61006c399404a6b56c488b4e3f2814dca745a299adc943ea44b7c81bb6470

- **DataEntry.scala**

  c49bc0f4cf1f7147b4afa0fca2c7eb22b5eaa46cc8bdcaa5a2d0c493140e59f6

- **DataType.scala**

  1a43fe7facb05fd6cd225f4b4455be1f2495e7b84b10eac191772f492aa7b79e

- **ExecutionContext.scala**

  bf3a1061976595ae026d6fedcaa9a358d217346222c7350b3c12a1e1804592ea

OpcDiff

- **AssertOpcDiff.scala**

  ec58ae24776979317c8099d89bb69e611f8a5568a00fe99c222651a630f376d5

- **BasicOpcDiff.scala**

  9eff8eca48e098b2aa5c6d2fe68204e065746d8fe39b4f64858083cc1f8eec6f

- **CDBVOpcDiff.scala**

  cf54b4bcc6a79b90230451d76f5050d1d7643855a05413fa66b625e7c83e73a2

- **CDBVROpcDiff.scala**

  6a994404c6975da8cffa80ed1629ea38526cd724bca6ef94d095130c89d84858

- **CallOpcDiff.scala**

  1680b67ec2f963d59ad63eeb09cf743f629d320cea98253730fcb05c2eb04148

- **CompareOpcDiff.scala**

  6860bfd38e7b42bdfb0c9a35b398b7265770cb3e8fbbb0d6aa3a58a867d4fff4

- **LoadOpcDiff.scala**

  aed0b93187b5bd80dd9d3c8c5047c60bdd3b4116497c92aa7aa3d5aa98712d6f

- **OpcDiff.scala**

  8f1416c30073c23955dde60fe2ec9fe754bd34a6b2b22b4ff4888863bb87b436

- **OpcDiffer.scala**

  147ae9590dba6813f35d43cc91ef8f53997eb09e323933e64440349296fd8cbd

- **OpcFuncDiffer.scala**

  0fd242d765b476028ffaa661ffcc695ff7bbf6f39db6abc19ef724641be86cb2

- **ReturnOpcDiff.scala**

  eba31d378c7edc70a2b7324144ff9f364063fe66ef75fb50b17bff464037f173

- **SystemTransferDiff.scala**

  718c7a53d0b07028effb30bf1ef0b6b5f139a17f89eaf4730432679c4c304ede

- **TDBAOpcDiff.scala**

  79e91b2618ae677c3540ecedc1fe4640156de6309da54e0e53522347231f75f8

- **TDBAROpcDiff.scala**

  dd3a4a47f24fd9a2b8eab9e19ba302717bf686f18276364f4c42ea557835bcf7

- **TDBOpcDiff.scala**

  e54a0188fc765b463ff0f3c9f7c94be66e038ca130d53dbb0f3219a0d9db897f

- **TDBROpcDiff.scala**

  0e4f13e8e108f8189a5416afa3b9ad9d91e8119767bac8ba8778d0ef087cc84

  4

Review Comments

- ContractDepositWithdrawProductive.scala
  - INFO
  - For depositTrigger and withdrawTrigger, the relation between tokenId and contractTokenId is defined to be equal, which seems not so intuitive.

blockchain/state/opcdiffs/

- TDBAOpcDiff.scala

  Token database rollback opcodes including deposit(), withdraw() and transfer(), where deposit() and withdraw() operation interact with contract address and the behavior of transfer() is like transferFrom() in Solidity.
  - INFO
  - Recommend ensuring the depositAmount always greater than 0 in deposit().
  - INFO
  - Recommend ensuring the withdrawAmount always greater than 0 in withdraw().
- TDBAROpcDiff.scala

  Get balance of given address.
  - INFO

- Recommend to check address in balance() is not zero address.

- TDBOpcDiff.scala

  Token database operations that can create newToken and split by setting new unity.

  - [Question] Based on the knowledge that before splitting, token issuers should notice the centralized exchanges to stop all business and then update the unity. We have some concerns on this unity change operation and would like to go deeper to the functionality of the split function if the balance would always be kept the same.
  - INFO
  - Recommend to replace magic numbers in parseBytes() with symbolic constants.

- TDBROpcDiff.scala

  Set max, unity, total and desc states.

  - INFO
  - Recommend to replace magic numbers in parseBytes() with symbolic constants.

Best Practice

Design of smart contract development requires a particular engineering mindset. A failure in the initial construction can be catastrophic, and changing the project after the fact can be exceedingly difficult.

To ensure success and to avoid the challenges above, design of smart contracts should here to best practices at their conception. Below, we summarized a checklist of key points & vulnerability vectors that help to indicate a high overall quality of the current V Systems project. (✓ indicates satisfaction,× indicates dissatisfaction,– indicates inapplicability).

General

Logging

- [✓] Specify error cases by defining various classes and objects extends ValidationError
- [✓] Use status code to monitor transaction status

Arithmetic Vulnerability

Two's Complement / Integer underflow / overflow

- [✓] Use Math library with addExact() before all arithmetic operations to catch integer overflow and underflow errors

Floating Points and Precision

- [✓] Correct handling the right precision when dealing ratios and rates

Access & Privilege Control Vulnerability

Circuit Breaker

- [–] Provide pause functionality for control and emergency handling

Restriction

- [✓] Provide proper access control for functions
- [✓] Establish rate limiter for certain operations
- [✓] Restrict access to sensitive functions
- [–] Restrict permission to contract destruction
- [–] Establish speed bumps slow down some sensitive actions, any malicious actions occur, there is time to recover.

DoS Vulnerability

A type of attack that makes the contract inoperable within a certain period of time or permanently.

Unexpected Revert

- [✓] States would be changed if and only if the diffcodes passed all of the validation checks, so that functions would not be reverted in unexpected situations.

Human Factor Manipulation Vulnerability

Avoid state changes before validation checks

- [✓] States would be changed if and only if the diffcodes passed all of the validation checks.

Visibility Vulnerability

The visibility determines whether a function can be called externally by users, by other derived contracts, only internally or only externally.

- [✓] Specify the visibility of all functions in a contract, even if they are intentionally public

Incorrect Interface Vulnerability

A contract interface defines functions with a different type signature than the implementation, causing two different methods to be created. As a result, when the interface is called, the fallback method will be executed.

- [✓] Ensure the defined function signatures are match with the contract interface and implementation

Documentation

The presence of documentation helps keep track of all aspects of an application and it improves on the quality of a software product. Its main focuses are development, maintenance and knowledge transfer to other developers.

- [✓] Provide project README and execution guidance
- [✓] Provide inline comment for complex functions intention
- [✓] Provide instruction to initialize and execute the test files

Testing

Rigorous testing of components and systems, and their associated documentation, can help reduce the risk of failures occurring during operation. When defects are detected, and subsequently fixed, this contributes to the quality of the components or systems.

- [✓] Provide test scripts and coverage for potential scenarios
  Overall we found the design of smart contracts based on opcodes to follow good practices. With the final update of source code and delivery of the audit report, we conclude that the design of smart contracts is structurally sound and not vulnerable to any classically known anti-patterns or security issues. The audit report itself is not necessarily a guarantee of correctness or trustworthiness, and we always recommend seeking multiple opinions, keep improving the codebase, and more test coverage and sandbox deployments.