CERTIK

Security Assessment

BAS

May 24th, 2022

Table of Contents

Summary

This report has been prepared for BAS to discover issues and vulnerabilities in the source code of the BAS 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	BAS
Description	BSC Application Sidechain
Platform	EVM Compatible
Language	Golang
Codebase	https://github.com/Ankr-network/bas-template-bsc/tree/e5ac3a4a037a350873306ce93f5778fb7bdc0843/
Commit	e5ac3a4a037a350873306ce93f5778fb7bdc0843

Audit Summary

Delivery Date	May 24, 2022 UTC
Audit Methodology	Static Analysis, Manual Review

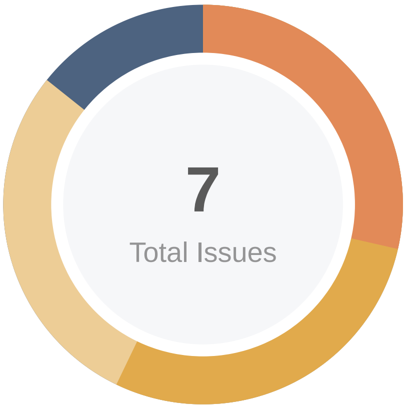
Vulnerability Summary

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

Audit Scope

ID	File	SHA256 Checksum
ERR	systemcontract/error.go	90050d2a5ab8eb0fd5cbdce40fc2aa00f8570f677c90f10e2cdbb84b28446cf7
COT	contracts.go	71ab48d3048066f5c5aa299ea22741bafc67694b705d7e97d09285a47a5a0fa7
EVM	evm.go	462255a596b95b62a347541adffa327101aad8bafe078625a44866dcecc11e98
TYP	systemcontract/types.go	21b567ac5e1df7bcf38914ceee088099bb8e73af9addafbd7a937e615d1b4a34
UPG	systemcontract/upgrade.go	ce369c4d363173603600343b6bc1c766f557d6775cffc7bade6260373ce2a2d3
ABI	abi.go	622802d232ca767abd77ada9bdf00fe0eaf41177f7be61c936104234fc02cb6e
CON	const.go	7af8375760f60790cec571c3079fca5d51720a76725f0ba7f59d51da6db85023
FAC	systemcontract/factory.go	1823c1de1f69e0fd2857948d96ecf7d62f44fc325cd2a994e3d3d33b87861c77

Findings



🟥 **Critical**	**0** (0.00%)
🟧 **Major**	**2** (28.57%)
🟨 **Medium**	**2** (28.57%)
▨ **Minor**	**2** (28.57%)
🟦 **Informational**	**1** (14.29%)
🟩 **Discussion**	**0** (0.00%)

ID	Title	Category	Severity	Status
CON-01	`TokenManagerContract` Is Missing In `systemContracts` Map	Logical Issue	● Medium	ⓘ Acknowledged
E5A-01	Redundant Definition Of `runtimeUpgradeContract`	Logical Issue	● Minor	ⓘ Acknowledged
EVM-01	Unused Function `CreateWithAddress()` And Meaningless Opcode `STOP`	Logical Issue	● Minor	ⓘ Acknowledged
UPG-01	The Situation Of Deploying New System Contracts Is Not Handled Properly	Logical Issue	● Major	ⓘ Acknowledged
UPG-02	For Upgrading Existing System Contracts, Deployment Code Must Be Run To Get The Final Code	Logical Issue	● Major	ⓘ Acknowledged
UPG-03	It Is Very Dangerous To Allow RuntimeUpgrade System Contract To Upgrade Itself	Logical Issue	● Medium	ⓘ Acknowledged
UPG-04	New Version And Old Version Of System Smart Contracts Must Have Compatible Storage Layout	Logical Issue	● Informational	ⓘ Acknowledged

CON-01 | `TokenManagerContract` Is Missing In `systemContracts` Map

Category	Severity	Location	Status
Logical Issue	● Medium	const.go (common/systemcontract): 19, 41~50	ⓘ Acknowledged

Description

`TokenManagerContract` is defined as one of BSC contracts. But it is missing in the `systemContracts` map. The code should make it clear whether it is enabled in BAS.

Recommendation

We recommend adding `TokenManagerContract` to the `systemContracts` map.

E5A-01 | Redundant Definition Of `runtimeUpgradeContract`

Category	Severity	Location	Status
Logical Issue	● Minor	const.go (common/systemcontract): 28, 36; systemcontract/upgrade.go (core/vm): 44	ⓘ Acknowledged

Description

The `runtimeUpgradeContract` address is defined in both `common/systemcontract/const.go` and `core/vm/systemcontract/upgrade.go`. It may lead to potential inconsistency in future changes.

Recommendation

We recommend removing `runtimeUpgradeContract` in `core/vm/systemcontract/upgrade.go`.

EVM-01 | Unused Function `CreateWithAddress()` And Meaningless Opcode `STOP`

Category	Severity	Location	Status
Logical Issue	● Minor	evm.go (core/vm): 571~575	ⓘ Acknowledged

Description

The function `CreateWithAddress()` is not used at all in the project. And it does not make any sense to use the opcode `STOP` for creating new contract.

Recommendation

We recommend removing the function `CreateWithAddress()`.

Alleviation

From BAS team: `CreateWithAddress()` is used in another project `create genesis`. Now we also use this function for the new system contract deployment.

UPG-01 | The Situation Of Deploying New System Contracts Is Not Handled Properly

Category	Severity	Location	Status
Logical Issue	● Major	systemcontract/upgrade.go (core/vm): 64	ⓘ Acknowledged

Description

Based on the example RuntimeUpgrade system smart contract at `https://github.com/Ankr-network/bas-genesis-config/blob/devel/contracts/RuntimeUpgrade.sol`, the RuntimeUpgrade evm hook can be used to deploy new system contracts. In such case, `StateDb.SetCode()` is not enough at all, many other actions like `Create a new account on the state`, `run the deployment code to get the final code`, `revert when deployment code fails`, etc must also be performed. Otherwise, deploying new system contracts will malfunction.

Recommendation

We recommend referencing the function `create()` in `https://github.com/Ankr-network/bas-template-bsc/blob/devel/core/vm/evm.go` for creating new system contracts.

Alleviation

From BAS team: Agree, in this case we might not be able to use constructor and init function after deployment will always skip calling ctor due to empty state. I'm adding new deployTo method that allows to deploy smart contract with constructors.

UPG-02 | For Upgrading Existing System Contracts, Deployment Code Must Be Run To Get The Final Code

Category	Severity	Location	Status
Logical Issue	● Major	systemcontract/upgrade.go (core/vm): 64	ⓘ Acknowledged

Description

The solidity compiler generates both deployment byte code and deployed byte code from source code. If the `upgradeTo()` parameter is deployment code, then the deployment code needs to be run in blockchain context to get the final contract byte code(deployed code) which is used as the 2nd parameter of function `StateDb.SetCode()`. No matter if the parameter is deployment code or deployed code, there must be NO immutables in system contracts. Otherwise, deployed code may NOT work.

Recommendation

We recommend handling the mentioned situation properly.

Alleviation

From BAS team: Try to bring compatibility with openzeppelin’s upgradable smart contracts. If upper solutions don’t work then make sure that we don’t lose any immutable private fields after the runtime upgrade

UPG-03 | It Is Very Dangerous To Allow RuntimeUpgrade System Contract To Upgrade Itself

Category	Severity	Location	Status
Logical Issue	● Medium	systemcontract/upgrade.go (core/vm): 56	ⓘ Acknowledged

Description

Upgrading system contract is dangerous action, especially for RuntimeUpgrade system contract itself. If there is any bug in the new version of RuntimeUpgrade system contract, the whole runtime upgrading system may stop working forever. Ideally the RuntimeUpgrade system contract should be kept minimal, simple, clear and bug free such that it does not need upgrade at all.

Recommendation

We recommend making RuntimeUpgrade system contract code immutable.

UPG-04 | New Version And Old Version Of System Smart Contracts Must Have Compatible Storage Layout

Category	Severity	Location	Status
Logical Issue	● Informational	systemcontract/upgrade.go (core/vm): 60	ⓘ Acknowledged

Description

New version and old version of system smart contracts must have compatible storage layout. Otherwise, the contract will malfunction and may be stuck in an unrecoverable state. And system contracts must avoid using immutables(better also avoid initializing state variables in field declarations and constructor(constructor must be empty)), otherwise deployed byte code will not work or deployment byte code may overwrite existing storage data and cause unrecoverable error. See https://docs.openzeppelin.com/upgrades-plugins/1.x/writing-upgradeable and https://github.com/bnb-chain/bsc-genesis-contract/tree/master/contracts.

Recommendation

We recommend reviewing new version and old version of system smart contracts before upgrade to make sure their storage layouts are absolutely compatible, avoiding immutables and keeping field declarations and constructor empty.

Alleviation

From BAS team: Try to bring compatibility with openzeppelin’s upgradable smart contracts

Appendix

Finding Categories

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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