#HashEx
BLOCKCHAIN SECURITY

ApeSwap IAZO

smart contracts
final audit report

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Contents

1. Disclaimer

This is a limited report on our findings based on our analysis, in accordance with good industry practice at the date of this report, in relation to cybersecurity vulnerabilities and issues in the framework and algorithms based on smart contracts, the details of which are set out in this report. In order to get a full view of our analysis, it is crucial for you to read the full report. While we have done our best in conducting our analysis and producing this report, it is important to note that you should not rely on this report and cannot claim against us on the basis of what it says or doesn't say, or how we produced it, and it is important for you to conduct your own independent investigations before making any decisions. We go into more detail on this in the disclaimer below – please make sure to read it in full.

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2. Overview

HashEx was commissioned by the ApeSwap Finance team to perform an audit of their smart contracts .

The code located in the github repository @apeswapfinance/apeswap-iazo was audited after the commit 74a5d9f. The updated code was re-checked after the 1fe0548 commit in the same repository.

The IAZO project is an ERC20 token sale platform with an optional add liquidity function and LP tokens locking. Documentation was provided with the README.md and separate contract descriptions. The repository contains tests with ~75% coverage.

The purpose of this audit was to achieve the following:

- Identify potential security issues with smart contracts.
- Formally check the logic behind given smart contracts.

Information in this report should be used to understand the risk exposure of smart contracts, and as a guide to improving the security posture of smart contracts by remediating the issues that were identified.

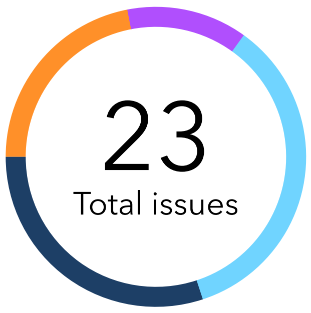
2.1 Summary

Project name	ApeSwap IAZO
URL	https://apeswap.finance/
Platform	Binance Smart Chain
Language	Solidity

2.2 Contracts

Name	Address
IAZOFactory	`0xD6C35D6551330a48Ed6d2e09b2BcBe38f6bA4C4a`
Gas optimizations and general recommendations	
IAZO	`0xd5536403D10E016176022AFB0bdff6fA035600E0`
IAZOLiquidityLocker	`0xE5D700E9819aE3d964C2312f9D372B3A07413A5a`
IAZOTokenTimelock	`0x427E1F5CdB7a0Fd20A893065a849c4a22118a002`
IAZOExposer	`0xFdfb230bFa399EC32EA8e98c2E7E3CcD953C860A`
IAZOSettings	`0x624433b9C78dE84c8Dd3C9e906046017Bb03E3A6`
IAZOUpgradeProxy	`0xD6C35D6551330a48Ed6d2e09b2BcBe38f6bA4C4a`
OwnableProxy	https://github.com/ApeSwapFinance/apeswap-iazo/blob/2540152d05640334ea8b71c0c5e41b081ca8d190/contracts/OwnableProxy.sol

3. Found issues



●	High	5 (22%)
●	Medium	3 (13%)
●	Low	8 (35%)
●	Info	7 (30%)

C33. IAZOFactory

ID	Severity	Title	Status
C33I7e	● High	setIAZOVersion() frontrun problem	✓ Acknowledged
C33I7f	● Medium	Reflect token protection doesn't work	✓ Acknowledged
C33I82	● Low	createIAZO lack of documentation	✓ Resolved
C33I80	● Low	TOKEN_PRICE lack of documentation	✓ Resolved
C33I81	● Low	Input data not checked	✓ Resolved

C3b. Gas optimizations and general recommendations

ID	Severity	Title	Status
C3bI93	● Low	OwnableProxy	✓ Resolved
C3bI92	● Info	IAZOSettings	✓ Resolved
C3bI83	● Info	IAZOFactory	✓ Resolved

C3bI87	● Info	IAZO	Partially fixed
C3bI8b	● Info	IAZOLiquidityLocker	✓ Resolved
C3bI8d	● Info	IAZOTimelock	✓ Resolved
C3bI90	● Info	IAZOExposer	✓ Acknowledged

C34. IAZO

ID	Severity	Title	Status
C34I84	● High	No restrictions on forceFailAdmin()	✓ Resolved
C34I85	● High	No input data checks in updateStart()	✓ Resolved
C34I86	● High	BNB transfer to fee address	✓ Resolved
C34I72	● Info	RFI and tokens with commissions	✓ Resolved

C35. IAZOLiquidityLocker

ID	Severity	Title	Status
C35I88	● Medium	Lack of documentation: revocable locks	✓ Resolved
C35I89	● Low	Unused parameter	✓ Resolved
C35I8a	● Low	apePairIsInitialised() not checked in lockLiquidity()	✓ Acknowledged

C36. IAZOTokenTimelock

ID	Severity	Title	Status
C36I8c	● High	Beneficiaries can't be removed	✓ Resolved

C37. IAZOExposer

ID	Severity	Title	Status
C37I8e	● Low	require() statement in view function	✓ Resolved
C37I8f	● Low	EnumerableSet is not used	✓ Resolved

C38. IAZOSettings

ID	Severity	Title	Status
C38I91	● Medium	Burn address can be changed by admin	✓ Resolved

4. Contracts

C33. IAZOFactory

Overview

Factory contract for creation of sales contracts by Clones library.

Issues

C33l7e setIAZOVersion() frontrun problem ● High ✓ Acknowledged

`setIAZOVersion()` function could be used by the owner to frontrun new IAZO and potentially steal the sale's earnings.

Recommendation

We recommend transferring admin/owner privileges to a Timelock contract.

C33l7f Reflect token protection doesn't work ● Medium ✓ Acknowledged

Reflect tokens protection in L205 doesn't work in general as transfers from the owner are usually free from taxes.

Recommendation

We recommend explicitly describing the risks of participating in malicious sales as Factory is meant to be used without constant admin intervention.

C33l82 createIAZO lack of documentation ● Low ✓ Resolved

In L219 min `_amount` is 1e4, but `_tokenPrice` isn't checked to be greater than `decimals/amount`, i.e. hardcap could be calculated as 0.

C33I80 TOKEN_PRICE lack of documentation ● Low ✓ Resolved

`TOKEN_PRICE` should have extended description, i.g. `BASE(or NATIVE) amount in wei for 1.0 IAZO (weis divided by 10^decimals)`. The current comment in L73 is insufficient and may confuse users.

C33I81 Input data not checked ● Low ✓ Resolved

The New IAZO owner is not checked for zero in `createIAZO()` function.

C3b. Gas optimizations and general recommendations

Overview

These issues are combined into one section with Informational severity. We recommend avoiding using modified OpenZeppelin contracts but inherit from originals if custom functionality is needed. We also recommend following Solidity naming conventions.

Issues

C3bI93 OwnableProxy ● Low ✓ Resolved

OwnableUpgradeable contract from OpenZeppelin could be used with initializable contracts.

C3bI92 IAZOSettings ● Info ✓ Resolved

Excessive reads in L129, 132,135, 149, 156.

Inconsistent comment and typos in L39-40 of the updated contract.

C3bI83 IAZOFactory ● Info ✓ Resolved

Excessive computations in L250: should be `amount*percent*tokenPrice/1000/listingPrice`.

Variable declaration with zero assignment L59.

C3bI87 IAZO ● Info ✓ Partially fixed

Excessive or unnecessary reads in L132, (208, 217, 220), (209, 222), (207, 226,230), (261, 262, 263), (271, 272, 273), (301, 304, 309), 317, (334, 338), (328, 345, 349, 351), 322, (365, 367, 369, 370). `IAZO_INFO.BASE_TOKEN` is read 3 to 5 times, `IAZO_INFO.IAZO_TOKEN` is read 6 to 7 times in the `addLiquidity()` function.

In the function `userDepositPrivate()` calculation of the `amount_in` variable is unnecessary, the `_amount` variable can always be used.

Checking input amount for zero in `userDepositPrivate()` may reduce gas consumption in certain cases.

In the function `userDepositPrivate()` there is an external call to IAZO_TOKEN to get the decimals value. It is more gas-efficient to store decimals in the global variable.

The variable is declared with zero assignment in L105.

`getIAZOState()` could use enum constants for better readability.

Structures in L49-89 could be modified and/or rearranged to save gas on storage by packing multiple variables into 256bit slots.

No checks on input data in the `initialize()` function, although they are mostly performed in the Factory contract.

Inconsistent comment in L54, should describe TOKEN_PRICE with mentioning decimals.

Typos in L71, 320, 327, 340.

C3bI8b IAZOLiquidityLocker ● Info ✓ Resolved

Contracts IAZOTokenTimelock can be deployed using Clones by OpenZeppelin.

No need to import full interfaces besides the needed functions.

Excessive read in L164, `createPair()` returns new address.

Typos in L122.

C3bI8d IAZOTimelock ● Info ✓ Resolved

Variables `releaseTime`, `IAZO_SETTINGS` and `revocable` can be marked as immutable. Also, the variable `isIAZOTokenTimelock` can be marked as constant.

C3bI90 IAZOExposer ● Info ✓ Acknowledged

Variable declaration with zero assignment L38.

C34. IAZO

Overview

Token sale contract for chosen currency or BNB. Automatically adds percent of liquidity to ApeSwap after a successful sale and locks LP tokens.

Issues

C34I84 No restrictions on forceFailAdmin() ● High ✓ Resolved

`forceFailAdmin()` function irreversibly changes IAZO state to `FORCE_FAILED`, causing changed conditions in `userWithdraw()` L247. The problem occurs if the sale has been successful and liquidity has already been added, leaving the contract without BASE tokens.

Recommendation

Deny `forceFailAdmin()` calls after adding liquidity.

C34I85 No input data checks in updateStart() ● High ✓ Resolved

`updateStart()` function doesn't check new `_activeTime` for max limit, i.e. `IAZO_SETTINGS.getMaxIAZOLength()`.

Recommendation

Limit updated value from above.

C34I86 BNB transfer to fee address ● High ✓ Resolved

Transferring fees in native currency in `addLiquidity()` function in L365 may fail if FEE_ADDRESS is set to the contract without receiving functions. In that case, all withdrawals would be blocked and the only possibility would be the FORCE_FAILED option. Also need to mention that the recommended way of sending native currency is `call()` with a reentrancy guard.

Recommendation

Implement a separate external function for fee collecting or use try/catch with a limited gas sending method.

C34I72 RFI and tokens with commissions ● Info ✓ Resolved

RFI tokens and tokens with ommissions aren't supported by the contract.

C35. IAZOLiquidityLocker

Overview

Support contract to be called by IAZO contracts to add liquidity. Creates a new vault contract for each IAZO to lock their LP tokens.

Issues

C35I88 Lack of documentation: revocable locks ● Medium ✓ Resolved

Admin can grant permission to withdraw tokens before `releaseTime` if the revocable variable on deploy is set to true, which it is by default. This must be described on the project's website and in its documentation, users should be aware of this feature.

C35I89 Unused parameter ● Low ✓ Resolved

`_iazoAddress` is always equal to `msg.sender` in L156. Updates of IAZO could use this to register wrong Timelock information in the Exposer contract, see L184.

C35I8a apePairIsInitialised() not checked in lockLiquidity() ● Low ✓ Acknowledged

`apePairIsInitialised()` is designed to be checked during `lockLiquidity()`, but it's called in the IAZO contract instead. The possible updates of the IAZO version may miss that part of the code and break the safety guard.

C36. IAZOTokenTimelock

Overview

Locking contract for storing LP tokens of successful sales. The minimum locking period is set in IAZOSettings by ApeSwap admin. By default, locks could be lifted with ApeSwap admin permission.

Issues

C36I8c Beneficiaries can't be removed ● High ✓ Resolved

`addBeneficiary()` function is irreversible, wrong or compromised address can be stopped only with transaction race.

Recommendation

Remove can be implemented via onlyAdmin and checking that at least 1 beneficiary remains in the list.

C37. IAZOExposer

Overview

Registry contract for tracking IAZOs. Stores all factory created contracts and their Timelock for successful sales.

Issues

C37I8e require() statement in view function ● Low ✓ Resolved

require() statement in `getTokenTimelock()` view function L94 may lead to wrong reads in explorers.

C37I8f EnumerableSet is not used ● Low ✓ Resolved

`EnumerableSet.AddressSet IAZOs` and `IAZOAddressToIndex` is redundant. The enumerable set already contains mapping address -> index. But single mapping address -> bool should be sufficient.

C38. IAZOSettings

Overview

Default parameters and limits for new IAZOs. Parameters, updatable for admins, are read-only at the moment of IAZO creation.

Issues

C38I91 Burn address can be changed by admin ● Medium ✓ Resolved

Admin can set the burn address to his own account and collect all leftovers of IAZO_TOKEN (in case of burning leftovers).

Recommendation

Burn address should be constant 0x00 or 0xdead.

C39. IAZOUpgradeProxy

Overview

TransparentUpgradeableProxy by OpenZeppelin.

C3a. **OwnableProxy**

Overview

Modification of Ownable contract from OpenZeppelin repository with a removed constructor to work with initializable contracts.

5. Conclusion

5 high severity issues were found. Most of the issues were fixed with the update. The contracts are highly dependent on the owner’s account. Users using the project have to trust the owner and that the owner's account is properly secured.

This audit includes recommendations on the code improving and preventing potential attacks.

Open for all `createIAZO()` function of IAZOFactory contract allows creating fraud sales. Deny of responsibility should be mentioned on the project website and docs section.

Audited implementations for IAZO, IAZOFactory, and IAZOLiquidityLocker contracts are deployed to the BSC mainnet: 0xd5536403D10E016176022AFB0bdff6fA035600E0, 0x4D72Fdd4798c200E1BA68eC86948F4D00dF063f2, and 0x9e04C2c3b5Fc6f6B9ba30BcEd6895816260572CF respectively with the EOA as the owner.

Appendix A. Issues' severity classification

- **Critical.** Issues that may cause an unlimited loss of funds or entirely break the contract workflow. Malicious code (including malicious modification of libraries) is also treated as a critical severity issue. These issues must be fixed before deployments or fixed in already running projects as soon as possible.
- **High.** Issues that may lead to a limited loss of funds, break interaction with users, or other contracts under specific conditions. Also, issues in a smart contract, that allow a privileged account the ability to steal or block other users' funds.
- **Medium.** Issues that do not lead to a loss of funds directly, but break the contract logic. May lead to failures in contracts operation.
- **Low.** Issues that are of a non-optimal code character, for instance, gas optimization tips, unused variables, errors in messages.
- **Informational.** Issues that do not impact the contract operation. Usually, informational severity issues are related to code best practices, e.g. style guide.

Appendix B. List of examined issue types

- Business logic overview
- Functionality checks
- Following best practices
- Access control and authorization
- Reentrancy attacks
- Front-run attacks
- DoS with (unexpected) revert
- DoS with block gas limit
- Transaction-ordering dependence
- ERC/BEP and other standards violation
- Unchecked math
- Implicit visibility levels
- Excessive gas usage
- Timestamp dependence
- Forcibly sending ether to a contract
- Weak sources of randomness
- Shadowing state variables
- Usage of deprecated code