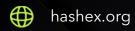


AmbiDex

smart contracts final audit report

August 2022





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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 AmbiDex team to perform an audit of their smart contract. The audit was conducted between 12/07/2022 and 26/07/2022.

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 for understanding 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.

Some of the audited contracts are designed to be deployed with <u>proxies</u>. Users have no choice but to trust the owners, who can update the contracts at their will.

The code is available at @rekursive-labs/ambidex GitHub repository after <u>08e9064</u> commit.

Update: the AmbiDex team has responded to this report. The updated code is located in the same repository after the commit <u>f3f814d</u>.

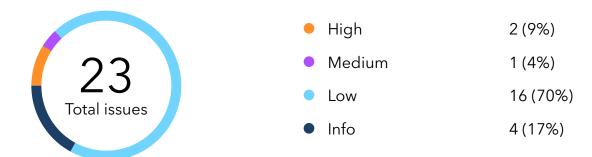
2.1 Summary

Project name	AmbiDex
URL	http://ambidex.fi
Platform	Hedera
Language	Solidity

2.2 Contracts

Name	Address
AddressProvider	
MasterChef	
LaunchADX	
StakingADX	
Treasury	
VestingADX	
MultiSigWallet	
utils/ folder	
lib/ folder	
dex/ folder	
Interfaces	

3. Found issues



C1. AddressProvider

ID	Severity	Title	Status
C1-01	High	Excessive owner's rights	
C1-02	Low	No events	
C1-03	Info	Variable visibility	

C2. MasterChef

ID	Severity	Title	Status
C2-01	Low	No events	
C2-02	Low	Indexation error	
C2-03	Low	Gas optimizations	
C2-04	Info	No support of tokens with commisions	Ø Acknowledged

C3. LaunchADX

ID	Severity	Title	Status
C3-01	Low	Gas optimizations	Partially fixed
C3-02	Info	Sale period is not determined	Ø Acknowledged

C4. StakingADX

ID	Severity	Title	Status
C4-01	• Low	Gas optimization	

C5. Treasury

ID	Severity	Title	Status
C5-01	High	Excessive owner's rights	← Partially fixed
C5-02	Low	No events	
C5-03	Low	Gas optimization	

C6. VestingADX

ID	Severity	Title	Status
C6-01	Low	No events	
C6-02	Low	No view function for vestingSchedulesIds[] array length	Ø Resolved

C6-03 • Low Ga	as optimizations	🚱 Partially fixed

C9. lib/ folder

ID	Severity	Title	Status
C9-01	Low	IHederaTokenService types mismatching	Ø Acknowledged
C9-02	Info	HederaTokenService disabled functionality	⊗ Resolved

C10. dex/folder

ID	Severity	Title	Status
C10-01	Medium	UniswapV2Router wHBAR functionality	
C10-02	Low	UniswapV2Pair initialization	Acknowledged
C10-03	Low	UniswapV2Router redundant code	
C10-04	Low	UniswapV2Router associations	Partially fixed
C10-05	Low	UniswapV2Router gas optimization	

4. Contracts

C1. AddressProvider

Overview

The contract stores Treasury, MasterChef, LaunchADX, StakingADX, VestingADX, UniswapV2Factory addresses, which are acquired by other contracts. The contract was initially designed to be deployed with proxy.

Issues

C1-01 Excessive owner's rights



Other contracts' logic depends on the addresses this contract stores. The owner can change them to malicious ones, which may lead to pernicious consequences including the loss of users' assets.

```
function setTreasury(address treasury) external override onlyOwner {
    require(treasury != address(0), ERROR_ZERO_ADDRESS);
    _addresses[TREASURY] = treasury;
}

function setMasterChef(address masterChef) external override onlyOwner {
    require(masterChef != address(0), ERROR_ZERO_ADDRESS);
    _addresses[MASTERCHEF] = masterChef;
}

function setLaunchADX(address launchADX) external override onlyOwner {
    require(launchADX != address(0), ERROR_ZERO_ADDRESS);
    _addresses[LAUNCH_ADX] = launchADX;
}

function setStakingADX(address stakingADX) external override onlyOwner {
    require(stakingADX(address stakingADX) external override onlyOwner {
    require(stakingADX != address(0), ERROR_ZERO_ADDRESS);
    _addresses[STAKING_ADX] = stakingADX;
}
```

```
function setVestingADX(address vestingADX) external override onlyOwner {
    require(vestingADX != address(0), ERROR_ZERO_ADDRESS);
    _addresses[VESTING_ADX] = vestingADX;
}

function setUniswapV2Factory(address uniswapV2Factory) external override onlyOwner {
    require(uniswapV2Factory != address(0), ERROR_ZERO_ADDRESS);
    _addresses[UNISWAP_V2_FACTORY] = uniswapV2Factory;
}
```

Recommendation

The ownership should be transferred to a <u>Timelock-like</u> contract with a minimum delay of at least 24 hours. This won't stop the owner from possible rights abuse but it will help users to be informed about upcoming changes. Also, consider adding <u>ERC165</u> standard support to the contracts whose addresses can be updated and check whether a new address implements the interface of the updated contract before address change to avoid accidental address setting.

Update

Within the update stored addresses re-initialization was restricted. Contract's deployment sheme has been changed from proxy to the direct one.

C1-02 No events

Low

Resolved

We recommend emitting events on important value changes to be easily tracked off-chain. No events are emitted in setter functions.

C1-03 Variable visibility

Info

Resolved

ERROR_ZERO_ADDRESS contains an error message for several setter functions. Its public visibility is redundant and can confuse users.

C2. MasterChef

Overview

MasterChef farming contract with a custom bonus reward system dependent on staked LP and IADX tokens. The contract is designed to be deployed with proxy.

Issues

C2-01 No events

We recommend emitting events on important value changes to be easily tracked off-chain. No events are emitted in the add() and set() functions.

C2-02 Indexation error

If the poolExists() modifier receives on input pool ID greater than poolInfo.length- 1, the transaction will be reverted with an inconsistent indexation error message.

C2-03 Gas optimizations

- a. There is no need for zero initializing of the **totalAllocPoint** variable in the **__MasterChef_init_unchained()** function.
- b. No need to require int256(_amount) <= type(int64).max on L162, 190, since the _amount variable has int64 type.

C2-04 No support of tokens with commissions

The contract doesn't support tokens with fees on transfers or rebasing tokens. Creating a liquidity pool with some will end up all LP tokens draining. The owner must avoid adding pools for such tokens.

Acknowledged

Resolved

Resolved

Resolved

Low

low

Low

Info

C3. LaunchADX

Overview

The contract enables private and public ADX token sales. The private sale is only available for whitelisted users. Both sales have a cap for ADX token sold. After tokens are bought with a private sale, they will be locked in the VestingADX contract, in case of a public sale they are instantly transferred to a user. The contract is designed to be deployed with proxy.

Issues

C3-01 Gas optimizations



a. addressProvider and privateSaleAmount /publicSaleAmount state variables are read multiple times in buyADXPrivate()/buyADXPublic();

b. Tokens addresses and their decimals parameters received with tokenUSDC(), tokenADX(), and decimals() external calls can be memorized to storage variables to reduce gas consumption;

c. Unchecked math could be used in L58, 78.

C3-02 Sale period is not determined

InfoAcknowledged

Low

Partially fixed

The owner can start and stop a private/public sale any time they want to. Though, the sale can not be re-opened after it's closed.

C4. StakingADX

Overview

Staking for the ADX token. Rewards are earned in IADX token. The code structure is quite similar to the MasterChef contract. The contract is designed to be deployed with proxy.

Issues

C4-01 Gas optimization

In the updateReward() modifier, state variable _rewardPerTokenStaked is read after writing to storage.

C5. Treasury

Overview

The contract is responsible for creating ADX and IADX tokens and their further distribution. ADX is minted with an initial supply of 25'000'000 tokens without any extra mint possibility, whereas IADX starts with 0 initial supply and can be minted by StakingADX and MasterChef. The contract is designed to be deployed with proxy.

Issues

C5-01 Excessive owner's rights

- HighPartially fixed
- a. The owner can withdraw all ADX tokens with transferToken() and withdrawADX() functions;
- b. The owner can substitute the **StakingADX** or **MasterChef** address to their own and unlimitedly mint **IADX** tokens, see more at Excessive owner's rights issue in the AddressProvider section.

Resolved

Low

Recommendation

a. The ownership should be transferred to a <u>Timelock-like</u> contract with a minimum delay of at least 24 hours and MultiSig account as admin. This won't stop the owner from possible rights abuse but it will help users to be informed about upcoming changes.

b. See C1 recommendation.

Update

a. The owner was removed from possible withdrawADX() callers, but still can abuse transferToken() to drain ADX.

b. See C1 update.

C5-02 No events

LowResolved

We recommend emitting events on important value changes to be easily tracked off-chain. No events are emitted in **onlyOwner** functions.

C5-03 Gas optimization

Low

Acknowledged

a. In function **createADXToken()** gloval variable **tokenADX** is read after writing. The same in function **createIADXToken()** with variable **tokenIADX**.

b. In function transferADXToBuyer() global variables addressProvider and availableADXForBuyers are read multiple times. The same in function mintIADX() with variables addressProvider and tokenIADX.

C6. VestingADX

Overview

The contract holds tokens bought in private sale with a total vesting period of 1.5 years. The contract is designed to be deployed with proxy.

Issues

C6-01 No events

Low

Resolved

We recommend emitting events on important value changes to be easily tracked off-chain. No events are emitted in the depositADX() function.

C6-02 No view function for vestingSchedulesIds[] array length

Low

Resolved

There is no public view function returning the length of the **vestingSchedulesIds[]** array. Lack of information about total number of vestings may be problematic for users trying to analyze the project's state of affairs or for those who monitor vesting updates.

C6-03 Gas optimizations

Low



a. In the function withdraw() in line 69 the variable vestingSchedule should be read into the memory instead of the storage to reduce the number of reads of fields in this structure;

b. In the function depositADX() the state variable addressProvider is read multiple times;

c. There is no need for the **SafeMath** library in the 0.8.0 and above version of solidity. It is embedded into the compiler;

d. In function withdraw() on line 80 in storage all struct is written, but only one field is changed.

C7. MultiSigWallet

Overview

Multi signature wallet by <u>Gnosis</u> with minor changes due to compiler version update. No issues were found.

C8. utils/folder

Overview

The folder contains generally imported contracts and libraries. Among them: math libraries, proxy contract, SafeERC20 wrapper, execution context providers, address library, SafeCast module, storage read auxiliaries, and hedera token helper. Most of the contents are imported from the <u>OpenZeppelin</u> repository.

HTSHelper

A modified version of the <u>TokenCreateContract</u> from @hashgraph/hedera-smart-contracts Hedera GiHub repository. Implements helper functions for token creation, minting, and burning. No issues were found.

C9. lib/ folder

Overview

The folder with Hedera Smart Contract Service supporting files. Imported from the @hashgraph/hedera-smart-contracts Hedera GiHub repository.

Issues

C9-01 IHederaTokenService types mismatching • Low O Acknowledged

Response codes' types are changed from int64 to int256 according to the official Hedera Token Service contract.

C9-02 HederaTokenService disabled functionality ● Info ⊘ Resolved

Default renew period **defaultAutoRenewPeriod** is disabled according to the official Hedera Token Service <u>contract</u>.

C10. dex/folder

Overview

The folder includes <u>UniswapV2</u> protocol contracts adapted for Hedera service.

Issues

C10-01 UniswapV2Router wHBAR functionality





No functions unwrap() and wrap() for wHBAR. This issue may cause problems in arbitrage for pairs with wHBAR. Also, users, who called swap to wHBAR by mistake, have no simple option to convert it to HBAR.

Issue was introduced in the code update.

Recommendation

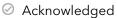
This issue can be fixed in two ways:

- 1. Make functions unwrap() and wrap() in UniswapV2Router contract;
- 2. Make separate contract for wHBAR with functionality of a token and with unwrap() and wrap() functions.

The first way is easier than the second one, but the second way is better in terms of backwards compatibility.

C10-02 UniswapV2Pair initialization





UniswapV2Pair contract uses HTSHelper.createToken() to create a token in Hedera Token Service. The newly created Pair contract becomes its own ADMIN, MINTER, and PAUSER, but the pausable and updating methods aren't implemented. Also, it uses DELEGATABLE_CONTRACT_ID_KEY key type, though the Pair contract is not a proxy.

```
constructor() payable {
```

```
lpToken = createToken("Ambidex Liquidity Token", "ADXLT", 0, 6, address(this));
    }
    function createToken(
        string memory name,
        string memory symbol,
        uint256 initialSupply,
        uint256 decimals,
        address treasury
    ) internal returns (address createdTokenAddress) {
        keys[0] = getSingleKey(
            HederaTokenService.ADMIN_KEY_TYPE,
            KeyHelper.DELEGATABLE_CONTRACT_ID_KEY,
            treasury
        );
        keys[1] = getSingleKey(supplyPauseKeyType, KeyHelper.DELEGATABLE_CONTRACT_ID_KEY,
treasury);
        IHederaTokenService.HederaToken memory myToken = IHederaTokenService.HederaToken(
            name,
            symbol,
            treasury,
            false,
            0,
            false,
            keys,
            getSecondExpiry(uint32(block.timestamp + 10 * 365 * 24 * 60 * 60)) // 10 years
        );
    }
```

C10-03 UniswapV2Router redundant code

Low

Resolved

addLiquidity() contains a requirement of pair != address(0) on L93, which has no use since
UniswapV2Library.pairFor() never returns zero.

C10-04 UniswapV2Router associations

Low

Partially fixed

In swap functions, Hedera Token Service associations can be made for users, who call the function, to make the execution possible for new users without a corresponding token association. Similarly, it was done in addLiquidity() function in L125-130.

C10-05 UniswapV2Router gas optimization

Low

Resolved

The global variable wHBAR can be set as immutable. Its creation could be moved to the constructor section.

Issue was introduced in the code update.

C11. Interfaces

Overview

It aggregates all inspected project's interfaces. Including: IAddressProvider.sol, IMasterChef.sol, ILaunchADX.sol, IStakingADX.sol, ITreasury.sol, IVestingADX.sol, IMultiSigWallet.sol. No issues were found.

5. Conclusion

2 high, 1 medium, 16 low severity issues were found during the audit. 1 high, 1 medium, 10 low issues were resolved in the update.

The reviewed 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.

Furthermore, such sensitive tokenomics contracts as **VestingADX**, **Treasury**, **LaunchADX**, **StakingADX**, **MasterChef** are designed to be deployed with proxies, opening the possibility for their implementation change over time that may have malicious intent or cause new vulnerabilities appearance.

This audit includes recommendations on code improvement and the prevention of potential attacks.

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

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