DYP-BRIDGE SMART CONTRACT AUDIT

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BLOCKCHAIN CONSILIUM

Contents

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Introduction

We first thank dyp.finance for giving us the opportunity to audit their smart contract. This document outlines our methodology, audit details, and results.

dyp.finance asked us to review their DYP bridge smart contract (GitHub Commit Hash: `6f0e31824733a5585a2ed692b791f92d0bfce12e`). Blockchain Consilium reviewed the system from a technical perspective looking for bugs, issues and vulnerabilities in their code base. The Audit is valid for above mentioned GitHub Commit Hash(es) only. The audit is not valid for any other versions of the smart contract. Read more below.

Audit Summary

This code is clean, thoughtfully written and in general well architected. The code conforms closely to the documentation and specification.

Overall, the code is clear on what it is supposed to do for each function. The visibility and state mutability of all the functions are clearly specified, and there are no confusions.

https://github.com/dypfinance/DYP-Bridge-and-Staking-on-Binance-Smart-Chain/blob/6f0e31824733a5585a2ed692b791f92d0bfce12e/Contracts/Bridge.sol

Audit Result	**PASSED AS PER SPECS, 3 INFORMATIONAL OBSERVATIONS**
High Severity Issues	None
Moderate Severity Issues	None
Low Severity Issues	None
Informational Observations	3

Overview

The project has one Solidity file for the Bridge Smart Contract, the Bridge.sol file that contains about 669 lines of Solidity code, and contains libraries from OpenZeppelin contracts. Code review of OpenZeppelin libraries or servers / backend system is outside the scope of this audit report. We manually reviewed each line of code in the smart contract.

Methodology

Blockchain Consilium manually reviewed the smart contract line-by-line, keeping in mind industry best practices and known attacks, looking for any potential issues and vulnerabilities, and areas where improvements are possible.

We also used automated tools like slither / surya for analysis and reviewing the smart contract. The raw output of these tools is included in the Appendix. These tools often give false-positives, and any issues reported by them but not included in the issue list can be considered not valid.

Classification / Issue Types Definition:

1. **High Severity:** which presents a significant security vulnerability or failure of the contract across a range of scenarios, or which may result in loss of funds.
2. **Moderate Severity:** which affects the desired outcome of the contract execution or introduces a weakness that can be exploited. It may not result in loss of funds but breaks the functionality or produces unexpected behaviour.
3. **Low Severity:** which does not have a material impact on the contract execution and is likely to be subjective.

The smart contract is considered to pass the audit, as of the audit date, if no high severity or moderate severity issues are found.

Specifications

DYP Team submitted the expected behaviour of the system as follows:

> *The smart contract will be deployed on both ETH and BSC networks with different chainIds, a backend system on a server will be used to sign cross chain deposit / withdrawal requests enabling ERC20/BEP20 deposits on one chain and withdrawals on another chain.*

Smart Contract Overview

Bridge smart contract is intended to be a bidirectional ERC20/BEP20 swap between Ethereum Blockchain and Binance Smart Chain. Users deposit the available Tokens to the smart contract on one blockchain and receives a signature from a bot which works on the backend (auditing of backend is outside the scope of this report).

Given the signature and message, a user may use the signature and message to withdraw the required number of tokens from the smart contract, chainId checks and

smart contract address used in creating and decoding message signature helps the same signature to not be used on both blockchains.

The smart contract has daily limits per account for withdrawals, and deposit transactions at a time cannot exceed the limit, withdraw transactions cannot exceed daily limit any day.

Any amount of funds may be withdrawn from the smart contracts using the backend bot's signatures by anyone who has the signature. It is recommended to have the backend and key management for the bot to be very secure.

Attacks & Issues considered while auditing

In order to check for the security of the contract, we reviewed each line of code in the smart contract considering several known Smart Contract Attacks & known issues.

- **Overflows and underflows**
  An overflow happens when the limit of the type variable uint256 , 2 ** 256, is exceeded. What happens is that the value resets to zero instead of incrementing more.

  For instance, if we want to assign a value to a uint bigger than 2 ** 256 it will simple go to 0—this is dangerous.

  On the other hand, an underflow happens when you try to subtract 0 minus a number bigger than 0.For example, if you subtract 0 - 1 the result will be = 2 ** 256 instead of -1.

  This is quite dangerous. This contract **DOES** check for overflows and underflows manually, but it also uses direct arithmetic operations, we highly recommend using **OpenZeppelin's** *SafeMath* for overflow and underflow protection.

- **Reentrancy Attack**
  One of the major dangers of calling external contracts is that they can take over the control flow, and make changes to your data that the calling function wasn't expecting. This class of bug can take many forms, and both of the major bugs that led to the DAO's collapse were bugs of this sort.

  This smart contract uses OpenZeppelin's ReentrancyGuard to protect against this attack.

- **Replay attack**
  The replay attack consists of making a transaction on one blockchain like the original Ethereum's blockchain and then repeating it on another blockchain like the Ethereum's classic blockchain. The ether is transferred like a normal transaction from a blockchain to another. Though it's no longer a problem because since the version 1.5.3 of *Geth* and 1.4.4 of *Parity* both implement the attack protection EIP 155 by Vitalik Buterin.

  So the people that will use the contract depend on their own ability to be updated with those programs to keep themselves secure.

  Since this full system is a cross-chain bridge between Binance Smart Chain and Ethereum Blockchains – it is recommended to not let users enter arbitrary chain IDs in the transfer and receipt requests which may result in a potential replay attack in the future.

- **Short address attack**
  This attack affects ERC20 tokens, was discovered by the Golem team and consists of the following:

  A user creates an Ethereum wallet with a trailing 0, which is not hard because it's only a digit. For instance: `0xiofa8d97756as7df5sd8f75g8675ds8gsdg0`
  Then he buys tokens by removing the last zero:
  Buy 1000 tokens from account `0xiofa8d97756as7df5sd8f75g8675ds8gsdg`. If the contract has enough amount of tokens and the buy function doesn't check the length of the address of the sender, the Ethereum's virtual machine will just add zeroes to the transaction until the address is complete.

  The virtual machine will return 256000 for each 1000 tokens bought. This is abug of the virtual machine.

  Here is a **fix for short address attacks**

```
modifier onlyPayloadSize(uint size) {
    assert(msg.data.length >= size + 4);
    _;
}
function transfer(address _to, uint256 _value) onlyPayloadSize(2 * 32) {
    // do stuff
}
```

  Whether or not it is appropriate for token contracts to mitigate the short-address attack is a contentious issue among smart-contract developers. Many, including those behind the OpenZeppelin project, have explicitly chosen not to

do so. Blockchain Consilium doesn't consider short address attack an issue of the smart contract at the token smart contract level.

This contract is not an ERC20 Token and thus is not found vulnerable to ERC20 Short Address Attacks.

You can read more about the attack here: ERC20 Short Address Attacks.

- **Approval Double-spend**

  ERC20 Standard allows users to approve other users to manage their tokens, or spend tokens from their account till a certain amount, by setting the user's allowance with the standard `approve` function, then the allowed user may use `transferFrom` to spend the allowed tokens.

  Hypothetically, given a situation where Alice approves Bob to spend 100 Tokens from her account, and if Alice needs to adjust the allowance to allow Bob to spend 20 more tokens, normally – she'd check Bob's allowance (100 currently) and start a new `approve` transaction allowing Bob to spend a total of 120 Tokens instead of 100 Tokens.

  Now, if Bob is monitoring the Transaction pool, and as soon as he observes new transaction from Alice approving more amount, he may send a `transferFrom` transaction spending 100 Tokens from Alice's account with higher gas price and do all the required effort to get his spend transaction mined before Alice's new approve transaction.

  Now Bob has already spent 100 Tokens, and given Alice's approve transaction is mined, Bob's allowance is set to 120 Tokens, this would allow Bob to spend a total of 100 + 120 = 220 Tokens from Alice's account instead of the allowed 120 Tokens. This exploit situation is known as Approval Double-Spend Attack.

  A potential solution to minimize these instances would be to set the non-zero allowance to 0 before setting it to any other amount.

  It's possible for `approve` to enforce this behaviour without interface changes in the ERC20 specification:

  ```
  if ((_value != 0) && (approved[msg.sender][_spender] != 0)) return false;
  ```

  However, this is just an attempt to modify user behaviour. If the user does attempt to change from one non-zero value to another, the double spend might still happen, since the attacker may set the value to zero by already spending all the previously allowed value before the user's new approval transaction.

If desired, a non-standard function can be added to minimize hassle for users:

```
function increaseAllowance (address _spender, uint256 _addedValue)
returns (bool success) {
  uint oldValue = approved[msg.sender][_spender];
  approved[msg.sender][_spender] = safeAdd(oldValue, _addedValue);
  return true;
}
```

Even if this function is added, it's important to keep the original for compatibility with the ERC20 specification.

Likely impact of this bug is low for most situations. This contract is not an ERC20 token, and thus it is not found vulnerable to Approval Doublespend attacks.

For more, see this discussion on GitHub:
https://github.com/ethereum/EIPs/issues/20#issuecomment263524729

- **Sybil attacks**
  In a Sybil attack, the attacker subverts the reputation system of a network service by creating a large number of pseudonymous identities and uses them to gain a disproportionately large influence.

  Normally in ERC20 & DeFi smart contracts, sybil attacks are related to voting power amplification where a user may use their vote more than once in case of governance tokens. This smart contract does not implement governance or voting and thus is not found vulnerable to this specific type of sybil attacks in smart contracts & tokens.

Issues Found

High Severity Issues

No high severity issues were found in the smart contract.

Moderate Severity Issues

No moderate severity issues were found in the smart contract.

Low Severity Issues

No low severity issues were found in the smart contract.

Informational Observations

- The smart contract does not have pausable functionality, it is optional but recommended to add pausable functionality so all functions of the smart contracts can be paused / unpaused in emergency if required, since this is a centralized system it might be a nice idea to add pausable features.

- The method used for signing and decoding the data is eth.accounts.sign – it is recommended to use Sign Typed Data v4 to save more gas while verifying the signatures on-chain, if interested, looking for ERC20 Permit implementation using this method may help https://docs.metamask.io/guide/signing-data.html#sign-typed-data-v4

- Any number of tokens can be withdrawn from the smart contract given the backend bot's signatures, it is highly recommended to have the backend bot isolated and secure and periodically changing the verifying address used for withdrawal signatures.

Appendix

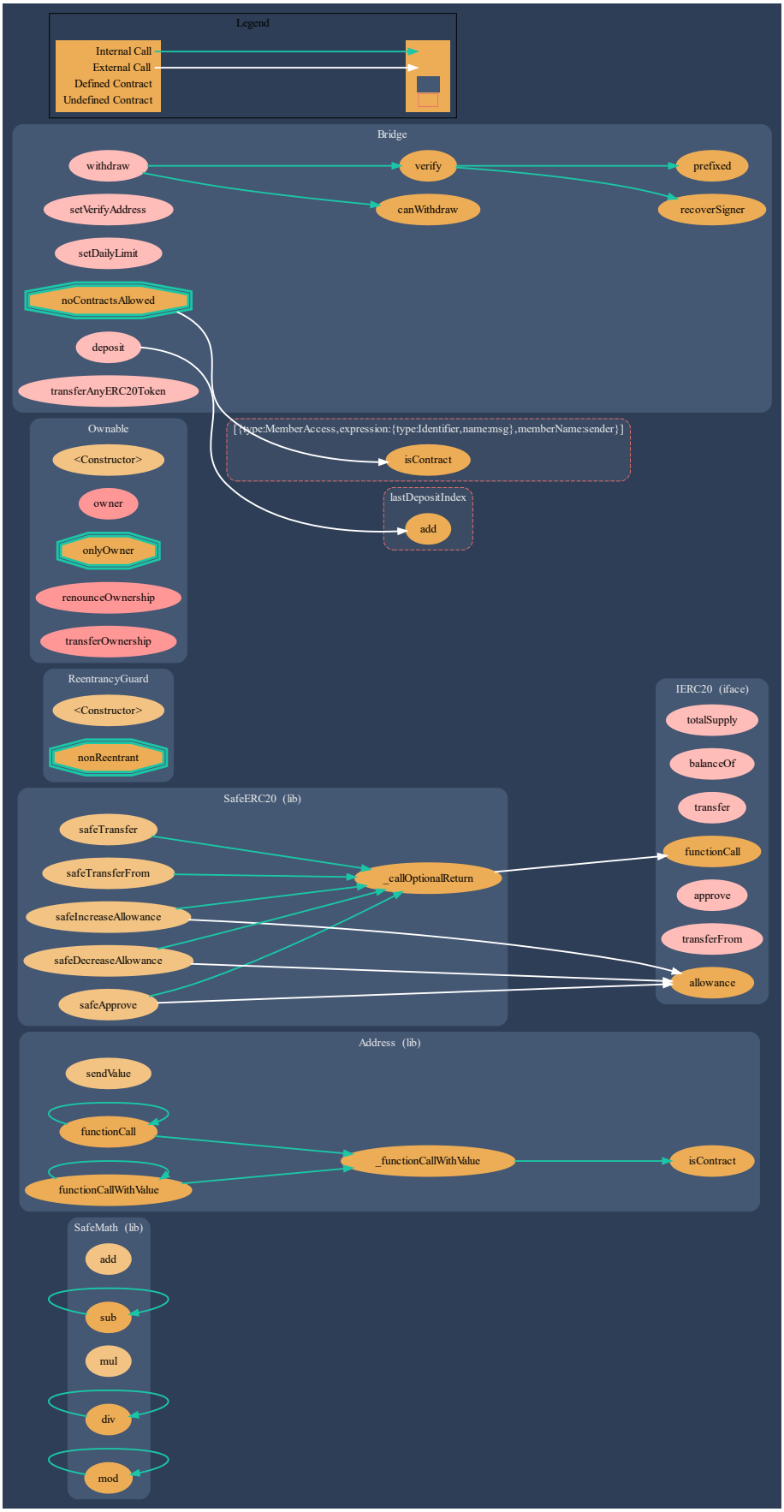
Smart Contract Summary

- Contract SafeMath (Most derived contract)
    - From SafeMath
        - add(uint256,uint256) (internal)
        - div(uint256,uint256) (internal)
        - div(uint256,uint256,string) (internal)
        - mod(uint256,uint256) (internal)
        - mod(uint256,uint256,string) (internal)
        - mul(uint256,uint256) (internal)
        - sub(uint256,uint256) (internal)
        - sub(uint256,uint256,string) (internal)
- Contract Address (Most derived contract)
    - From Address
        - _functionCallWithValue(address,bytes,uint256,string) (private)
        - functionCall(address,bytes) (internal)
        - functionCall(address,bytes,string) (internal)
        - functionCallWithValue(address,bytes,uint256) (internal)
        - functionCallWithValue(address,bytes,uint256,string) (internal)
        - isContract(address) (internal)
        - sendValue(address,uint256) (internal)
- Contract SafeERC20 (Most derived contract)
    - From SafeERC20
        - _callOptionalReturn(IERC20,bytes) (private)
        - safeApprove(IERC20,address,uint256) (internal)
        - safeDecreaseAllowance(IERC20,address,uint256) (internal)
        - safeIncreaseAllowance(IERC20,address,uint256) (internal)
        - safeTransfer(IERC20,address,uint256) (internal)
        - safeTransferFrom(IERC20,address,address,uint256) (internal)
- Contract IERC20 (Most derived contract)
    - From IERC20

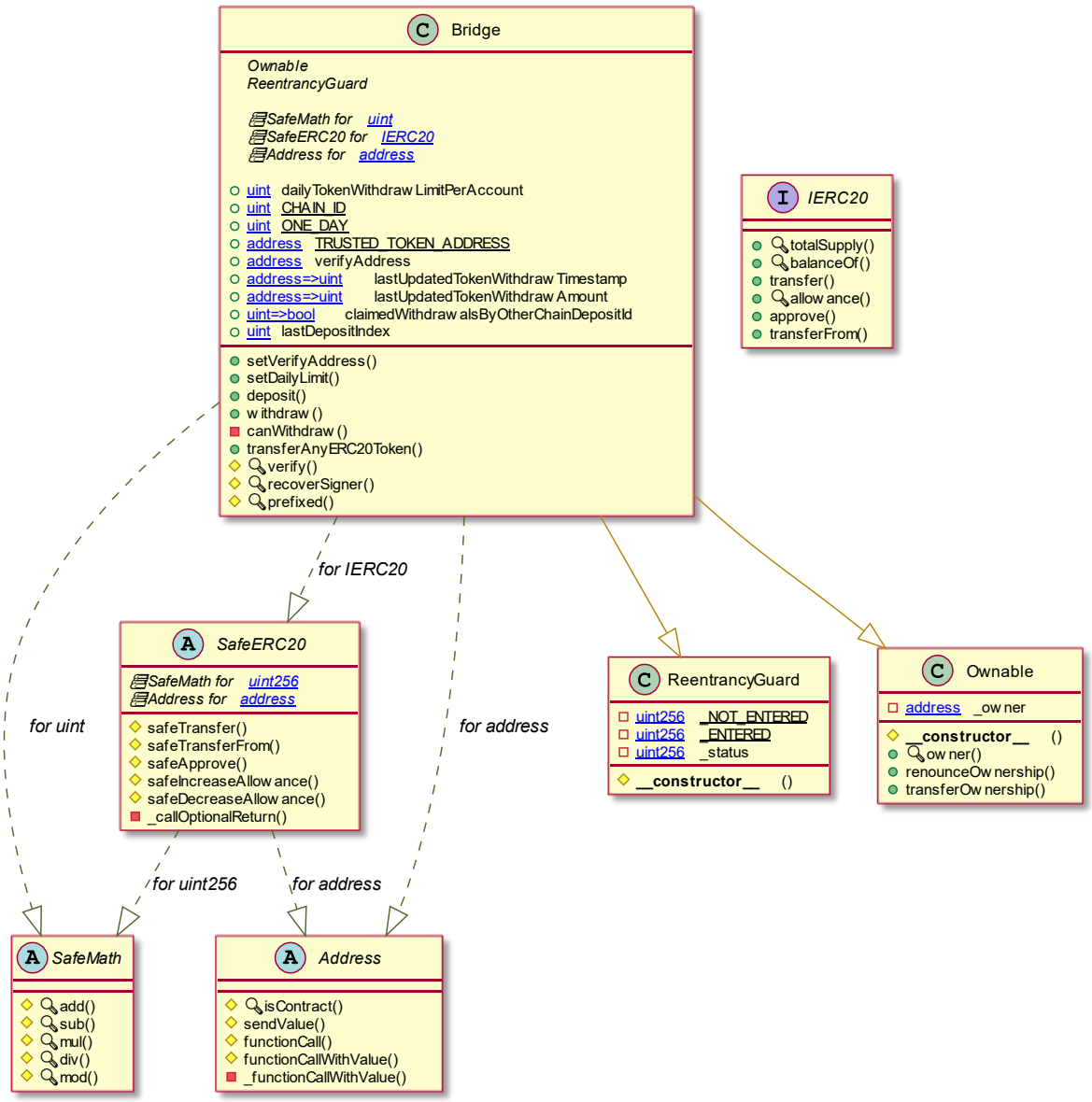
        - allowance(address,address) (external)
        - approve(address,uint256) (external)
        - balanceOf(address) (external)
        - totalSupply() (external)
        - transfer(address,uint256) (external)
        - transferFrom(address,address,uint256) (external)

- Contract ReentrancyGuard
    - From ReentrancyGuard
        - constructor() (internal)
- Contract Ownable
    - From Ownable
        - constructor() (internal)
        - owner() (public)
        - renounceOwnership() (public)
        - transferOwnership(address) (public)
- Contract Bridge (Most derived contract)
    - From ReentrancyGuard
        - constructor() (internal)
    - From Ownable
        - owner() (public)
        - renounceOwnership() (public)
        - transferOwnership(address) (public)
    - From Bridge
        - canWithdraw(address,uint256) (private)
        - deposit(uint256) (external)
        - prefixed(bytes32) (internal)
        - recoverSigner(bytes32,bytes) (internal)
        - setDailyLimit(uint256) (external)
        - setVerifyAddress(address) (external)
        - transferAnyERC20Token(address,address,uint256) (external)
        - verify(address,uint256,uint256,uint256,bytes) (internal)
        - withdraw(uint256,uint256,uint256,bytes) (external)

Control Flow Graph



Inheritance Graph and UML Diagram



Slither Results

```
> slither Bridge.sol

INFO:Detectors:
Bridge.setDailyLimit(uint256) (Bridge.sol#603-605) should emit an event for:
        - dailyTokenWithdrawLimitPerAccount =
newDailyTokenWithdrawLimitPerAccount (Bridge.sol#604)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-
events-arithmetic
INFO:Detectors:
```

```
Bridge.setVerifyAddress(address).newVerifyAddress (Bridge.sol#600) lacks a zero-
check on :
                - verifyAddress = newVerifyAddress (Bridge.sol#601)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#missing-
zero-address-validation
INFO:Detectors:
Reentrancy in Bridge.deposit(uint256) (Bridge.sol#607-614):
        External calls:
        -
IERC20(TRUSTED_TOKEN_ADDRESS).safeTransferFrom(msg.sender,address(this),amount)
(Bridge.sol#611)
        Event emitted after the call(s):
        -
Deposit(msg.sender,amount,block.number,block.timestamp,lastDepositIndex)
(Bridge.sol#613)
Reentrancy in Bridge.withdraw(uint256,uint256,uint256,bytes) (Bridge.sol#615-625):
        External calls:
        - IERC20(TRUSTED_TOKEN_ADDRESS).safeTransfer(msg.sender,amount)
(Bridge.sol#622)
        Event emitted after the call(s):
        - Withdraw(msg.sender,amount,id) (Bridge.sol#624)
Reference: https://github.com/crytic/slither/wiki/Detector-
Documentation#reentrancy-vulnerabilities-3
INFO:Detectors:
Bridge.canWithdraw(address,uint256) (Bridge.sol#627-634) uses timestamp for
comparisons
        Dangerous comparisons:
        - block.timestamp.sub(lastUpdatedTokenWithdrawTimestamp[account]) >=
ONE_DAY (Bridge.sol#628)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#block-
timestamp
INFO:Detectors:
Address.isContract(address) (Bridge.sol#182-191) uses assembly
        - INLINE ASM (Bridge.sol#189)
Address._functionCallWithValue(address,bytes,uint256,string) (Bridge.sol#275-296)
uses assembly
        - INLINE ASM (Bridge.sol#288-291)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#assembly-
usage
INFO:Detectors:
solc-0.6.12 is not recommended for deployment
Reference: https://github.com/crytic/slither/wiki/Detector-
Documentation#incorrect-versions-of-solidity
INFO:Detectors:
Low level call in Address.sendValue(address,uint256) (Bridge.sol#209-215):
        - (success) = recipient.call{value: amount}() (Bridge.sol#213)
Low level call in Address._functionCallWithValue(address,bytes,uint256,string)
(Bridge.sol#275-296):
        - (success,returndata) = target.call{value: weiValue}(data)
(Bridge.sol#279)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-
level-calls
INFO:Detectors:
owner() should be declared external:
        - Ownable.owner() (Bridge.sol#529-531)
renounceOwnership() should be declared external:
        - Ownable.renounceOwnership() (Bridge.sol#548-551)
transferOwnership(address) should be declared external:
        - Ownable.transferOwnership(address) (Bridge.sol#557-561)
```

```
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#public-
function-that-could-be-declared-external
INFO:Slither:Bridge.sol analyzed (7 contracts with 72 detectors), 13 result(s)
found
INFO:Slither:Use https://crytic.io/ to get access to additional detectors and
Github integration
```