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CSE A 6th Sem.

BUILDING DEFI PROTOCOL ERC20 Token Smart Contract for Ethereum Blockchain

Since the inception of Blockchain technology; Bitcoin, Ethereum, or crypto-currencies are hot topics and buzzing around the world many startups based on Blockchain technologies are using cryptocurrencies, in other words, crypto tokens for the utilization of their products. These crypto tokens can be deployed on many Blockchain like Ethereum, Cardano, Binance, Polkadot, etc. It's another topic of discussion, on which blockchain these crypto tokens need to be implemented but as Ethereum being the first market mover, this blog post explains, how you can create such a token on the Ethereum blockchain.

Before creating an Ethereum based token (ERC20 token), understand first the basics of Smart-contract and their native programming language Solidity.

Smart Contract

A smart contract is simply a set of rules that contains the business logic or a protocol according to which all the transactions on a Blockchain should happen. The general purpose of a Smart contract is to satisfy common contractual conditions like creating its token, perform arbitrary competitions, function to send and receive tokens, and store states of transactions.

Solidity

Solidity is an object-oriented and high-level smart-contract programming language, which is developed on top of Ethereum Virtual Machine (EVM). Solidity compiler converts smart-contract code into EVM bytecode which is sent to the Ethereum network as a deployment transaction. It would be best to have a good understanding of Solidity programming language to efficiently write an Ethereum Smart Contract and build an application on smart-contract.
Coding example of smart-contract

This section contains the example of a smart-contract code written using the Solidity programming language.

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Prerequisite

Integrated development environment (IDE)

Remix as the IDE. It is a web-based IDE with built-in static analysis and a testnet EVM. Remix provides the possibility to compile and deploy it to Ethereum testnet with Metamask. Here is a good blog post for it.

There is also another web-based IDE available like EthFiddle. For more information related to IDE please visit here.

Programming Language

Solidity

ERC20 Token Info

- Symbol – **N47**
- Name – **N47Token**
- Decimals – **0**
- Total Supply – **1000000**

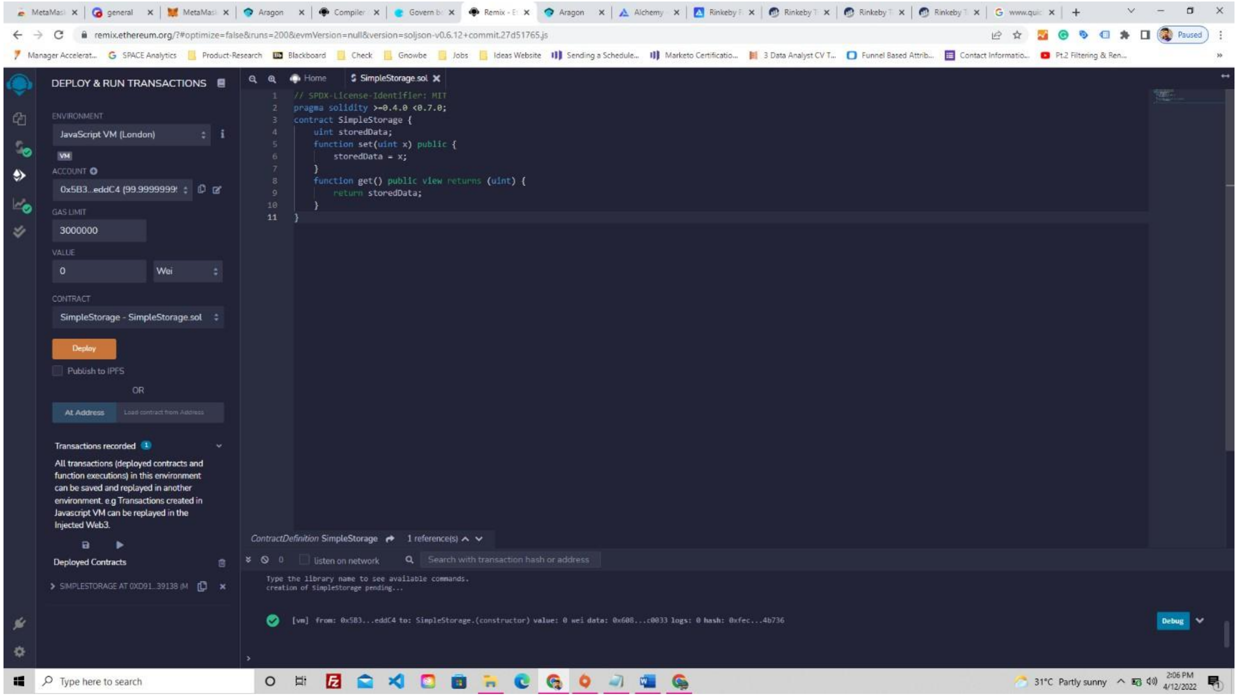
Smart-contract Code

```
// SPDX-License-Identifier: unlicensed
pragma solidity 0.8.4;
//----------------------------------------------------------------------------
// Safe maths
//----------------------------------------------------------------------------
contract SafeMath {
  function safeAdd(uint a, uint b) public pure returns (uint c)
    {c = a + b;
    require(c >= a);
  }
  function safeSub(uint a, uint b) public pure returns (uint c)
    {require(b <= a);
    c = a - b;
  }
}
//----------------------------------------------------------------------------
// ERC Token Standard #20 Interface
// https://github.com/ethereum/EIPs/blob/master/EIPS/eip-20.md
// ----------------------------------------------------------------------------
abstract contract ERC20Interface {
  function totalSupply() virtual public view returns (uint);
  function balanceOf(address tokenOwner) virtual public view returns (uint balance);
  function allowance(address tokenOwner, address spender) virtual public view returns (uint remaining);
  function transfer(address to, uint tokens) virtual public returns (bool success);
  function approve(address spender, uint tokens) virtual public returns (bool success);
  function transferFrom(address from, address to, uint tokens) virtual public returns (bool success);
  event Transfer(address indexed from, address indexed to, uint tokens);
  event Approval(address indexed tokenOwner, address indexed spender, uint tokens);
}
// ----------------------------------------------------------------------------
// ERC20 Token, with the addition of symbol, name and decimals
// assisted token transfers
// ----------------------------------------------------------------------------
contract N47Token is ERC20Interface, SafeMath {
  string public symbol;
  string public  name;
  uint8 public decimals;
  uint public _totalSupply;
  mapping(address => uint) balances;
  mapping(address => mapping(address => uint)) allowed;
  // ------------------------------------------------------------------------
  // Constructor
  // ------------------------------------------------------------------------
  constructor() {
    symbol = "N47";
    name = "N47Token";
    decimals = 0;
    _totalSupply = 1000000;
    balances[msg.sender] = _totalSupply;
    emit Transfer(address(0), msg.sender, _totalSupply);
}
// ----------------------------------------------------------------------------
  // Total supply
  // ----------------------------------------------------------------------------
  function totalSupply() public override view returns (uint) {
  return _totalSupply - balances[address(0)];
  }
  // ----------------------------------------------------------------------------
  // Get the token balance for account tokenOwner
  // ----------------------------------------------------------------------------
  function balanceOf(address tokenOwner) public override view returns (uint balance) {
  return balances[tokenOwner];
  }
  // ----------------------------------------------------------------------------
  // Transfer the balance from token owner's account to receiver account
  // - Owner's account must have sufficient balance to transfer
  // - 0 value transfers are allowed
  // ----------------------------------------------------------------------------
  function transfer(address receiver, uint tokens) public override returns (bool success) {
    balances[msg.sender] = safeSub(balances[msg.sender], tokens);
    balances[receiver] = safeAdd(balances[receiver], tokens);
    emit Transfer(msg.sender, receiver, tokens);
    return true;
```

```
}
// ----------------------------------------------------------------------------
// Token owner can approve for spender to transferFrom(...) tokens
// from the token owner's account
//
// https://github.com/ethereum/EIPs/blob/master/EIPS/eip-20.md
// recommends that there are no checks for the approval double-spend attack
// as this should be implemented in user interfaces
// ----------------------------------------------------------------------------
function approve(address spender, uint tokens) public override returns (bool success) {
   allowed[msg.sender][spender] = tokens;
   emit Approval(msg.sender, spender, tokens);
return true;
}
// ----------------------------------------------------------------------------
// Transfer tokens from sender account to receiver account
//
// The calling account must already have sufficient tokens approve(...)-d
// for spending from sender account and
// - From account must have sufficient balance to transfer
// - Spender must have sufficient allowance to transfer
// - 0 value transfers are allowed
// ----------------------------------------------------------------------------
function transferFrom(address sender, address receiver, uint tokens) public override returns (bool success
   balances[sender] = safeSub(balances[sender], tokens);
   allowed[sender][msg.sender] = safeSub(allowed[sender][msg.sender], tokens);
   balances[receiver] = safeAdd(balances[receiver], tokens);
   emit Transfer(sender, receiver, tokens);
```

```
        return true;
    }
    // -----------------------------------------------------------------------------------------------
    // Returns the amount of tokens approved by the owner that can be
    // transferred to the spender's account
    // -----------------------------------------------------------------------------------------------
    function allowance(address tokenOwner, address spender) public override view returns (uint remaining) {
        return allowed[tokenOwner][spender];
    }
}
```

Using the above code, smart-contract can be deployed on Ethereum Mainnet or Testnet. Deploying a smart contract is technically a transaction, that needs to pay Gas (fees) in terms of ETH (Native token for Ethereum network), in the same way, that needs to pay gas for a simple ETH transfer. However, Gas costs for contract deployment are far higher.



remix.ethereum.org/?#optimize=false&runs=200&evmVersion=null&version=soljson-v0.6.12+commit.27d51765.js

DEPLOY & RUN TRANSACTIONS

ENVIRONMENT: JavaScript VM (London)

ACCOUNT: 0x5B3...eddC4 (99.9999999

GAS LIMIT: 3000000

VALUE: 0 Wei

CONTRACT: SimpleStorage - SimpleStorage.sol

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.4.0 <0.7.0;
contract SimpleStorage {
    uint storedData;
    function set(uint x) public {
        storedData = x;
    }
    function get() public view returns (uint) {
        return storedData;
    }
}
```

Transactions recorded 1

All transactions (deployed contracts and function executions) in this environment can be saved and replayed in another environment. e.g Transactions created in Javascript VM can be replayed in the Injected Web3.

Deployed Contracts

SIMPLESTORAGE AT 0XD91...39138 (M

ContractDefinition SimpleStorage 1 reference(s)

```
Type the library name to see available commands.
creation of SimpleStorage pending...

[vm] from: 0x5B3...eddC4 to: SimpleStorage.(constructor) value: 0 wei data: 0x608...c0033 logs: 0 hash: 0xfec...4b736
```

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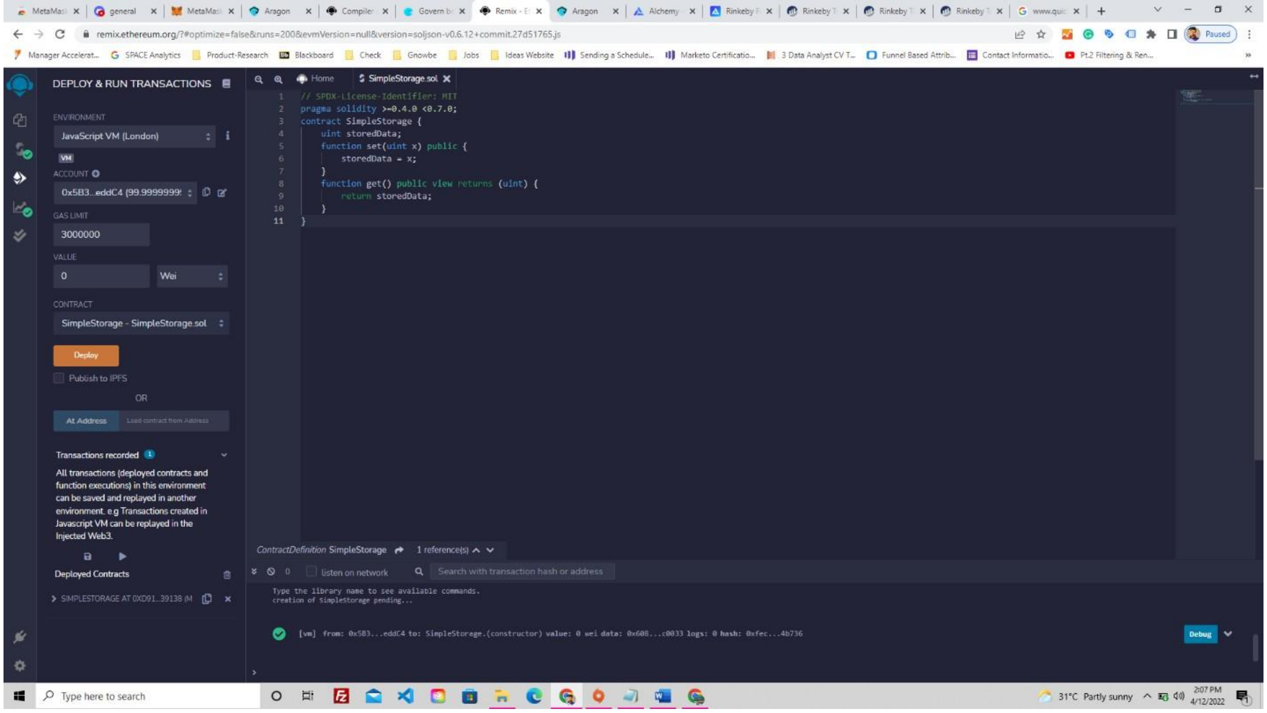

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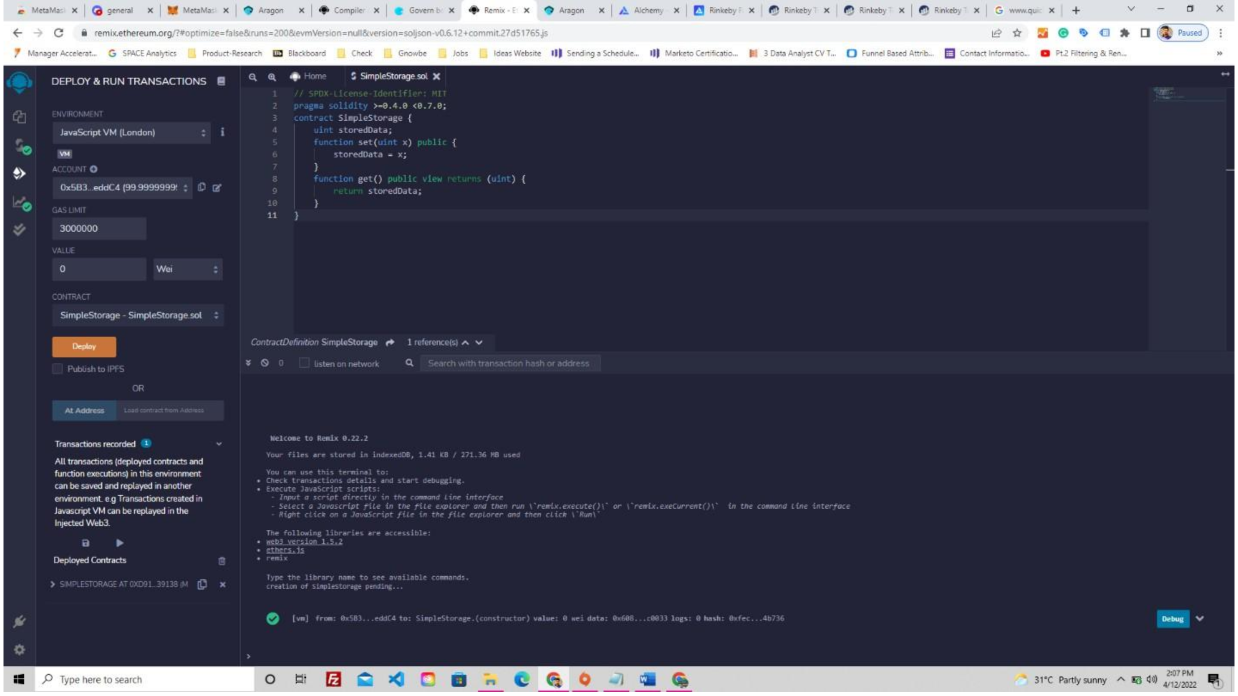
```

remix.ethereum.org/?#optimize=false&runs=200&evmVersion=null&version=soljson-v0.6.12+commit.27d51765.js
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
ContractDefinition SimpleStorage
1 reference(s)
listen on network
Search with transaction hash or address
Debug
Type here to search
31°C Partly sunny
2:07 PM
4/12/2022



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    }
}
```

```
 Welcome to Remix 0.22.2

 Your files are stored in indexedDB, 1.41 KB / 271.36 MB used

 You can use this terminal to:
• Check transactions details and start debugging.
• Execute JavaScript scripts:
  - Input a script directly in the command line interface
  - Select a Javascript file in the file explorer and then run \`remix.execute()\` or \`remix.exeCurrent()\`  in the command line interface
  - Right click on a JavaScript file in the file explorer and then click \`Run\`

 The following libraries are accessible:
• web3 version 1.5.2
• ethers.js
• remix

 Type the library name to see available commands.
 creation of simplestorage pending...

[vm] from: 0x5B3...eddC4 to: SimpleStorage.(constructor) value: 0 wei data: 0x608...c0033 logs: 0 hash: 0xfec...4b736
```

remix.ethereum.org/?#optimize=false&runs=200&evmVersion=null&version=soljson-v0.6.12+commit.27d51765.js
Deploy
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At Address
Load contract from Address
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Search with transaction hash or address
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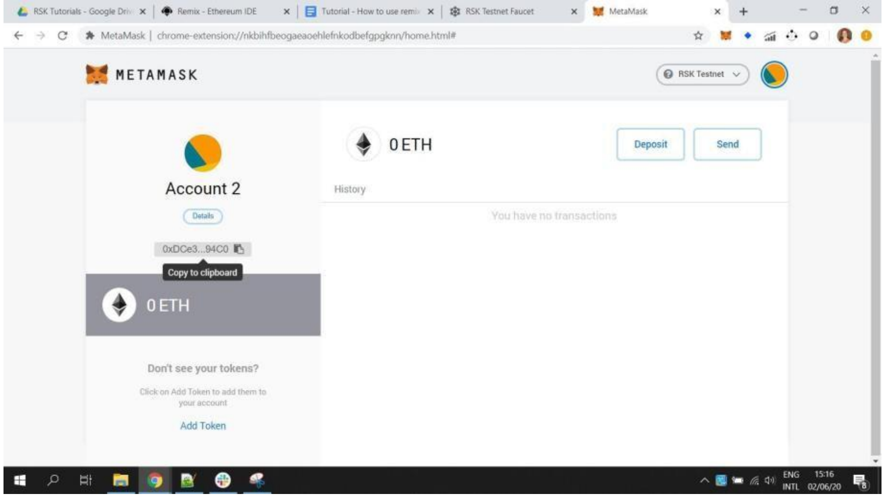
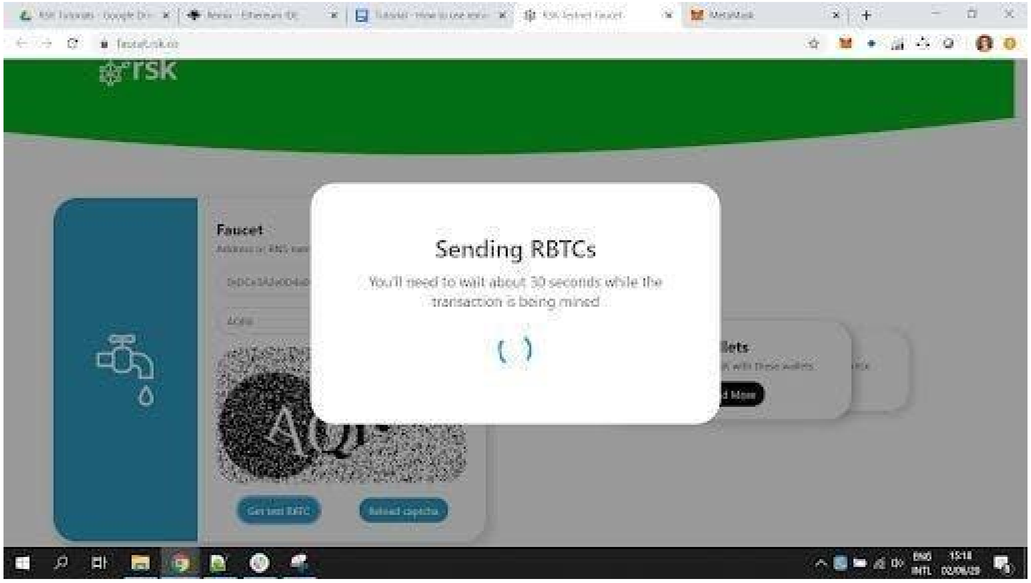


You have no transactions

Don't see your tokens?

Click on Add Token to add them to your account



Sending RBTCs

You'll need to wait about 30 seconds while the transaction is being mined

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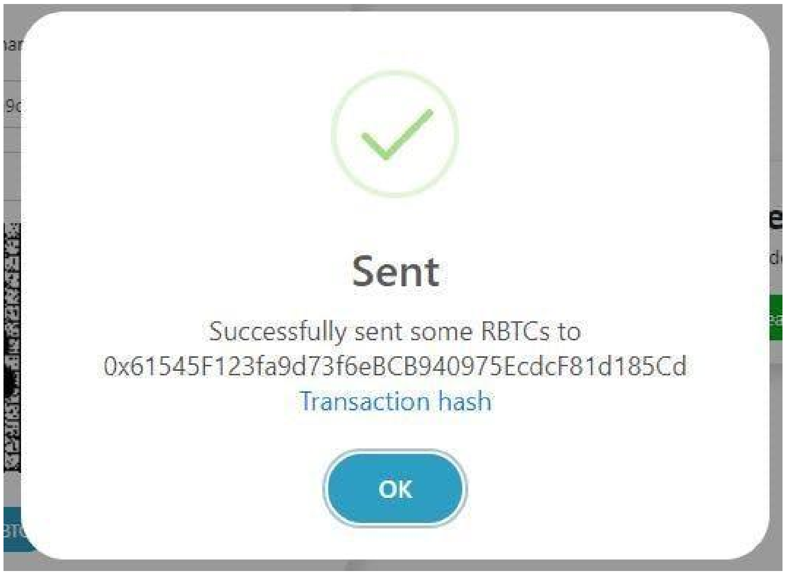
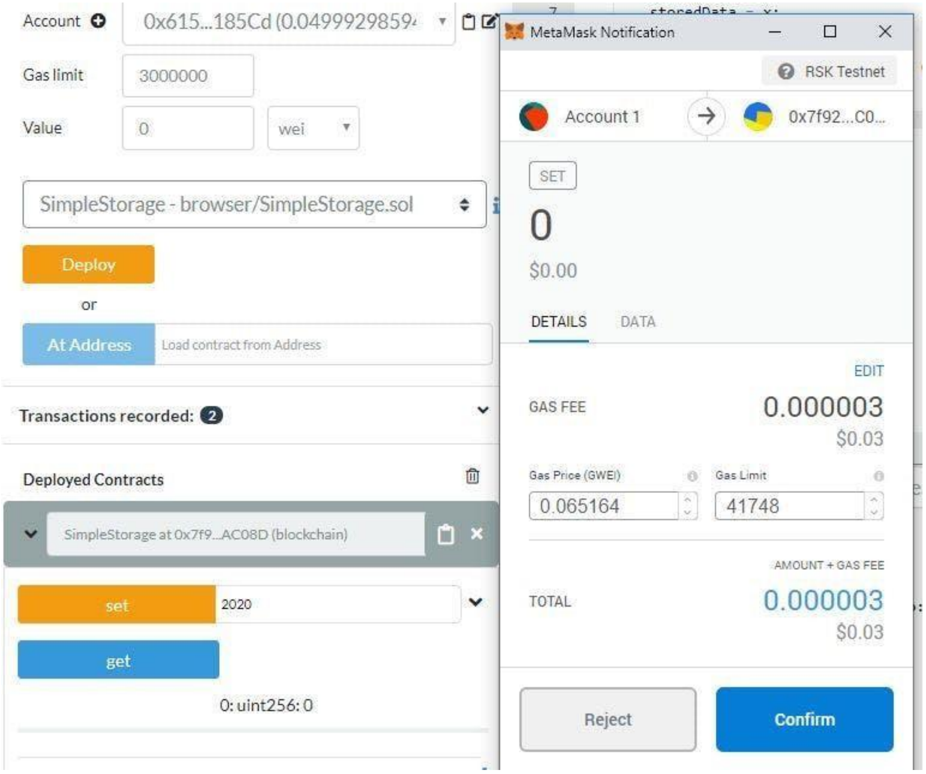


Sent

Successfully sent some RBTCs to 0x61545F123fa9d73f6eBCB940975EcdcF81d185Cd

Transaction hash



Account: 0x615...185Cd (0.0499929859

Gas limit: 3000000

Value: 0 wei

SimpleStorage - browser/SimpleStorage.sol

Transactions recorded: 2

Deployed Contracts

SimpleStorage at 0x7f9...AC08D (blockchain)

set: 2020

get

0: uint256: 0

MetaMask Notification

RSK Testnet

Account 1 → 0x7f92...C0...

SET

0

$0.00

GAS FEE: 0.000003 $0.03

Gas Price (GWEI): 0.065164

Gas Limit: 41748

AMOUNT + GAS FEE

TOTAL: 0.000003 $0.03

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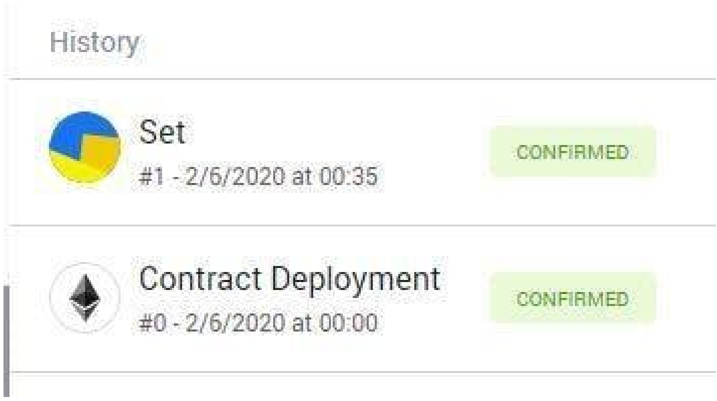

History

Set
#1 - 2/6/2020 at 00:35
CONFIRMED

Contract Deployment
#0 - 2/6/2020 at 00:00
CONFIRMED