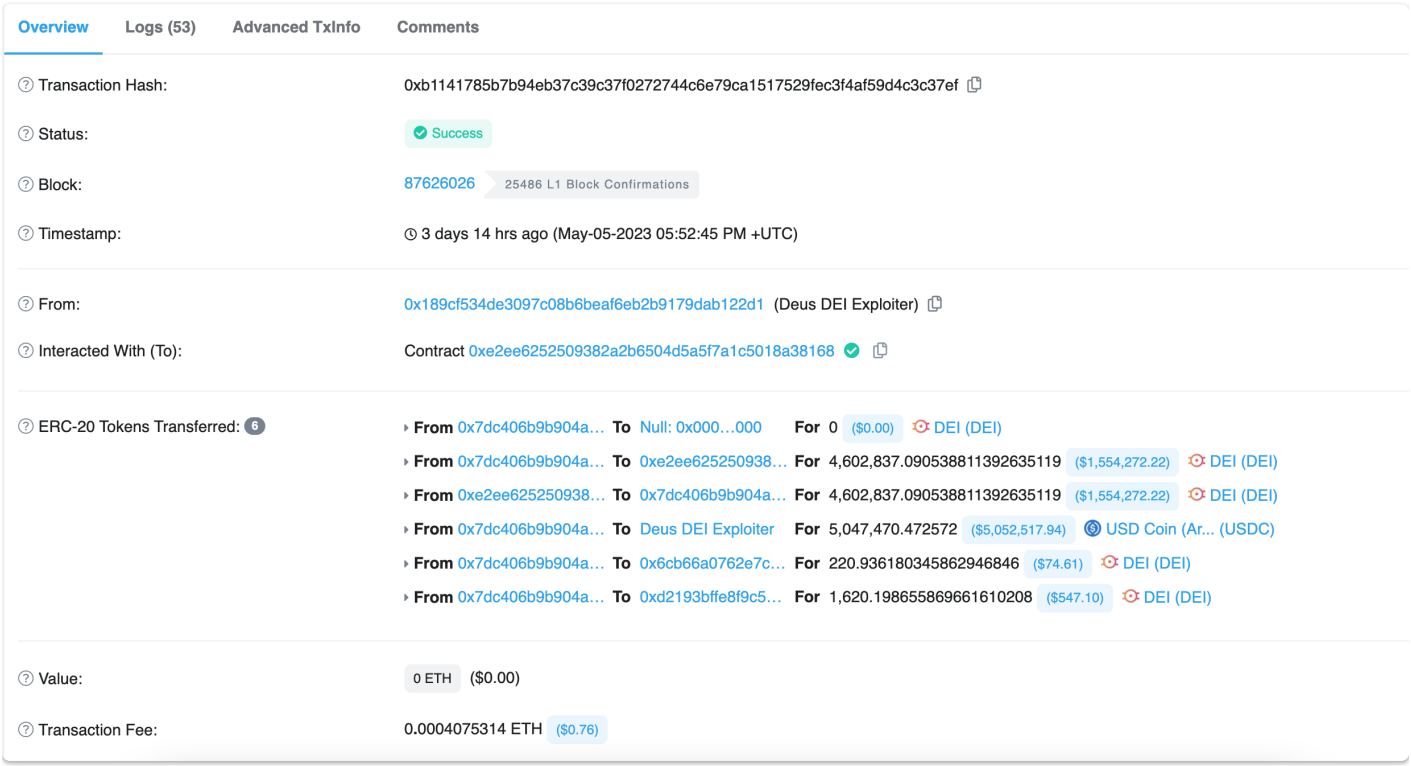
Lesson 10 - Security

Deus DAO

See Rekt write up

$DEI was exploited on Arbitrum and other chains,

See transaction




```
Call Trace
[call][397482] [Exploiter Contract].swap(arg0=[TransparentUpgradeableProxy], arg1=[Victim]) → ()
  [call][34040][🙈] [TransparentUpgradeableProxy].approve(arg0=[Victim], arg1=115792089237316195423570985008687907853269984665640564039457584007913129639935) → ()
  [call][32254][🙈] [TransparentUpgradeableProxy].burnFrom(arg0=[Victim], arg1=0) → ()
  [staticcall][1412][🙈] [TransparentUpgradeableProxy].balanceOf(arg0=[Victim]) → ()
  [call][31455][🙈] [TransparentUpgradeableProxy].transferFrom(arg0=[Victim], arg1=[Exploiter Contract], arg2=4602837090538811392635119) → ()
  [call][123662][🙈] [Victim].sync() → ()
  [staticcall][1412][🙈] [TransparentUpgradeableProxy].balanceOf(arg0=[Exploiter Contract]) → ()
  [staticcall][33983][🙈] [Victim].getAmountOut(arg0=4602837090538811392635119, arg1=[TransparentUpgradeableProxy]) → ()
  [call][4152][🙈] [TransparentUpgradeableProxy].transfer(arg0=[Victim], arg1=4602837090538811392635119) → ()
    [call][328] [Victim].token0() → ()
    [call][1054] [Victim].token1() → ()
  [call][117704][🙈] [Victim].swap(arg0=0, arg1=5047470472572, arg2=0x189cF534de3097C08B6bEAF6EB2B9179DAb122d1, arg3=0x) → ()
  [staticcall][1296][🙈] [TransparentUpgradeableProxy].balanceOf(arg0=0x189cF534de3097C08B6bEAF6EB2B9179DAb122d1) → ()
```

The problem function is the `burnFrom` function

```
function burnFrom(address account, uint256 amount) public virtual {
    uint256 currentAllowance = _allowances[_msgSender()][account];
    _approve(account, _msgSender(), currentAllowance - amount);
    _burn(account, amount);
}
```

and the approve mapping

```
function _approve(
    address owner,
    address spender,
    uint256 amount
) internal virtual {
    require(owner != address(0), "ERC20: approve from the zero address");
    require(spender != address(0), "ERC20: approve to the zero address");

    _allowances[owner][spender] = amount;
    emit Approval(owner, spender, amount);
}
```

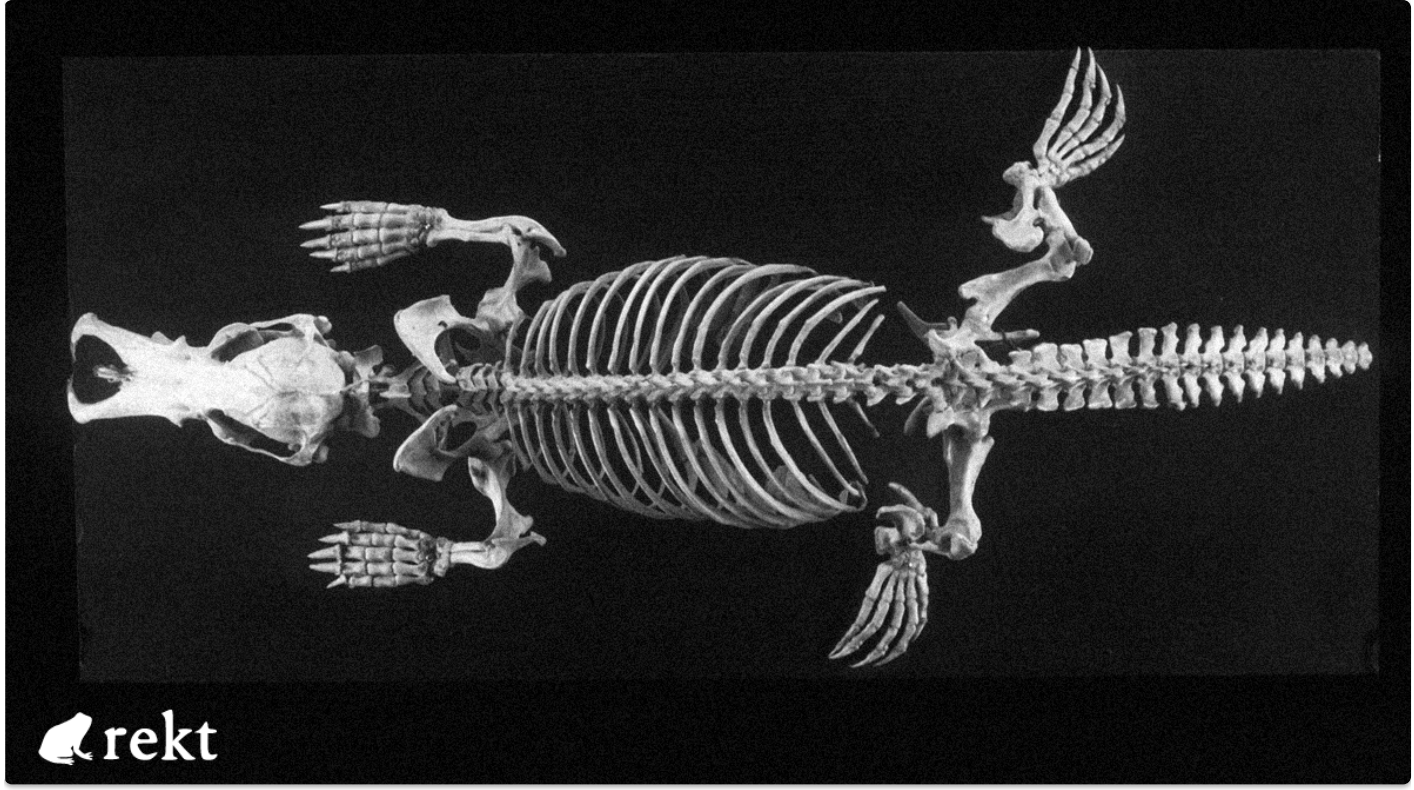
The attacker can set up a large allowance to the victim
The attacker can use their own approval to burn the victim's tokens.
Then the allowance is written back so that the victim now has 'approved' a large allowance for the attacker.
The attacker can then call `TransferFrom` to take the victim's tokens.

From rekt.news

"Luckily, the exploit on BSC was frontrun, and an on-chain message to the Deus Deployer shows the intent to return the funds. Other whitehats also sprang into action, and over $600k in USDC has so far been returned to a recovery multisig.

However, there were also doubts about the usefulness of giving funds back to a team that produced such a trivial bug"

Platypus Finance



References :
[Rekt.news]

This was quite a simple exploit

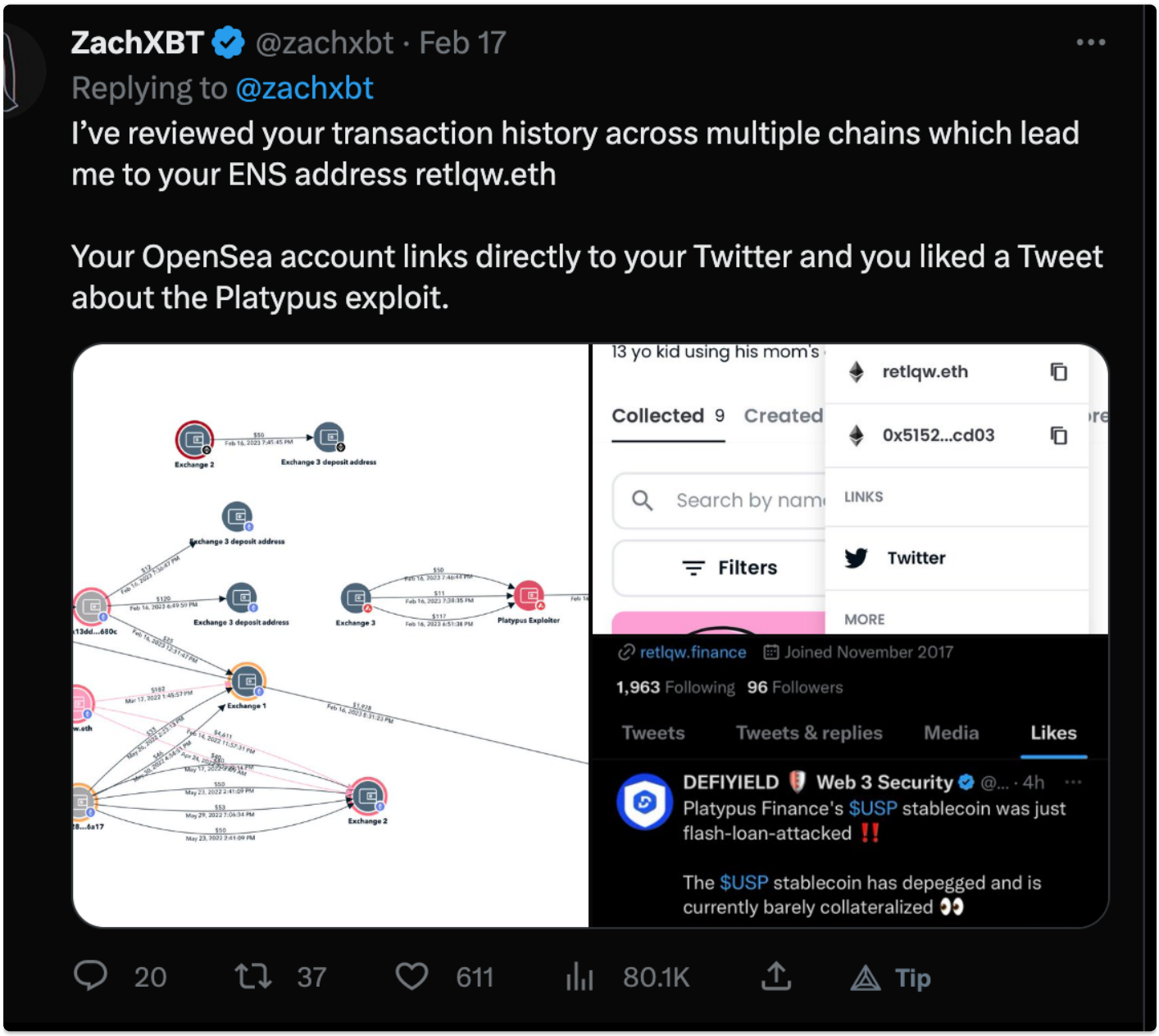
It started with the taking a flash loan of 44M USDC which was deposited into Platypus. The resulting LP tokens were then used as collateral to borrow 41.7M USP.

The *emergencyWithdraw()* function only checks whether the user's position is *currently* solvent, but neglects to first check against any the effect of any borrowed funds. This allows the attacker to withdraw the supplied collateral while keeping the borrowed USP.

```
function emergencyWithdraw(uint256 _pid) public nonReentrant {
    PoolInfo storage pool = poolInfo[_pid];
    UserInfo storage user = userInfo[_pid][msg.sender];

    if (address(platypusTreasure) != address(0x00)) {
        (bool isSolvent, ) = platypusTreasure.isSolvent(msg.sender, address(poolInfo[_pid].lpToken), true);
        require(isSolvent, 'remaining amount exceeds collateral factor');
    }

    // reset rewarder before we update lpSupply and sumOfFactors
    IBoostedMultiRewarder rewarder = pool.rewarder;
    if (address(rewarder) != address(0)) {
        rewarder.onPtpReward(msg.sender, user.amount, 0, user.factor, 0);
    }

    // SafeERC20 is not needed as Asset will revert if transfer fails
    pool.lpToken.transfer(address(msg.sender), user.amount);

    // update non-dialuting factor
    pool.sumOfFactors -= user.factor;

    user.amount = 0;
    user.factor = 0;
    user.rewardDebt = 0;
```

The collateral withdrawn was then used to replay the flash loan, and the USP was swapped for other stablecoins.

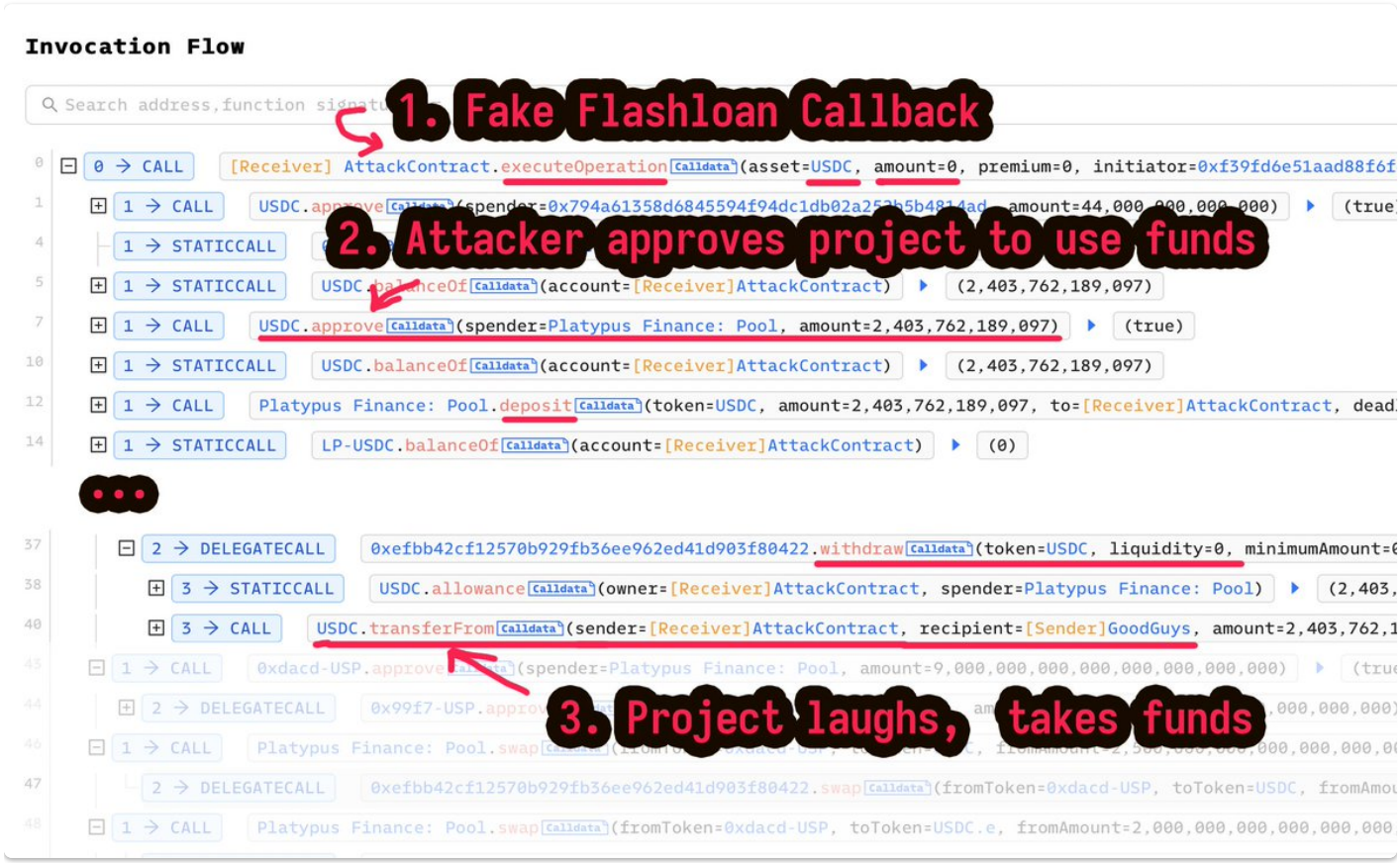
The attacker was however tracked down



In a further twist funds were then taken from the attacker

details from Daniel Von Fange

"The attacker forgot to code any way collect the funds after stealing them, so the funds were locked in the attack contract. They also neglected Flash Loan 101 and allowed anyone to call the flash loan callback code. No check that they had started the flash loan. "
"This allowed @BlockSecTeam and the project to retrigger the hack, but with one major twist - the project contracts had been upgraded to steal back from the attacker during the hack"
"The attack sequence involved taking flash loaned USDC, approving it, and depositing into the project. But during the retrigger, the attack code used its own stolen USDC to approve and deposit instead. The new project code simply took the attacker's USDC and ran with it."



Wintermute Hack

Rekt article
Mudit Gupta blog
Evgeny Gaevoy CEO of Wintermute tweets

Attack vector

An admin address was compromised using the profanity vulnerability, Wintermute had removed funds from this address, but hadn't removed its admin role, which allowed the attacker to remove tokens from the vault.

The address was compromised because it had been created using the profanity tool, which was recently found to have a vulnerability.
Admin Address : 0x0000000fe6a514a32abdcdfcc076c85243de899b
It was created in this way to have large number of leading zeros which can save gas.

Evgeny Gaevoy explained :
"Last time we generated addresses this way was in June. We have since moved to a more secure key generation script. As we learned about the Profanity exploit last week, we accelerated the “old key” retirement
And then, due to an internal (human) error, a wrong function has been called and we blacklisted the router instead of the operator (contract that signs)
And such is a challenge of running a (truly) automated Market Maker in the Dark Forest. You must automate processes as much as possible as multisig solutions are not applicable to our way of high speed trading "

The attack started with :
https://etherscan.io/tx/0xeecba26d5eb7939257e5b3e646e4bc597b73e256a89cb84a6dfc58de250d8a38 where Wintermute’s hot wallet (https://etherscan.io/address/0x0000000fe6a514a32abdcdfcc076c85243de899b) started calling their vault contract (https://etherscan.io/address/0x00000000ae347930bd1e7b0f35588b92280f9e75) to transfer tokens out to the hacker’s contract (https://etherscan.io/address/0x0248f752802b2cfb4373cc0c3bc3964429385c26)

Profanity vulnerability

see 1inch write up
The author of the tool says :
"I've decided to also archive this repository to further reduce risk that someone uses this tool. The code will not recieve any updates and I've left it in an uncompilable state. Use something else! "

Evgeny Gaevoy finishes his tweets with
"And this is what we are planning to do. No lay-offs. No strategy changes. No emergency

> fundraise. Not giving up on defi. Keep moving forward through this bear market with the rest of you"

Nomad bridge Hack

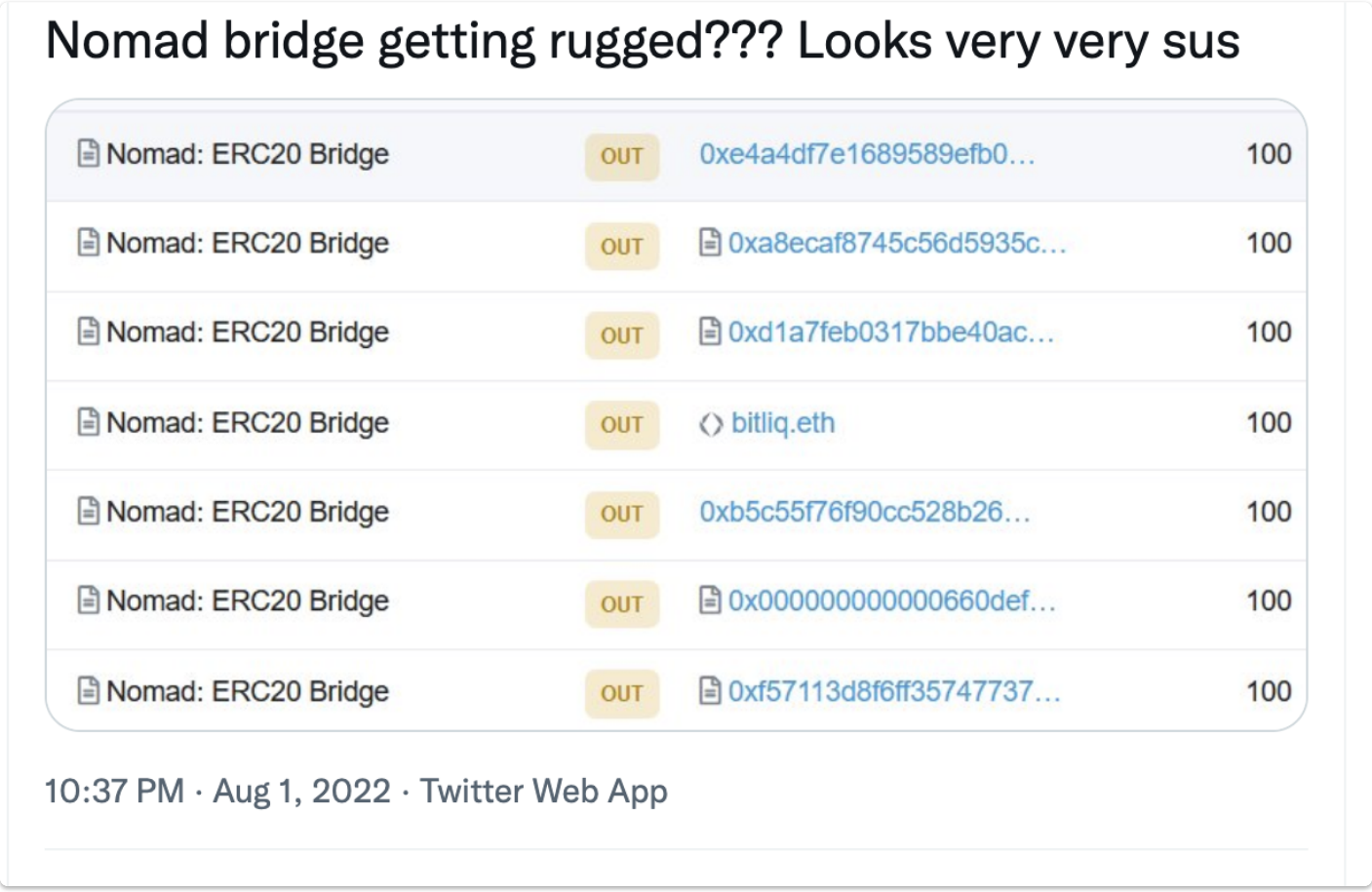
Thanks to Rekt and @samczsun for their insights.

On 1st August 2022 the Nomad bridge was hacked and within 3 hours about $190 M of funds were taken. The attack affected related projects such as EVMOS, Milkomeda and Moonbeam.

August 1st 2022

The exploits unfolds...

The exploit was spotted as unusual activity by @spreekaway, see this thread



It seemed that transactions were draining funds from the bridge, by sending 0.01 WBTC you could get 100 WBTC back

In theory the bridge was controlled by a transfer first being. proved and then a transaction could go through to process the movement of the funds.

So what *should* have been happening is that the messages submitted should have been proven, then included in a merkle tree whose root is stored and flagged as confirmed at a certain time.

What seemed to be happening is that messages were being processed that hadn't previously been confirmed. Once the initial exploiting transaction went through, anyone could simply submit a similar transaction to drain funds for themselves.

Subsequently there were many such transactions from exploiters, white hats , along with the use of MEV techniques to take advantage of the situation.

	0x13ea2c98982d1fde14...	Process	15259332	4 days 11 hrs ago	0xe4a4df7e1689589efb0...
	0x8183fe98f81deb8aa37...	Process	15259332	4 days 11 hrs ago	Nomad Bridge Exploiter 3
	0xa304a513cc1b62da3d...	Process	15259312	4 days 11 hrs ago	Resident Arbitrageur
	0xe7fd692fcfae783149b...	Process	15259312	4 days 11 hrs ago	Nomad Bridge Exploiter 1
	0xa9ddf5f8c22c33f814a...	Process	15259312	4 days 11 hrs ago	0xa5eff6157b44d7eba6b...
	0xe0112511747dd3b0c3...	Process	15259303	4 days 11 hrs ago	bitliq.eth
	0x39b107d43d88f1120e...	Process	15259303	4 days 11 hrs ago	Nomad Bridge Exploiter 3
	0xcd54193008330871d8...	Process	15259282	4 days 11 hrs ago	Resident Arbitrageur
	0x6ae090b41da74ed958...	Process	15259249	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0x370e7192707fa7d4da...	Process	15259240	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0xef73e48c1be5f025412...	Process	15259240	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0x8732887090364bd5f8...	Process	15259217	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0x282525e58e17d5f442...	Process	15259217	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0xa9108b394beeb02efc...	Process	15259217	4 days 11 hrs ago	Nomad Bridge Exploiter 2
	0x51f0ed5db858a85218...	Process	15259202	4 days 11 hrs ago	0xe4a4df7e1689589efb0...
	0xbbb009a4b5cb19d8ae...	Process	15259201	4 days 11 hrs ago	bitliq.eth
	0x11f468aa89bc97d748...	Process	15259200	4 days 11 hrs ago	Nomad Bridge Exploiter 1
	0x56b4ade16ad35792f0...	Process	15259159	4 days 11 hrs ago	0xe4a4df7e1689589efb0...
	0x73ae1f3a7f81d140e21...	Process	15259156	4 days 11 hrs ago	0xa5eff6157b44d7eba6b...
	0xb0447743d0d29c5756...	Process	15259155	4 days 11 hrs ago	bitliq.eth
	0x5c5f3325d212b8e086...	Process	15259155	4 days 11 hrs ago	Nomad Bridge Exploiter 3
	0x498a0778cc8448a100...	Process	15259104	4 days 12 hrs ago	0xe4a4df7e1689589efb0...
	0xa5fe9d044e4f3e5aa5b...	Process	15259101	4 days 12 hrs ago	bitliq.eth
	0xb1fe26cc8892f58eb46...	Process	15259101	4 days 12 hrs ago	Nomad Bridge Exploiter 3

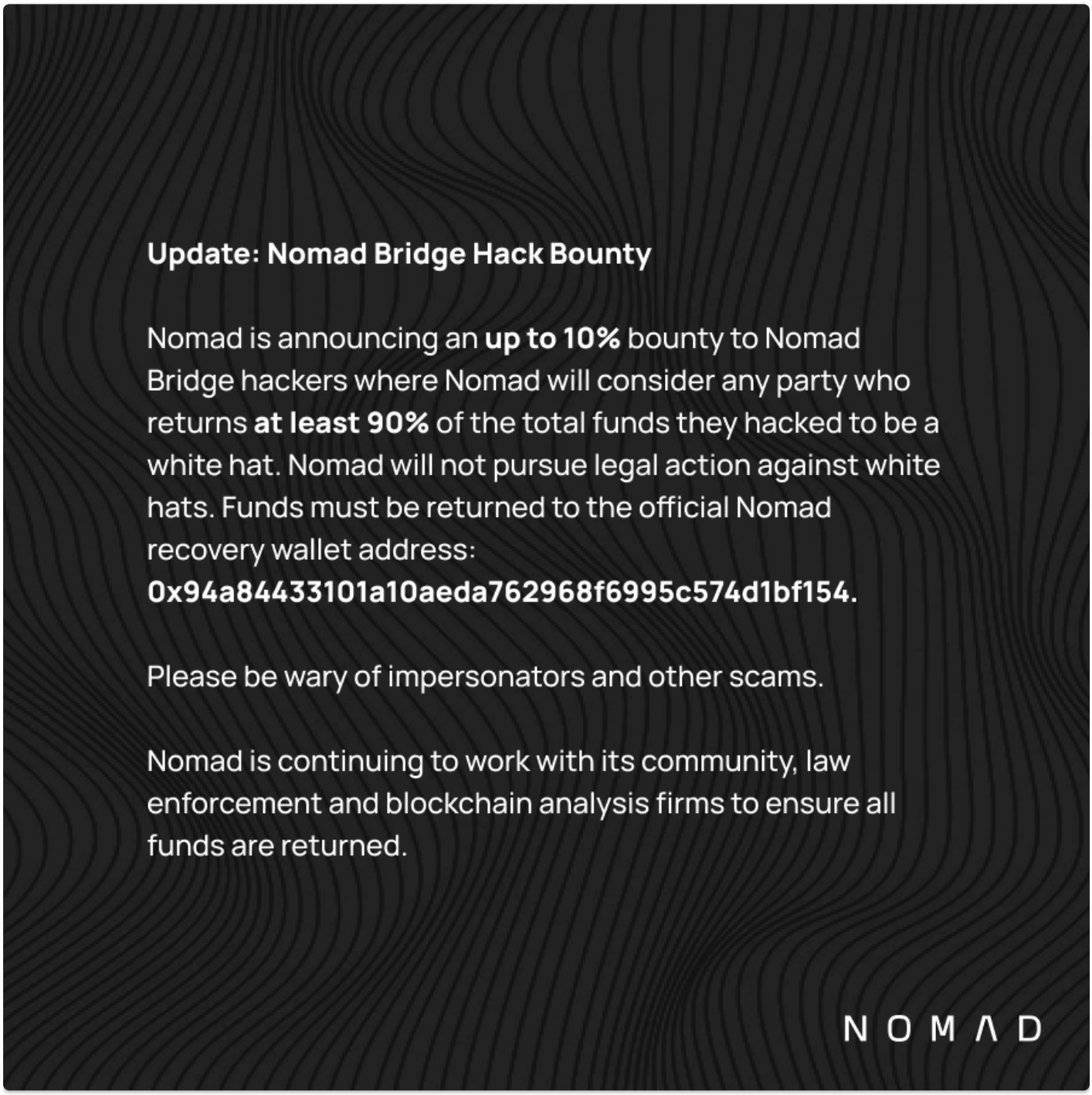
The top 3 exploiters were

0x56D8B635A7C88Fd1104D23d632AF40c1C3Aac4e3 ($47M)
0xBF293D5138a2a1BA407B43672643434C43827179 ($40M)
0xB5C55f76f90Cc528B2609109Ca14d8d84593590E ($8M)

Some exploiters sent their funds through Tornado Cash to obfuscate the trail of funds.

As usual the exploited project appealed for people to return their funds.

Nomad have offered a deal to the exploiters asking for return of 90% of the funds, allowing the other 10% to be regarded as a bug bounty

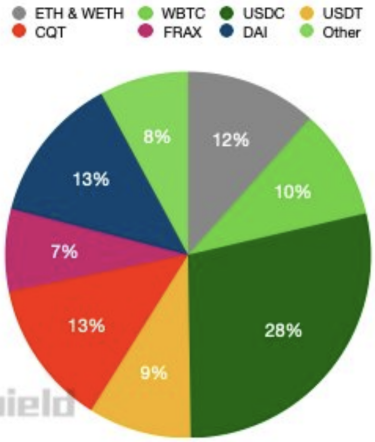


Return of funds

From @PeckShieldAlert as of August 5th, about 11% of funds have been recovered / returned

Nomad Funds Recovery Address

Token	Amount	Value ($)
ETH	241	$399,392
WETH	1,308.86	$2,163,813.5
WBTC	92.7	$2,145,448.8
USDC	6,261,842	$6,268,104
USDT	2,013,335.7	$2,015,349
CQT	34,366,035	$2,836,778.8
FRAX	1,614,400	$1,612,913
DAI	2,879,523.8	$2,882,403
CARDS	158,082.5	$41,911
IAG	247,189,221	$1,308,560
SUSHI	4,557	$6,835
C3	1,649,120	$237,192
GERO	23,101,165.5	$43,500
HBOT	1,200,320	$4,279
FXS	12,503	$93,647



Some white hats have managed to recover some of the funds

Exploit Details

The vulnerable contract is the Replica contract
This contract was upgraded and had the following initializer

```
  function initialize(
        uint32 _remoteDomain,
        address _updater,
        bytes32 _committedRoot,
        uint256 _optimisticSeconds
        ) public initializer {

        __NomadBase_initialize(_updater);
        // set storage variables
        entered = 1;
        remoteDomain = _remoteDomain;
        committedRoot = _committedRoot;
        // pre-approve the committed root.
        confirmAt[_committedRoot] = 1;
        _setOptimisticTimeout(_optimisticSeconds);

}
```

It was initialized with the zero address
Transaction

```
Function: initialize(uint32 _remoteDomain, address _updater, bytes32 _committedRoot, uint256
_optimisticSeconds)

MethodID: 0xe7e7a7b7
[0]:  0000000000000000000000000000000000000000000000000000000000000000
[1]:  0000000000000000000000000000000000000000000000000000000000000000
[2]:  0000000000000000000000000000000000000000000000000000000000000000
[3]:  0000000000000000000000000000000000000000000000000000000000000000
```

```
     function initialize(
       uint32 _remoteDomain,
       address _updater,
       bytes32 _committedRoot,
       uint256 _optimisticSeconds
   ) public initializer {
       __NomadBase_initialize(_updater);
       // set storage variables
       entered = 1;
       remoteDomain = _remoteDomain;
       committedRoot = _committedRoot;
       // pre-approve the committed root.
       confirmAt[_committedRoot] = 1;
```

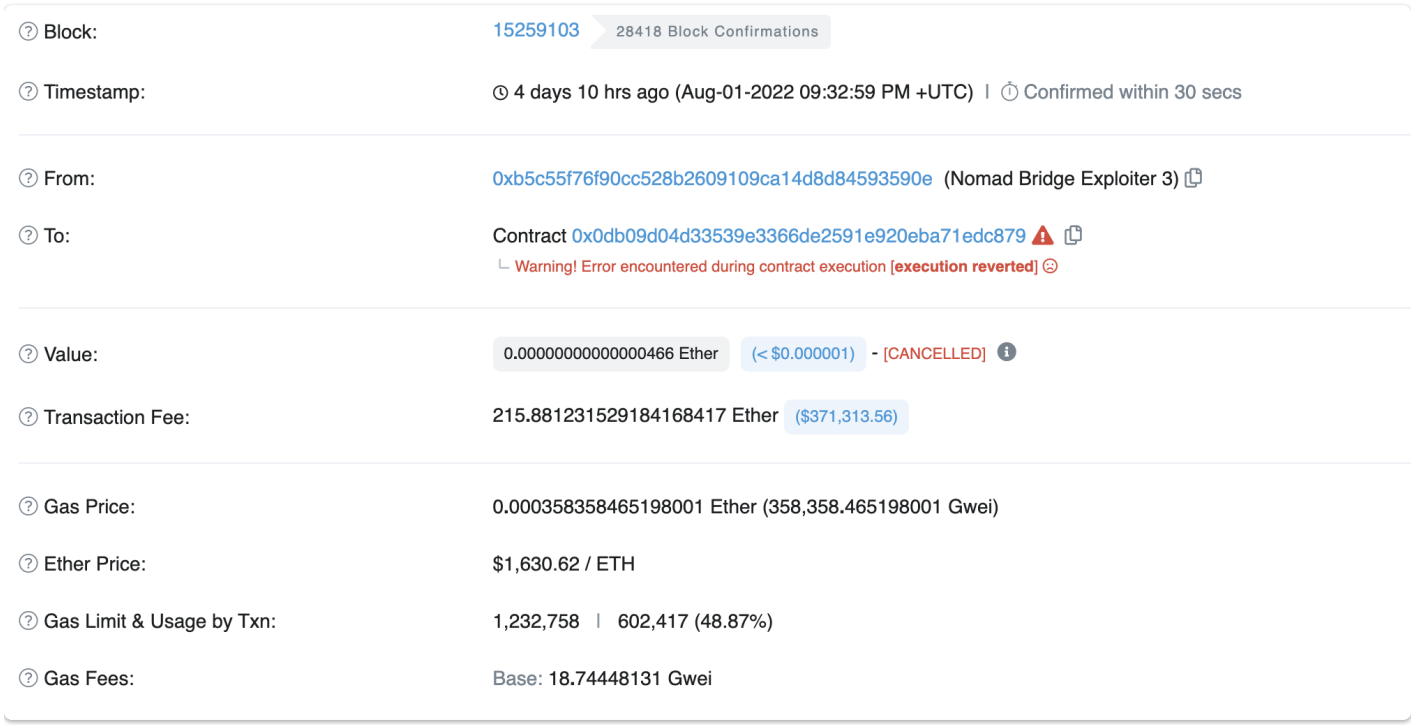
```
        _setOptimisticTimeout(_optimisticSeconds);
    }
```

In the initialize function, committedRoot is set to 0x00

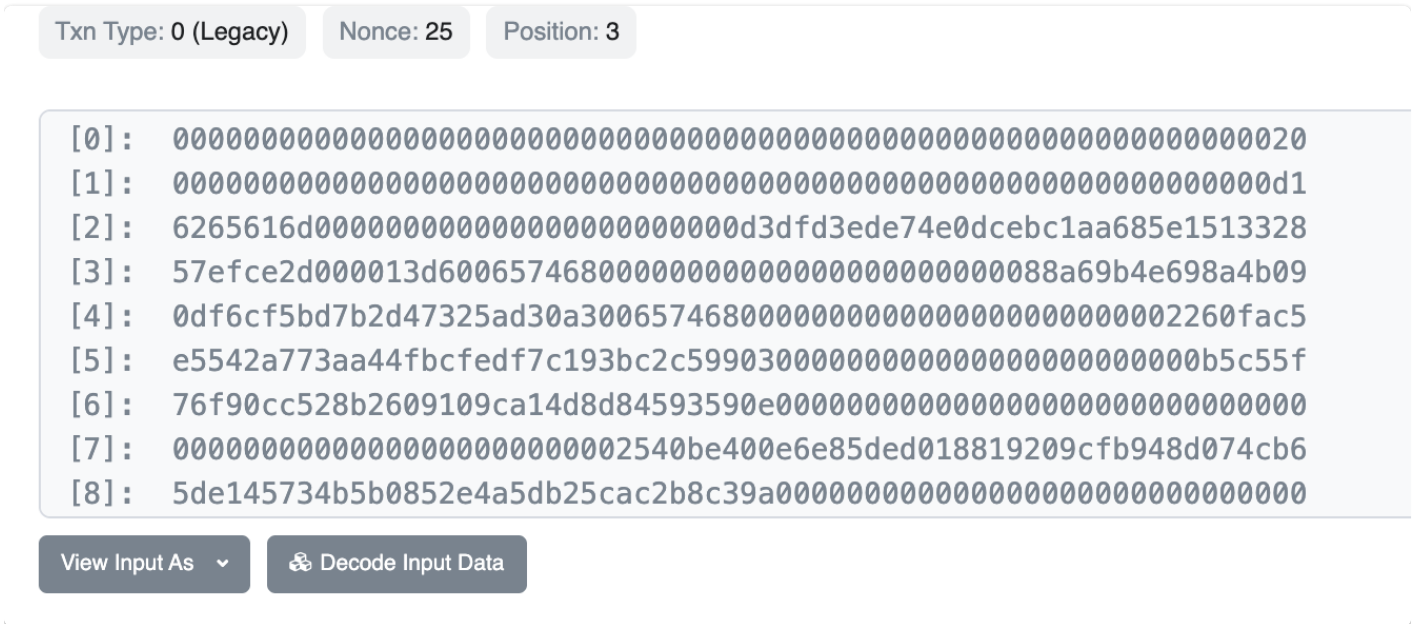
```
          committedRoot = _committedRoot;
        // pre-approve the committed root.
        confirmAt[_committedRoot] = 1;
```

and so
`confirmAt[_committedRoot] = 1;`

The first attempt to exploit the contract failed, it was an expensive failure costing 215 ETH.



This was followed by the exploiting transaction calling the process function with the following arguments



The process function can be called by anyone, and is intended to process messages that have already been proved.

The process function

```
    function process(bytes memory _message) public returns (bool _success) {
        // ensure message was meant for this domain
        bytes29 _m = _message.ref(0);
        require(_m.destination() == localDomain, "!destination");
        // ensure message has been proven
        bytes32 _messageHash = _m.keccak();
        require(acceptableRoot(messages[_messageHash]), "!proven");
        // check re-entrancy guard
        require(entered == 1, "!reentrant");
        entered = 0;
        // update message status as processed
        messages[_messageHash] = LEGACY_STATUS_PROCESSED;
        // call handle function
        IMessageRecipient(_m.recipientAddress()).handle(
            _m.origin(),
            _m.nonce(),
            _m.sender(),
            _m.body().clone()
        );
        // emit process results
        emit Process(_messageHash, true, "");
        // reset re-entrancy guard
        entered = 1;
        // return true
        return true;
    }
```

This line

`require(acceptableRoot(messages[_messageHash]), "!proven");`

checks the validity of the merkle root of of the messages

using this function

```
  function acceptableRoot(bytes32 _root) public view returns (bool) {
// this is backwards-compatibility for messages proven/processed
// under previous versions
if (_root == LEGACY_STATUS_PROVEN) return true;
if (_root == LEGACY_STATUS_PROCESSED) return false;
uint256 _time = confirmAt[_root];
if (_time == 0) {
return false;
}
return block.timestamp >= _time;
}
```

using the following constants declared earlier.

```
  bytes32 public constant LEGACY_STATUS_NONE = bytes32(0);
bytes32 public constant LEGACY_STATUS_PROVEN = bytes32(uint256(1));
bytes32 public constant LEGACY_STATUS_PROCESSED = bytes32(uint256(2));
```

The line

`uint256 _time = confirmAt[_root];`

now returns 1 (remember in initialize, `confirmAt[0x00]` is set to 1)

You can check the return value of this function yourself on etherscan as I did :

"LatestCourse/img/Screenshot 2022-08-06 at 09.51.41.png" is not created yet. Click to create.

Thus any message sent to process would succeed !

Note

The audit report from Quanstamp is available, their finding 'QSP–19 Proving With An Empty Leaf' is particularly relevant to this exploit, but perhaps not understood by the Nomad team.

Poly Network hack

Recap of function selectors

Encoding the function signatures and parameters

Example

```
pragma solidity ^0.8.0;                                                    language-none

contract MyContract {

  Foo otherContract;


  function callOtherContract() public view returns (bool){
      bool answer = otherContract.baz(69,true);
      return answer;
  }
}


contract Foo {
    function bar(bytes3[2] memory) public pure {}
    function baz(uint32 x, bool y) public pure returns (bool r) {
    r = x > 32 || y;
    }
    function sam(bytes memory, bool, uint[] memory) public pure {}
}
```

The way the call is actually made involves encoding the function selector and parameters

If we wanted to call *baz* with the parameters 69 and true , we would pass 68 bytes total, which can be broken down into:

1. the Method ID. This is derived as the first 4 bytes of
   the Keccak hash of the ASCII form of the signature baz(uint32,bool).

   ```
   ***0xcdcd77c0:***
   ```

2. the first parameter, a uint32 value 69 padded to 32 bytes

   0x0000000000000000000000000000000000000000000000000000000000000045:
3. the second parameter - boolean true, padded to 32 bytes

   0x0000000000000000000000000000000000000000000000000000000000000001:

In total

0xcdcd77c000000000000000000000000000000000000000
000000000000000000000450000000000000000000000000
000000000000000000000000000000000001

The Polynetwork Hack - $600M stolen

Poly Network – Stolen Funds Breakdown

Ethereum Blockchain

	Quantity stolen
USDC	96,389,444
WBTC (wrapped Bitcoin)	1,032
DAI	673,227
UNI (Uniswap)	43,023
SHIBA	259,737,345,149
renBTC	14.47
USDT	33,431,197
wETH (wrapped Ether)	26,109
FEI USD	616,082

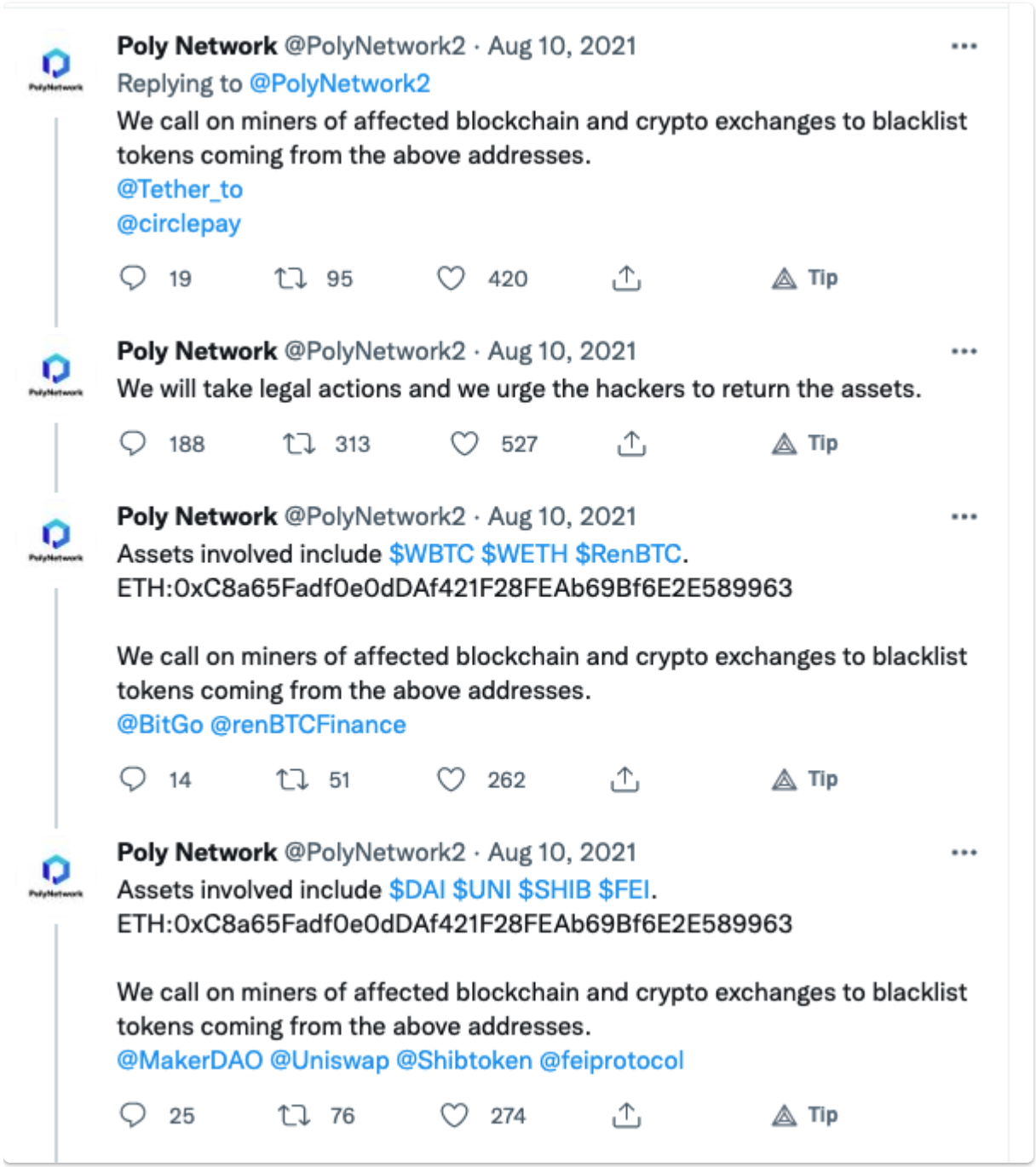
Binance Smart Chain

	Quantity stolen
BNB	6,613.44
USDC	87,603,373
ETH	299
BTCB	26,629
BUSD	1,023

Polygon Blockchain

	Quantity stolen
USDC	85,089,610

Polynetwork react to attack



Example messages to the attacker

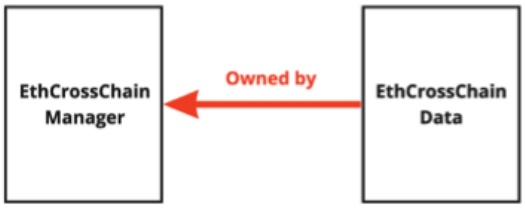
- Can I have some ETH? i been losing a lot of money Thank you
- Consider donating to public goods after all the pleasure you've got from using public infra 🌱
- ngmi
- Welcome to the crypto world. Fee Tips: Use tornado.cash to laundry your money ASAP.
- Forget your USDT. Forget your USDC.
- Swap tokens to ETH then deposit to tornado.cash . Good luck.
- Hi. Boos. Can. You. Give me eth thanks
- You can use Tornado for currency mixing
- DONT USE YOUR USDT TOKEN YOU VE GOT BLACKLISTED
- You can buy every pudgy penguin on opensea :)
- Dad, this is my only asset. Please accept it
- JOINING FOR EPIC SCREENCAP

- Please gice me some eth
- DONT USE YOUR USDT TOKEN
  YOU VE GOT BLACKLISTED,god bless you
- Remove liquidity from curve pool in form of DAI,
  and exchange it for Eth and launder with Tornado

Exploit Details

Mismanagement of access rights between two contracts

EthCrossChainManager is an owner of EthCrossChainData,
= EthCrossChainManager can execute privileged functions!



_method is user defined
= can be set at will.

```
bytes4(keccak256(abi.encodePacked(_method, "(bytes,bytes,uint64)"))),
```

5

Vulnerable Contract 2: `EthCrossChainData`

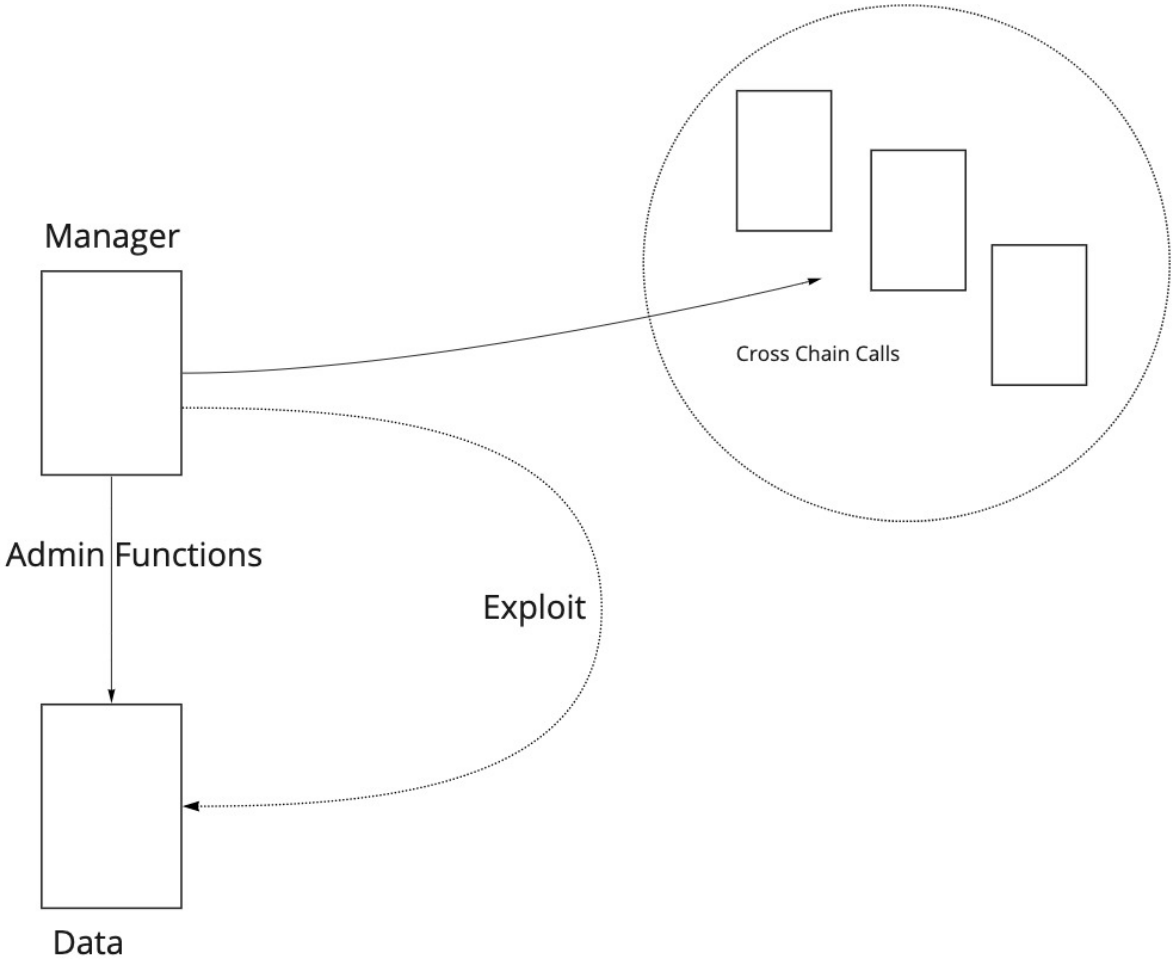
Very High Privileged contract ! ➔ Can only be called by its owners.

Set + manage list of **"Keepers"**
= list of public keys that manage the wallets in the underlying liquidity chain

➔ **Keepers have the right to execute large transactions,** transfer large amounts to other wallets.

Vulnerable function: *putCurEpochConPubKeyBytes*
= become a **"Keeper"**
Set the public key (passed as parameter) as a Keeper

10



Aiming to find X such that

Hash(X,bytes,bytes,uint64)

=

Hash(putCurEpochConPubKeyBytes,bytes) = 0x41973cd9

The Brute Force solution was

X = f1121318093

The Attacker reconsiders

The attacker received a rather cryptic message
" Dont instant tornado funds, dont instant move blacklistable tokens to DAI/ETH? Insider confirmed!"

The attacker was looking at Tornado Cash and sent themselves a message

"Wonder why Tornado? Will miners stop me? Teach me please"

Then someone found a link between an address used by the attacker and some exchanges and tweeted

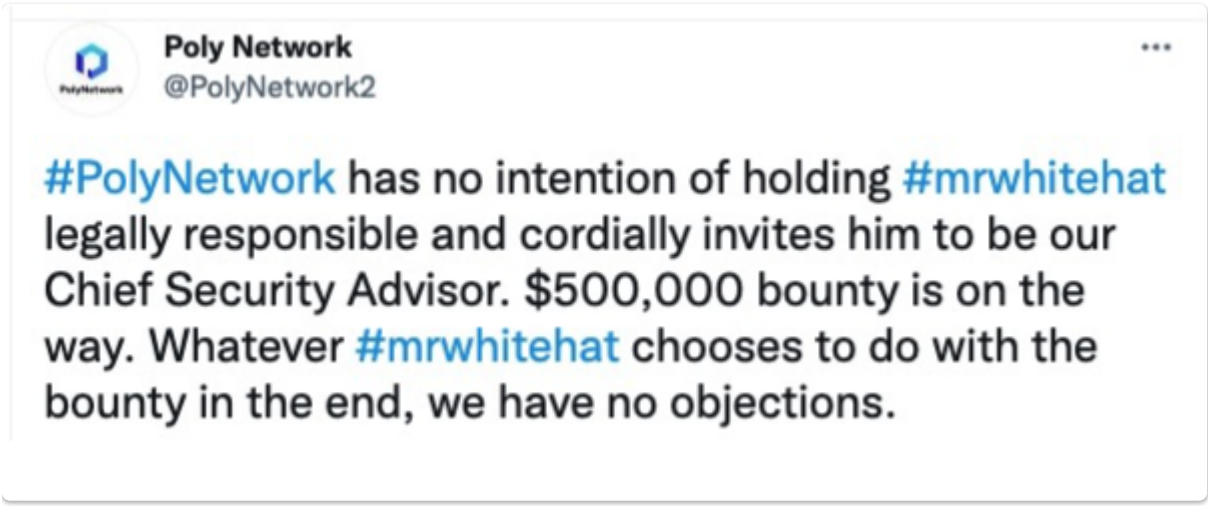
“Did the PolyNetwork Exploiter accidentally use the wrong sender address for this tx 0xb12681d9e? The sender address is tied to FTX, Binance, Okex accounts.”

The hacker’s attitude started to change, he suggested he could return "some tokens" or even abandon them, saying that they were "not so interested in the money".

Followed by a suggestion : “What if I make a new token and let the DAO decide where the tokens go”

Finally the attacker messaged "Ready to return the fund !"

See this spreadsheet for all communications
The attacker starts to return the funds
Polynetwork starts to refer to the attacker as 'Mr White Hat' and offer him a job and bounty



'We appreciate you sharing your experience and believe your action constitutes white hat behavior. But we can't touch user assets and Poly Network doesn't have its own token. Since , we believe your action is white hat behavior, we plan to offer you a $500,000 bug bounty after you complete the refund fully. Also we assure you that you will not be accountable for this incident. We hope that you can return all tokens as soon as possible. You can reserve the equivalent value of 500,000 USD in any assets to the current owner address. We will make up this part of the assets to Poly Network users.
Your contribution is very helpful to us. Again, we think this behavior is white hat behavior, therefor this 500,000 USD will be seen as completely legal bounty reward. We will also ensure that you will not be held accountable for this incident, and we will publicly express our gratitude to you.'

Lasttime Refund	Chain	Hacker Address	Hack	Refund
12/8/2021 15:40:04	ETH Chain	0xC8a65Fadf0e0dDAf421F28FEAb69Bf6E2E589	272 mil	Almost
	BSC Chain	0x0D6e286A7cfD25E0c01fEe9756765D8033B32	253mil	ALL
	Polygon Chain	0x5dc3603c9d42ff184153a8a9094a73d46166321	85 mil	ALL

Still waiting more Fund	Chain	Receive Address (Polynetwork Multisig)	Balance	Received
8394,74 Hours	ETH Chain	0x71Fb9dB587F6d47Ac8192Cd76110E05B8fd21	Almost	Almost
	New Multisig W	0x34d6b21d7b773225a102b382815e00ad876e2:	ALL	ALL
	BSC Chain	0xEEBb0c4a5017bEd8079B88F35528eF2c722b:	ALL	ALL
	Polygon Chain	0xA4b291Ed1220310d3120f515B5B7AccaecD66	ALL	ALL

A number of rather lengthy messages follow the return of the funds

Q & A, PART TWO:

Q: WHAT REALLY HAPPENED 30 HOURS AGO?
A: LONG STORY.

BELIEVE IT OR NOT, I WAS _FORCED_ TO PLAY THE GAME.

THE POLY NETWORK IS A SOPHISTICATED SYSTEM, I DIDN'T MANAGE TO BUILD A LOCAL TESTING ENVIRONMENT. I FAILED TO PRODUCE A POC AT THE BEGINNING. HOWEVER, THE AHA MOMEMNT CAME JUST BEFORE I WAS TO GIVE UP. AFTER DEBUGGING ALL NIGHT, I CRAFTED A _SINGLE_ MESSAGE TO THE ONTOLOGY NETWORK.

I WAS PLANNING TO LAUNCH A COOL BLITZKRIEG TO TAKE OVER THE FOUR NETWORK: ETH, BSC, POLYGON & HECO. HOWEVER THE HECO NETWORK GOES WRONG! THE RELAYER DOES NOT BEHAVE LIKE THE OTHERS, A KEEPER JUST RELAYED MY EXPLOIT DIRECTLY, AND THE KEY WAS UPDATED TO SOME WRONG PARAMETERS. IT RUINED MY PLAN.

I SHOULD HAVE STOPPED AT THAT MOMENT, BUT I DECIDED TO LET THE SHOW GO ON! WHAT IF THEY PATCH THE BUG SECRETLY WITHOUT ANY NOTIFICATION?

HOWEVER, I DIDN'T WANT TO CAUSE _REAL_ PANIC OF THE CRYPTO WORLD. SO I CHOSE TO IGNORE SHIT COINS, SO PEOPLE DIDN'T HAVE TO WORRY ABOUT THEM GOING TO ZERO. I TOOK IMPORTANT TOKENS (EXCEPT FOR SHIB) AND DIDN'T SELL ANY OF THEM.

Q: THEN WHY SELLING/SWAPPING THE STABLES?
A: I WAS PISSED BY THE POLY TEAM FOR THEIR INITIAL REPONSE.

THEY URGED OTHERS TO BLAME & HATE ME BEFORE I HAD ANY CHANCE TO REPLY! OF COURSE I KNEW THERE ARE FAKE DEFI COINS, BUT I DIDN'T TAKE IT SERIOUSLY SINCE I HAD NO PLAN LAUNDERING THEM.

IN THE MEANWHILE, DEPOSITING THE STABLES COULD EARN SOME INTEREST TO COVER POTENTIAL COST SO THAT I HAVE MORE TIME TO NEGOTIATE WITH THE POLY TEAM.

Arbitrum critical vulnerability

A critical vulnerability that was spotted in time, caused by too much optimisation.

See writeup from white hat.

A bridge address is used to receive funds deposited in Arbitrum, it is vital that this address is set up correctly and cannot be switched to a malicious contract.

Upgradeable contracts can go very wrong if the initialize function isn't adequately secured.
In this contract there were 2 flags in storage to check if initialize had been run or was running

```
modifier initializer() {
    // If the contract is initializing we ignore whether _initialized is set in order to support multiple
    // inheritance patterns, but we only do this in the context of a constructor, because in other contexts the
    // contract may have been reentered.
    require(_initializing ? _isConstructor() : !_initialized, "Initializable: contract is already initialized");

    bool isTopLevelCall = !_initializing;
    if (isTopLevelCall) {
        _initializing = true;
        _initialized = true;
    }

    _;

    if (isTopLevelCall) {
        _initializing = false;
    }
}
```

The initialize function also had check to see if the bridge address was already set

```
105         function initialize(IBridge _bridge, ISequencerInbox _sequencerInbox)
106             external
107             initializer
108             onlyDelegated
109         {
    -           if (address(bridge) != address(0)) revert AlreadyInit();
110             bridge = _bridge;
111             sequencerInbox = _sequencerInbox;
112             allowListEnabled = false;
113             __Pausable_init();
114         }
```

Unfortunately that checked had been taken out to reduce gas, but things would still be ok, as long as the flags were still set...

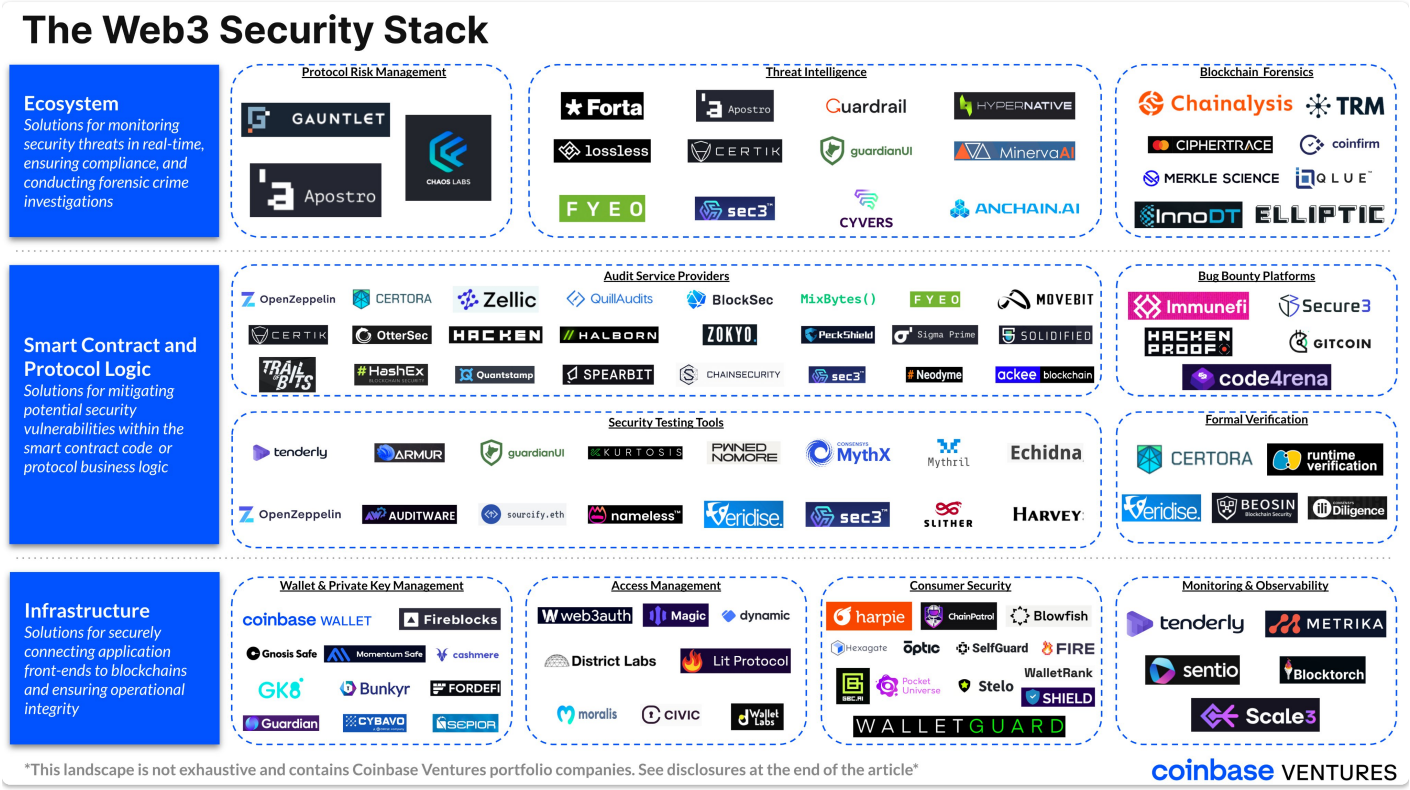
A further optimisation cleared out the first 3 storage slots after upgrade

```
function postUpgradeInit(IBridge _bridge) external onlyDelegated onlyProxyOwner {
    uint8 slotsToWipe = 3;
    for (uint8 i = 0; i < slotsToWipe; i++) {
        assembly {
            sstore(i, 0)
        }
    }
    allowListEnabled = false;
    bridge = _bridge;
}
```

So, an attacker could now call the initialize function, setting the address of the bridge contract to a contract that they control, and thus receive any ETH that users deposit.

Basic Security

Ecosystem



Consensys Best Practices

General

- Prepare for Failure
- Stay up to Date
- Keep it Simple
- Rolling out
- Blockchain Properties
- Simplicity vs. Complexity

Precautions

- General
- Upgradeability
- Circuit Breakers
- Speed Bumps
- Rate Limiting
- Deployment
- Safe Haven

Solidity Specific

- Assert, Require, Revert

- Modifiers as Guards
- Integer Division
- Abstract vs Interfaces
- Fallback Functions
- Payability
- Visibility
- Locking Pragmas
- Event Monitoring
- Shadowing
- tx.origin
- Timestamp Dependence
- Complex Inheritance
- Interface Types
- EXTCODESIZE Checks

Token Specific

- Standardization
- Frontrunning
- Zero Address
- Contract Address

Documentation

- General
- Specification
- Status
- Procedures
- Known Issues
- History
- Contact

Attacks

- Reentrancy
- Oracle Manipulation
- Frontrunning
- Timestamp Dependence
- Insecure Arithmetic
- Denial of Service
- Griefing
- Force Feeding

Advanced Security

Oracle Manipulation

A smart contract must determine the value of an asset, such as when a user deposits ETH into the system. To accomplish this, the protocol refers to its corresponding Uniswap pool as a source of price information.
This behaviour can be exploited by an attacker, who might use a flash loan to empty one side of the Uniswap pool.
Due to the reliance on a single data source, the protocol's internal price can be directly tampered with, for instance, increasing it to 100 times its original value. The attacker can then capitalise on this inflated value by executing an arbitrage trade based on the new price discrepancy or securing a favourable position within the system.

The issues can be summarised as:

1. The smart contract's reliance on a single price feed source makes it susceptible to on-chain manipulation through flash loans.
2. Even when a significant anomaly is present, smart contracts that use the price data continue to function based on the distorted information.

Example

The following code shows that on deposit, the price feed is fetched directly from Uniswap:

```
  uint160 sqrtPrice = TickMath.getSqrtRatioAtTick(currentTick()); uint256 price = FullMath.mulDiv(uint256(sqrtPrice).mul(uint256(sqrtPrice)), PRECISION, 2**(96 * 2));
```

Here, `currentTick()` directly fetches the current price tick from a Uniswap pool:

```
  // @return tick Uniswap pool's current price tick function currentTick() public view returns (int24 tick) { (, tick, , , , , ) = pool.slot0(); }
```

As this price data is fetched from an on-chain dependency, and the price data is determined in the current transaction context, this spot price can be manipulated in the same transaction.

1. An attacker can take out a flash loan on the incoming asset A and on the relevant Uniswap pool, swap asset A for asset B with a large volume.
2. This trade will increase the price of asset B (increased demand) and reduce the cost of asset A (increased supply).
3. When asset B is deposited into the above function, its price is still pumped up by the flash loan.
4. Consequentially, asset B gives the attacker an over-proportional amount of shares.
5. These shares can be withdrawn, giving the attacker equal parts of asset A and asset B from the pool.
6. Repeating this process will drain the vulnerable pool of all funds.

7. With the money gained from the withdrawal of their shares, the attacker can repay the flash loan.

Read only re entrancy

Also see this : https://youtu.be/8D5ZJyU-dX0

Classical reentrancy exploits occur in state-modifying functions, leading to inconsistent state usage for malicious storage writes. To mitigate this, contracts often implement reentrancy locks to protect the state.

In contrast, the read-only reentrancy is a reentrancy scenario where a view function is reentered, which in most cases is unguarded as it does not modify the contract's state. However, if the state is inconsistent, wrong values could be reported.

As In result, other protocols blindly relying on a return value (e.g. from Oracles or Price Feeds) can be tricked into reading the wrong state to perform unwanted actions.

There have been two exploits using this vulnerability, both in LPs interacting with certain Curve Pools.
An attacker manipulates the collateral price, borrows all the funds from the pool, and walks away with bad debts.

To simplify, that's what happened in four steps in both cases.

1. Deposit large amounts of liquidity.
2. Remove liquidity. (that triggers a callback)
3. During the callback, the attacker performs malicious actions.
4. Profit.

The reentrancy occurs during step 3, when balances still need to be fully updated while total LP token supply decreases.
This is achieved by compromising Curve's Oracle's price feed and borrowing funds at an inflated price.

see Oracle manipulation post mortem report

Security Tools

Overview

TABLE I
OVERVIEW OF ALL TOOLS INDICATING PURPOSE, CODE LEVEL, TYPE, PRE-PROCESSING, AND METHODS OF ANALYSIS

	Purpose				Level		Type		Code transformation						Analysis method					
Tool	Security issues	Exploits	Formal guarantees	Bulk analysis	Bytecode	Solidity code	Static analysis	Dynamic analysis	Contextualization	Disassembly	Control flow graph	Call graph	AST analysis	Decompilation	Code instrumentation	Symbolic execution	Constraint solving	Abstract interpretation	Horn logic	Model checking
contractLarva	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
E-EVM	✗	✗	✗	✗	✓	✗	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Erays	✗	✗	✗	✗	✓	✗	✓	✗	✗	✓	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗
EthIR	✗	✗	✗	✗	✓+	✗	✓	✗	✗	✓	✓	✗	✗	✓	✗	✓	✓	✗	✗	✗
EtherTrust	✗	✗	✓	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✗
FSolidM	✗	✗	✗	✗	form.spec		✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓
KEVM	✗	✗	✓	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
MAIAN	✓	✓+	✗	✓	✓+	✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
Manticore	✓	✓	✗	✗	✓+	✗	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗
Mythril	✓	✓	✗	✗	✓+	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
Osiris	✓	✗	✗	✓	✓+	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
Oyente	✓	✗	✗	✓	✓+	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
Porosity	✓	✗	✗	✗	✓+	✗	✓	✗	✗	✓	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗
Rattle	✗	✗	✗	✗	✓	✗	✓	✗	✗	✓	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗
Remix-IDE	✓	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Securify*	✓	✗	✓	✓	✓+	✗	✓	✗	✓	✓	✗	✗	✗	✓	✗	✗	✗	✓	✓	✗
SmartCheck*	✓	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Solgraph	✓	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗
SolMet	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Vandal	✓	✗	✗	✓	✓	✗	✓	✗	✗	✓	✓	✗	✗	✓	✗	✓	✗	✓	✓	✗
Ether*	✓	✗	✗	✓	✓+	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Gasper	✓	✗	✗	✓	✓	✗	✓	✗	✗	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
ReGuard	✓	✗	✗	✓	✓	✓	✗	✓	✓	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗
SASC	✓	✗	✗	✓	✗	✓	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓	✗	✗	✗
sCompile	✓	✗	✗	✓	✗	✓	✓	✗	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗
teEther	✓	✓+	✗	✓	✓	✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗
Zeus	✓	✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓	✗	✓	✗

LEGEND. *Tool:* * indicates that we consider the academic version instead of the enhanced company version of the tool, due to availability. *Security issues:* detection of vulnerabilities and potential security problems. *Exploit*: generates exploits, with ✓+indicating multi-transactional exploits. *Formal guarantees:* proves that a contract has a certain property. *Bulk analysis:* suitable for the analysis of large sets of contracts. *Level* of code at which analysis is performed; ✓+ indicates analysis of bytecode including information from the corresponding Solidity code such as the ABI; 'form.spec' means formal specification, from which Solidity code is generated.

From
A Survey of Tools for Analyzing Ethereum Smart Contracts

Introduction to Slither

See repo

Slither performs static analysis on source code, it has 'detectors' for known vulnerabilities / patterns.
It also includes some tools to help visualise / understand contracts and program flow.

Features

- Detects vulnerable Solidity code with low false positives (see the list of trophies)
- Identifies where the error condition occurs in the source code
- Easily integrates into continuous integration and Truffle builds

- Built-in 'printers' quickly report crucial contract information
- Detector API to write custom analyses in Python
- Ability to analyze contracts written with Solidity >= 0.4
- Intermediate representation (SlithIR) enables simple, high-precision analyses
- Correctly parses 99.9% of all public Solidity code
- Average execution time of less than 1 second per contract

Slither can

1. produce markdown reports:
2. Display inheritance
3. produce call graphs
4. Show updatable variables and function authorisation
5. Check updatability
6. Flatten code
7. Read storage in a contract.

Installation

```
pip3 install slither-analyzer
```

Ethereum Security Toolbox

Trail of Bits have a security toolbox :
This includes

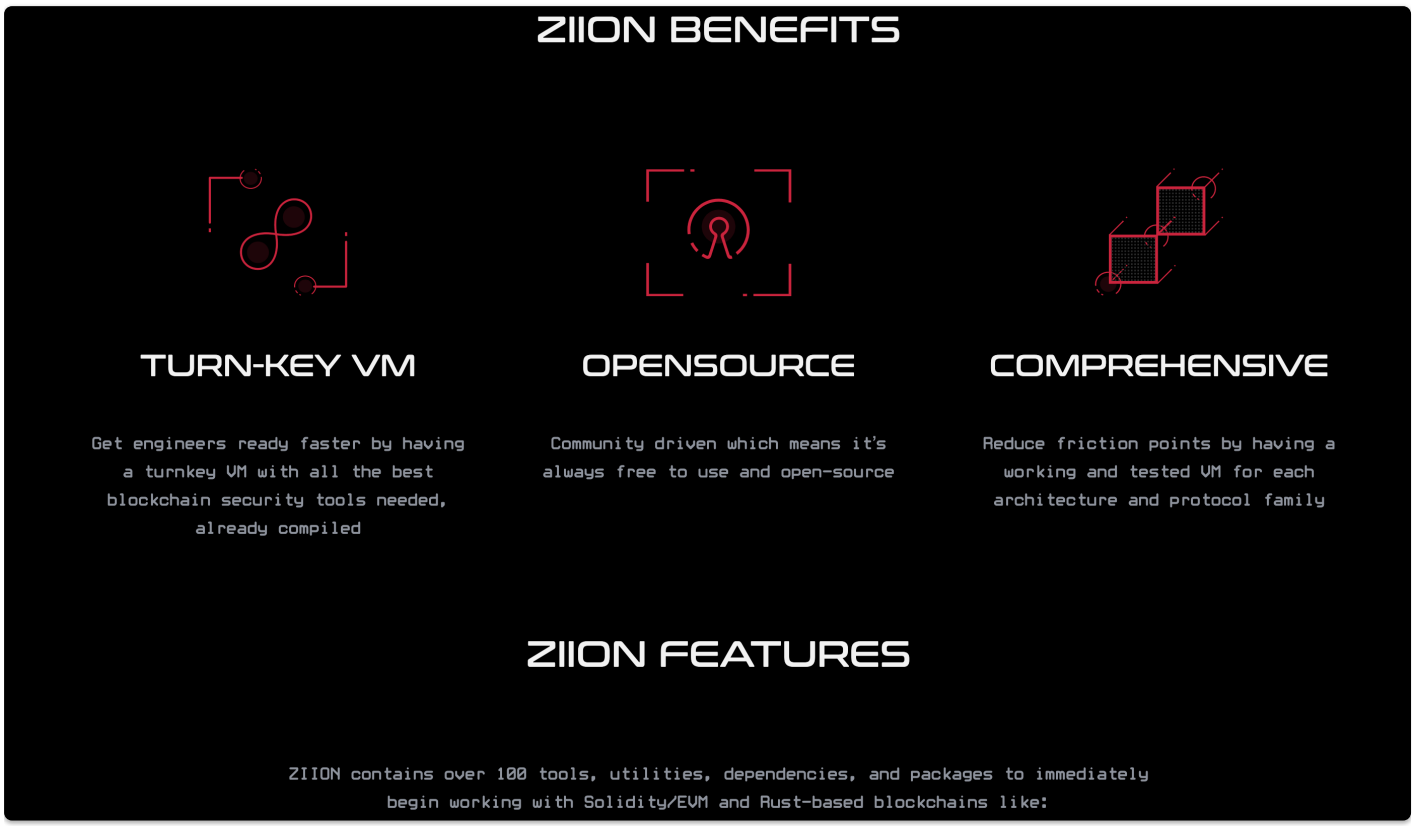
- Echidna property-based fuzz tester
- Etheno integration tool and differential tester
- Manticore symbolic analyzer and formal contract verifier
- Slither static analysis tool
- Rattle EVM lifter
- Not So Smart Contracts repository

Install in docker with

```
  docker pull trailofbits/eth-security-toolbox
docker run -it trailofbits/eth-security-toolbox
```

ZIION from Halborn

See Docs
Download



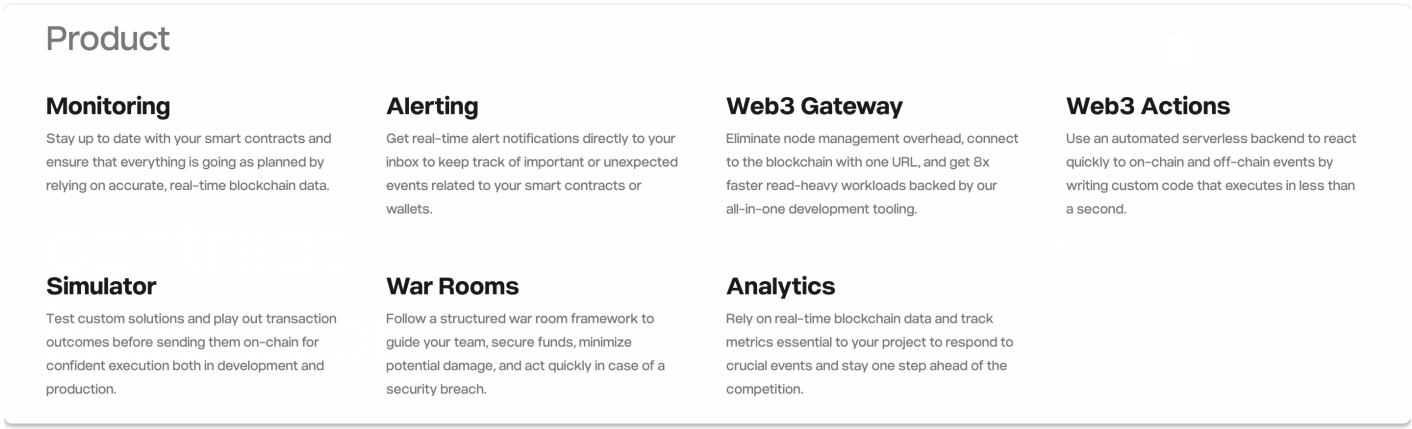
Blockchains targeted

- Ethereum (EVM)
- Bitcoin
- Solana
- Polygon
- BSC
- Substrate
- Near

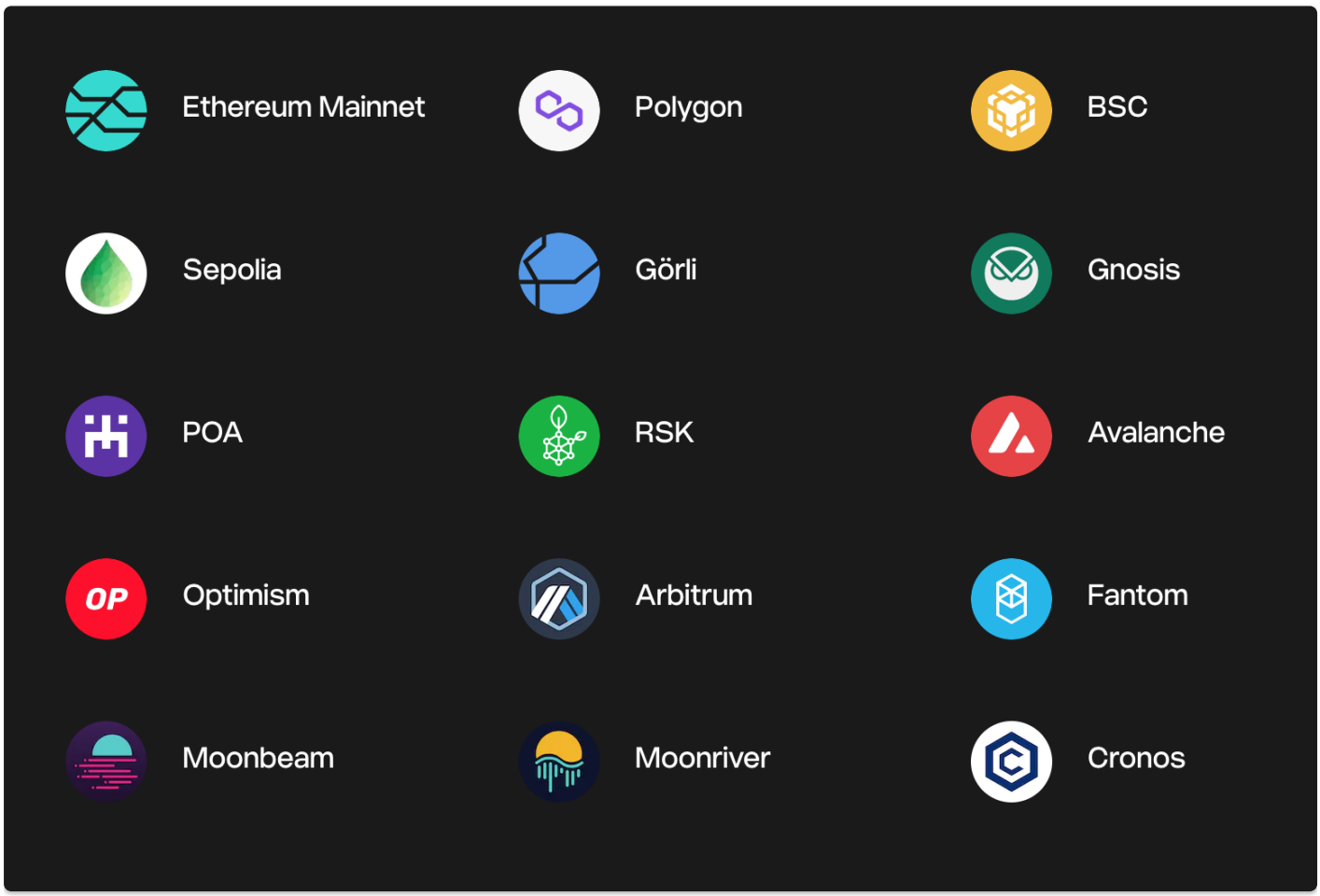
Tools include
Manticore, Slither, Mythril, Solgraph, Echidna, Certora-cli, Foundry

Post deployment monitoring

Tenderly

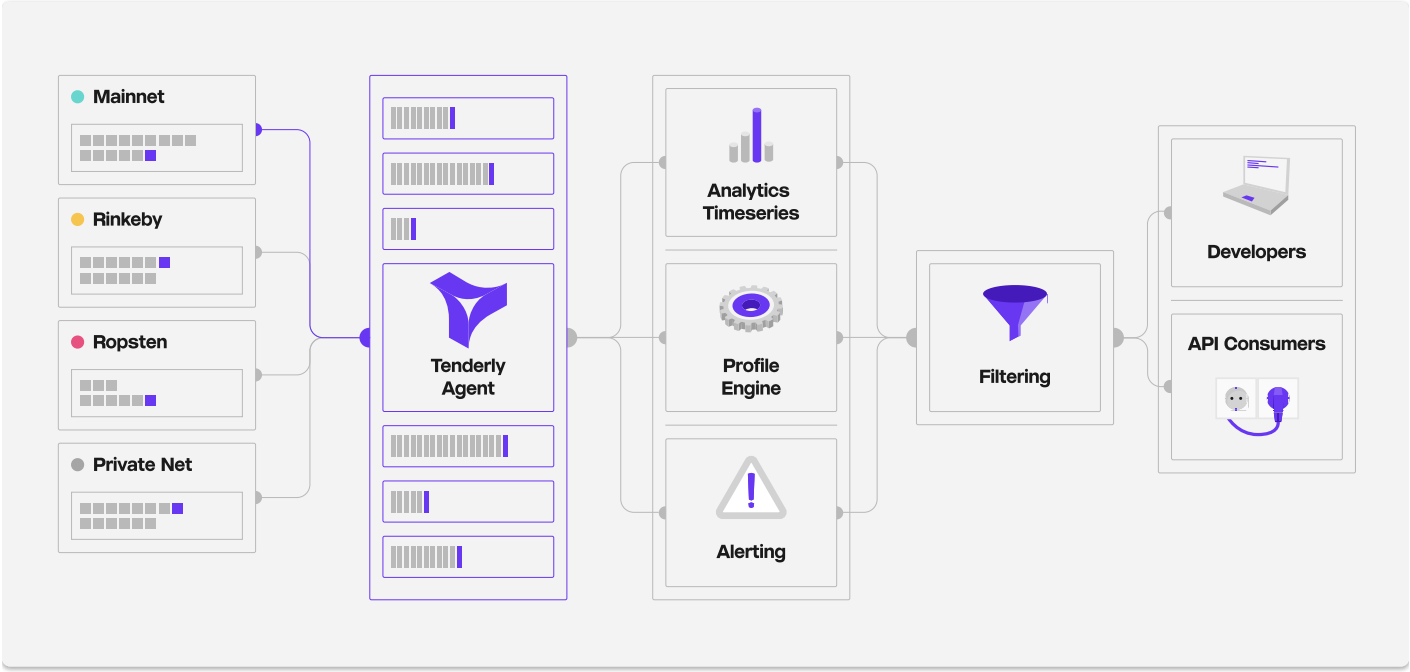


Supported Networks

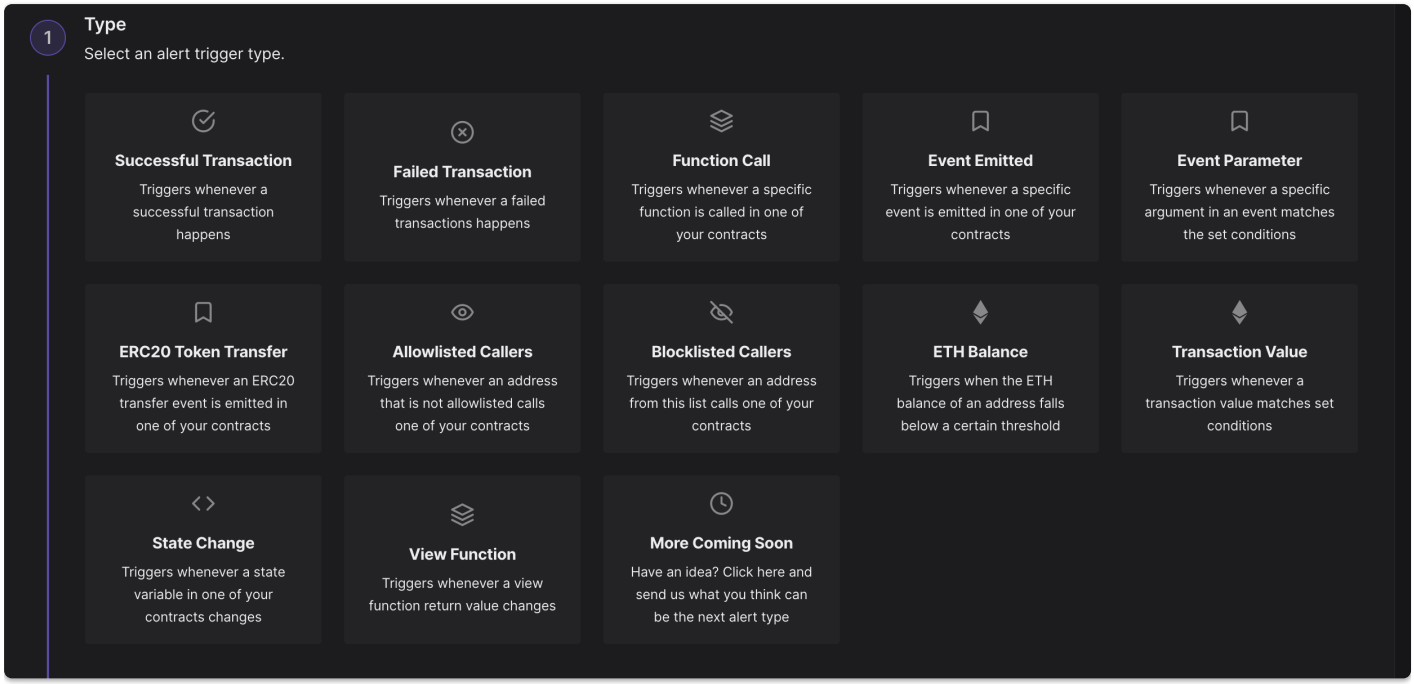


See [Documentation] (https://docs.tenderly.co/)

Monitoring


Mainnet
Rinkeby
Ropsten
Private Net
Tenderly Agent
Analytics Timeseries
Profile Engine
Alerting
Filtering
Developers
API Consumers

Alerts



Web3 Gateway

See Docs

Tenderly Web3 Gateway is a production node that offers reliable, fast, and consistent access to the blockchain.

Use the Tenderly node to:

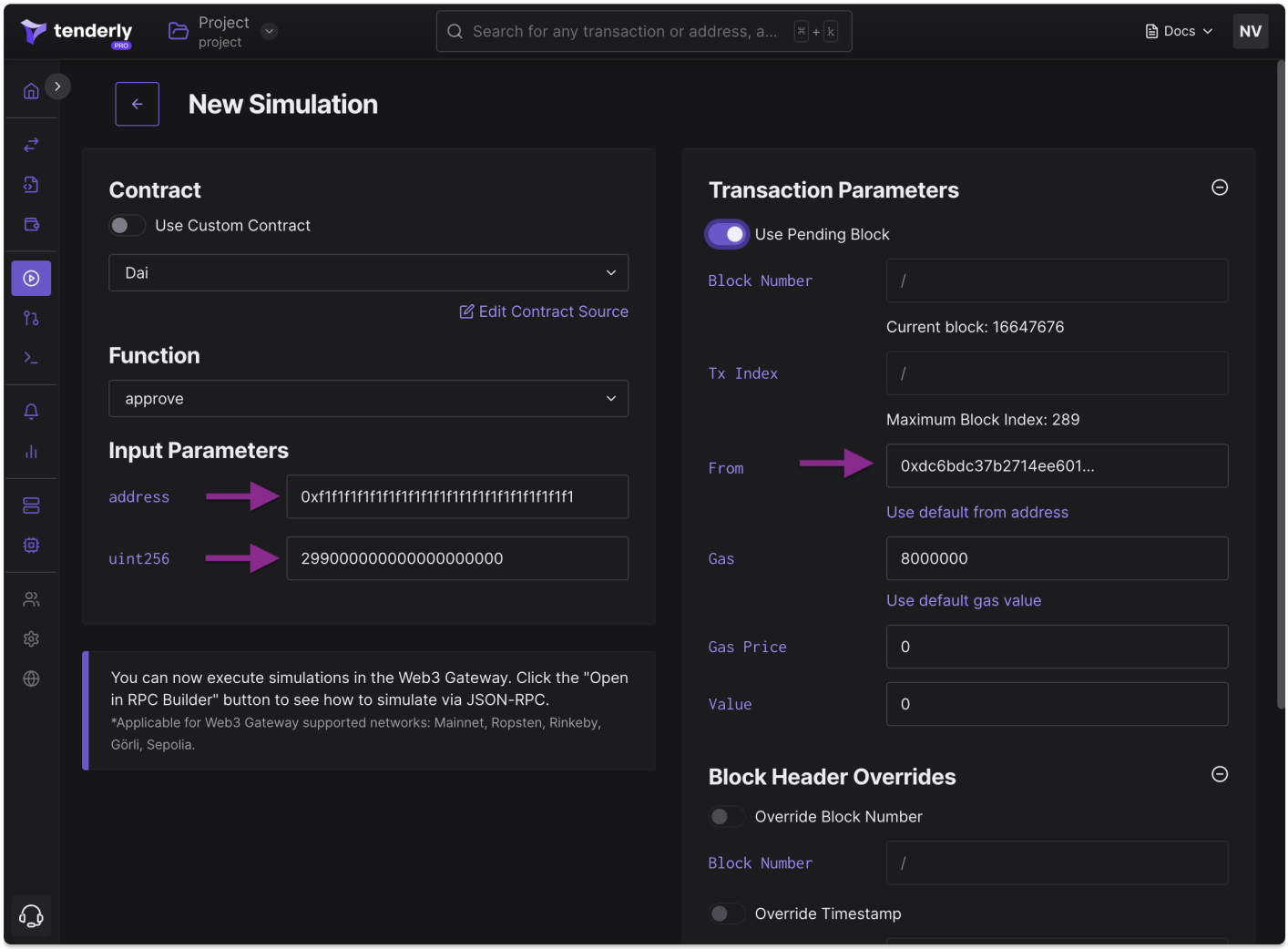
- Read, stream, and analyze blockchain data with 100% consistency.
- Run tx simulations before sending them on-chain using a single RPC URL.

Simulators

Transaction Simulator allows you to see a transaction's execution without sending it to the blockchain. It gives you the results of running a transaction against any point in blockchain history, including the latest block.

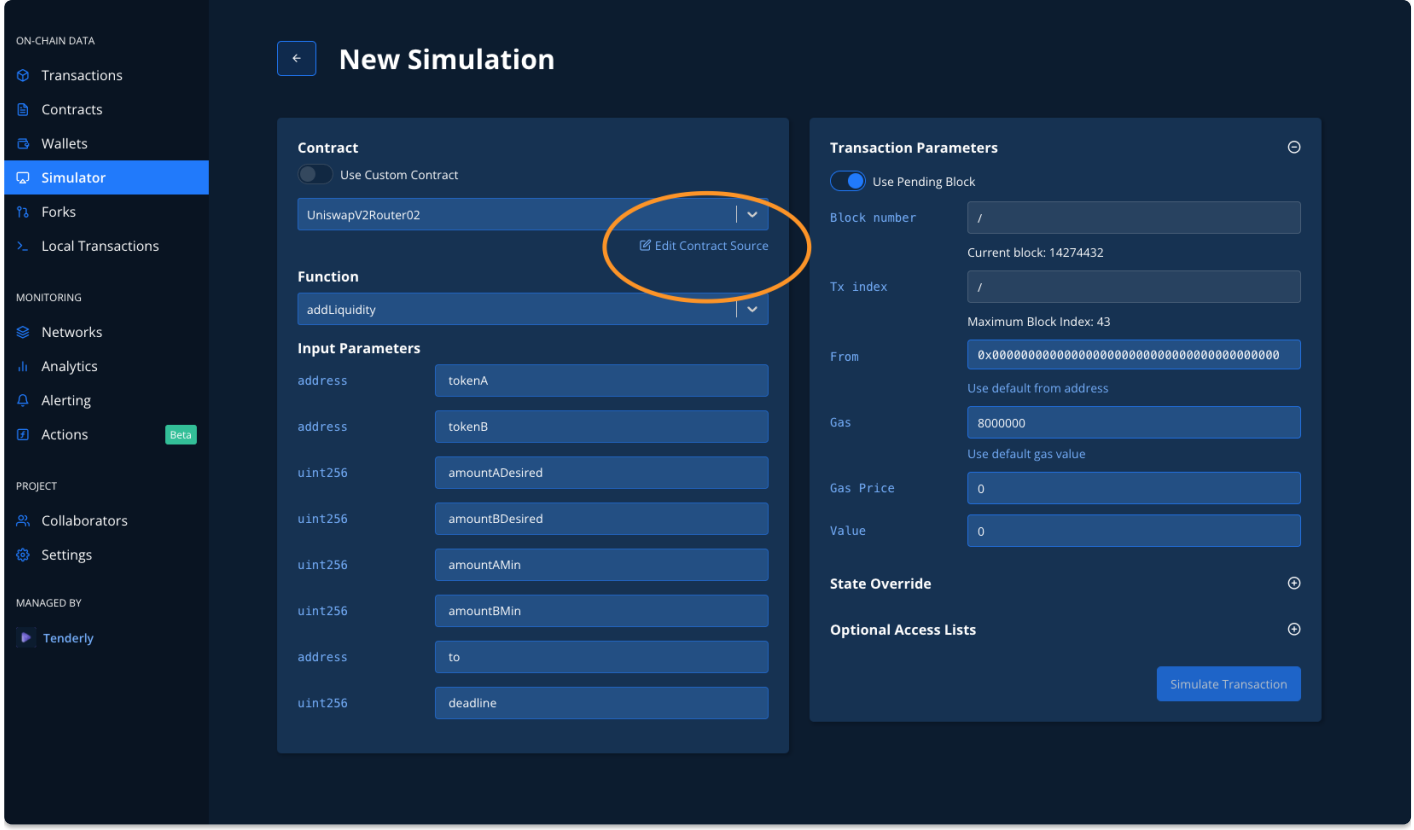
With Transaction Simulator, your transactions are run in a lightweight simulation environment, delivering detailed information about state changes, emitted events (logs), gas usage, and all calls that a simulated transaction made.

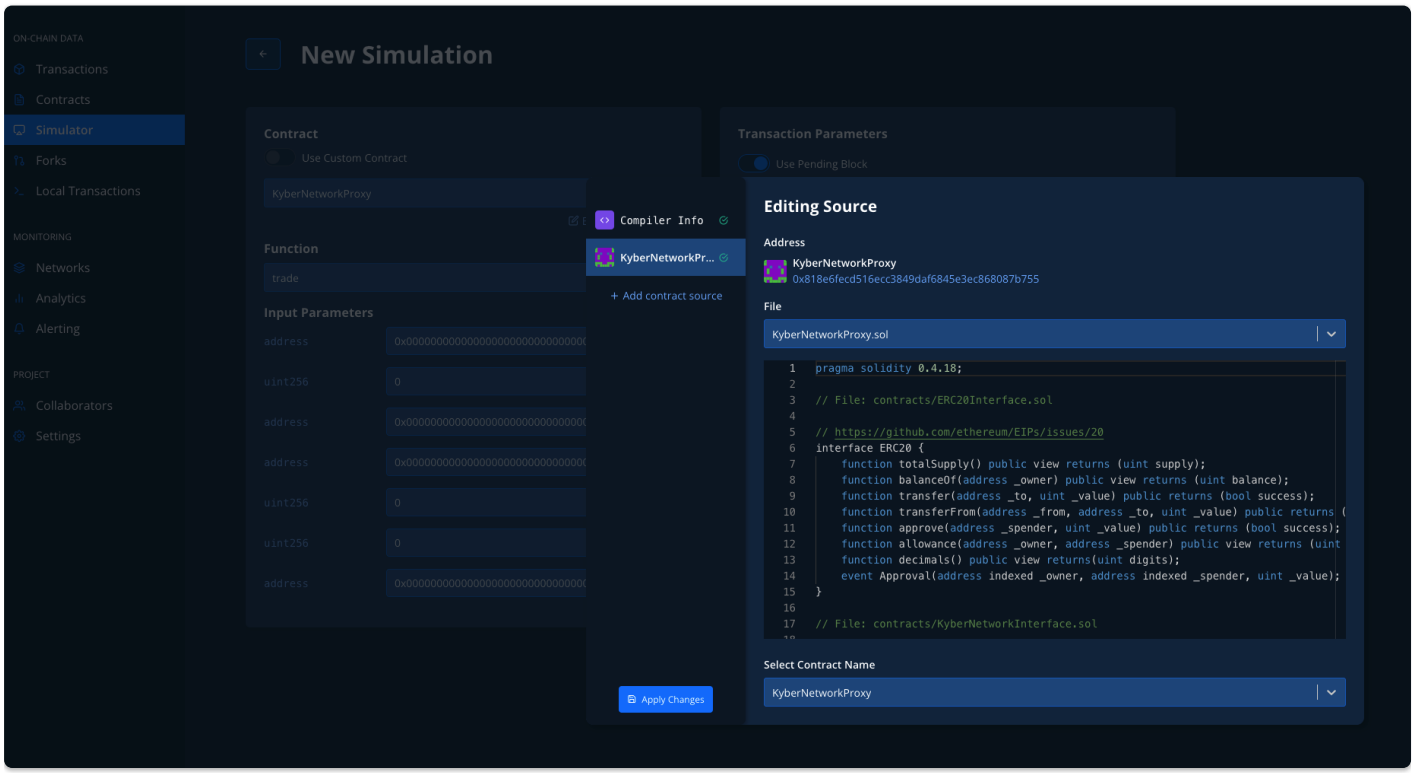
For example you can simulate a DAI approval



Editing contract Source in a simulation

You can edit the contract source on the fly while setting up your simulation or re-simulating, by showing the entire code and giving access to any line or parameter you would want to change.





You can also change the following compiler parameters for the simulation execution:

- Compiler Version
- Optimization Used
- Optimization Count
- EVM Version

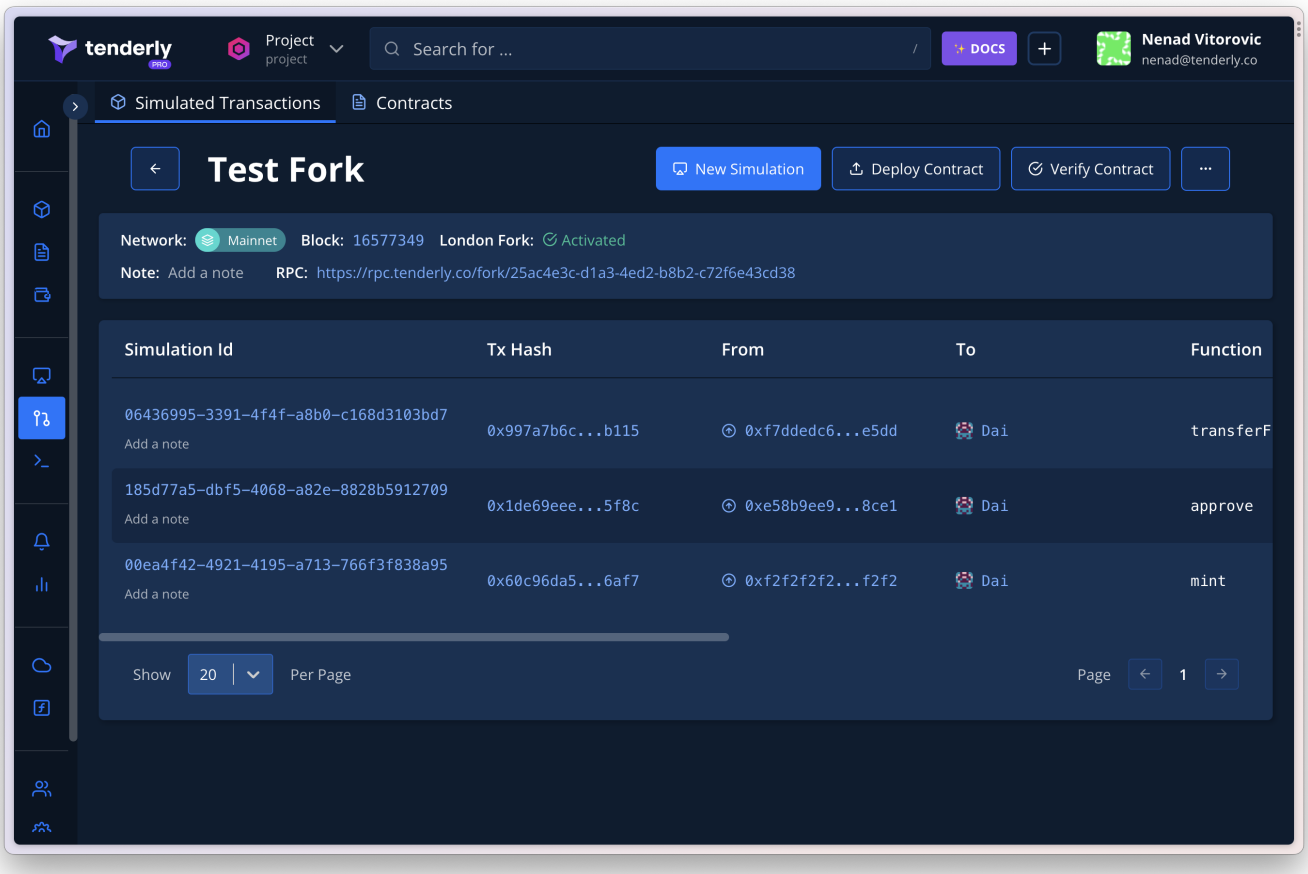
You can add a custom contract source to any contract you have chosen to edit or any address.

Forks

Tenderly Forks are a lightweight blockchain replica where you can run transaction simulations. You can base your Fork on one of Tenderly's supported networks and any of the blocks in a specific network's history. All transactions you simulate through Forks are recorded in an isolated timeline.

Additionally, you can do various custom actions on a Fork:

- Advance/mine a block (`evm_increaseBlocks`)
- Advance time on the Fork (setting the `timestamp`)
- Move the head of the Fork (`evm_snapshot` and `evm_revert`)
- Manage account balances (`tenderly_setBalance` and `tenderly_addBalance`)
- Override smart contract storage (`tenderly_setStorageAt`)



CI / CD

See Docs
The docs have examples of using a fork for your CI, and an example github action workflow yaml file.