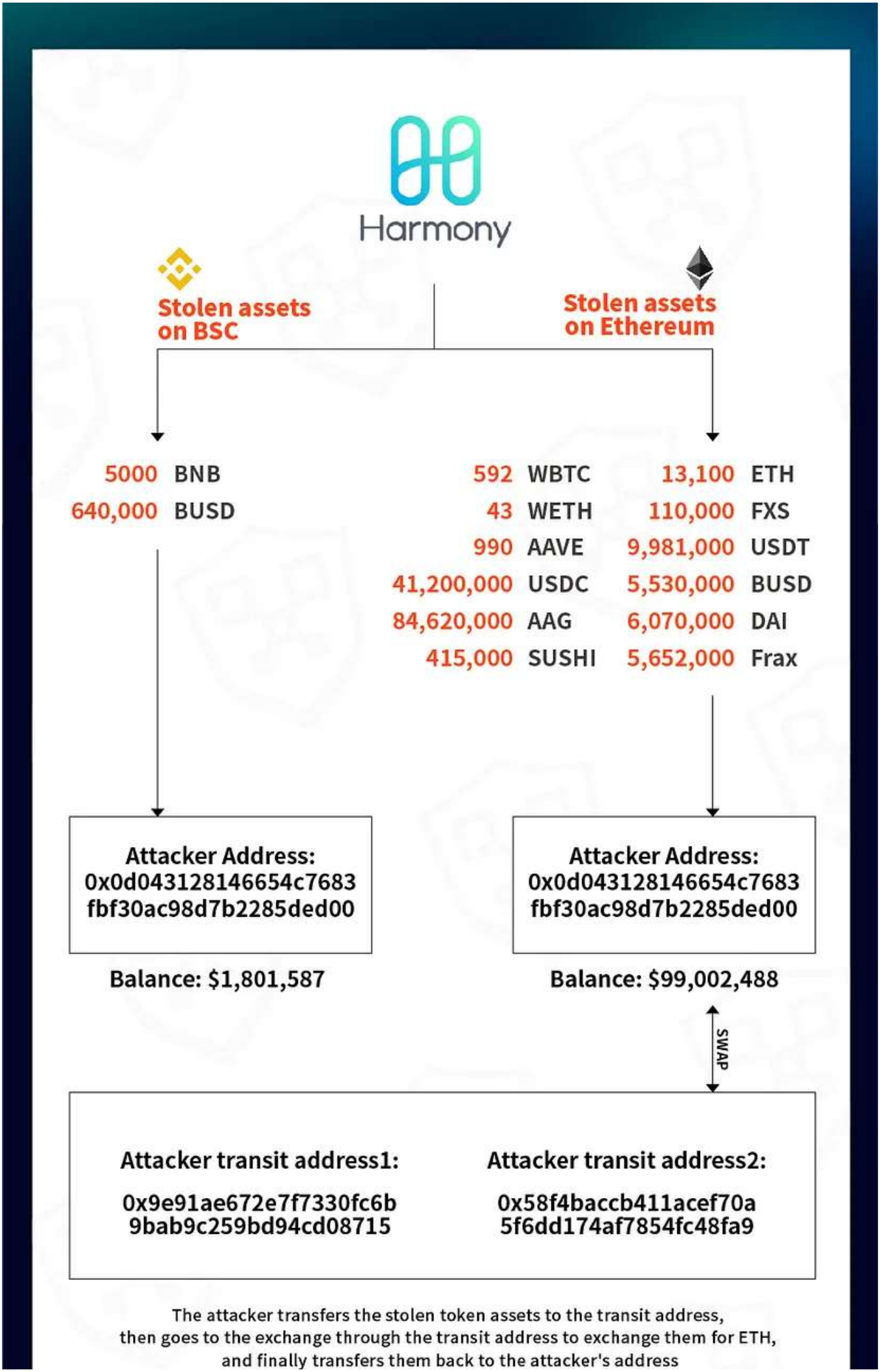
Harmony Bridge Hacked for $100M due to Suspected Private Key Compromise

On June 24, Harmony Bridge was hacked for about $100M due to suspected private key compromise. Here's our analysis of this incident.

Background

Harmony Bridge is a cross-chain bridge with five validators for operational verification. The main reason for this attack is that the private keys of two validators are suspected to be compromised, resulting in the *confirmTransaction* function of the contract to be called successfully.

```
198     /// @param transactionId Transaction ID.
199     function confirmTransaction(uint256 transactionId)
200         public
201         ownerExists(msg.sender)
202         transactionExists(transactionId)
203         notConfirmed(transactionId, msg.sender)
204     {
205         confirmations[transactionId][msg.sender] = true;
206         emit Confirmation(msg.sender, transactionId);
207         executeTransaction(transactionId);
208     }
```


Harmony
Stolen assets on BSC
Stolen assets on Ethereum
5000 BNB
640,000 BUSD
592 WBTC
43 WETH
990 AAVE
41,200,000 USDC
84,620,000 AAG
415,000 SUSHI
13,100 ETH
110,000 FXS
9,981,000 USDT
5,530,000 BUSD
6,070,000 DAI
5,652,000 Frax
Attacker Address:
0x0d043128146654c7683
fbf30ac98d7b2285ded00
Balance: $1,801,587
Attacker Address:
0x0d043128146654c7683
fbf30ac98d7b2285ded00
Balance: $99,002,488
SWAP
Attacker transit address1:
0x9e91ae672e7f7330fc6b
9bab9c259bd94cd08715
Attacker transit address2:
0x58f4baccb411acef70a
5f6dd174af7854fc48fa9
The attacker transfers the stolen token assets to the transit address,
then goes to the exchange through the transit address to exchange them for ETH,
and finally transfers them back to the attacker's address

0xf845A7ee8477AD1FB4446651E548901a2635A915

0x812d8622C6F3c45959439e7ede3C580dA06f8f25

Victim contract:

0x715cdda5e9ad30a0ced14940f9997ee611496de6

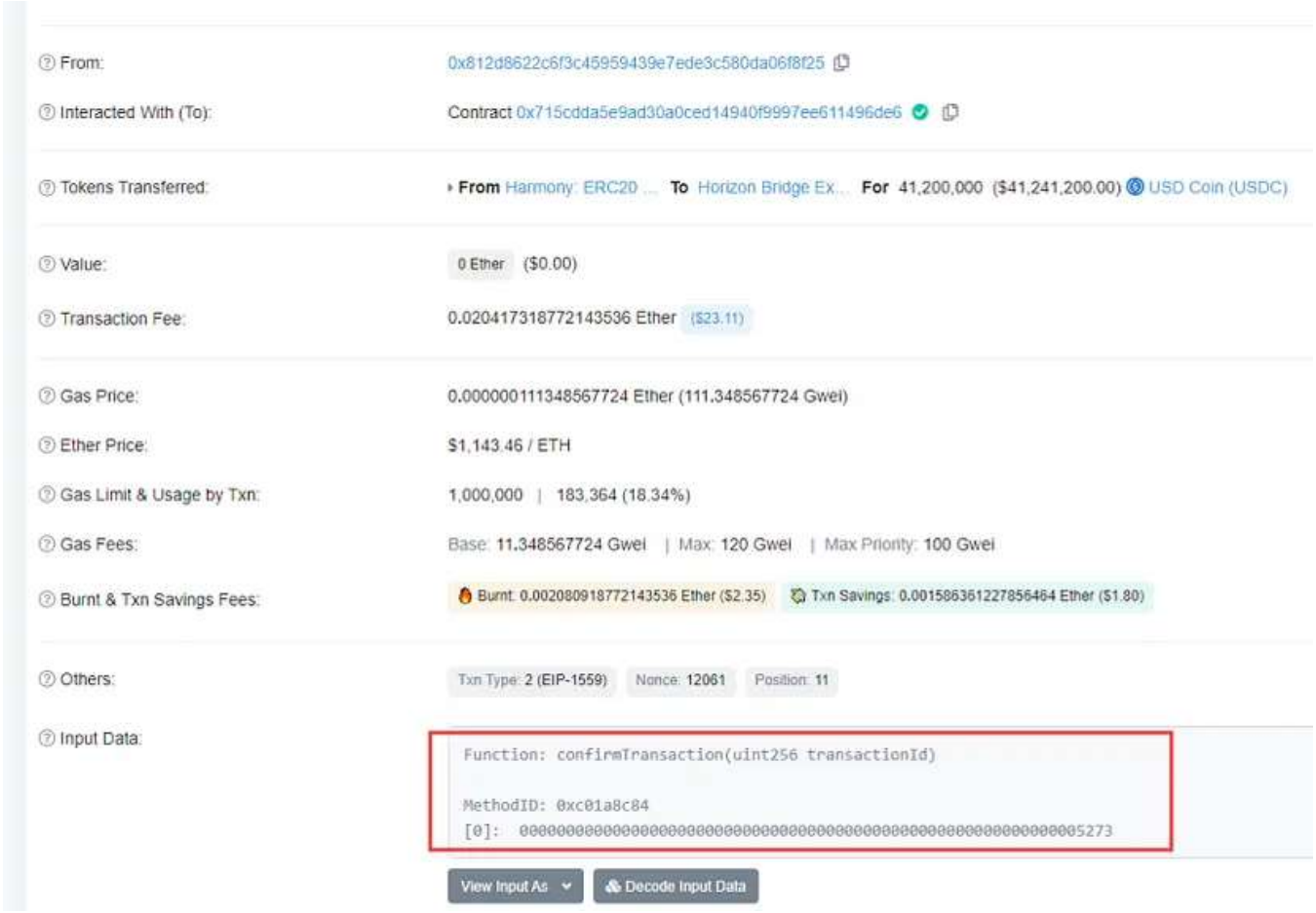
Example hash:

0x6e5251068aa99613366fd707f3ed99ce1cb7ffdea05b94568e6af4f460cecd65

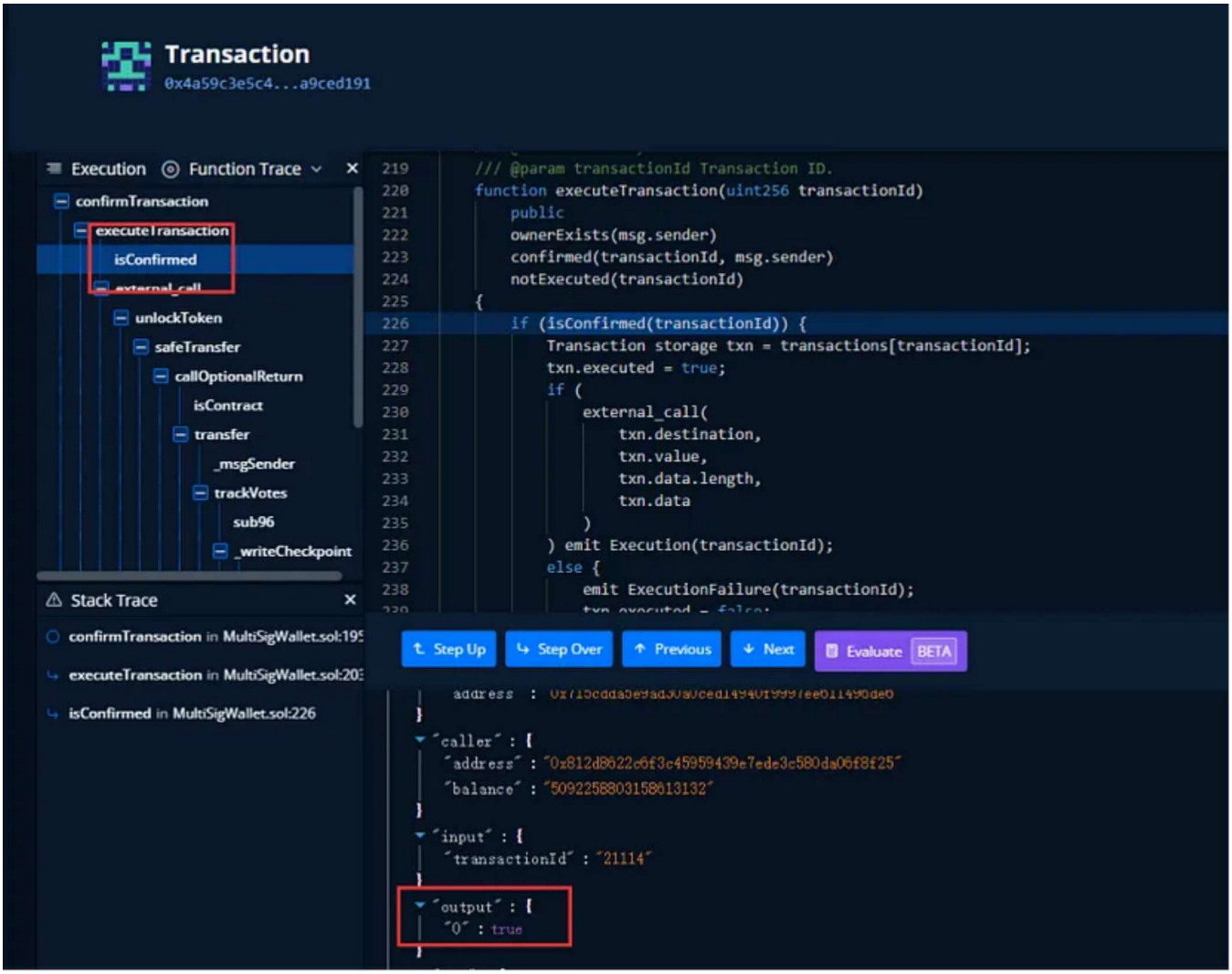
Related transactionId:

21106–21118(ETH),120515–120518(BNB)

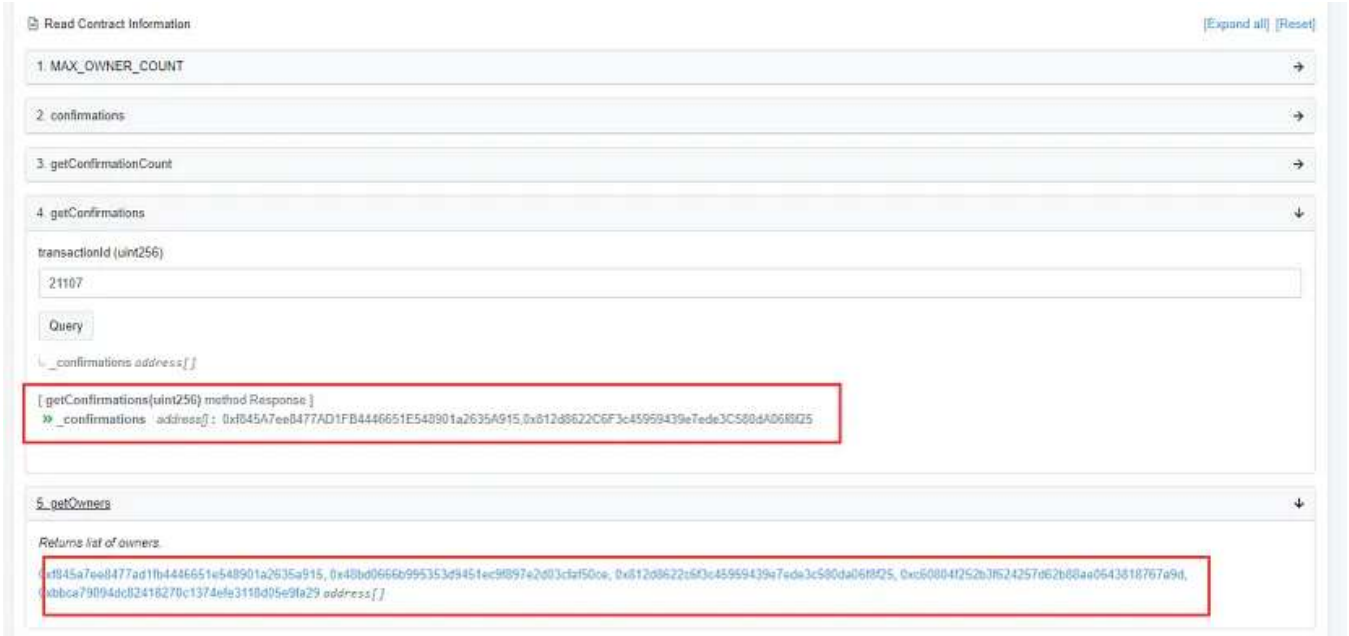
The private key compromise address 0x812d86 calls the *confirmTransaction* function of the 0x715cdd contract for operation verification, and the transactionId for verification is 21107 (here the transactionId of 21107 is used as an example).



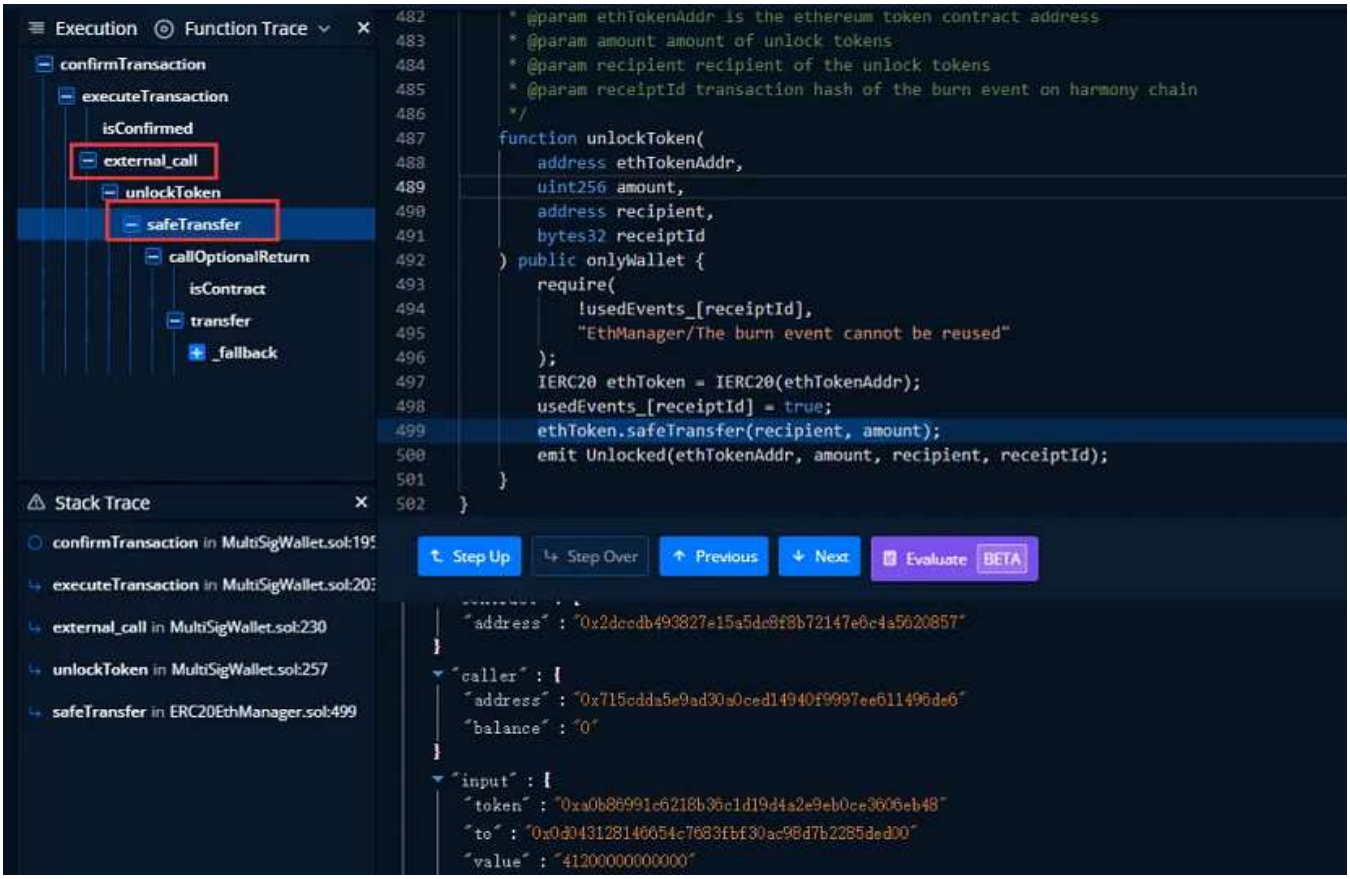
It can be found that in this transaction, the validation of isConfirmed returns true.



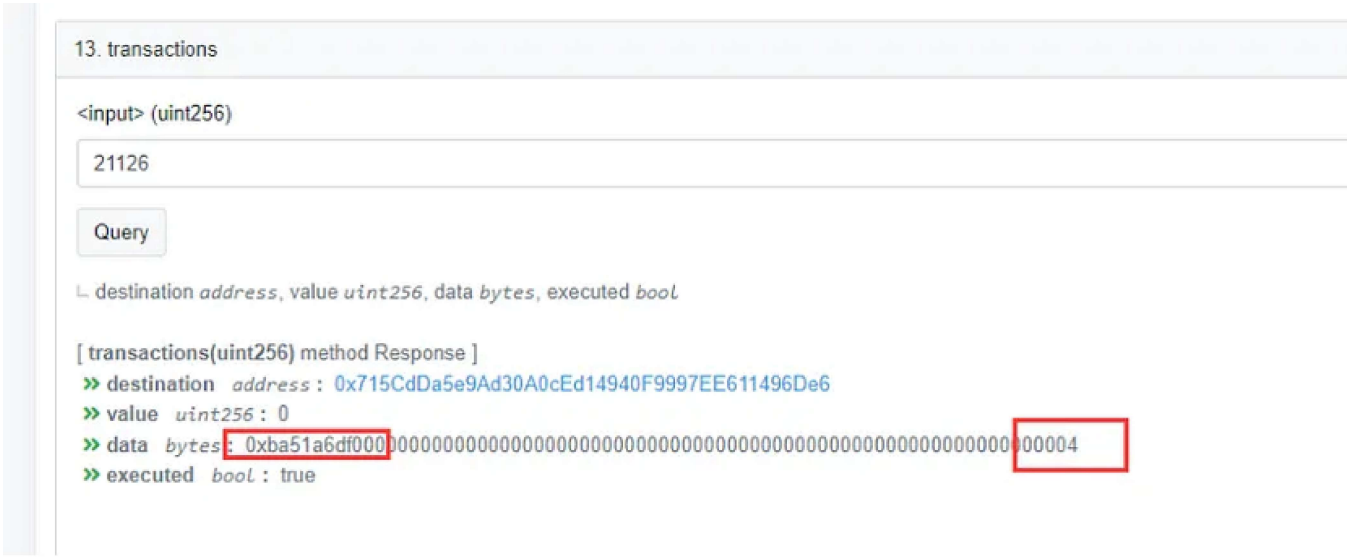
However, a validator node query in the contract shows that although there are five owners, only two have been verified.



The attacker then uses these two validator nodes to successfully get the corresponding tokens using external_call and repeatedly exploits this attack to profit.



The project subsequently changed the number of validator nodes required to pass from 2 to 4 via transactionId of 21126 (120531 on BNB Chain).



Fund Flow

The attack resulted in the loss of 85,867 ETH, 990 AAVE and 78,500,000 AAG on Ethereum, and 5,000 BNB and 640,000 BUSD on BNB Chain, for a total of about $100,428,116. The stolen funds are still held at the attacker's address.

Summary

The attacker took advantage of the low number of validator node verification requirements and used two validator nodes to steal millions of dollars in assets. It is recommended that the project owner try to choose more nodes when designing the number of validator verification requirements and do a good job of validator security.

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