Ministry of Education and Science of Ukraine
NATIONAL UNIVERSITY OF KYIV-MOHYLA ACADEMY
Department of Informatics of the Faculty of Informatics

Creation of an atomic cross-chain escrow, which supports EVM, Solana and TON

Volodymyr Rastiehaiev

Thesis supervisor - Kyrylo Gorokhovskyi

2025

Terms

- Escrow is a financial arrangement where a third party holds and manages assets or funds on behalf of two parties involved in a transaction, releasing them only when agreed-upon conditions are met.
- Atomic escrow is a type of escrow mechanism that ensures a transaction between parties is completed entirely or not at all.

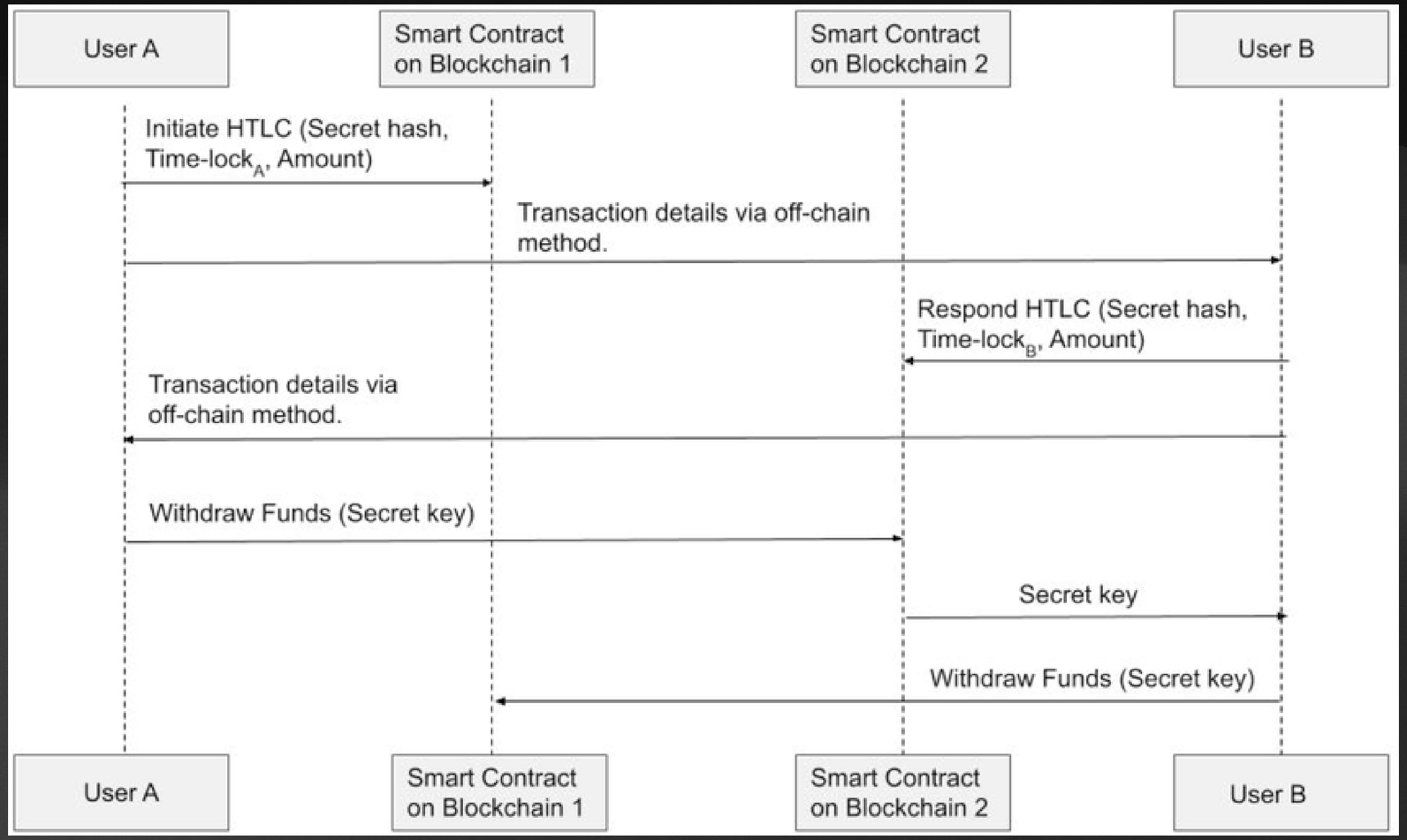
Objectives

- Addresses the interoperability issue.
- Research approaches.
- Create an HTLC-based atomic cross-chain escrow for Solana, TON and EVM.
- Develop contracts for all mentioned blockchains.

What is HTLC?

- HTLC (Hashed TimeLock Contract) is a smart contract used to enable secure, time-bound transactions between untrusted parties.
  It requires the receiver to provide a cryptographic proof (a hash) within a specified time to claim the funds.
  If the proof isn’t provided in time, the sender can reclaim the funds.

HTLC diagram



HTLC sequence diagram

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EVM

- EVM has two main types of accounts:
  - Externally Owned Accounts (EOA) – Controlled by private keys, used by users to send transactions and hold ETH or tokens.
  - Contract Accounts – Controlled by code, execute logic when triggered by transactions or messages.
- Smart contracts store both code and state on EVM.

Solana

- In Solana, accounts store data and are central to the execution of programs.
- There are two main types of accounts:
  - Data Accounts - These store persistent data and are used by programs to maintain state.
  - Program Accounts - These contain the compiled executable code and are marked as executable.
- On Solana, programs are stateless and require accounts that store state to be passed on invoke.

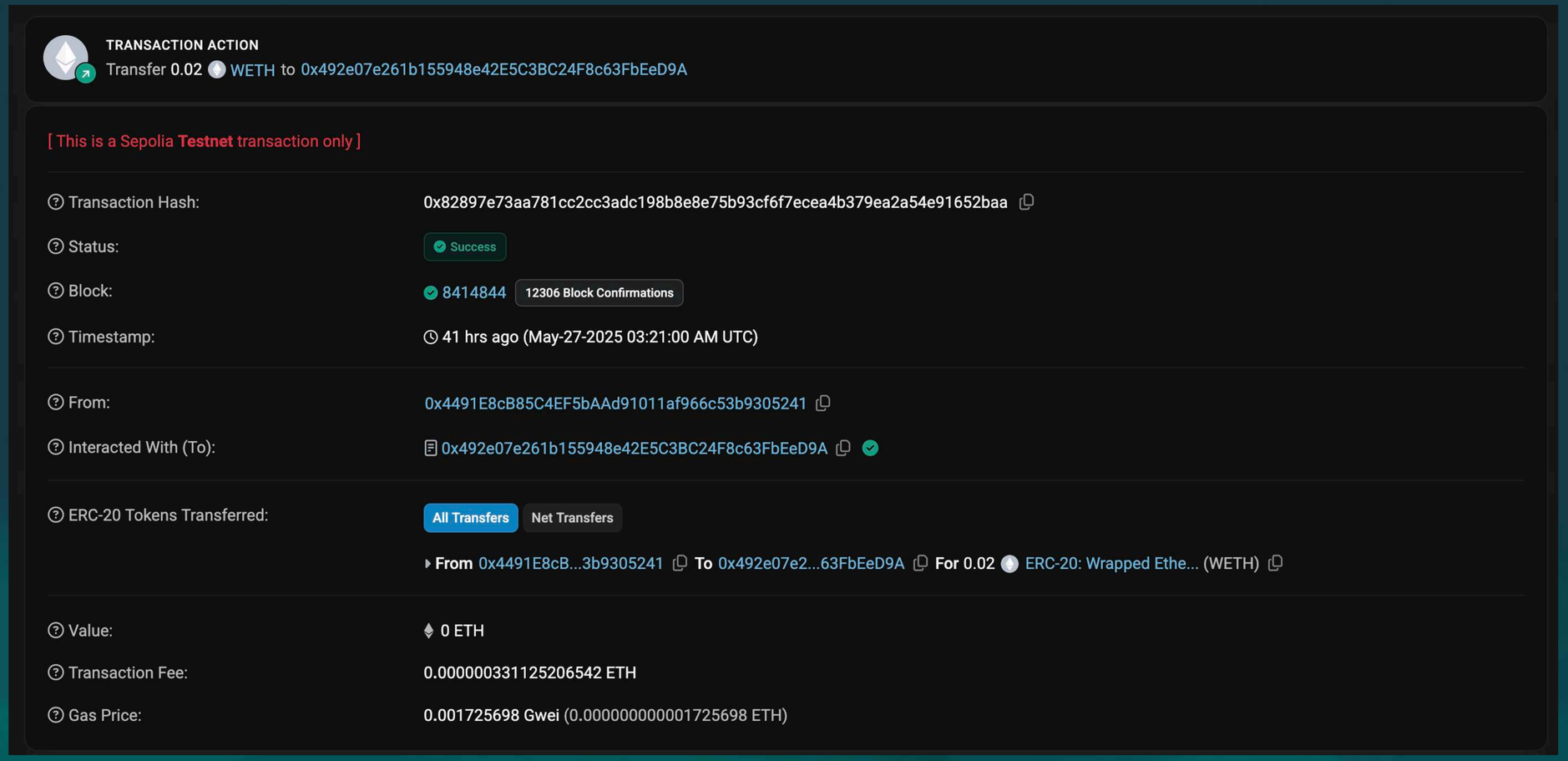
TON

- In TON, everything is a smart contract with its own code and persistent data.
- Unlike Solana and EVM, TON is asynchronous:
  - Actor Model: Each smart contract is an independent actor that communicates via messages, similar to concurrent systems.
  - Contracts execute only when they receive messages. All communication between contracts is asynchronous, enabling parallelism but making it important for developer to think about contracts interactions and architecture.

Technologies used

- For hashing algorithm, keccack256 was chosen as it is available in all of three blockchains and is needed to achieve compatibility with EVM.
- EVM:
  - Solidity language for smart contracts
  - Hardhat js framework for testing & deploying
- Solana:
  - Rust language for smart contracts & testing
  - Solana-sdk library for deploying smart contracts & blockchain interactions
  - Litesvm library for smart contract testing
- TON:
  - Tolk language for smart contracts
  - Blueprint js framework for testing & deployment

EVM



createTrade transaction on Sepolia testnet

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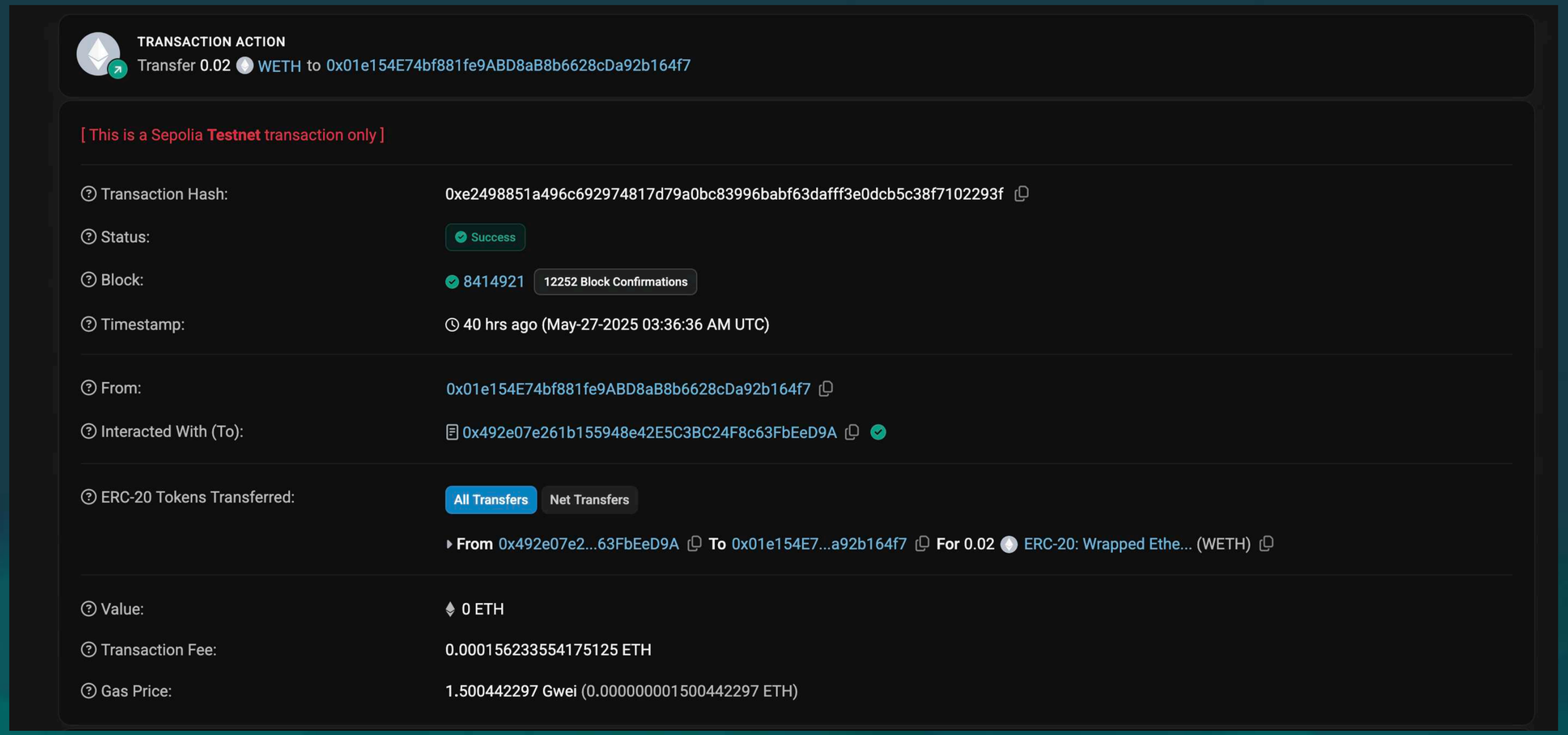
EVM



Withdraw transaction on Sepolia testnet

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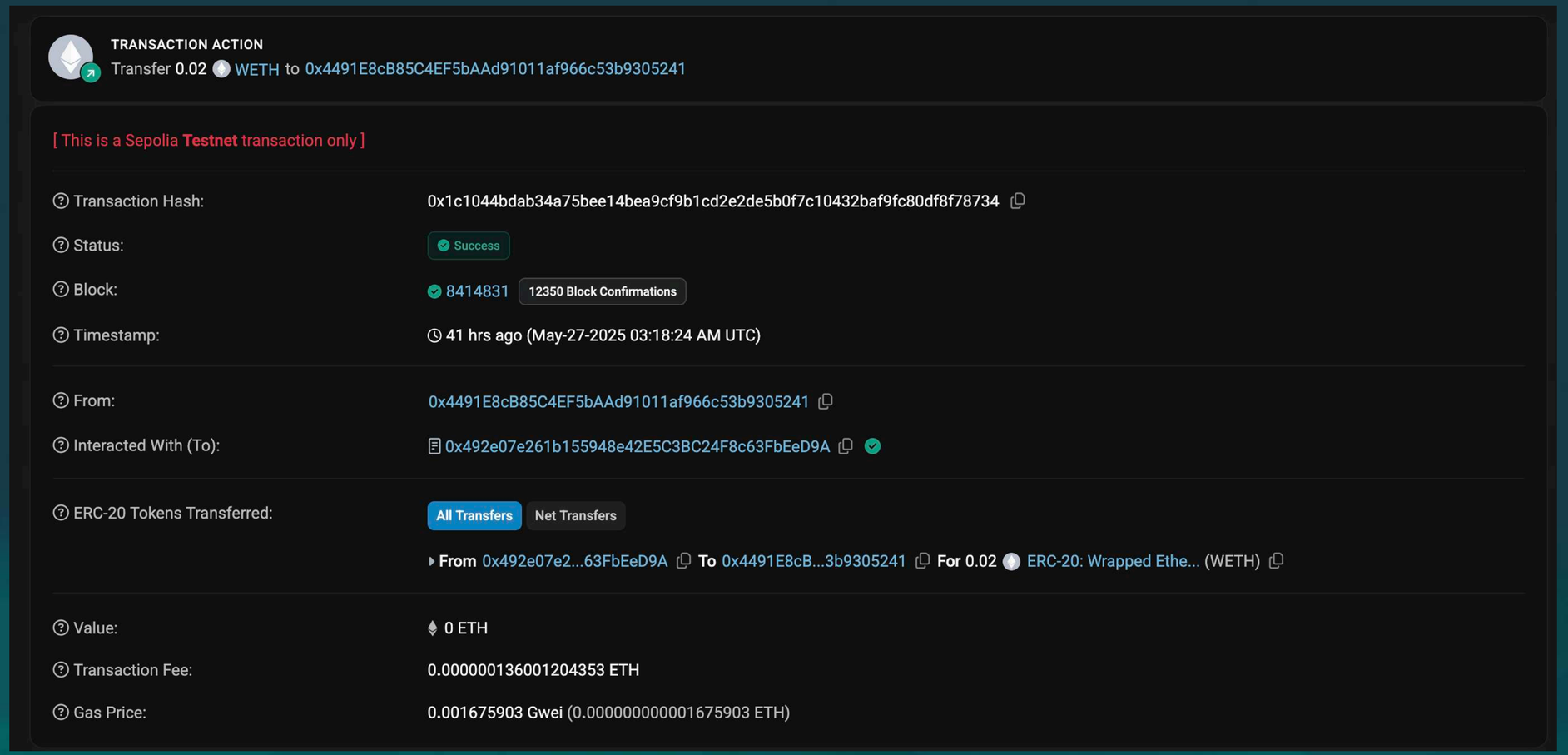
EVM



Refund transaction on Sepolia testnet

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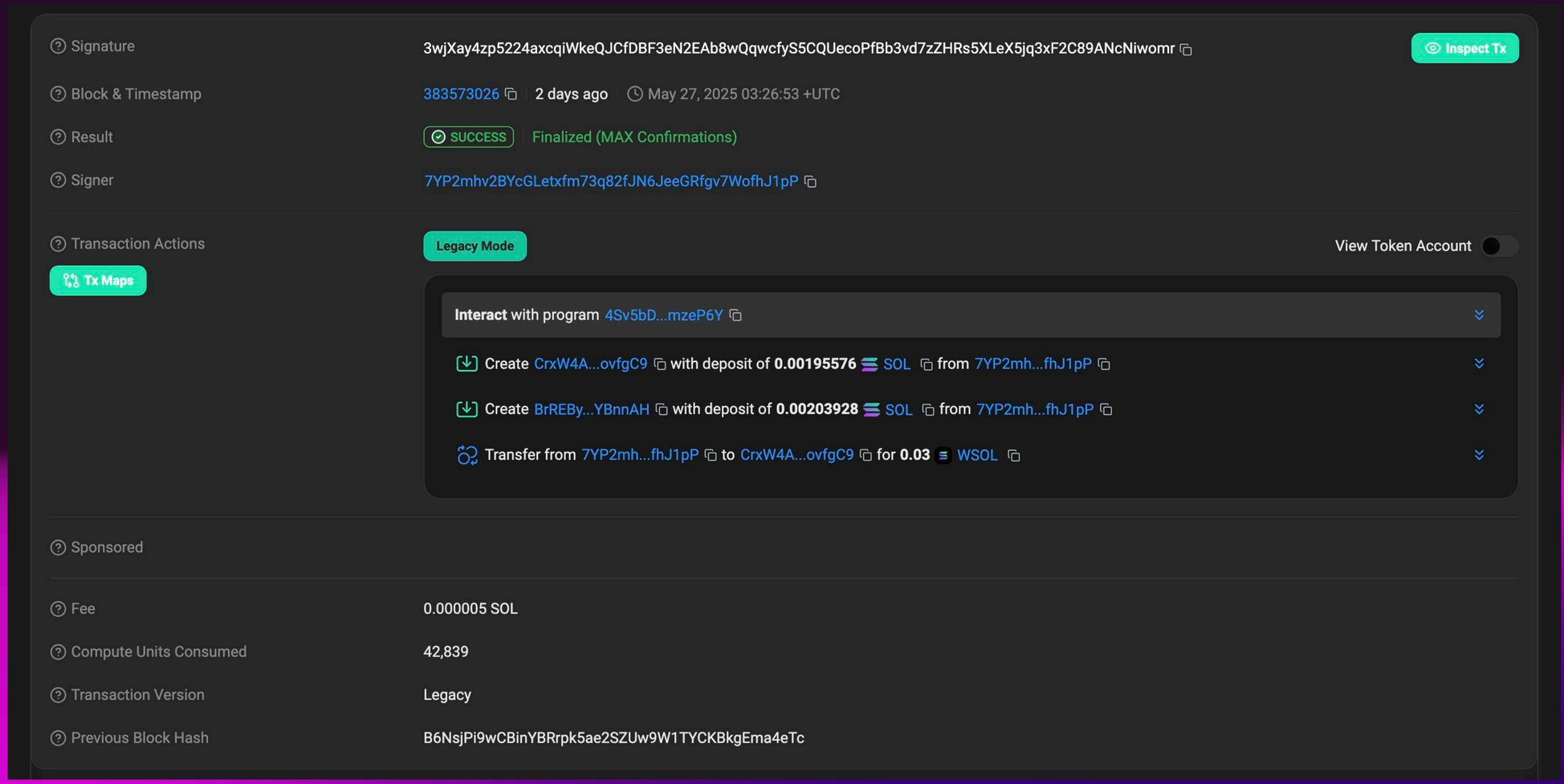
Solana



Deposit transaction on Solana devnet

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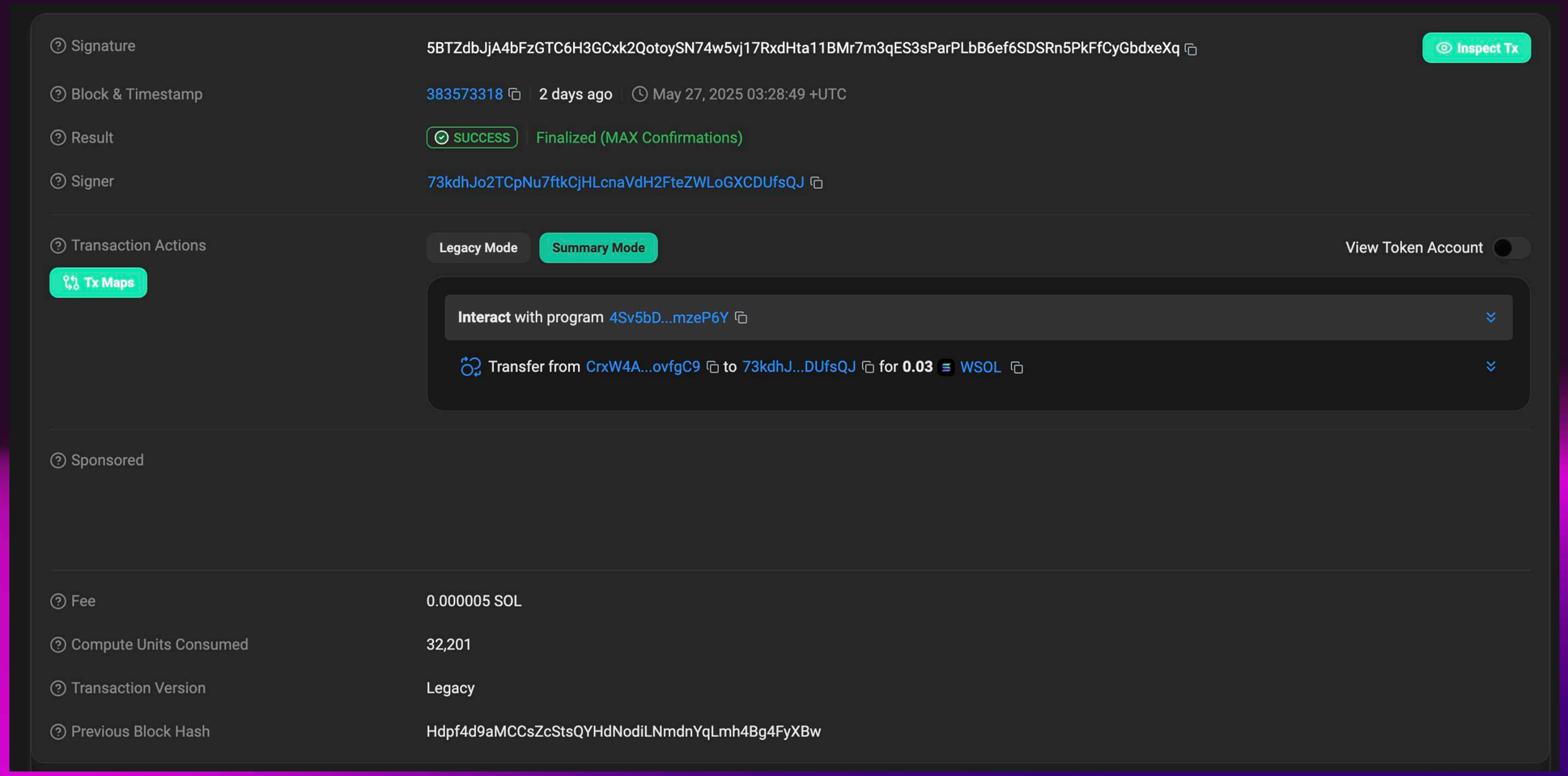
Solana



Withdraw transaction on Solana devnet

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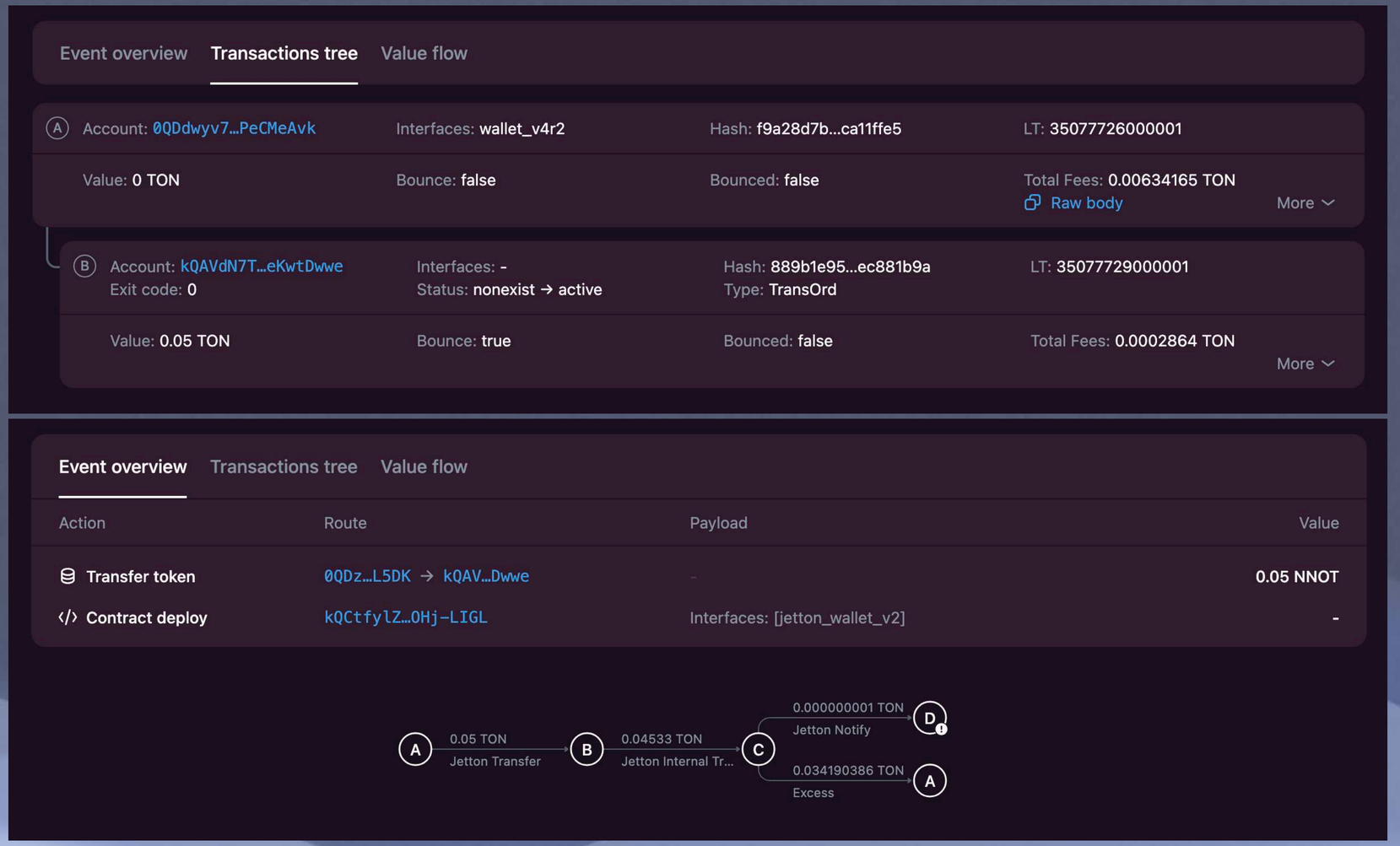
TON



Contract deploy & deposit on TON testnet

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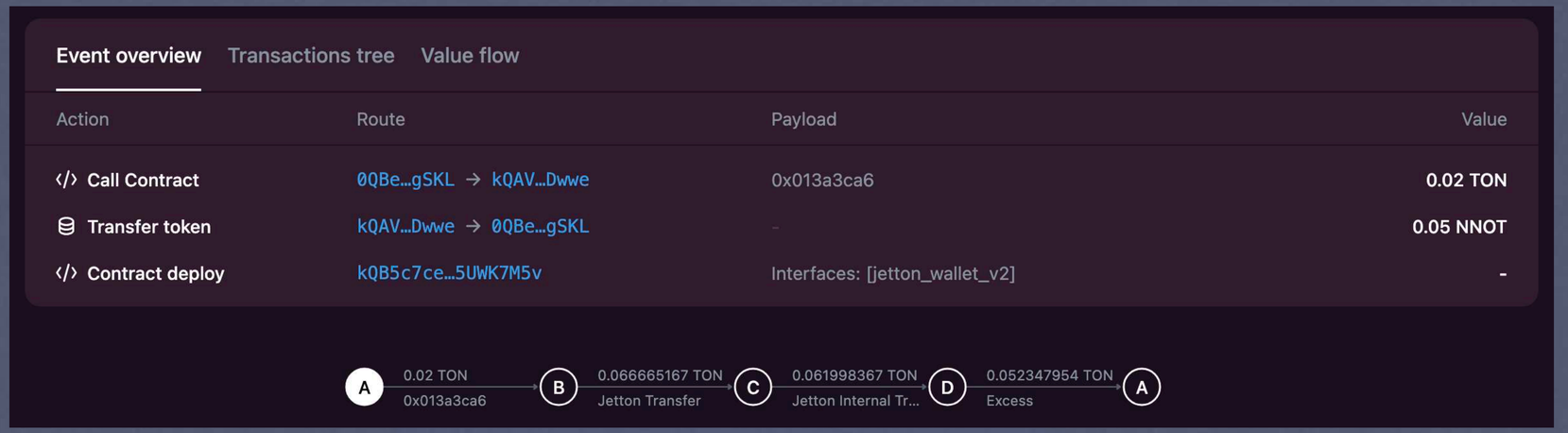
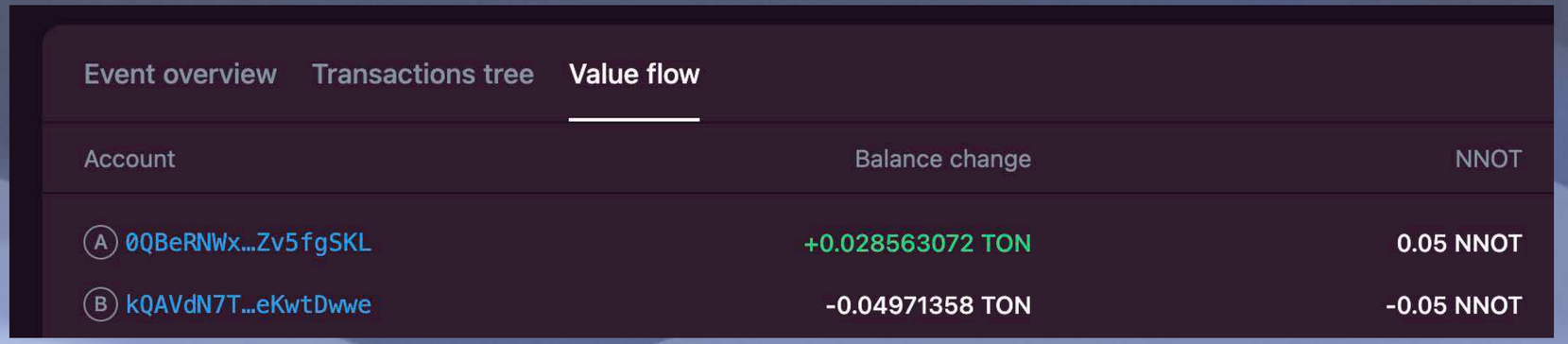
TON





Withdraw on TON testnet

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Conclusion

- Traditional methods often of cross-chain escrow often rely on trusted intermediaries or complex bridging mechanisms, introducing points of failure and security vulnerabilities.
- This work addressed this challenge by focusing on the design, development, and evaluation of an atomic cross-chain escrow system.
- As a result, the system was implemented to support specifically EVM, Solana and TON.
- This work successfully demonstrated the technical feasibility of such a system, providing a functional and evaluated solution.

Thanks for your attention