

Kohaku Hardware Signer: First Post-Quantum Secure Element Implementation

Simon Masson, Renaud Dubois
ZKNox



Account Abstraction Hub

November 19th, 2025 – Buenos Aires, DevConnect

ZKNOX team



Nicolas Bacca

20⁺ years experience (10⁺y web3)
Security and hardware specialist
Prev. Ledger cofounder/CTO



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Expertise and innovation to every challenge on the whole security chain:

- ▶ user end
(secure enclaves, hardware wallets),
- ▶ back end
(TEE, HSMs),
- ▶ on-chain
(smart contracts).



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<https://zknox.eth.limo/>

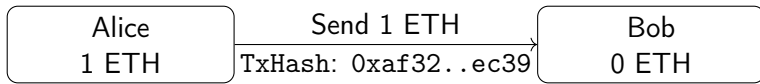
<https://github.com/zknoxhq/>

Account Abstraction

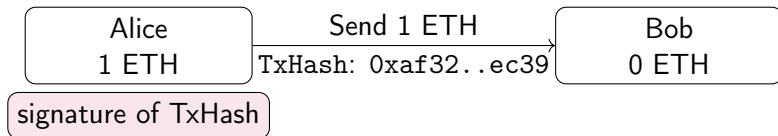
Alice
1 ETH

Bob
0 ETH

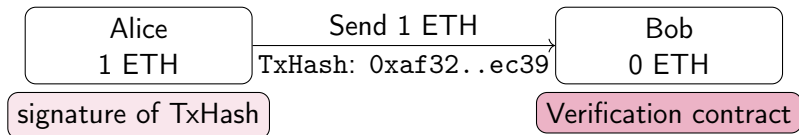
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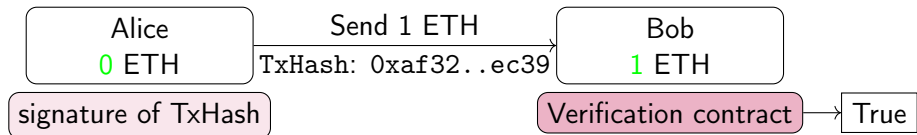
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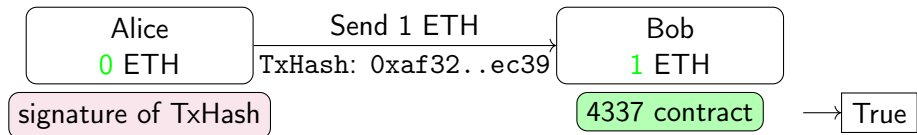
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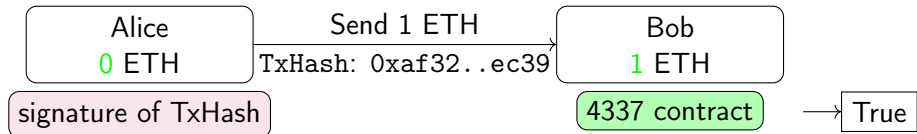
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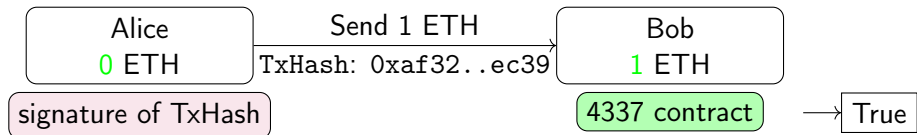


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Execution layer: ECDSA signature (not resistant to quantum attacks)

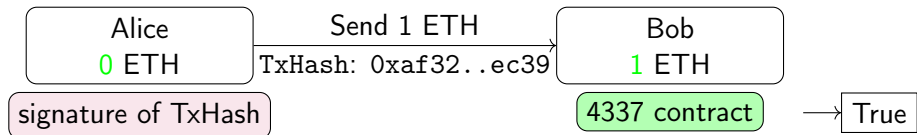
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This work:

- ▶ smart account with hybrid ECDSA+MLDSA verification!
- ▶ same user experience, but hardware and post-quantum security.

Post-quantum signature candidates

Standard	FN-DSA	ML-DSA	SLH-DSA
Name	Falcon	Dilithium	Sphincs
FIPS	203	204	205
Family	Lattice	Lattice	Hash
Signature			
Public key			
Signer			
Verifier			

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We implement ML-DSA (Dilithium) following EIP 8051

EIP 8051

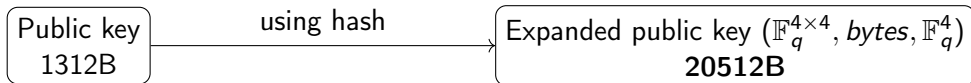
Two precompiles:

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- ▶ ML-DSA-ETH: using the hash function KECCAK256 (efficient in Ethereum contracts)

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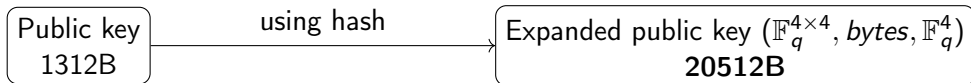
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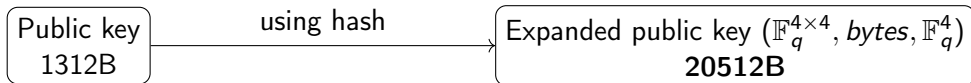


Public key provided in expanded form to save hashes.

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Verifier cost: **5** calls to hash (SHAKE256 or KECCAK256) and **9** NTTs.

Hardware implementation

- ▶ Start from NIST FIPS 204 reference code



pq-crystals / **dilithium**

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- ▶ Soon on other HW...

Demonstration

Let's see how it works in practice



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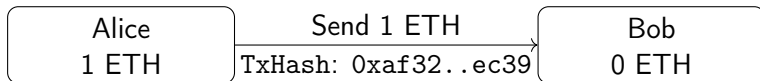
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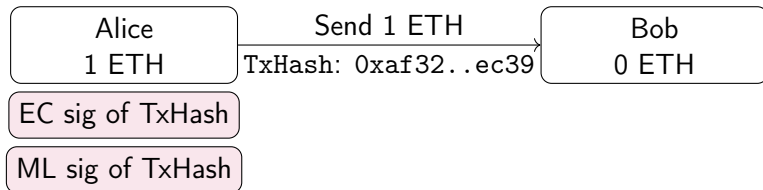
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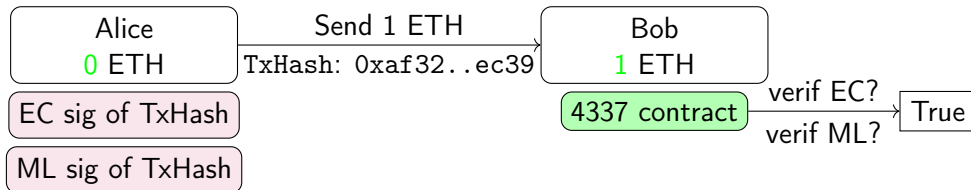
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