Bridging and Scaling

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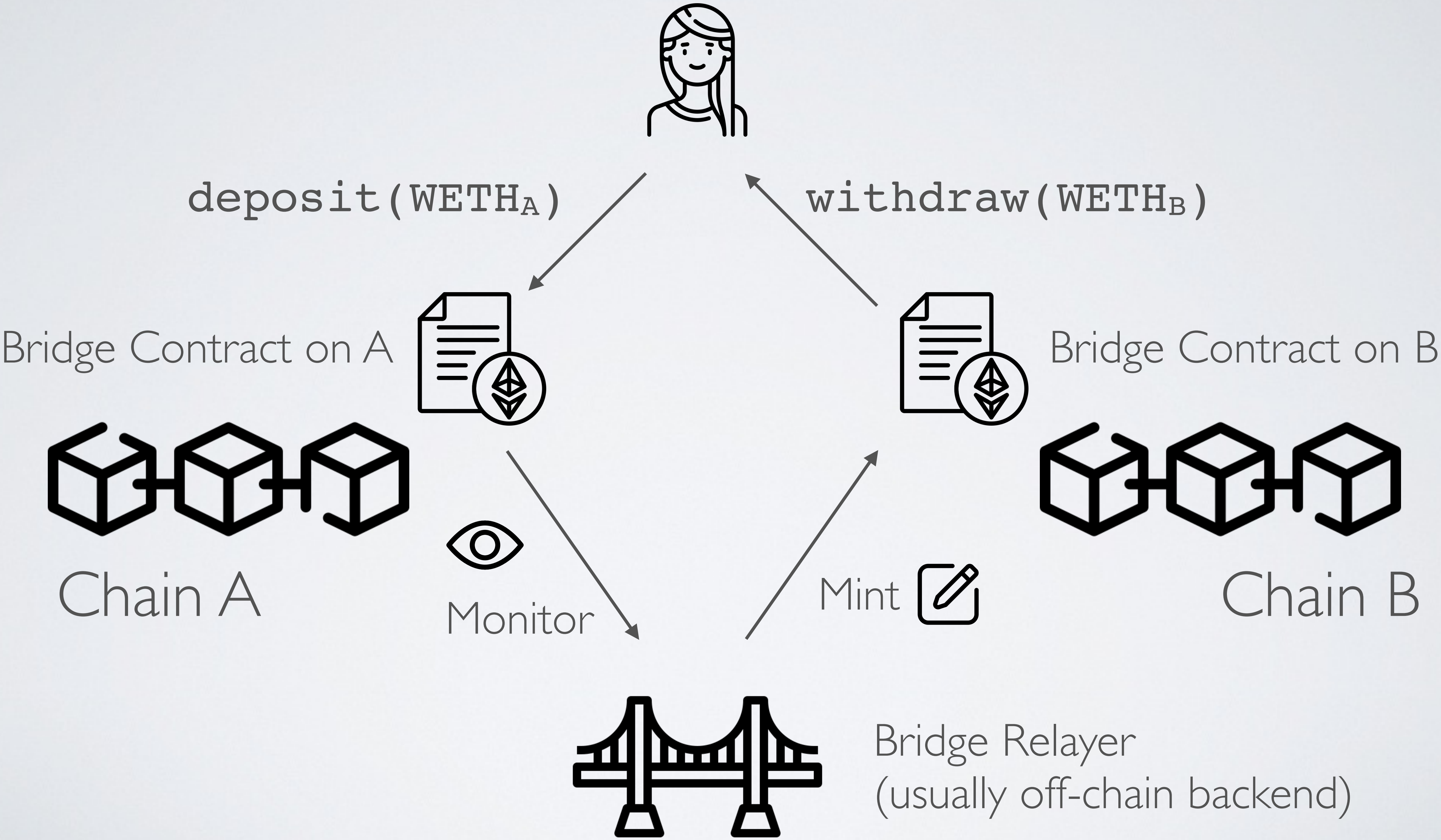
Bridging

Transferring assets from one chain to another (and vice versa)



`deposit(WETHA)`

`withdraw(WETHB)`

Bridge Contract on A

Bridge Contract on B

Chain A

Chain B

Monitor

Mint

Bridge Relayer
(usually off-chain backend)

Scaling

The problem with blockchain mainnets

Transaction Speed

- Bitcoin: 7 tx/s
- Ethereum: 15 tx/s

Transaction Fees

- Bitcoin: 0.000012 BTC (~$1 USD)
- Ethereum: 0.0002 ETH (~ $2 USD)

◉ Transaction speed and transaction fees are **not arbitrary**

➡ They are a direct result of deliberate design choices that **prioritize decentralization** and **security**
i.e the cost to ensure that no single entity can dominate the network

Solutions

- Use a faster consensus
(hard without compromising with security)
- Split the chains into multiple ones called "shards"
(work in progress for Ethereum)
- **Rollups** for off-chain or L2-chains

The concept of Rollup

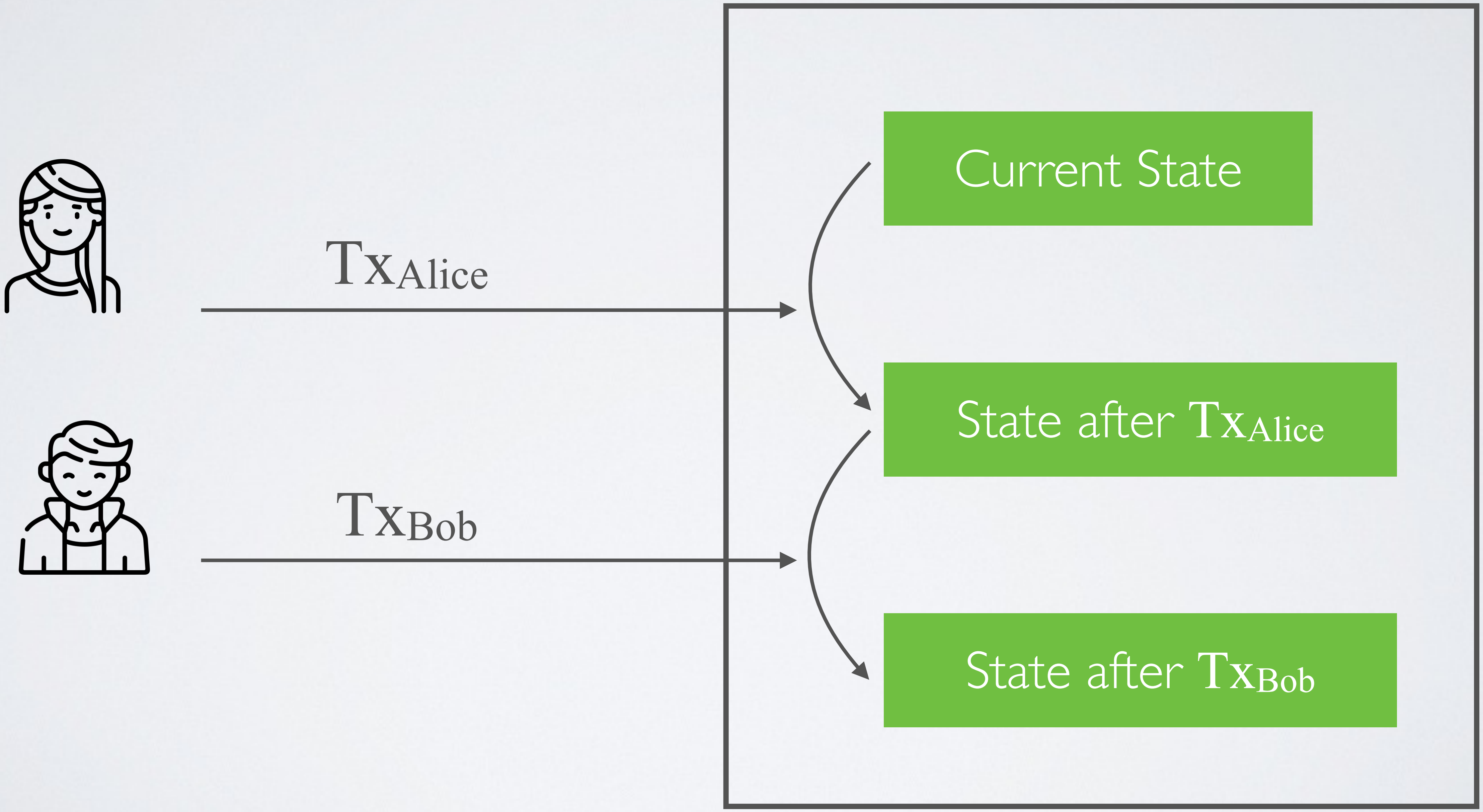
The idea is to process transactions outside of the main chain

- either off-chain
- or onto another L2-chain (bridging)
  with a faster/cheaper validation

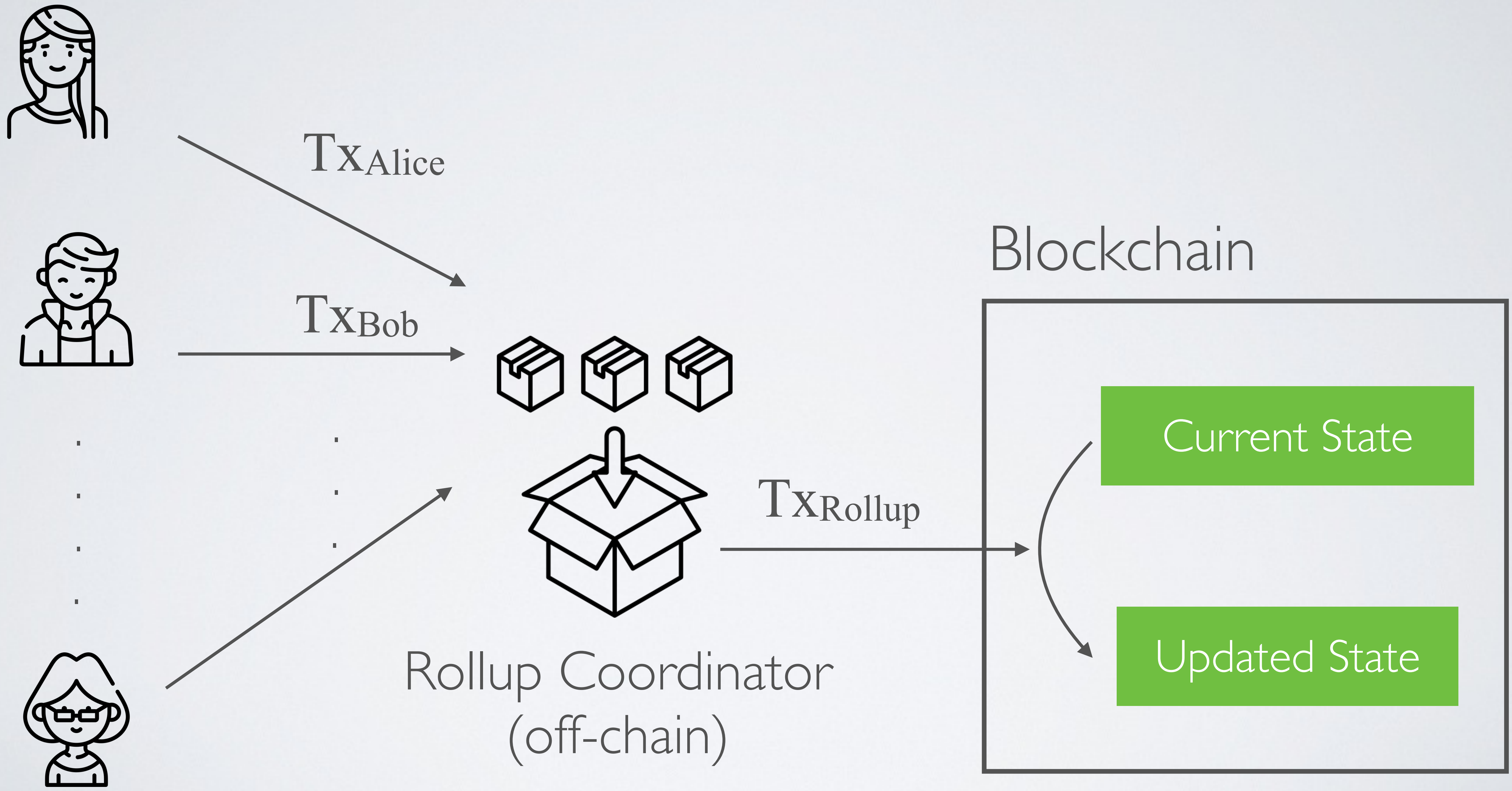
◉ Both are a necessary trade of with security and decentralization

Basic Blockchain

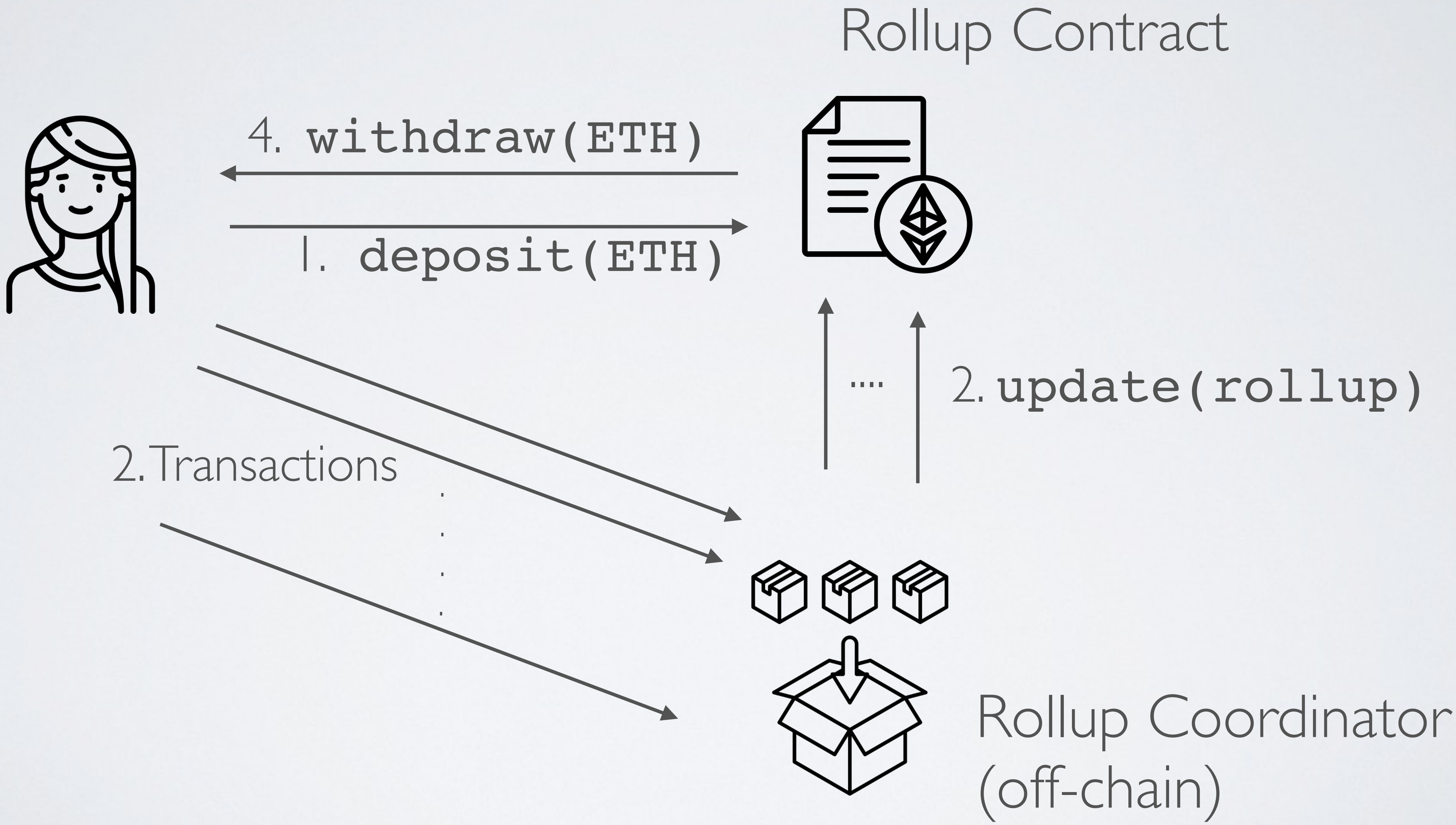
The blockchain update its state (balances, storage, ...) after each transaction



Using a rollup to batch many transactions into one



Using a rollup contract



Three types of Rollup

Naive Rollup (not gas efficient)
The rollup is entirely verified on-chain
(not use in practice because but good to understand the concept of rollup)

Optimistic Rollup (very gas efficient)
The rollup is verified off-chain (after deployment)

Zk-Rollup (pretty gas efficient)
The rollup comes with a ZK-proof that is verified on-chain

Naive Rollup

➡ The rollup contract keeps track of all users' balances

A rollup is the list of transactions verified on-chain by

- verifying each transaction signature
- checking and updating each user's balances accordingly

◉ Not use in practice because gas inefficient

Optimistic Rollup

The rollup contract only stores the root of a Merkle tree with the leafs being the different users balances

➡ When users want to withdraw funds, they need to provide a Merkle proof showing that the pair `(address, balance)` is in the corresponding tree

The rollup is

1. the list of transactions verified off-chained
2. and the new tree root computed off-chain

➡ The rollup coordinator is trusted to compute the right balances and build the right tree

Once the rollup submitted on-chain, verifiers can check it and challenge it during a dispute period (usually 7 days)

◉ If the rollup is proved fraudulent, it is rolled back and the stake deposited by the rollup coordinator is slashed

Zk-Rollup

The rollup contract stores a Merkle root (similar to Optimistic)

The rollup is

1. the list of transactions verified off-chained,
2. the new tree root computed off-chain
3. and a ZK-proof proving that given the old tree and the list of transactions, the new tree is correct

✓ The Zk-proof is verified on-chain