State of the Ark

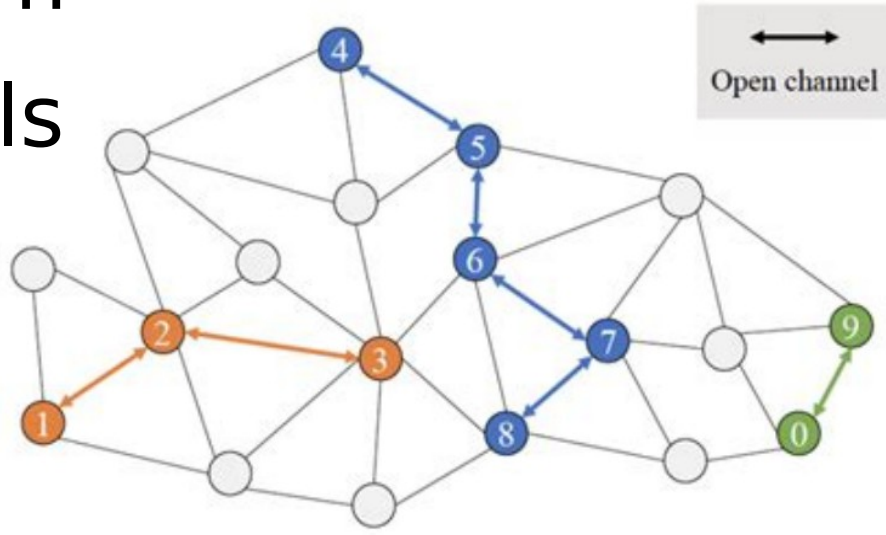
progress on a new Bitcoin layer 2 protocol

Who am I?

- Steven Roose
- Bitcoin dev >10 years
- formerly Liquid team @ Blockstream
- rust-bitcoin

Lightning Network

- off-chain payment protocol
- connected graph of two-party channels
- inbound liquidity problem
- on-chain cost of channels



Introducing Ark

- new layer 2 protocol for Bitcoin
  - → interoperable with Lightning
- shared UTXO model: VTXOs
  - → exchanging VTXOs for new VTXOs

Covenants

- restriction on where the money in a UTXO can go
- can be emulated by pre-signed transactions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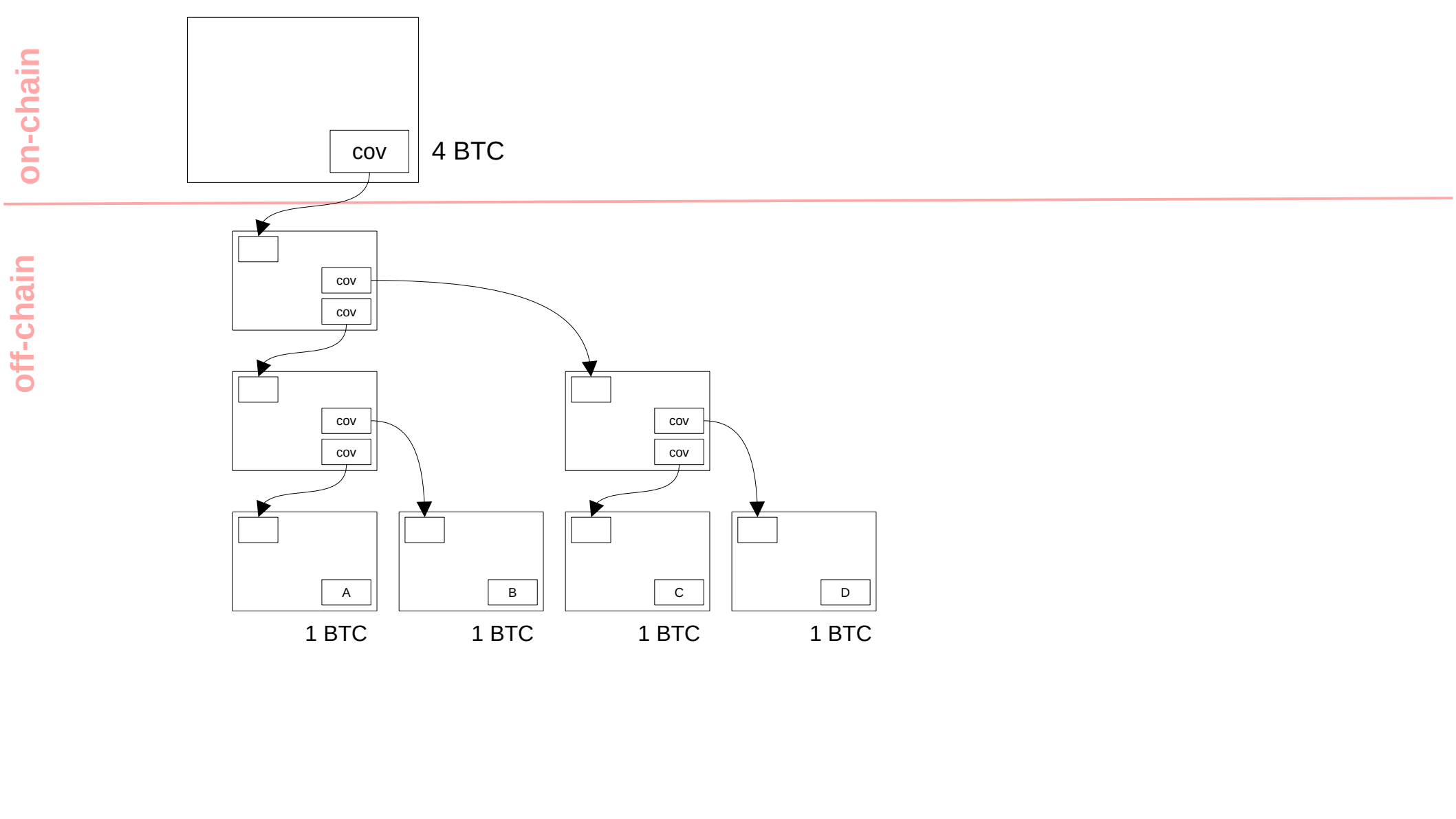
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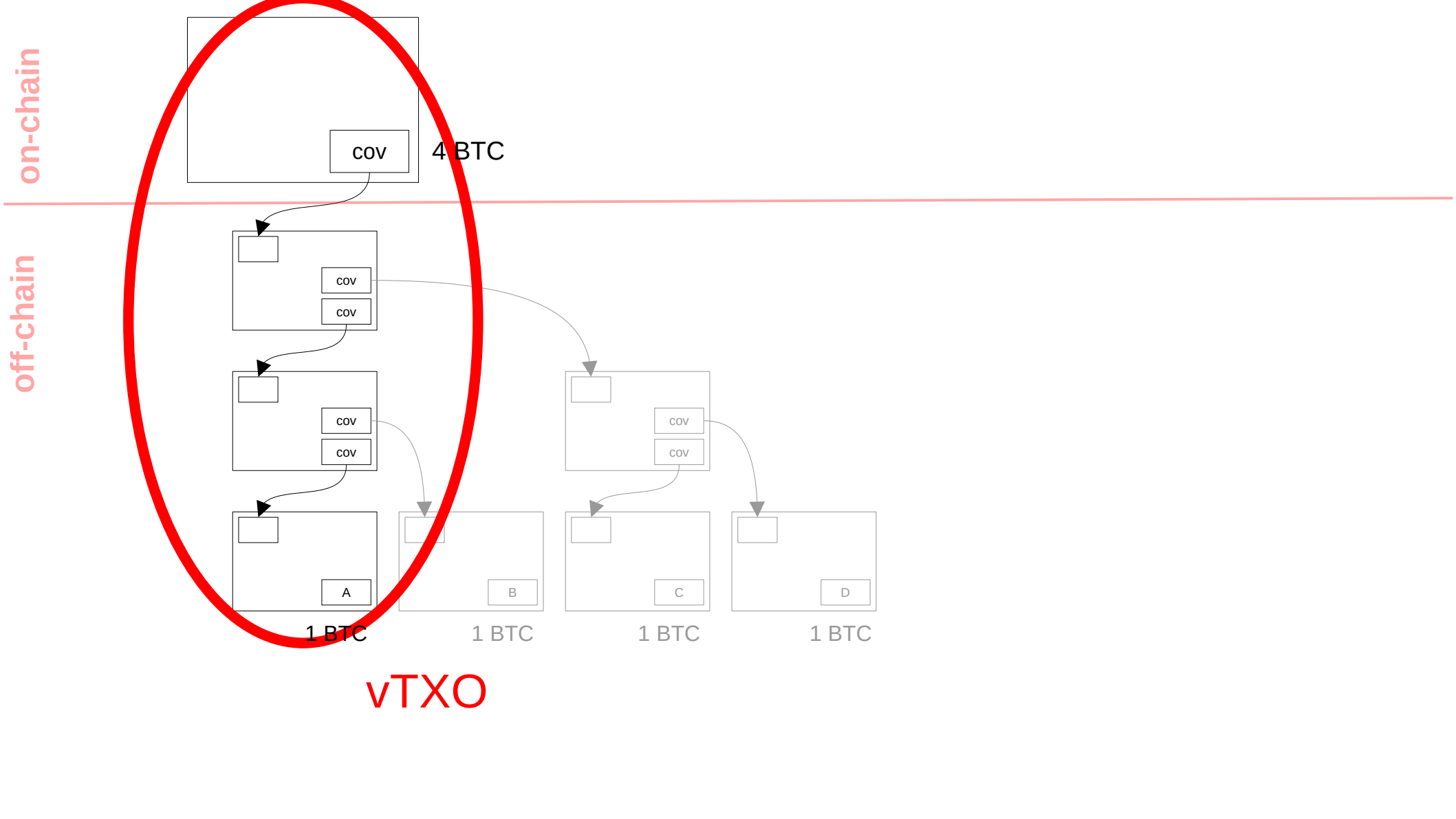
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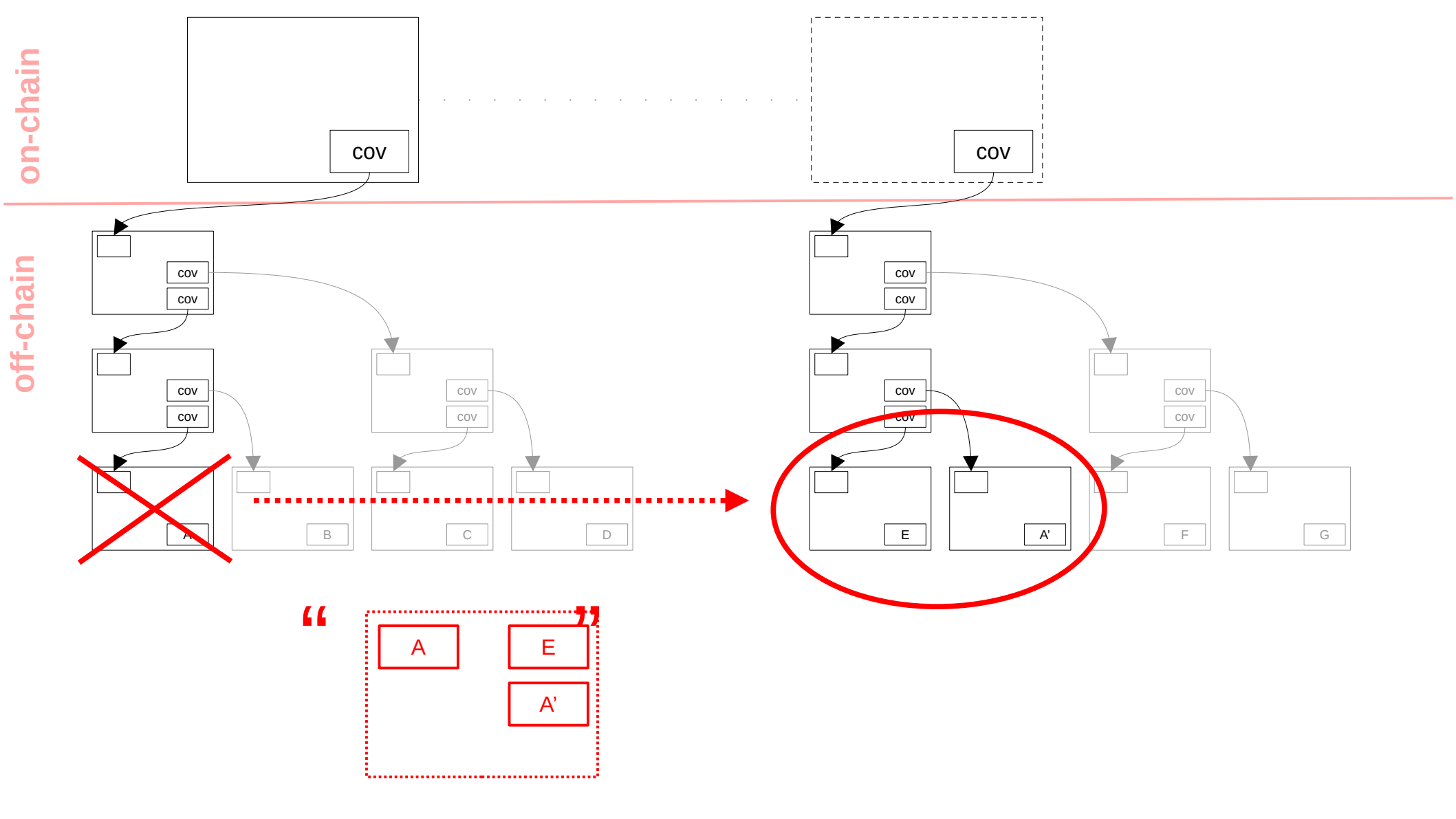
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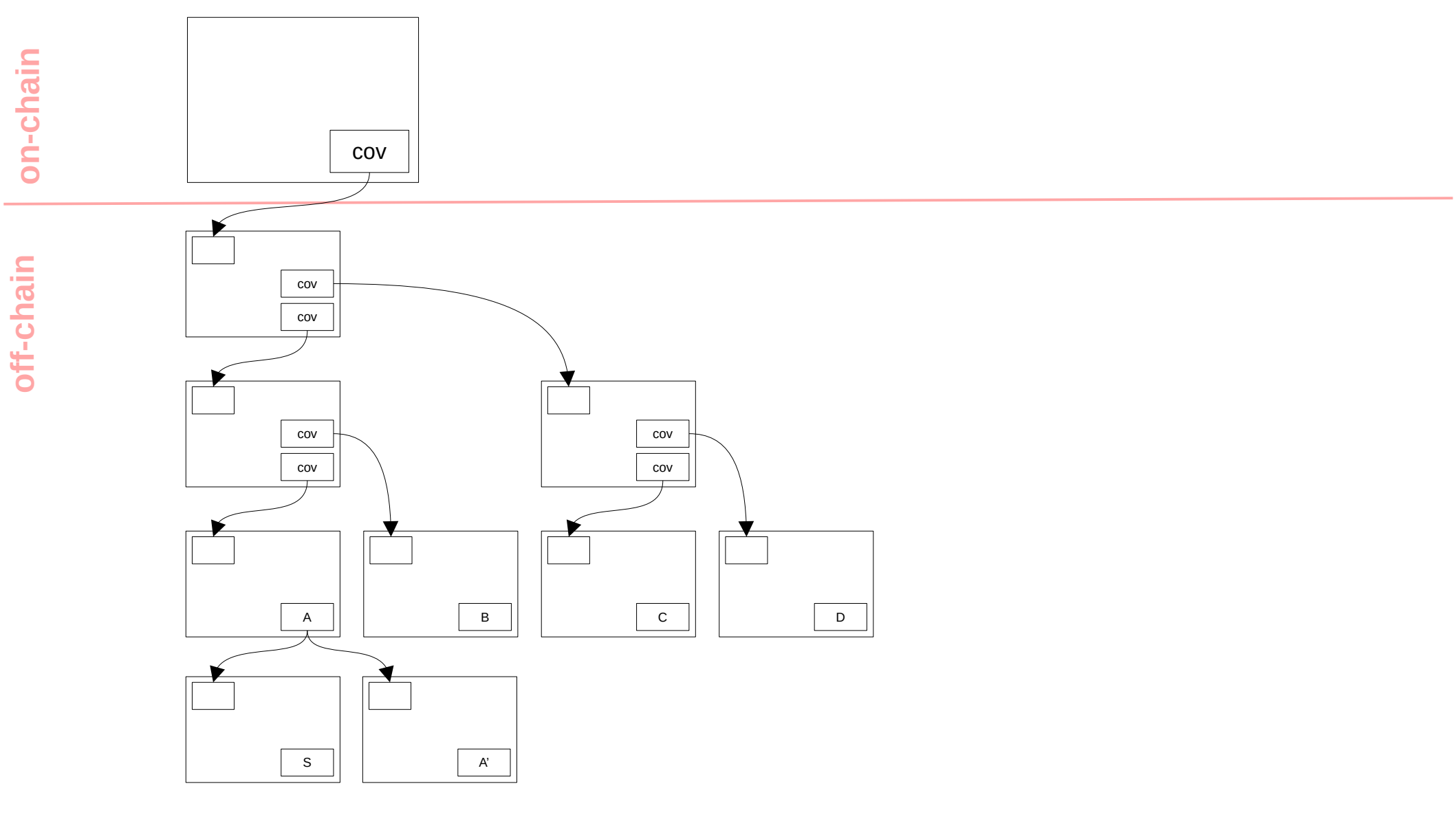
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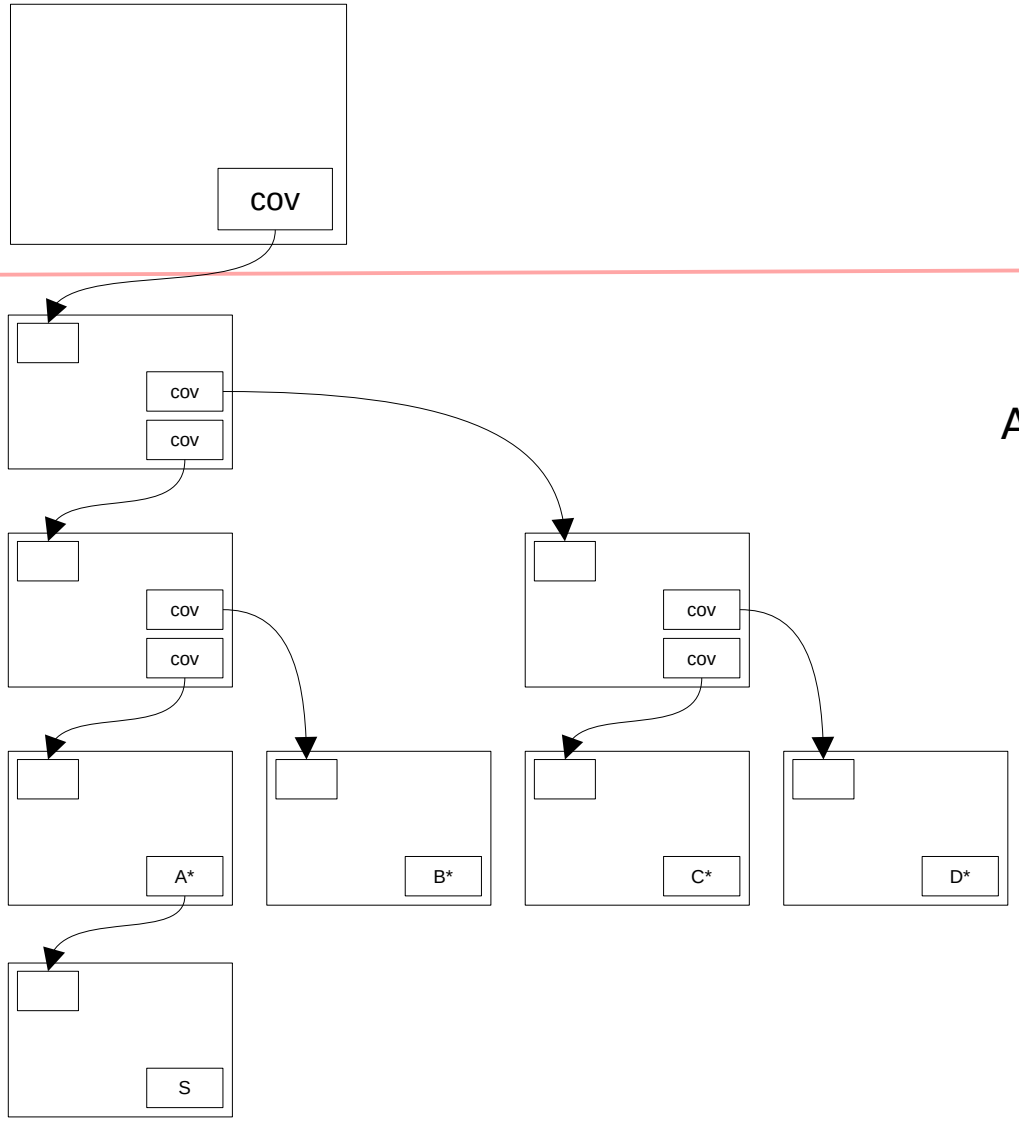

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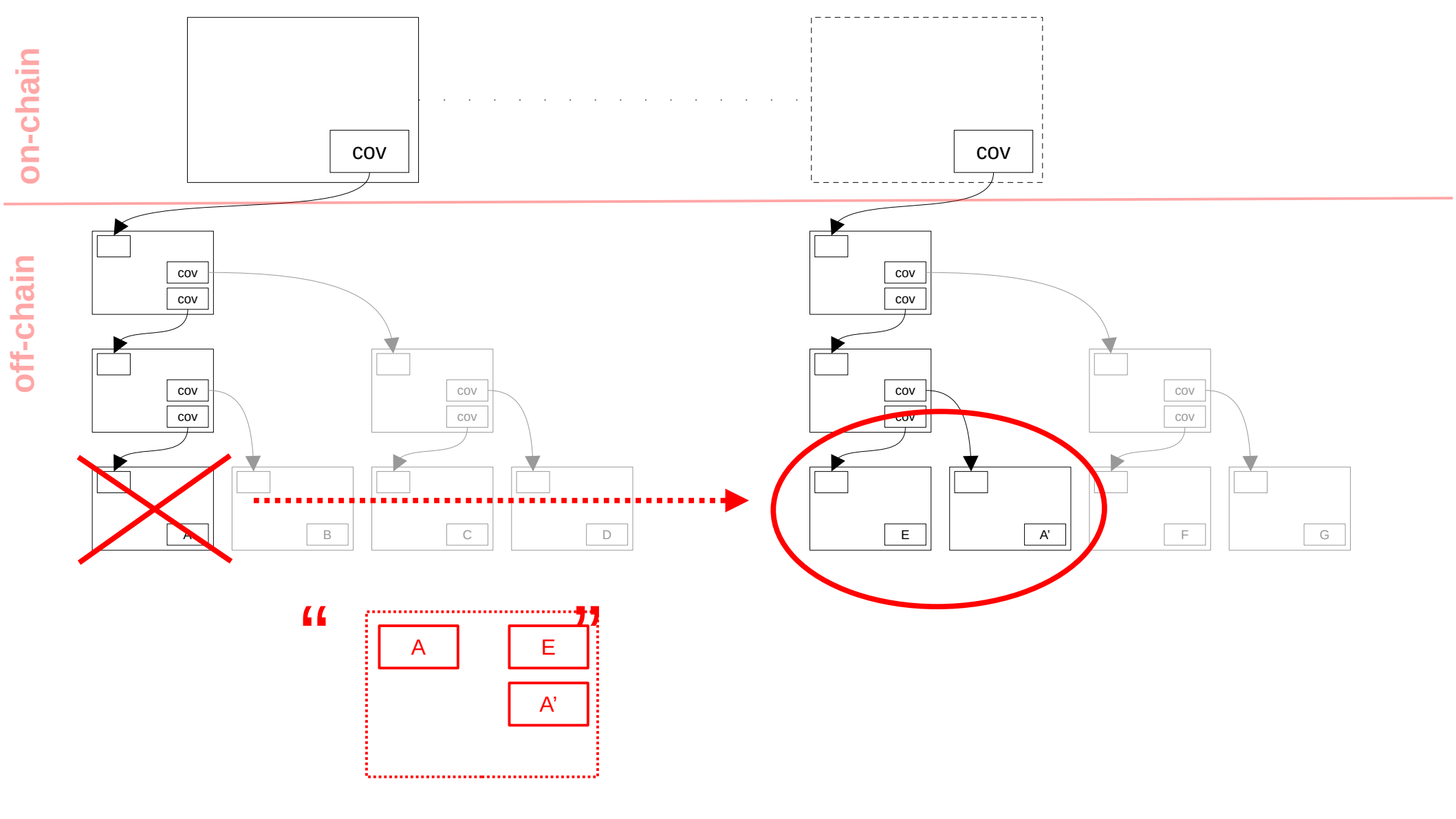
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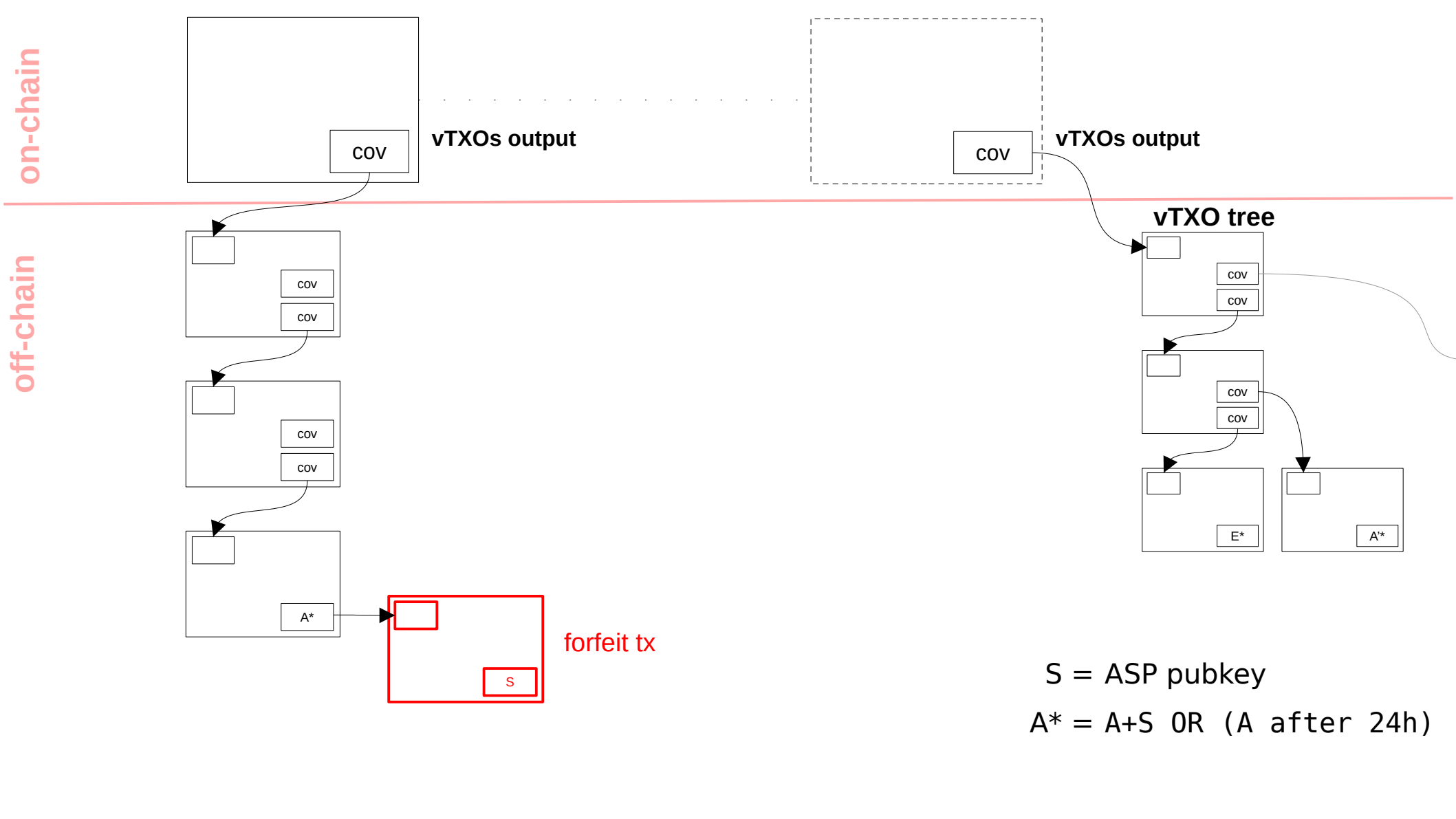
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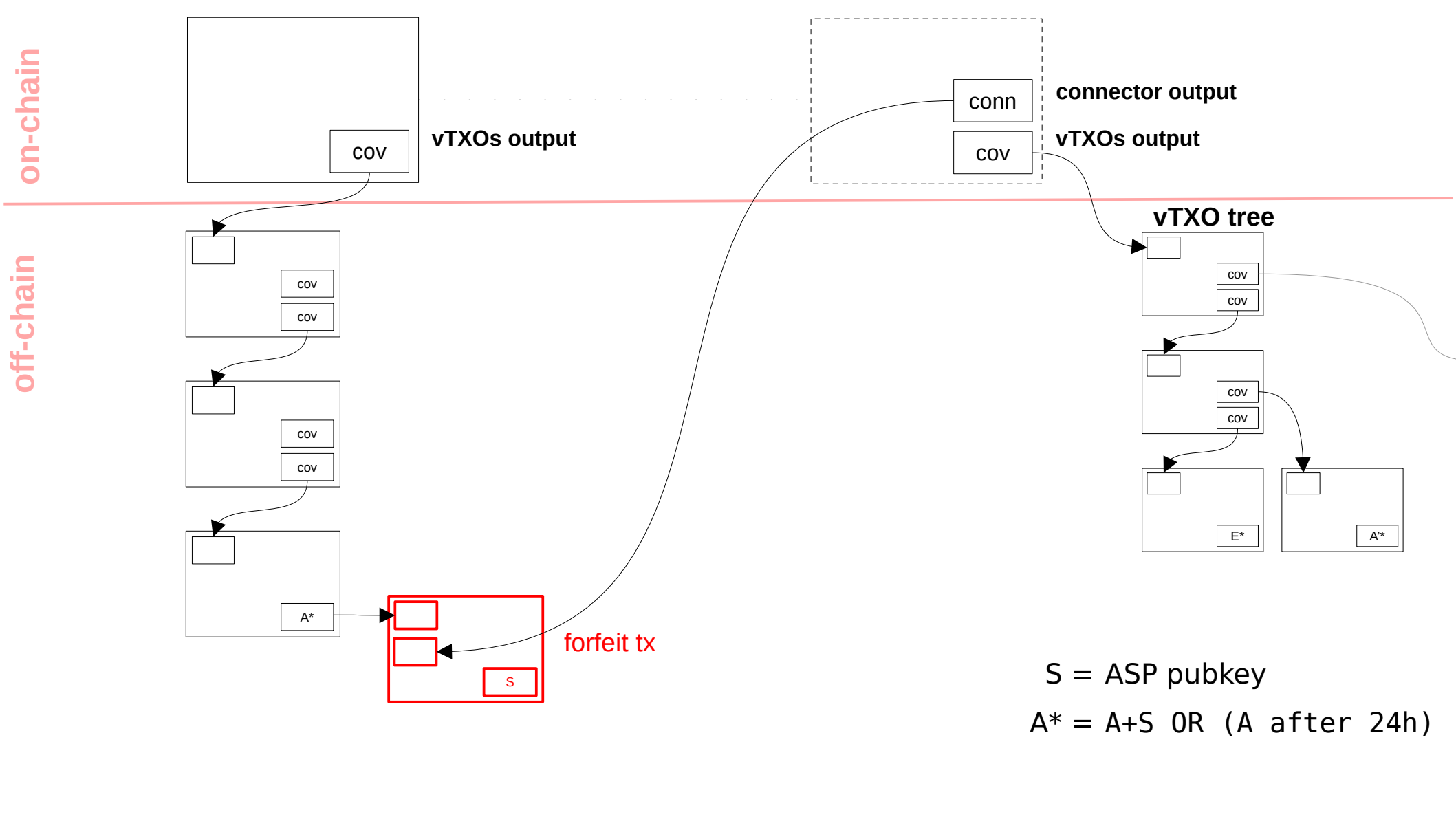
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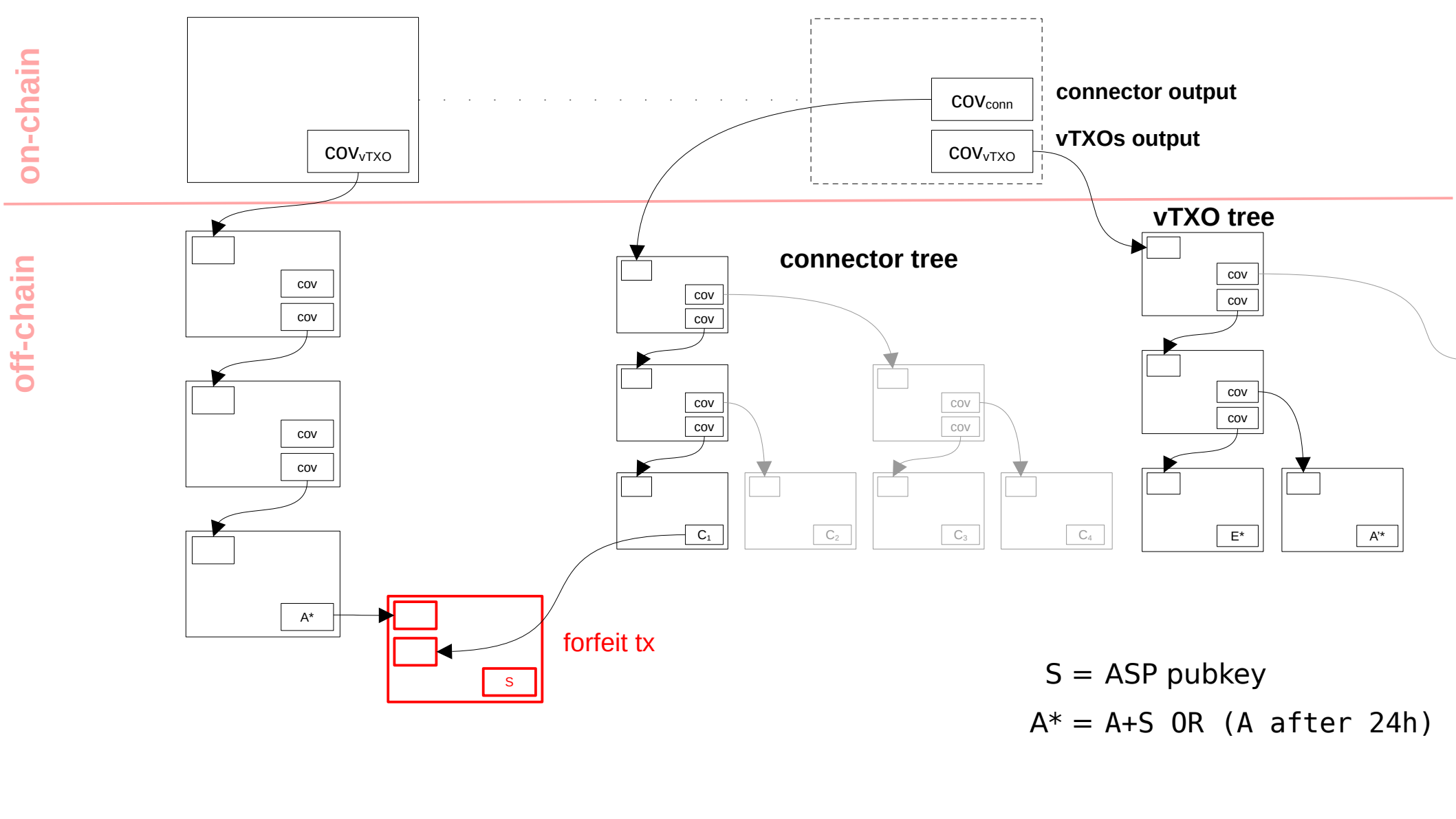
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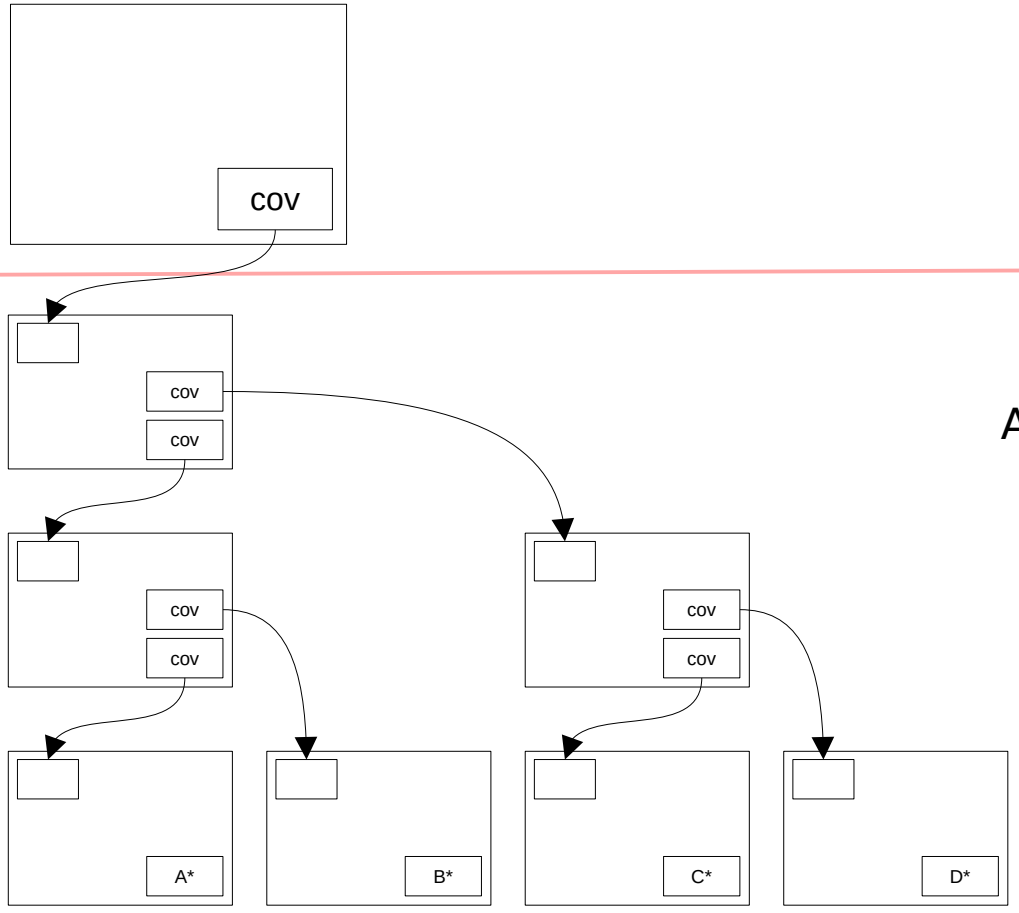
off-chain



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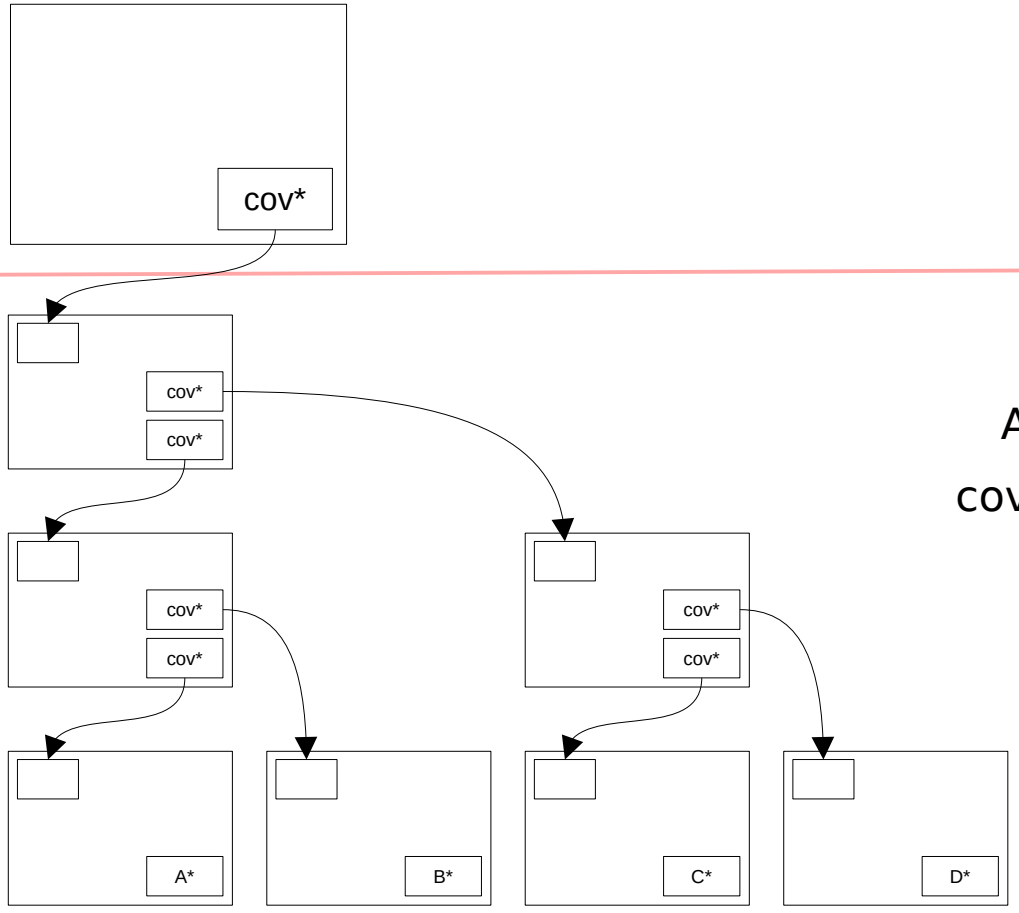

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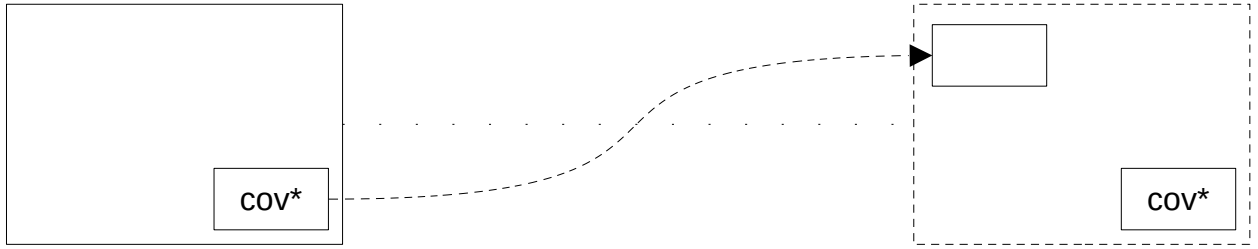

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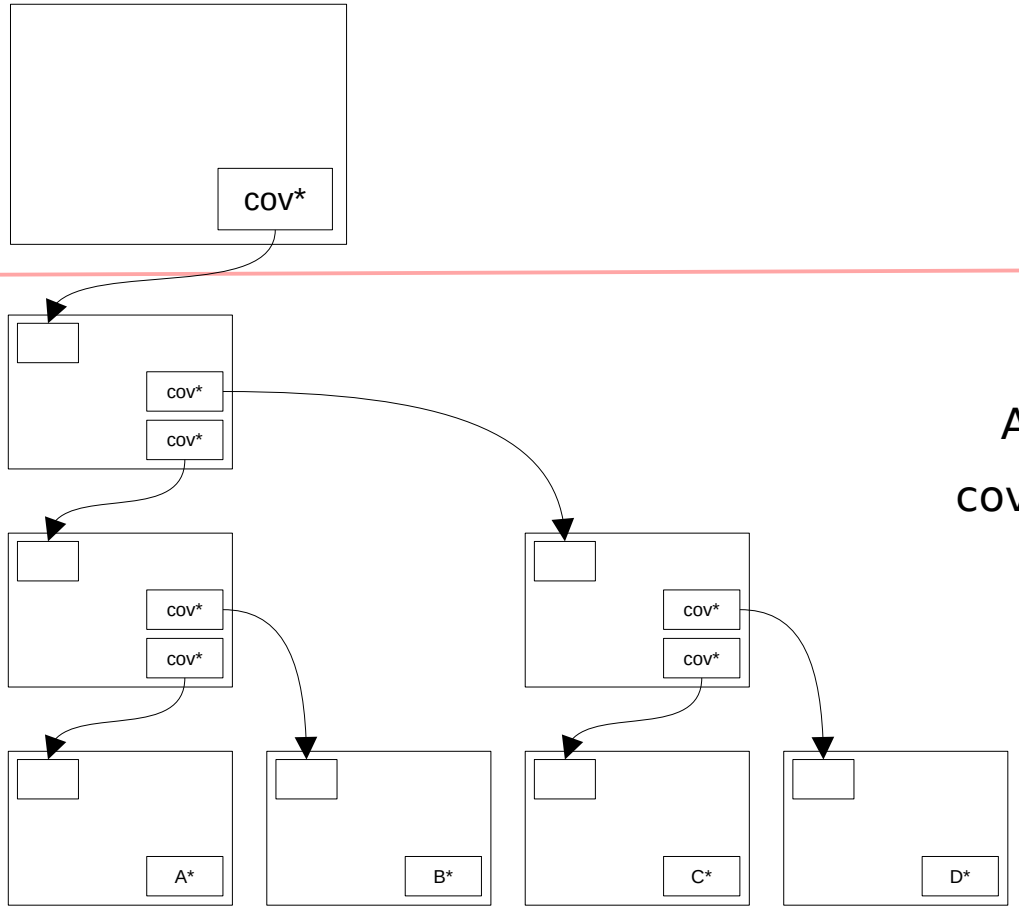

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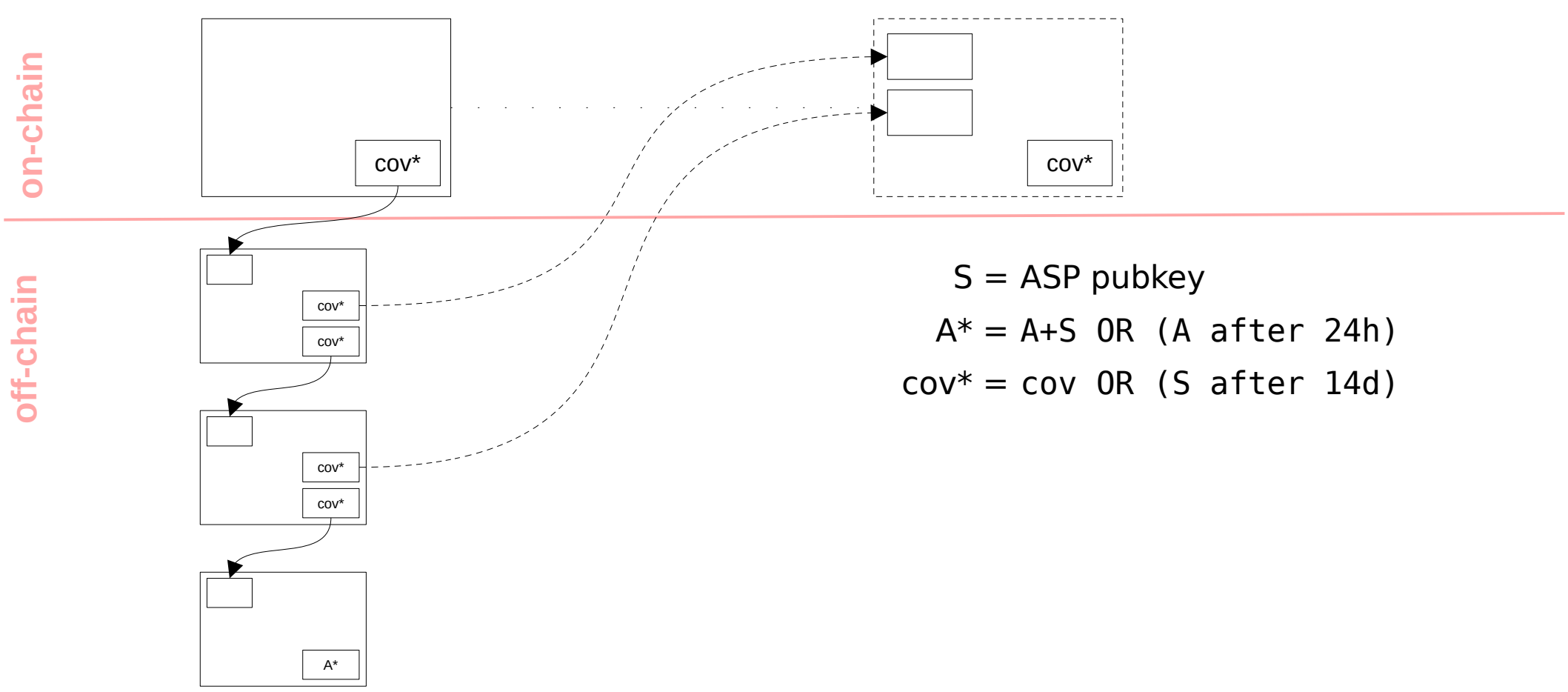

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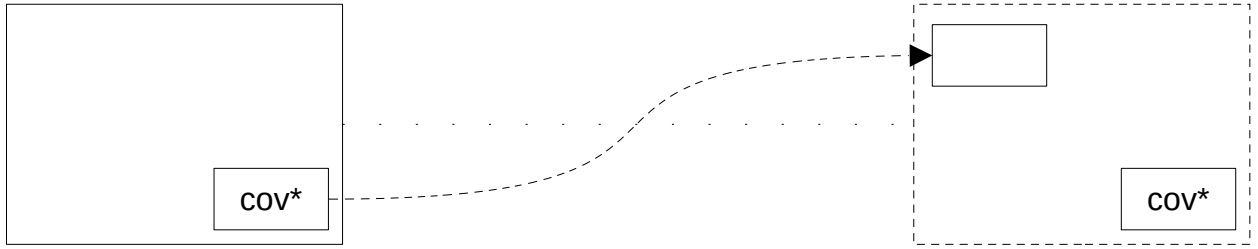

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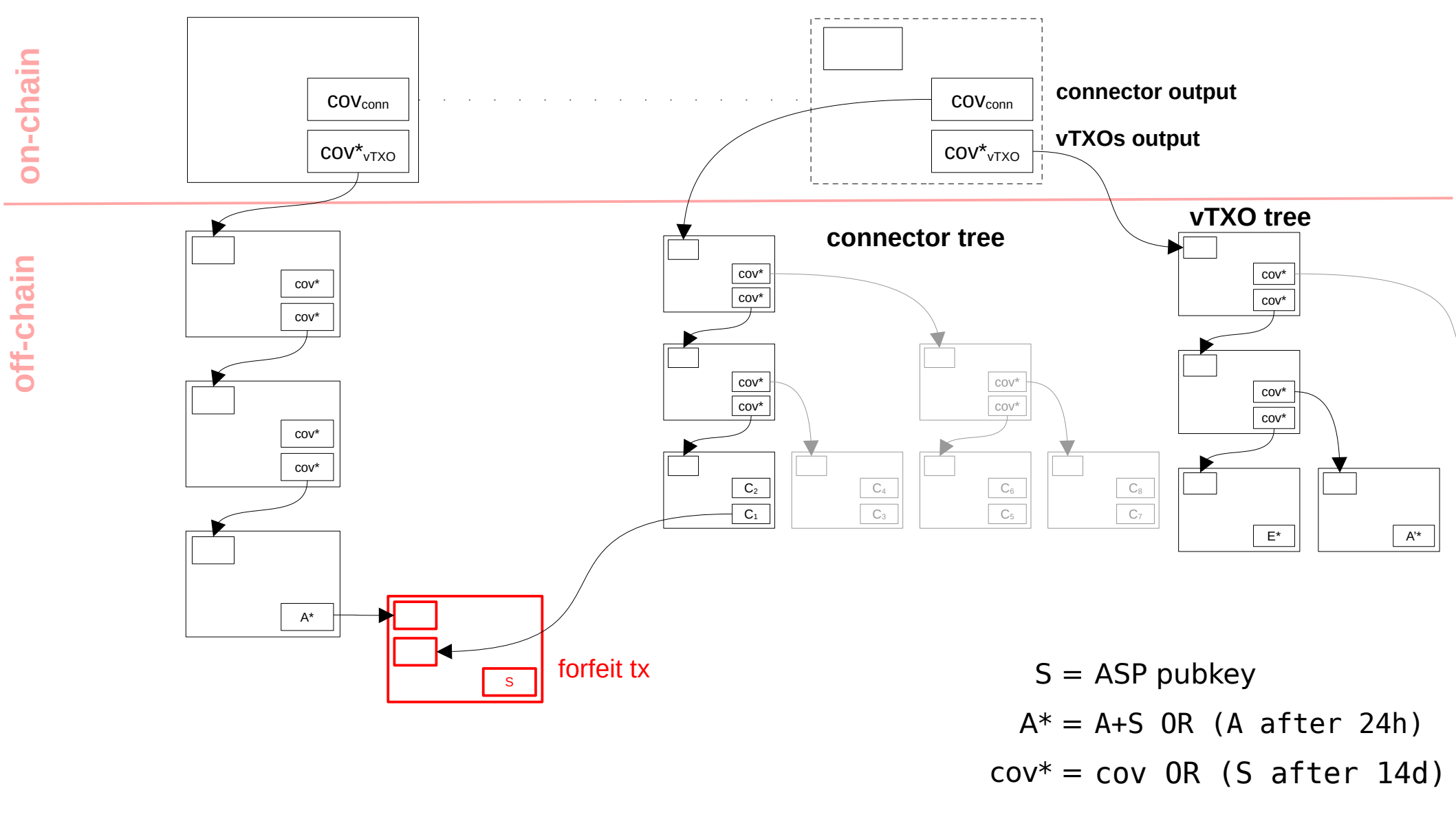
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forfeit tx
S = ASP pubkey
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What is (an) Ark?

- series of “Ark rounds”
  - → atomic spending VTXOs to create new ones
  - → one on-chain Bitcoin tx per round
- single service provider: “ASP”
  - → coordinates rounds & provides liquidity
  - → users always have unilateral exit

Why is this cool?

- UTXO-style off-chain txs

  → can make HTLCs for Lightning payments

- minimal on-chain footprint
- only client-server interactions

  → simpler than Lightning

- anyone can receive (no liquidity required!)

You said Lightning?

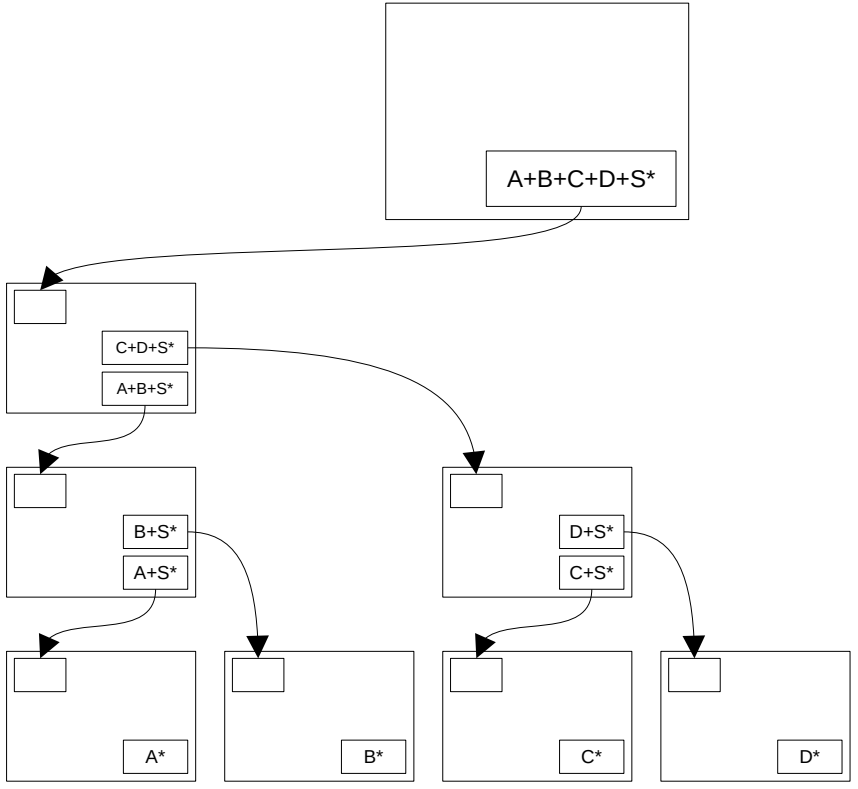
- make Lightning payments from Ark
  - → HTLC as VTXO
  - → ASP can function as LSP
- create Lightning channels inside Ark
  - → channel factory”: commitment VTXOs
  - → cheap channels with expiry

But what about?

- covenants
- liquidity requirement of ASP
- unilateral exit cost

clArk: covenant-less Ark

- pre-signed txs instead of covenants
  - → all receivers co-sign with ASP
  - → requires receivers online



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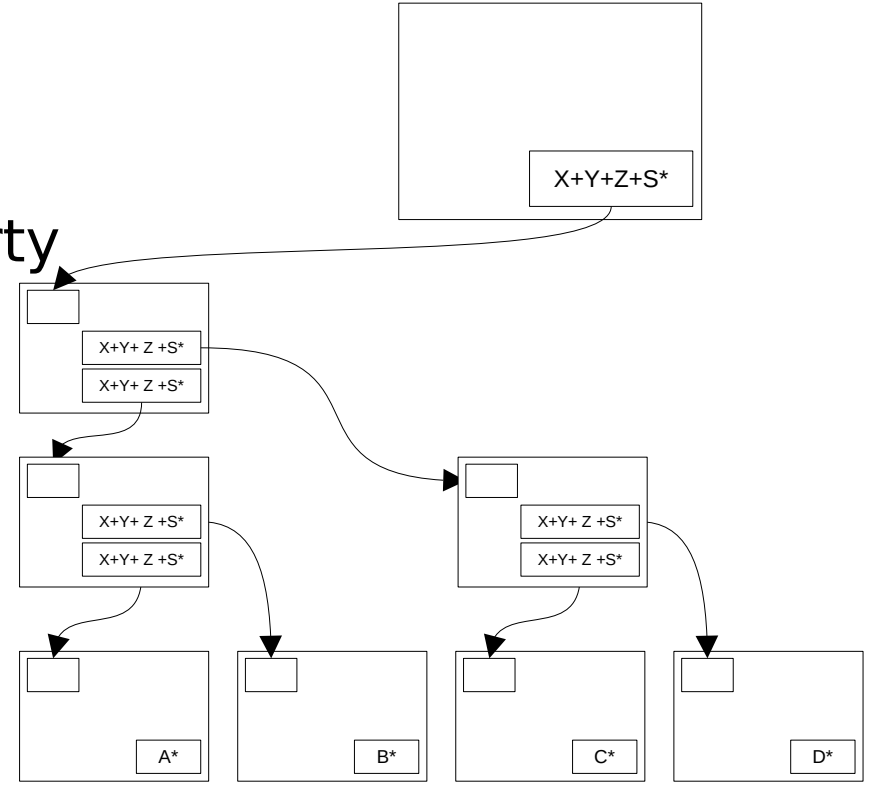
A+B+S* = A+B+S OR (S after 14d)

A* = A+S OR (A after 24h)

clArk: covenant-less Ark

- pre-signed txs instead of covenants
  - → all senders co-sign with ASP
  - → senders are already online
- secure as long as single honest party (N-of-N)
- possible on Bitcoin today



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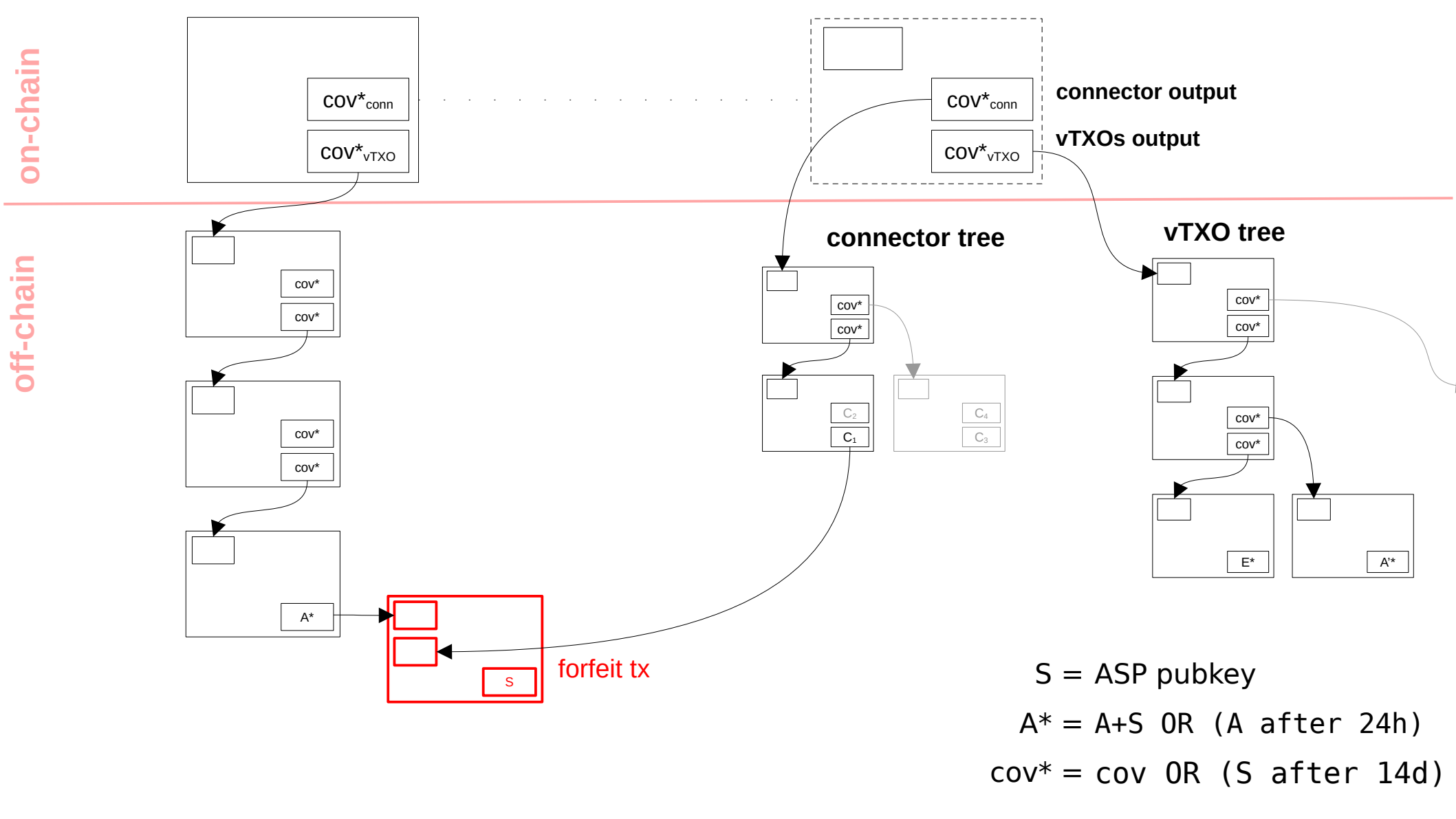
Liquidity

- function of user activity, not deposits
- when a VTXO gets spent, ASP provides liquidity for the value of the VTXO until it expires
- incentivize users to spend VTXOs closest to expiring

Out-of-Round Payments

- liquidity needed to spend in round
- we can send a VTXO directly
  → without participating in round
- “Somsen Shortcut”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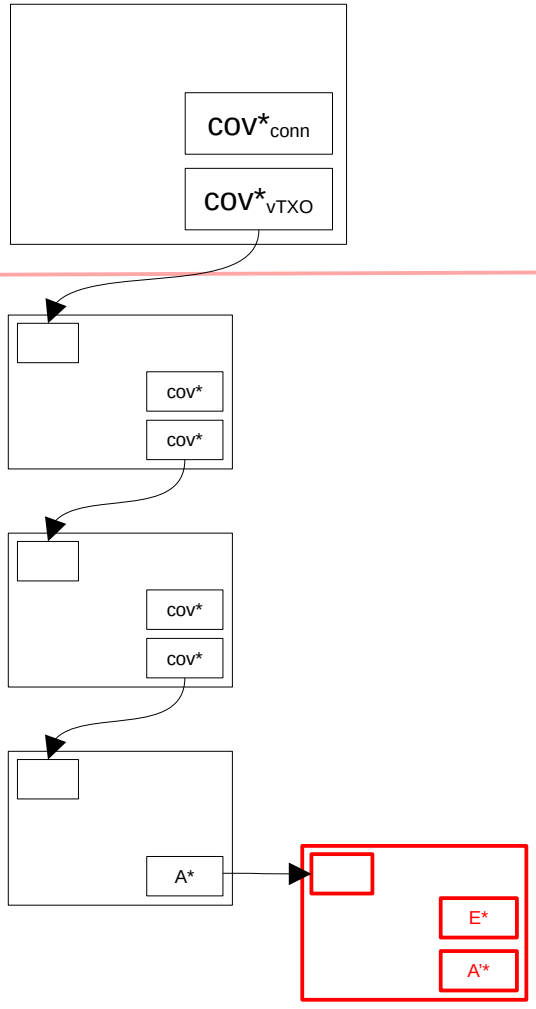

OOR tx

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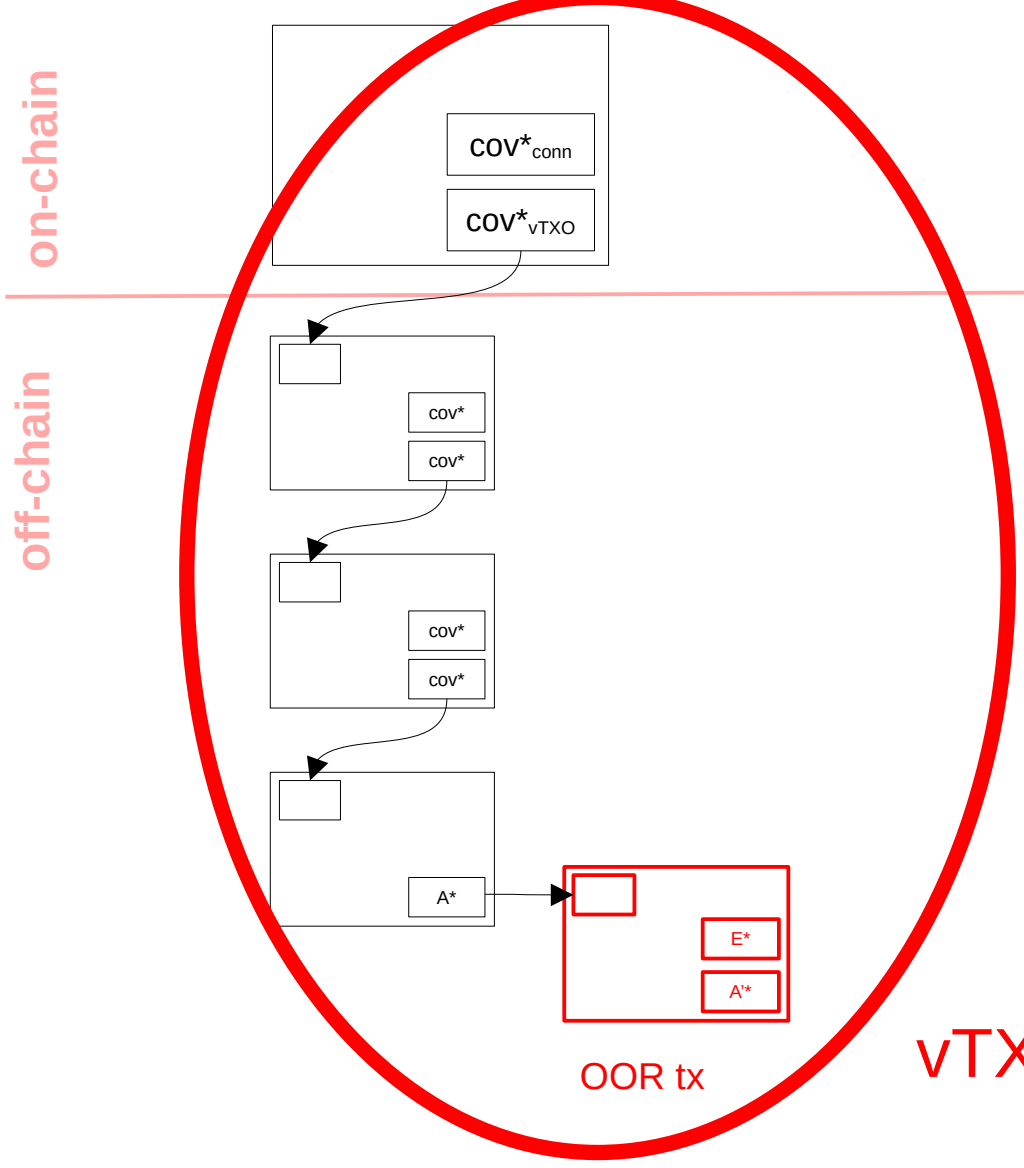

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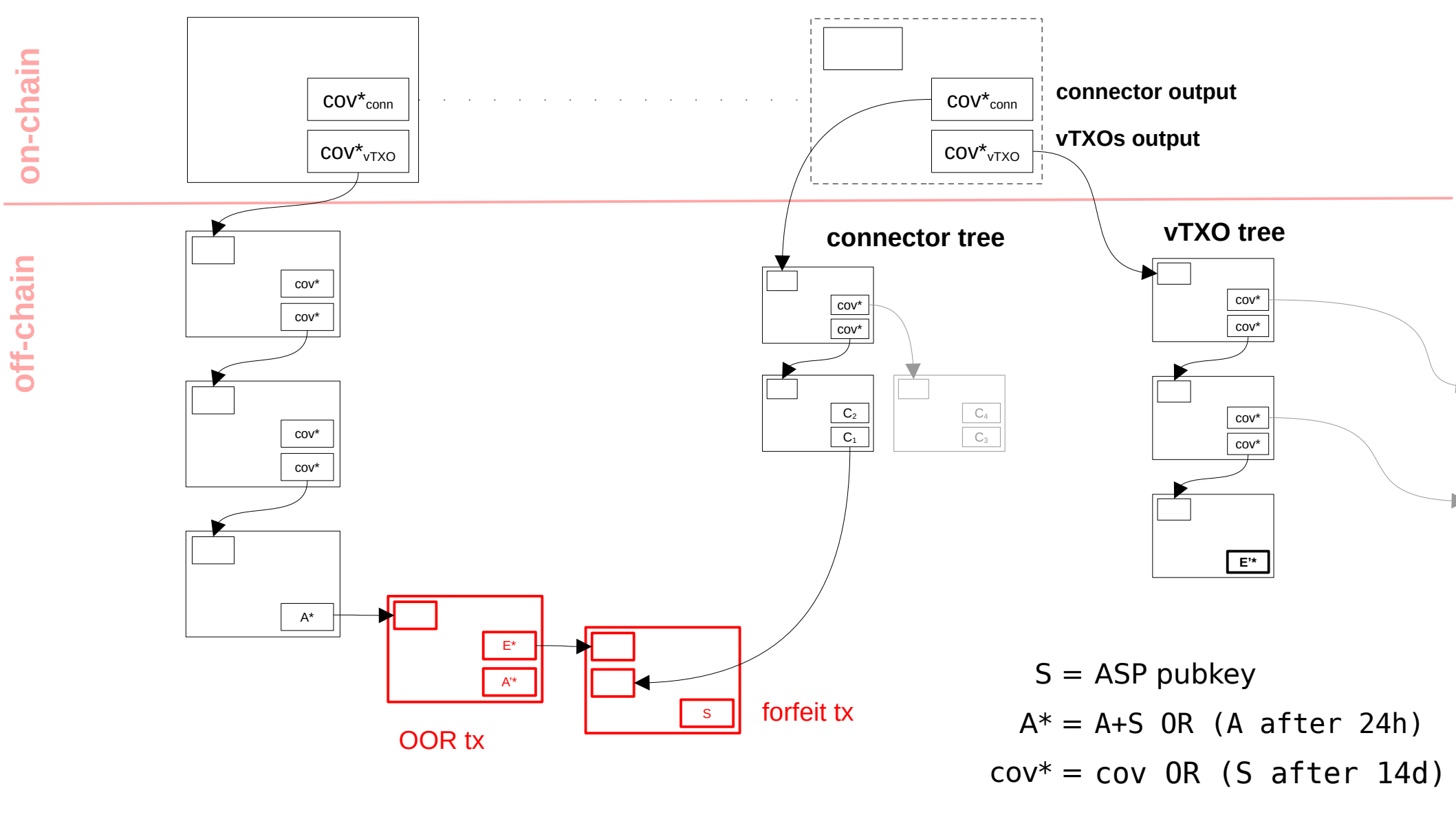
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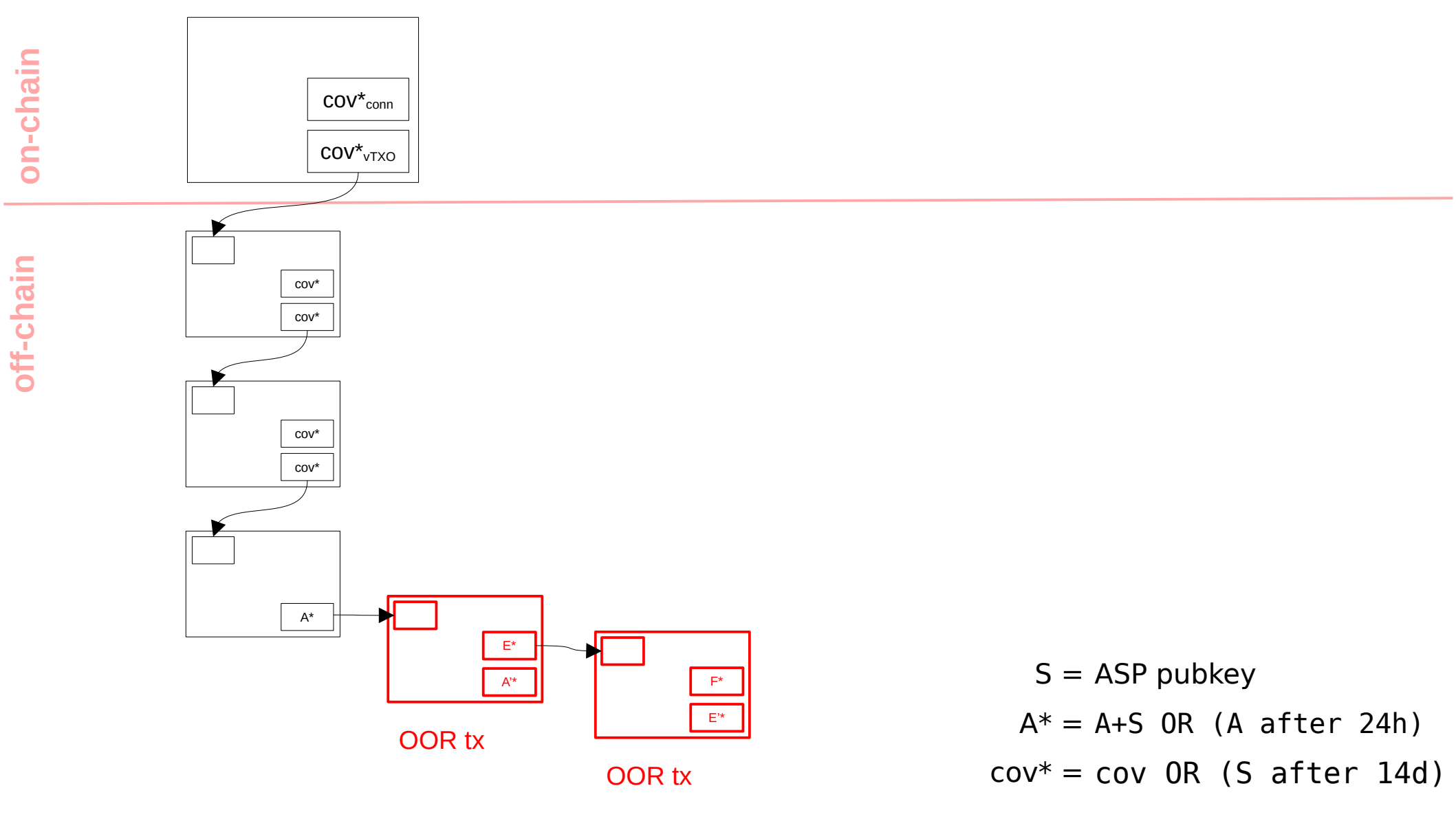
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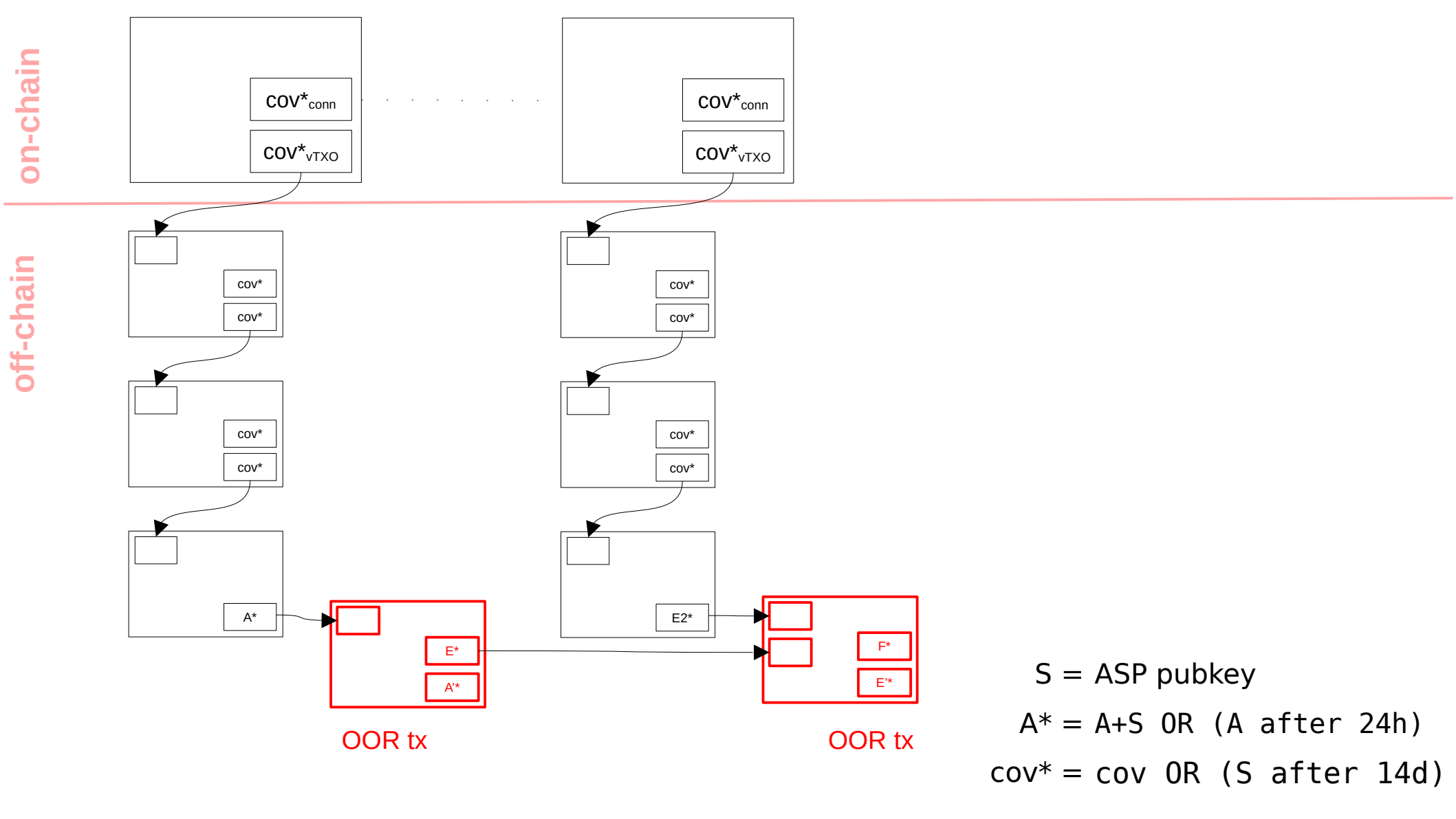
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OOR tx
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Arkoor

- instant VTXO txs
- super cheap
  - → no liquidity fee
- opt-out of by cycling in next round
- save liquidity fee by holding OORs
- in cycles, senders == receivers → clArk++

Unilateral Exit

- ASP disappears → mass exit
  - → larger VTXO holders carry the cost for smaller
- ASP censors specific VTXOs
  - → unilateral exit
  - → cost can easily exceed value of VTXO
- watchtowers can oversee ASP behavior

State of the Ark

- impl of clArk on Bitcoin using MuSig2
- impl on Liquid using covenants

Thanks

- https://roose.io/presentations
- https://ark-protocol.org/
- Questions?