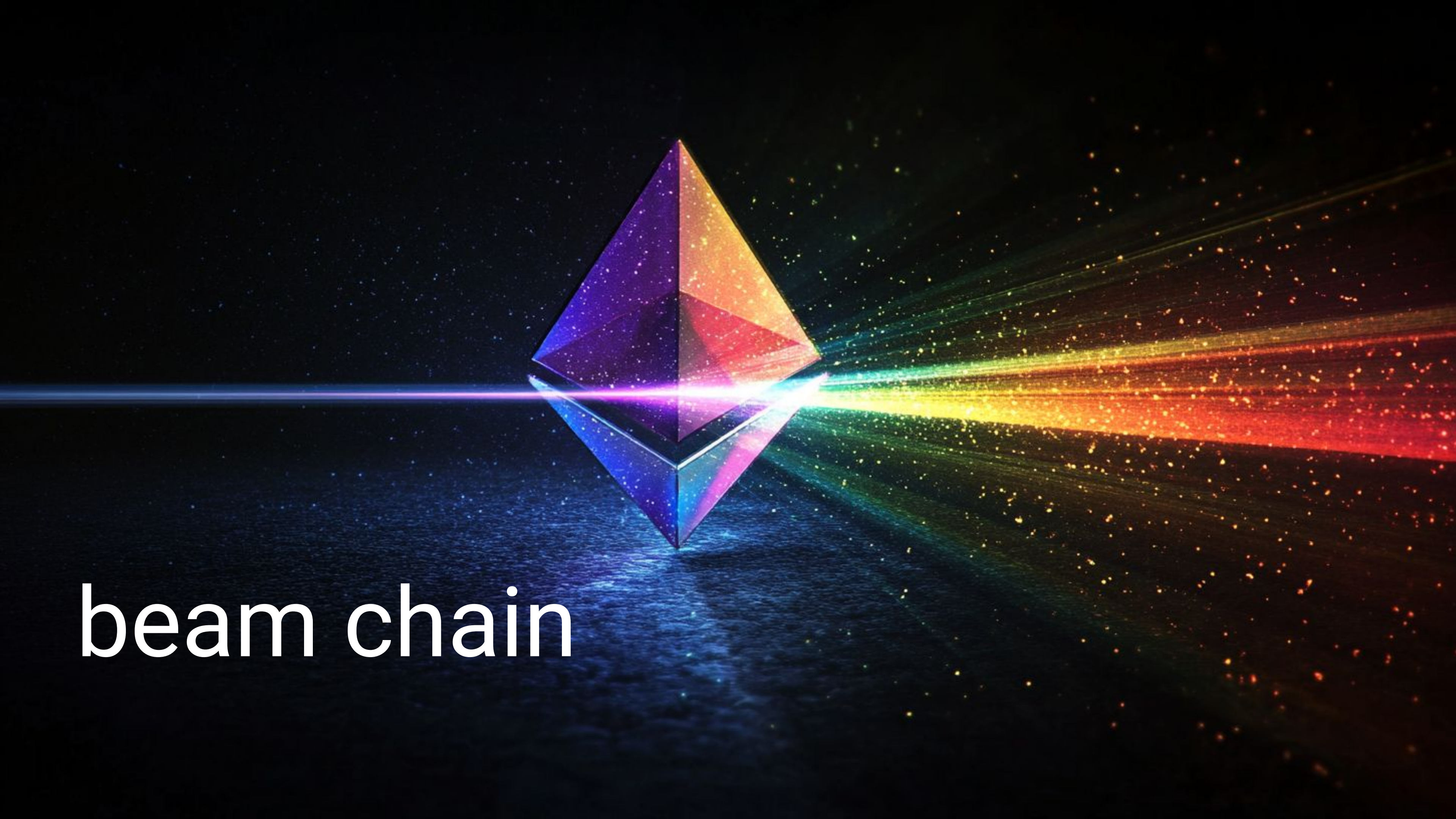
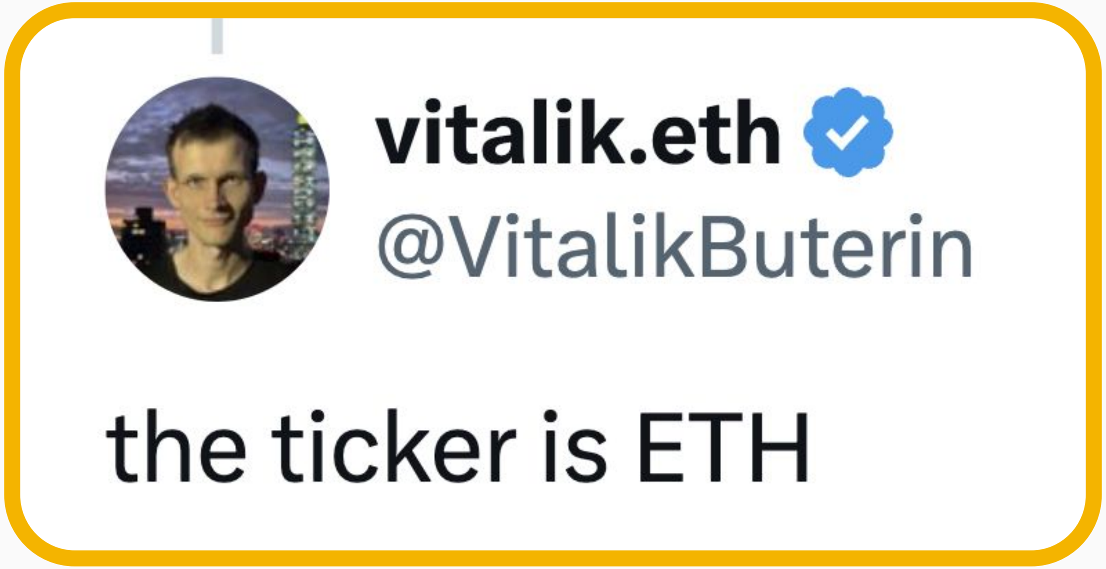
[redacted]



beam chain

disclaimer #1—a proposal

disclaimer #2—same ticker


vitalik.eth
@VitalikButerin

the ticker is ETH

part 1—vision

part 2—tech

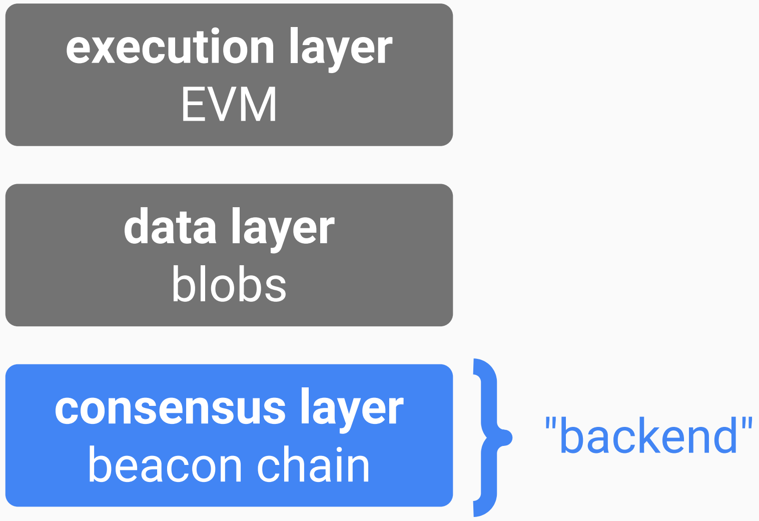
part 3—plan

part 1—vision

part 2—tech

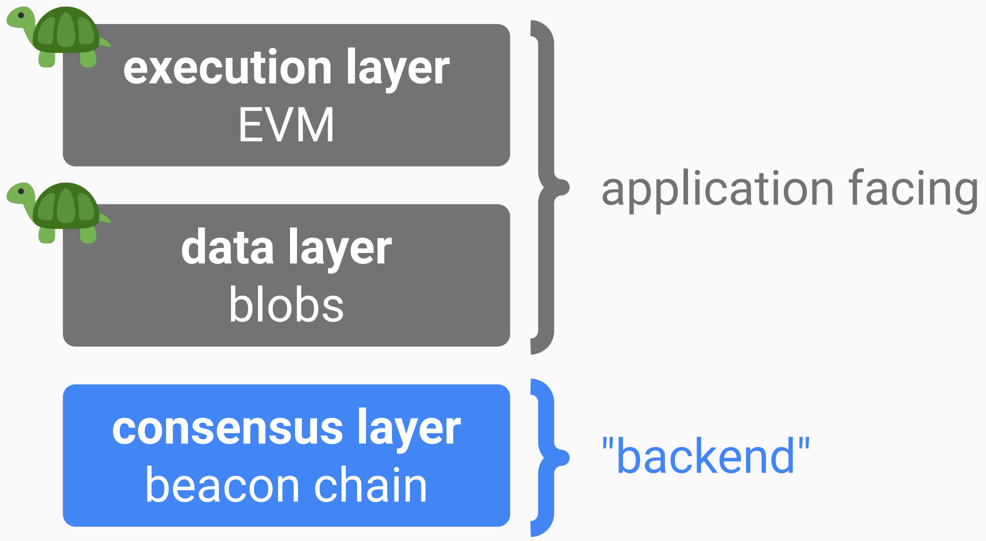
part 3—plan

scope



execution layer
EVM
data layer
blobs
consensus layer
beacon chain
"backend"

scope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EVM
data layer
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consensus layer
beacon chain
application facing
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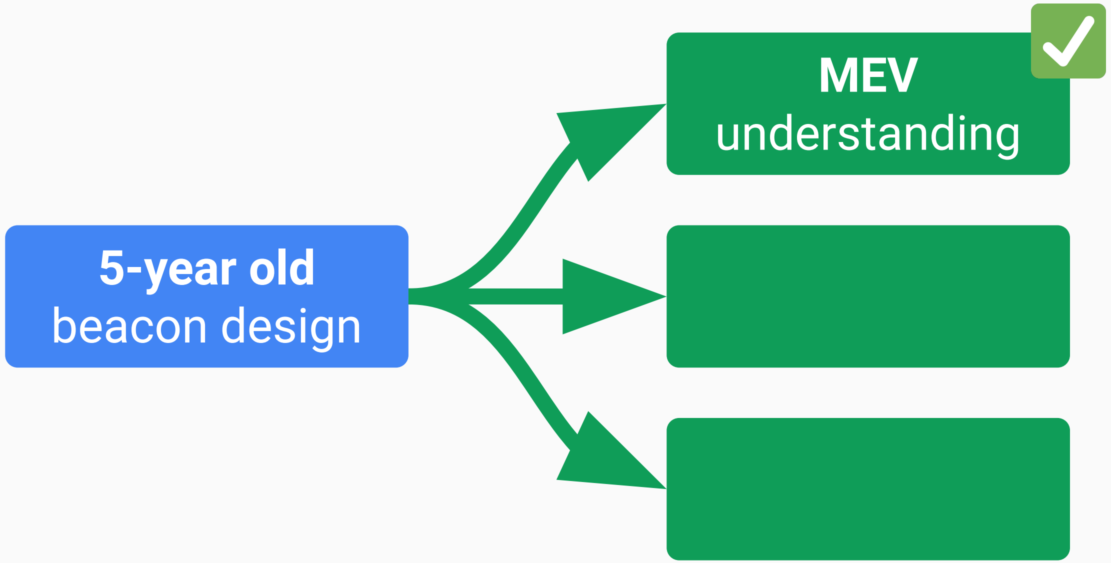
why now?



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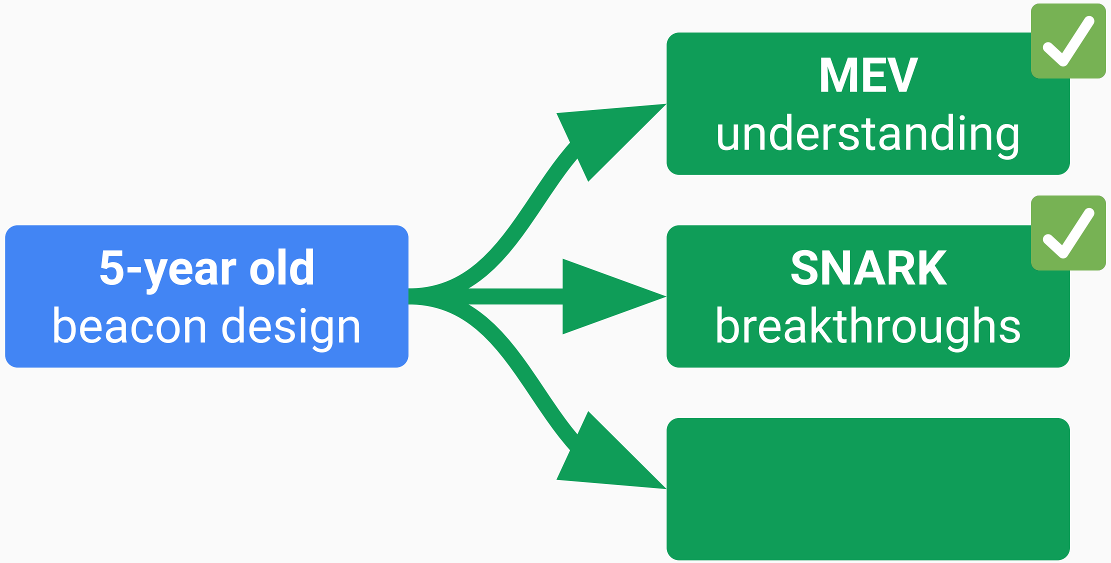
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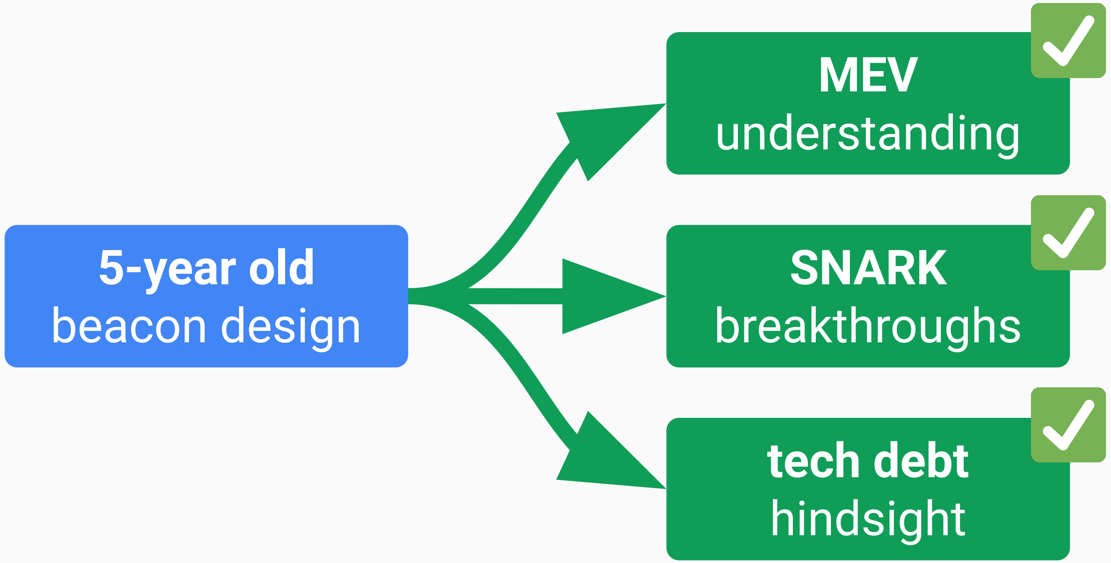
beacon design
MEV
understanding
✓
SNARK
breakthroughs
✓

why now?


5-year old beacon design
MEV understanding ✓
SNARK breakthroughs ✓
tech debt hindsight ✓

consensus layer roadmap

block production

P0

censorship resistance
e.g. FOCIL

🌶️ **P1**

isolated validators
e.g. execution auctions

P2

faster slots
e.g. 4 seconds

staking

cryptography

consensus layer roadmap

block production

P0
censorship resistance
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staking

P0
smarter issuance
e.g. stake cap

P1
smaller validators
e.g. 1 ETH Orbit staking

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faster finality
e.g. 3-slot FFG

cryptography

consensus layer roadmap

block production

- 🟩 **P0** **censorship resistance** e.g. FOCIL
- 🟩 🌶️ **P1** **isolated validators** e.g. execution auctions
- 🟥 **P2** **faster slots** e.g. 4 seconds

staking

- 🟩 🌶️ **P0** **smarter issuance** e.g. stake cap
- 🟩 **P1** **smaller validators** e.g. 1 ETH Orbit staking
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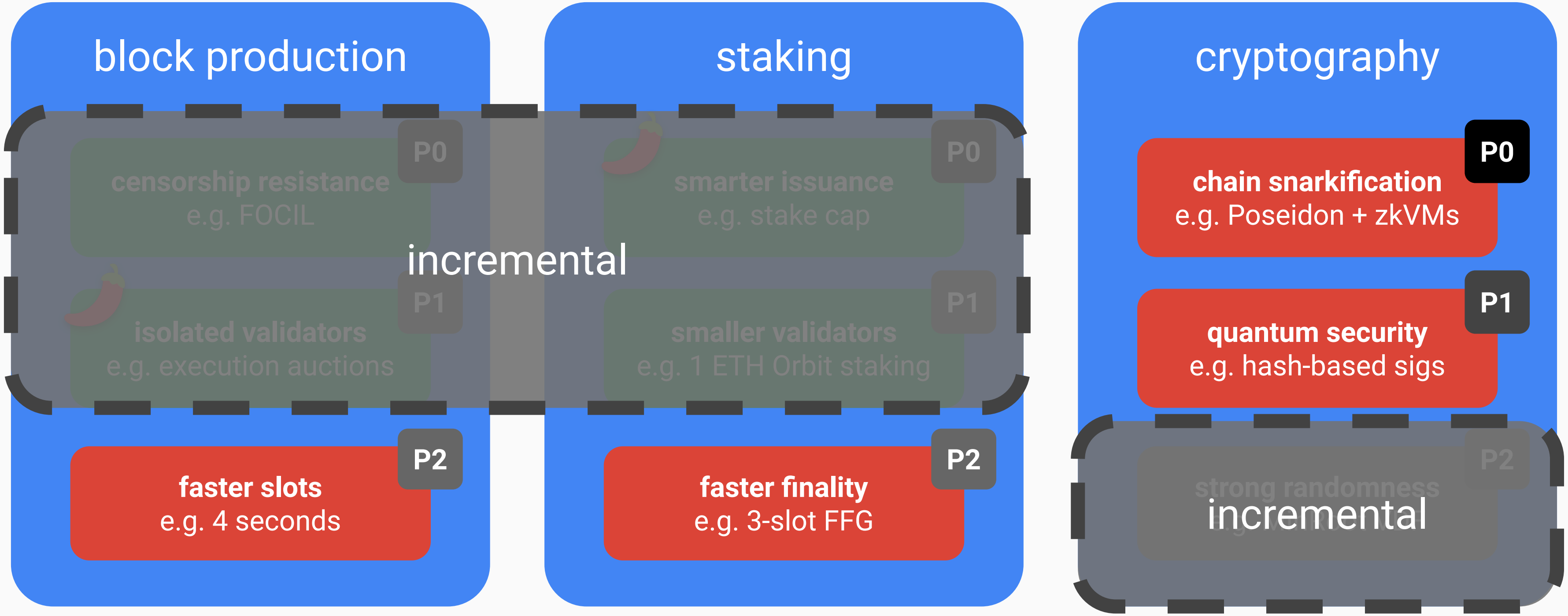
cryptography

- 🟥 **P0** **chain snarkification** e.g. Poseidon + zkVMs
- 🟥 **P1** **quantum security** e.g. hash-based sigs
- ⬜ **P2** **strong randomness** e.g. MinRoot VDF

consensus layer roadmap



Vitalik's roadmap (Dec 2023)

block production

P0 **censorship resistance**
e.g. FOCIL

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e.g. execution auctions

P2 **faster slots**
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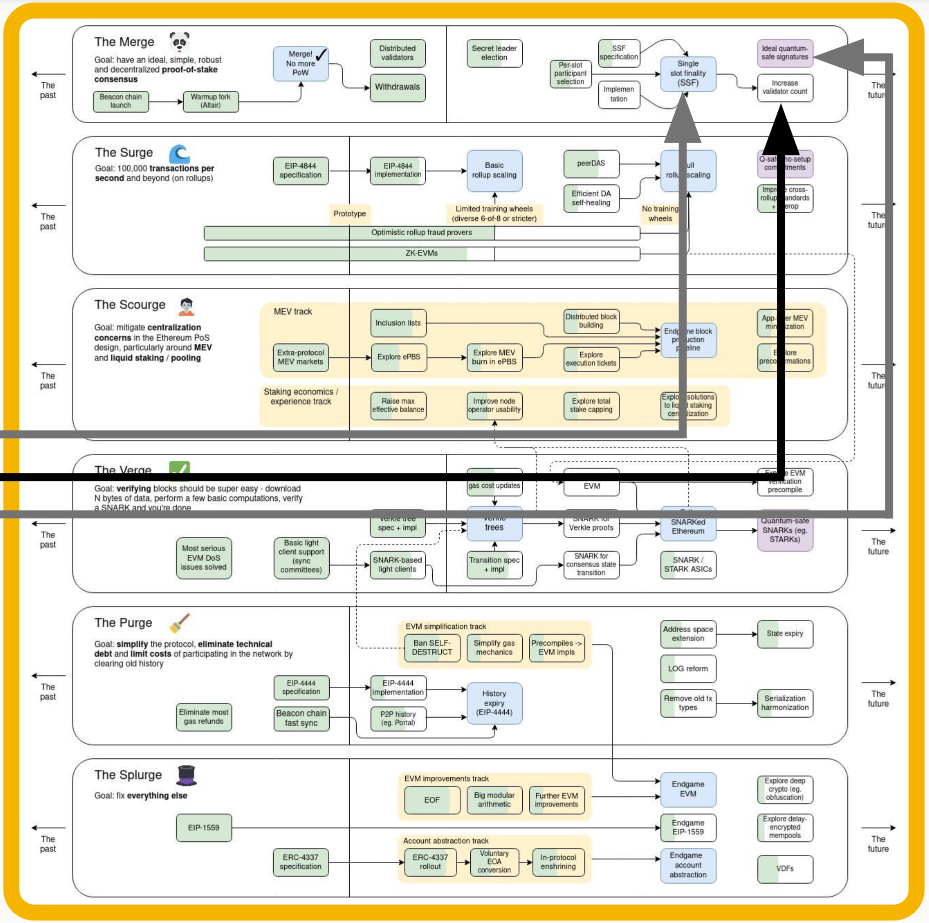

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Beacon chain launch
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Merge! No more PoW
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ZK-EVMs
The Scourge
Goal: mitigate centralization concerns in the Ethereum PoS design, particularly around MEV and liquid staking / pooling
MEV track
Inclusion lists
Distributed block building
Endgame block production pipeline
App-layer MEV minimization
Extra-protocol MEV markets
Explore ePBS
Explore MEV burn in ePBS
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In-protocol enshrining
Endgame account abstraction
VDFs
The past
The future

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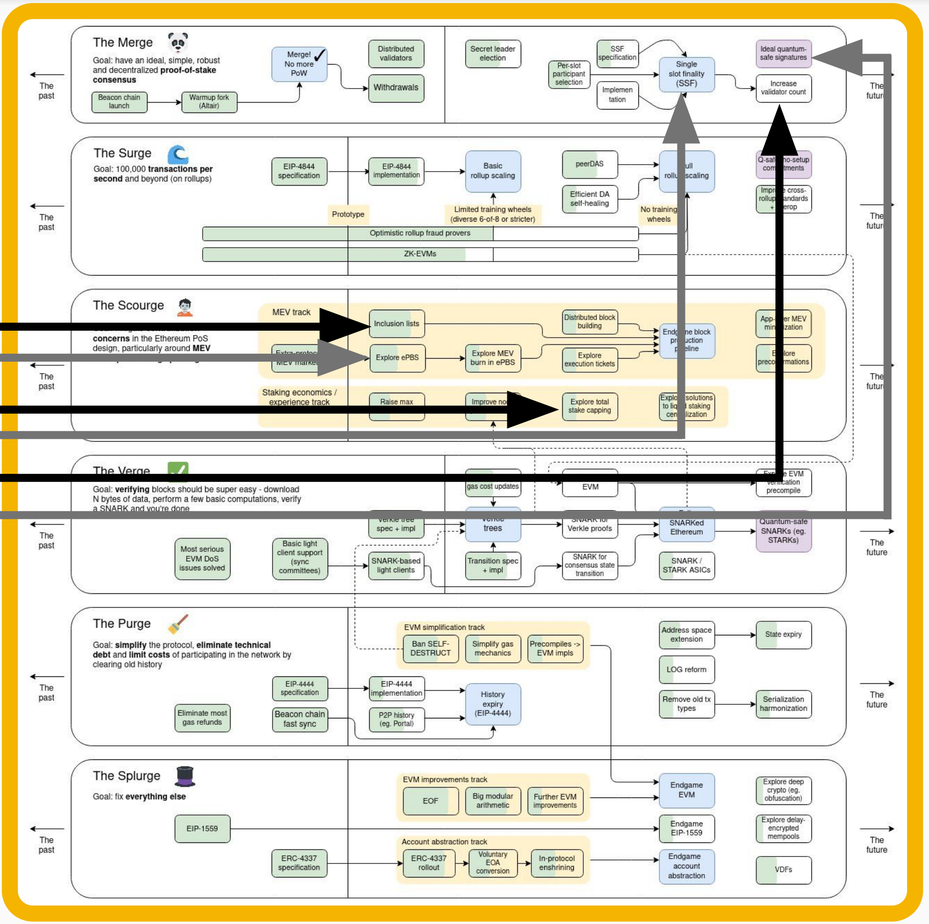
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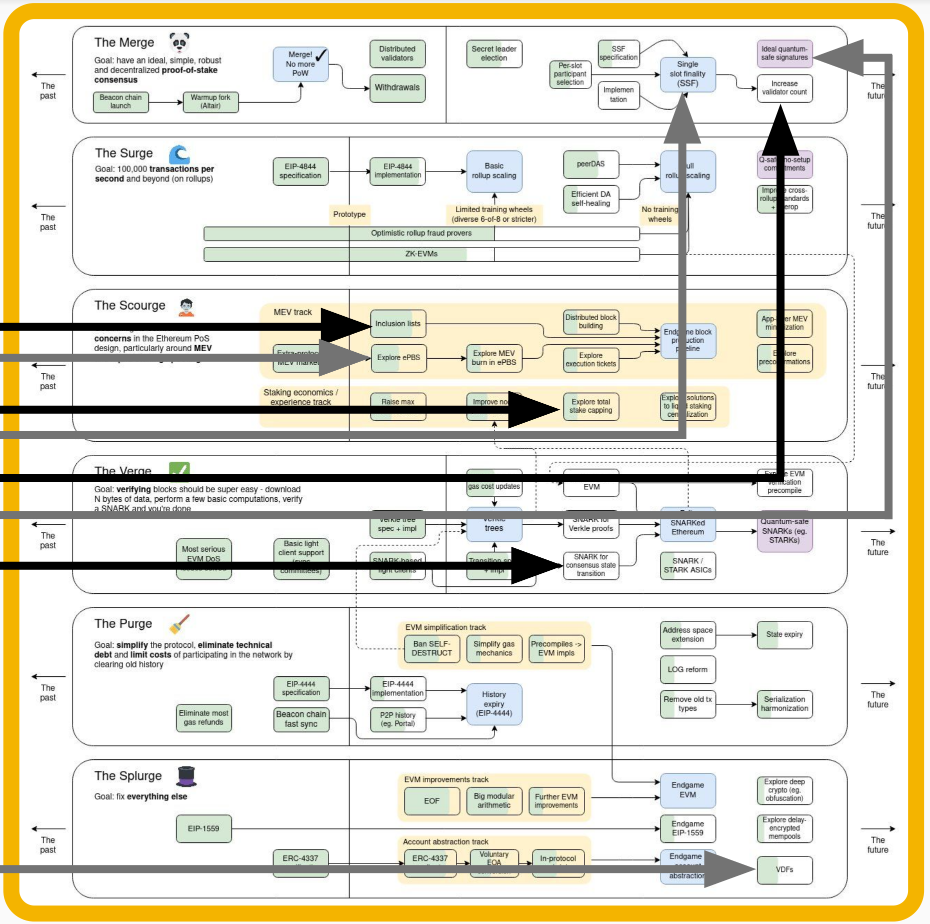

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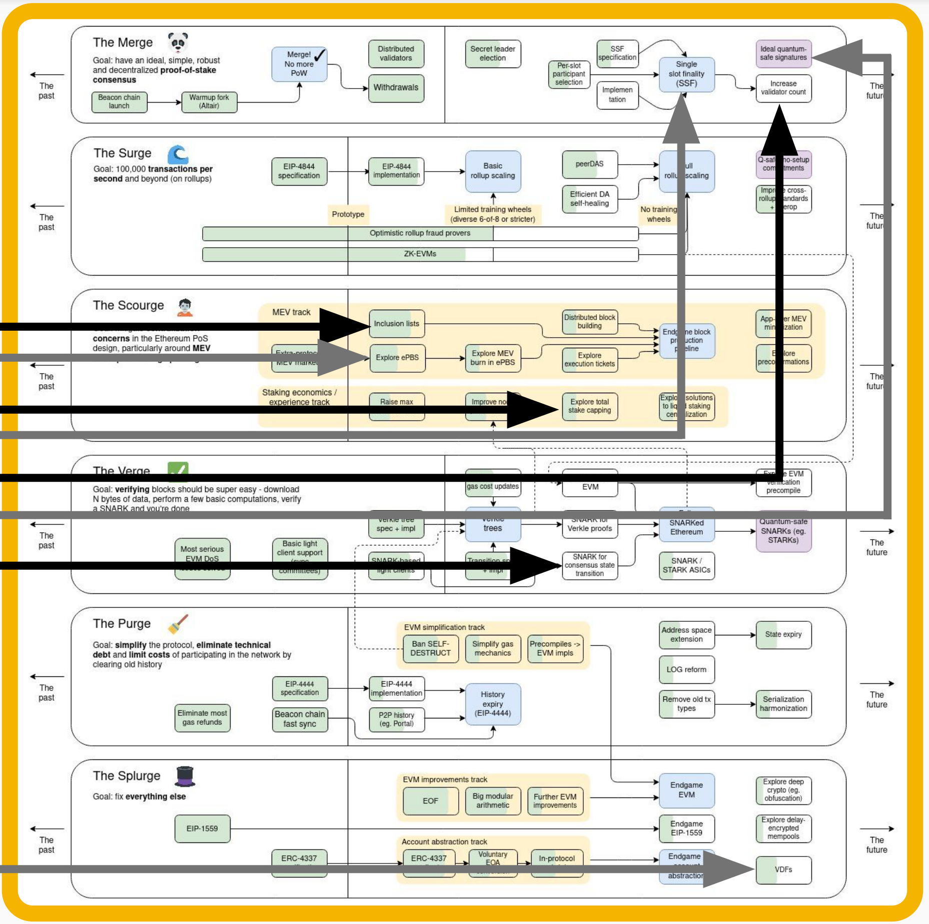

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consensus purge

epochs
only slots

deposit contract
only precompile

sync committees
only SNARK proofs

max balance
only min balance

deposit tree
only EVM root

withdrawal credentials
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effective balances
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committee indices
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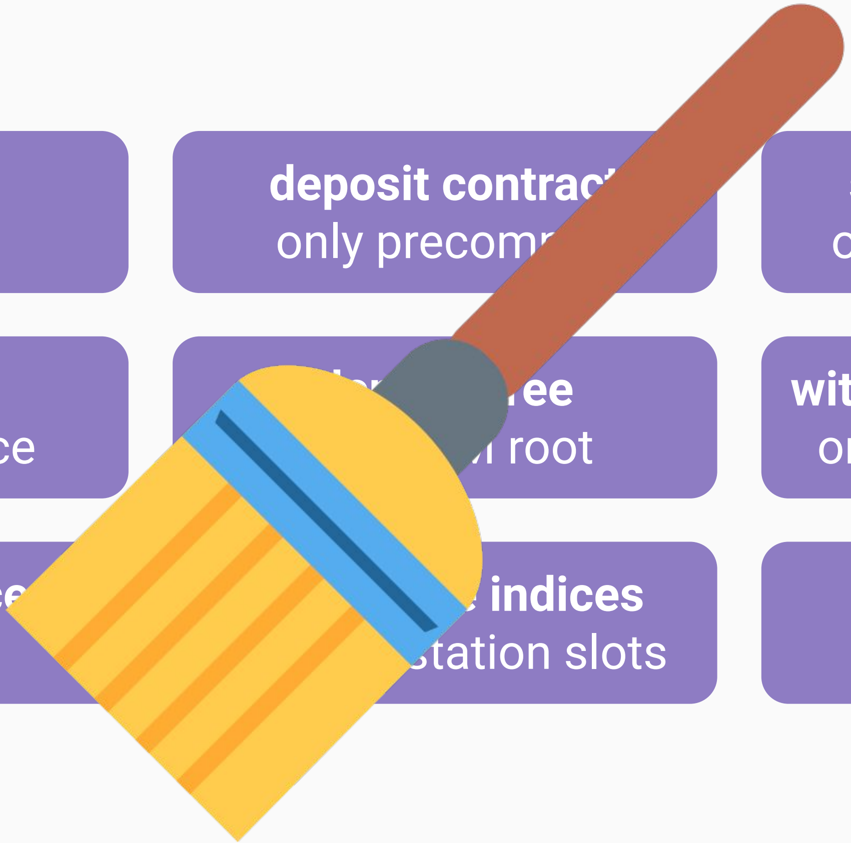
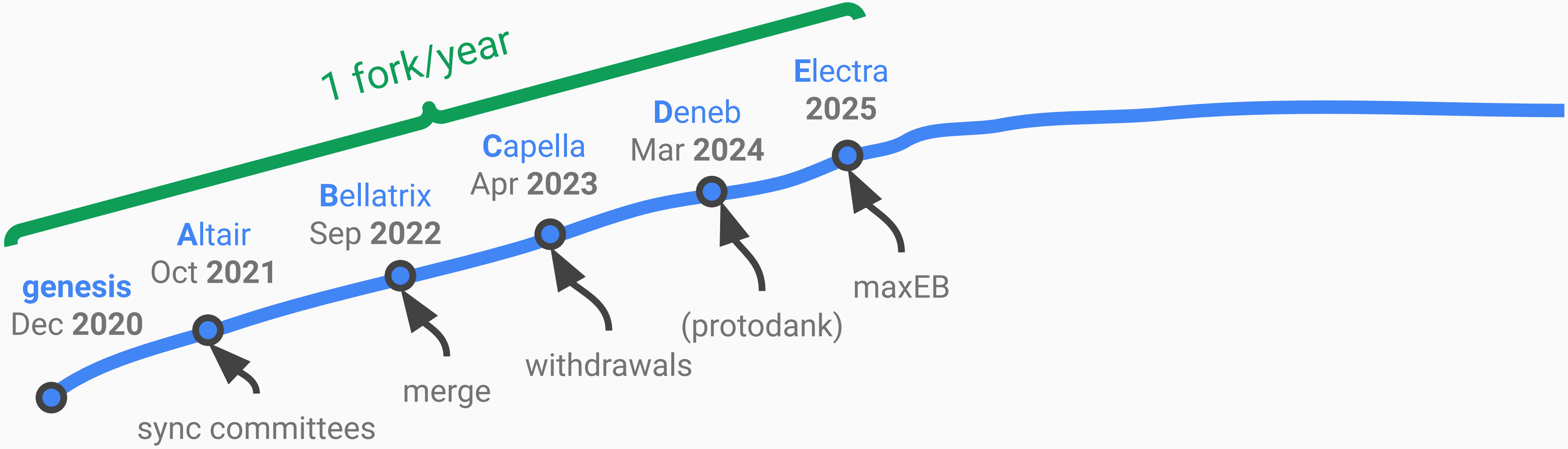


technical debt hindsight

Devconnect staking gathering

Nov 2023, Istanbul (talk link)

ossification accelerationism (oss/acc)



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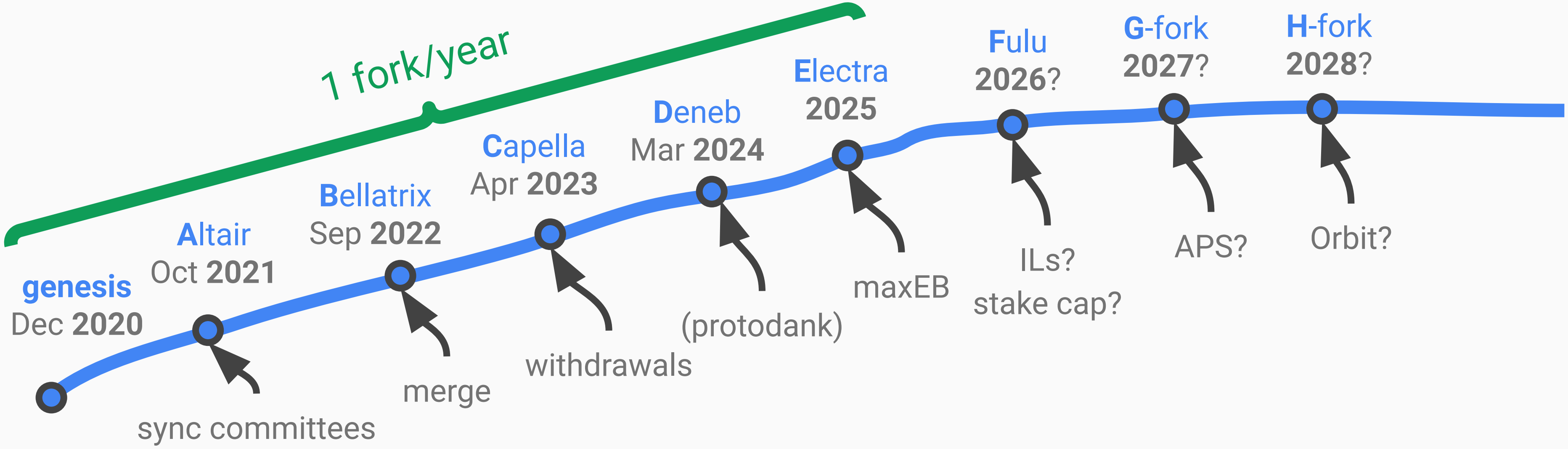

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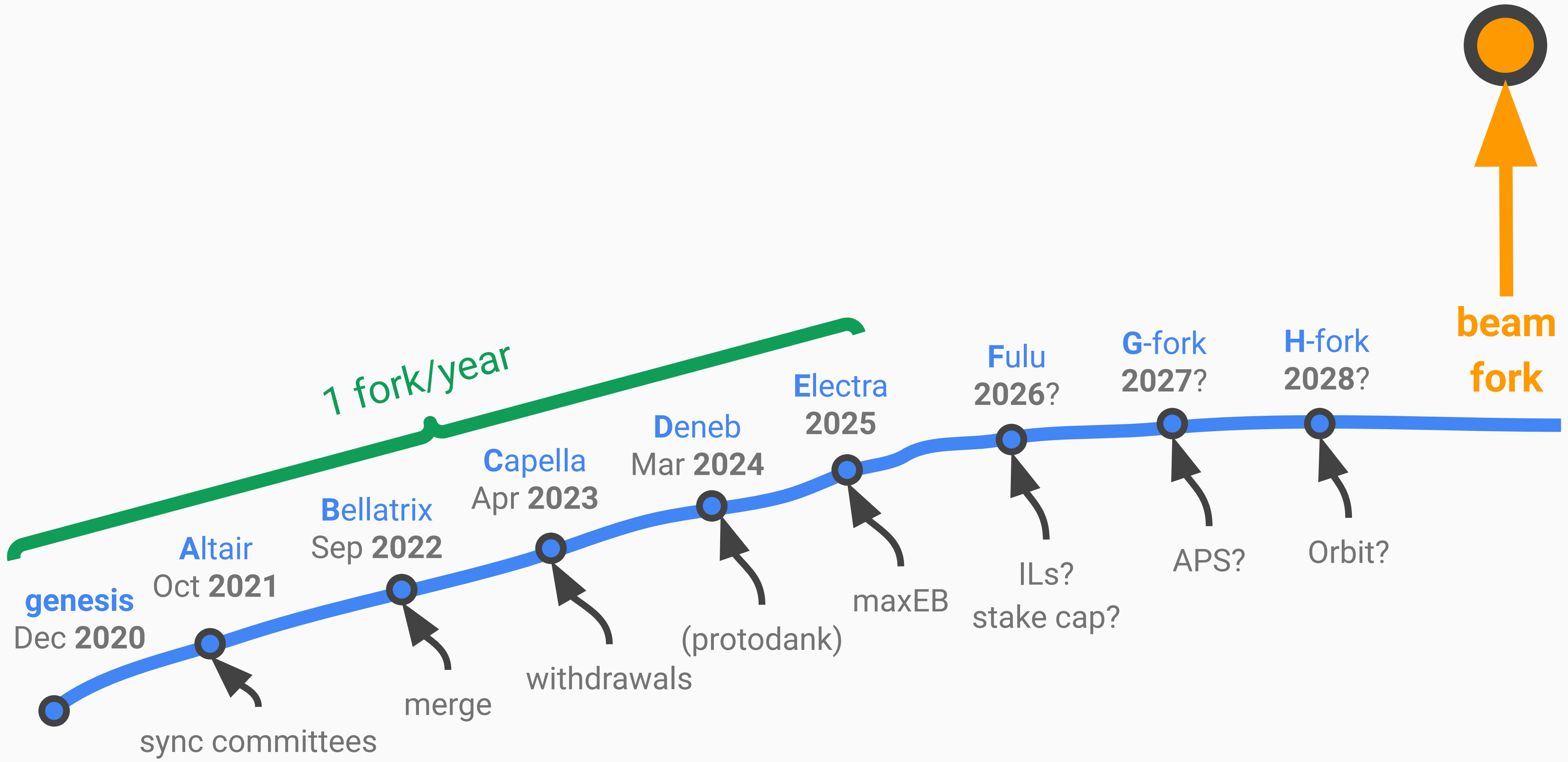

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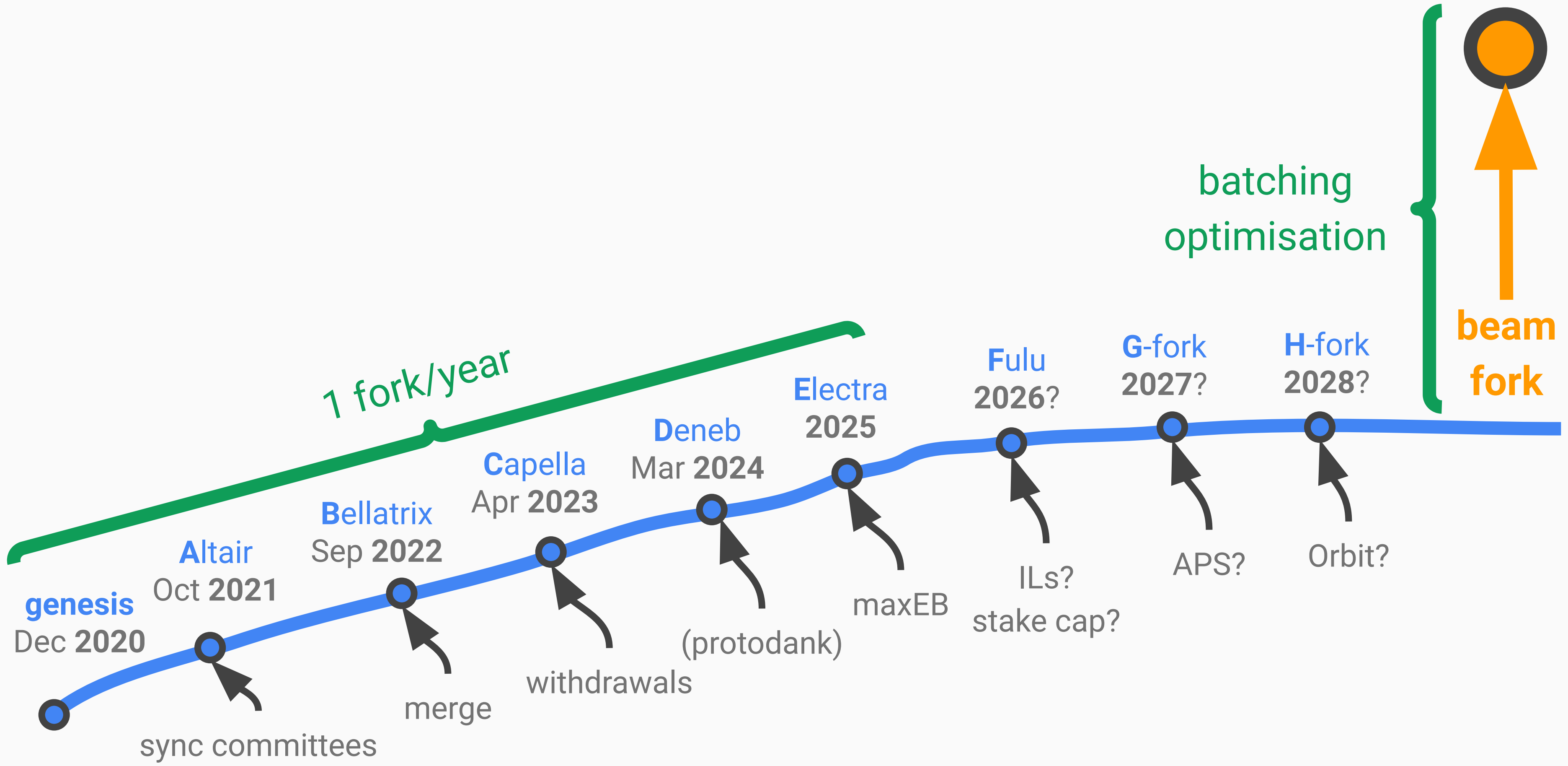

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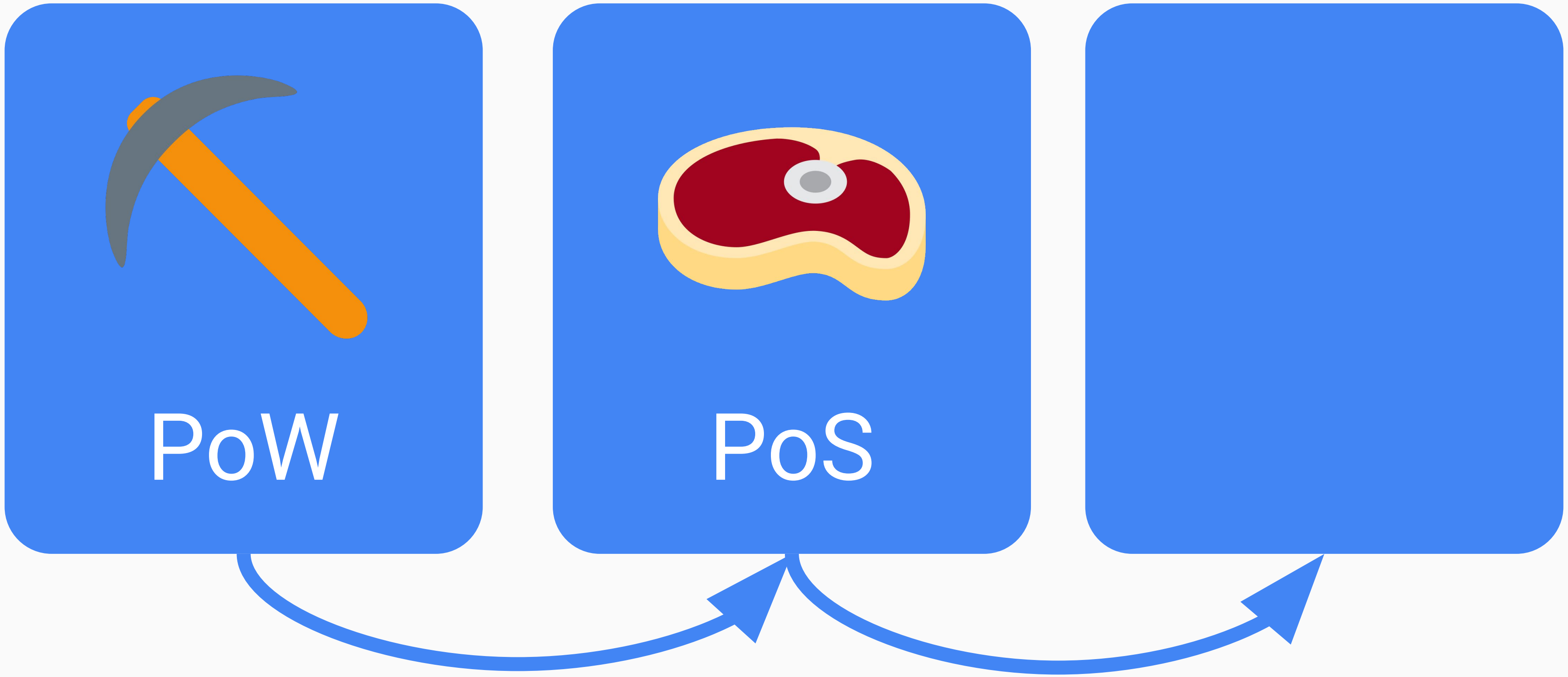

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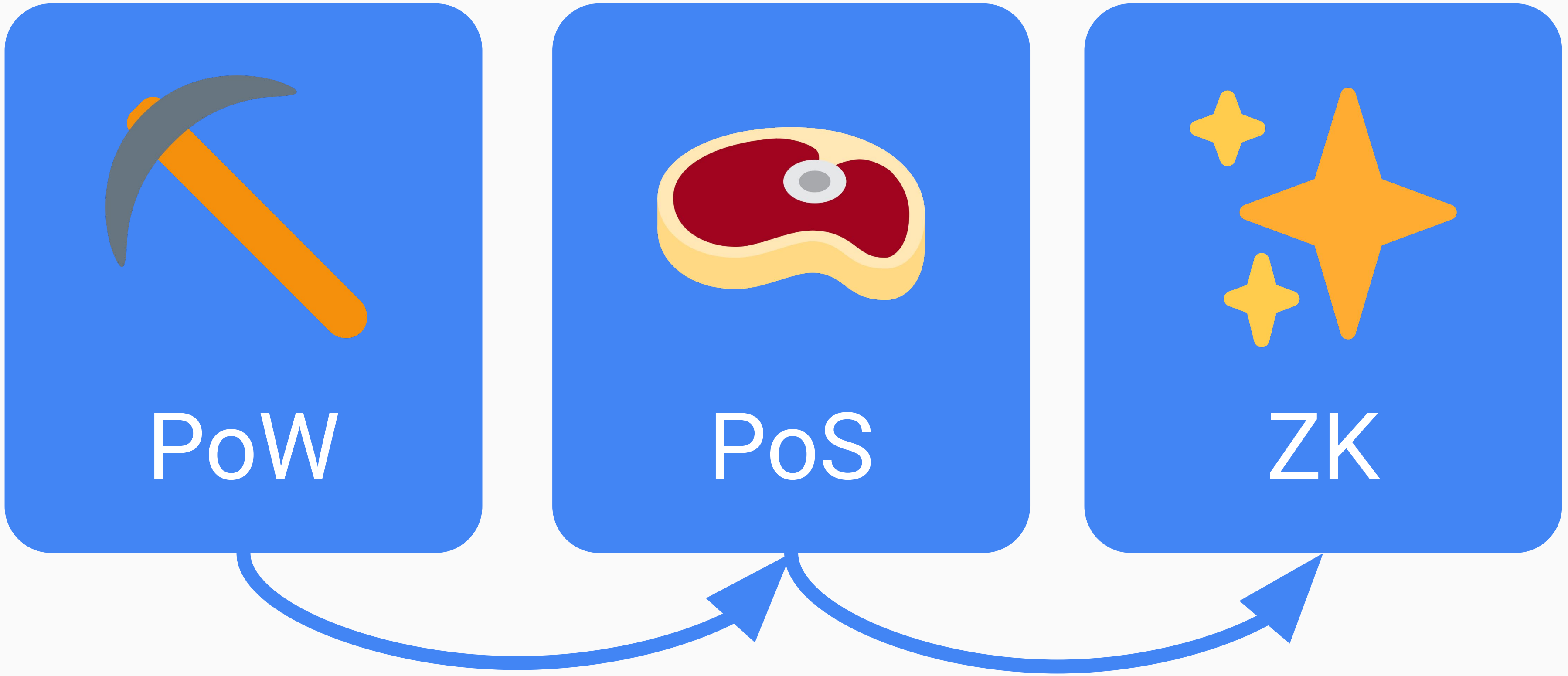
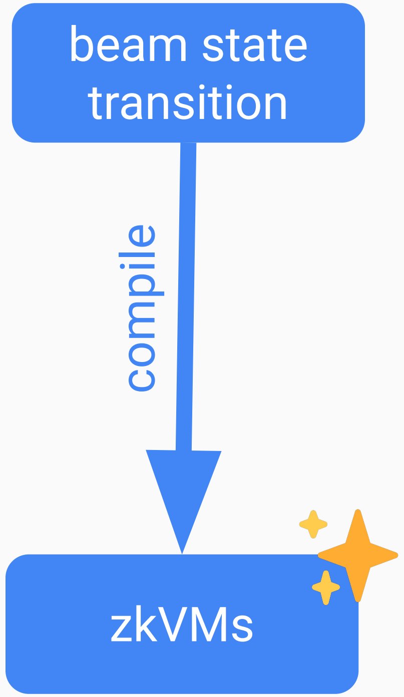


chain snarkification

rbeam
gobeam
wazbeam
...



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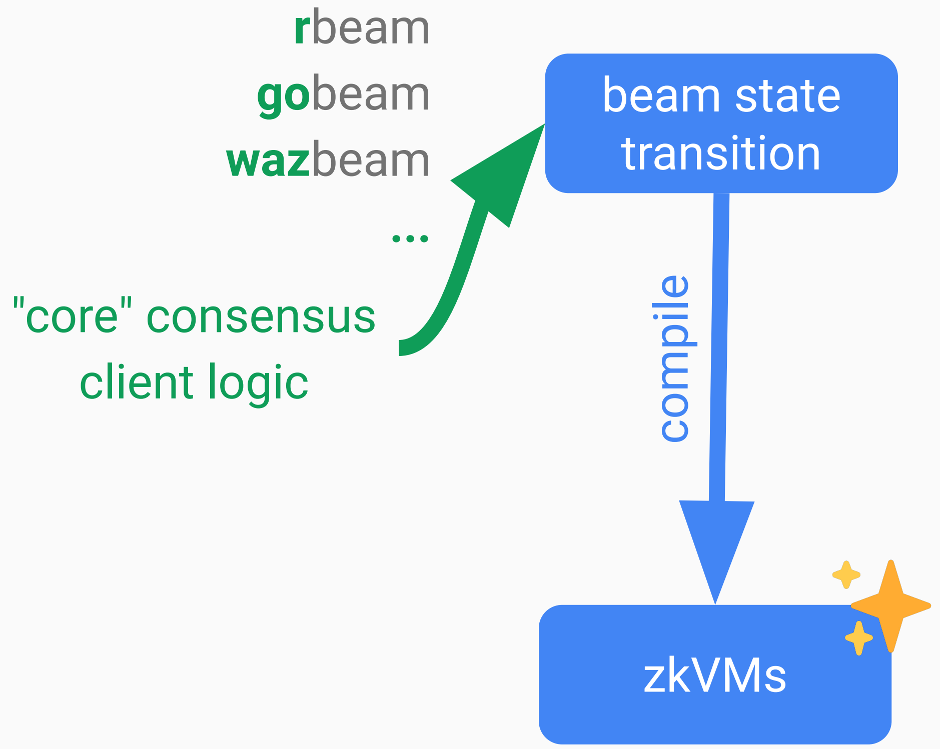

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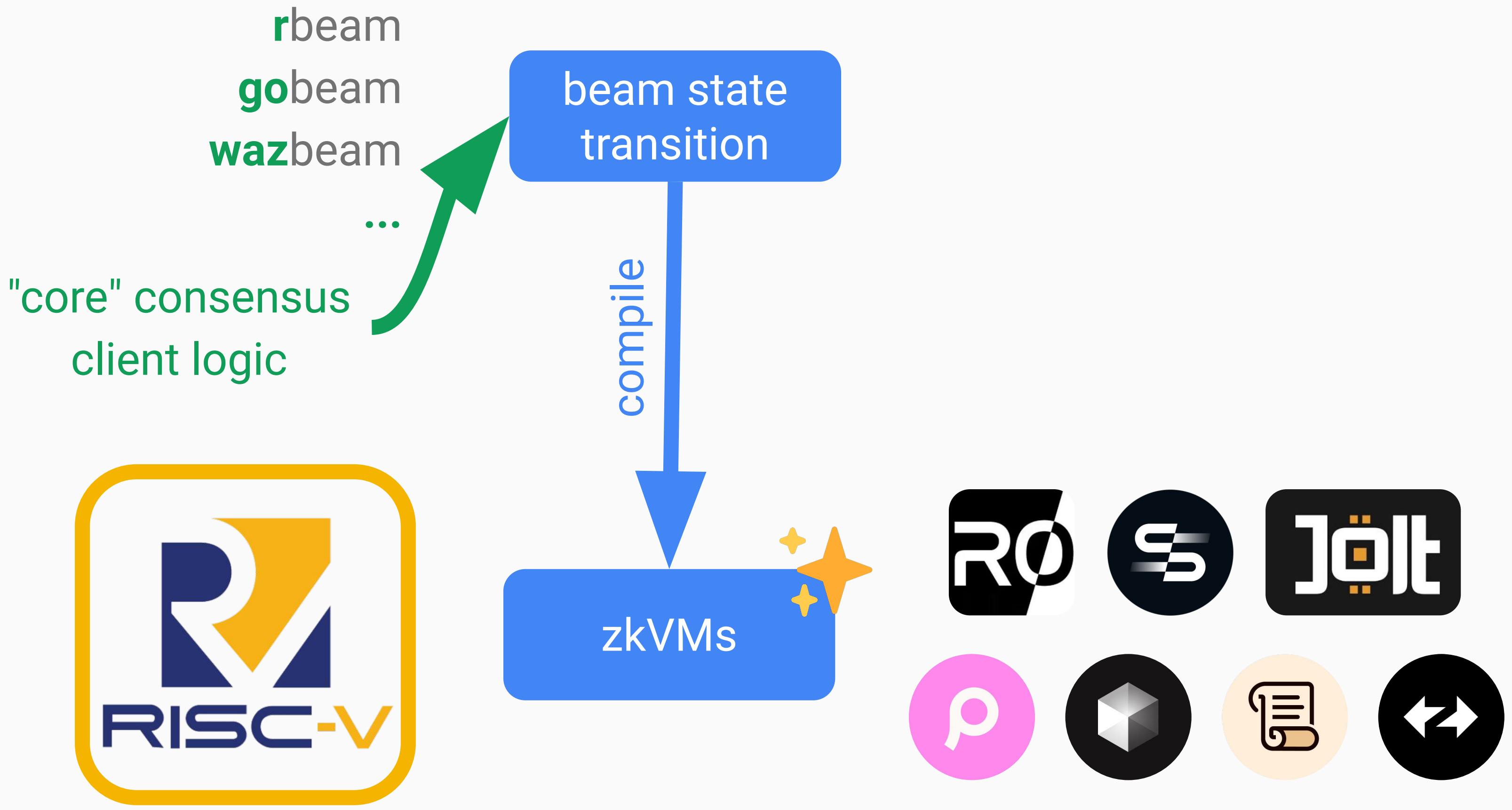

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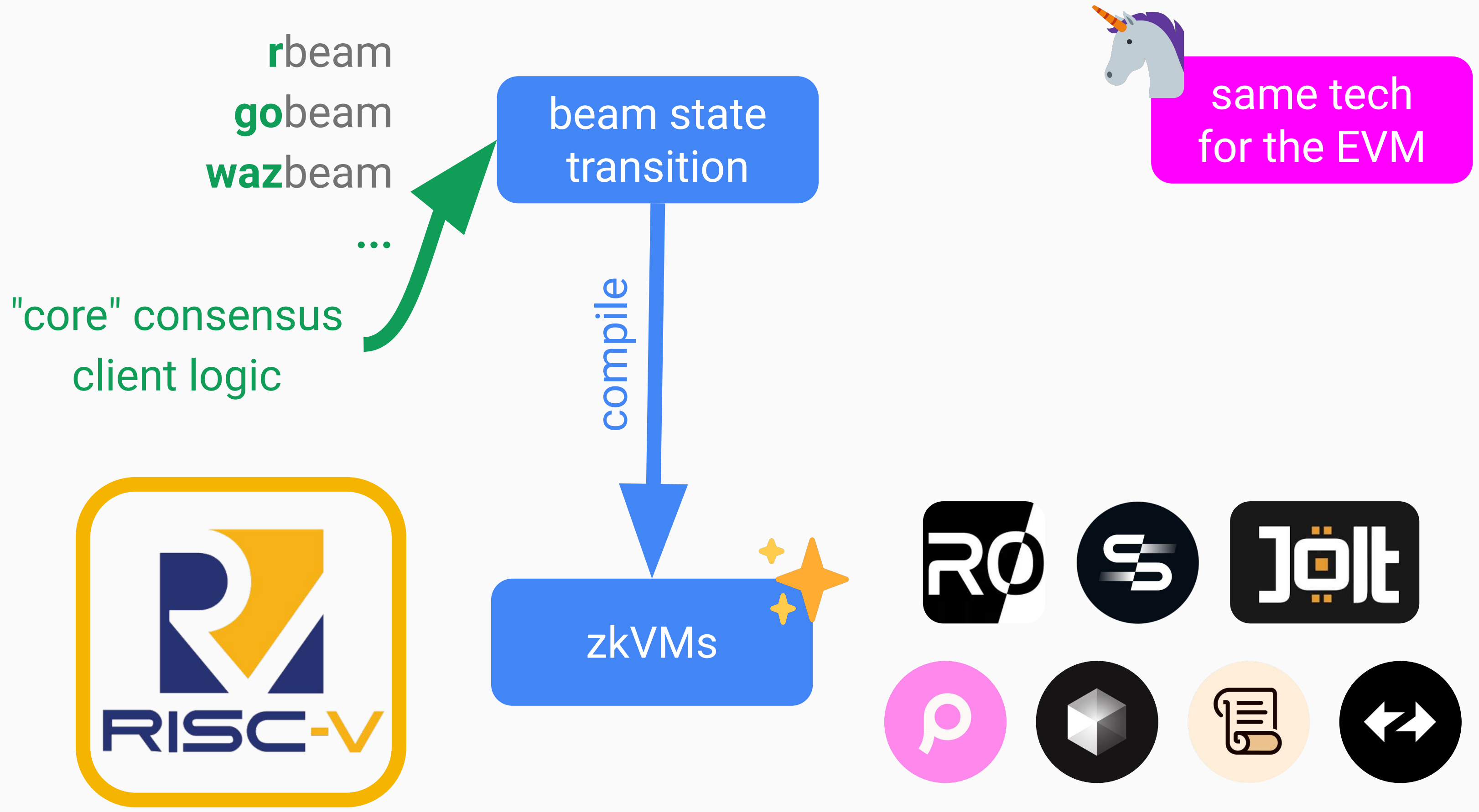

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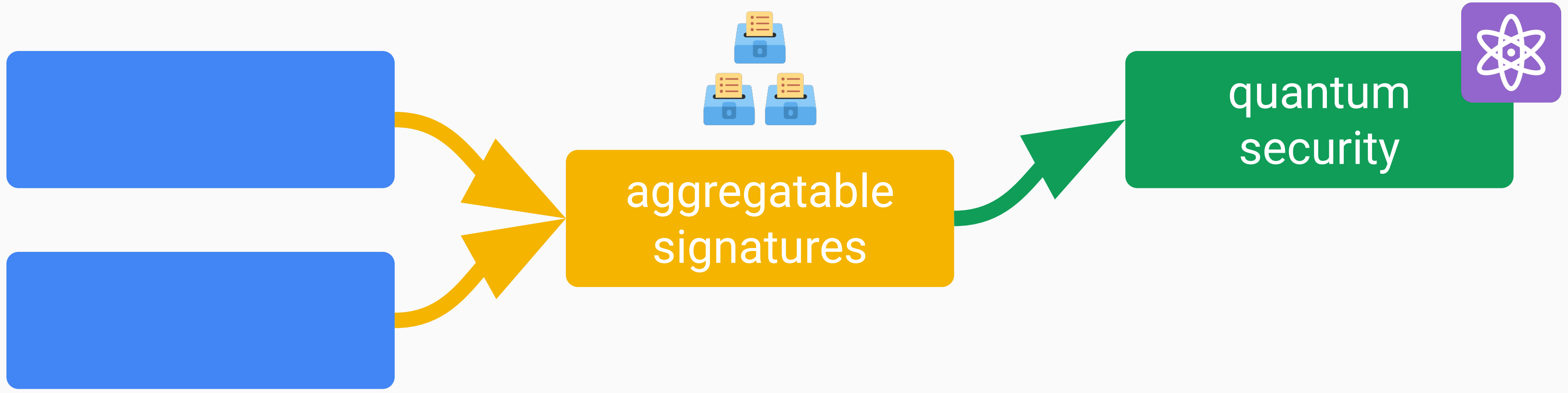

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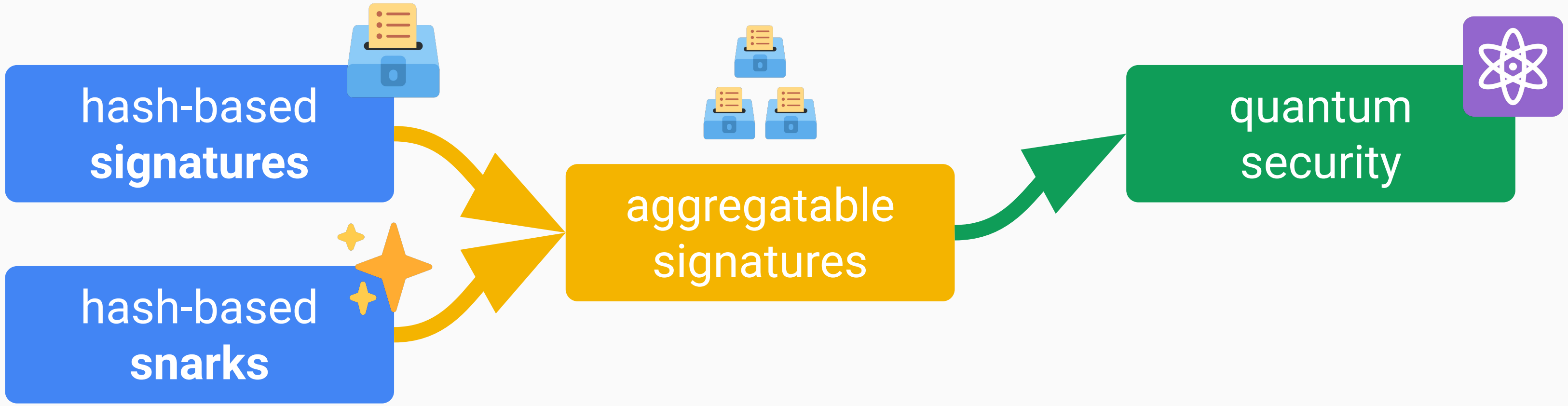

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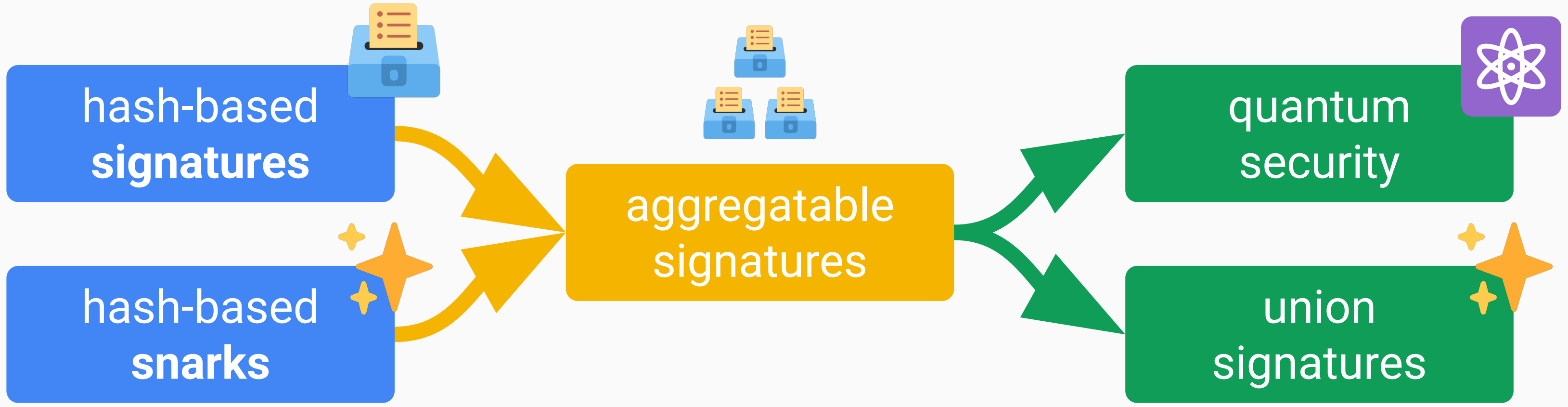

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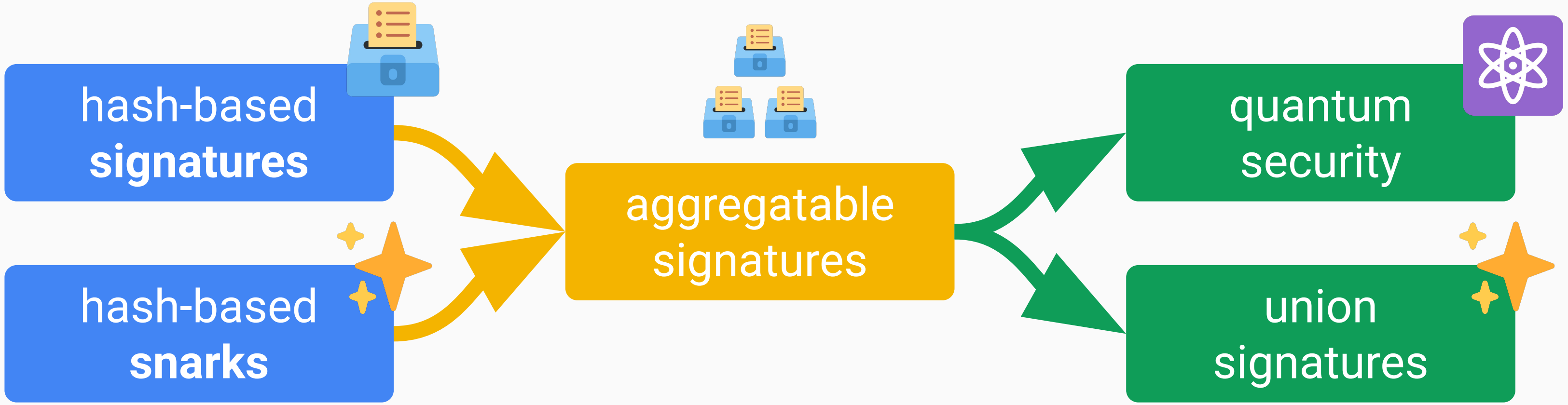

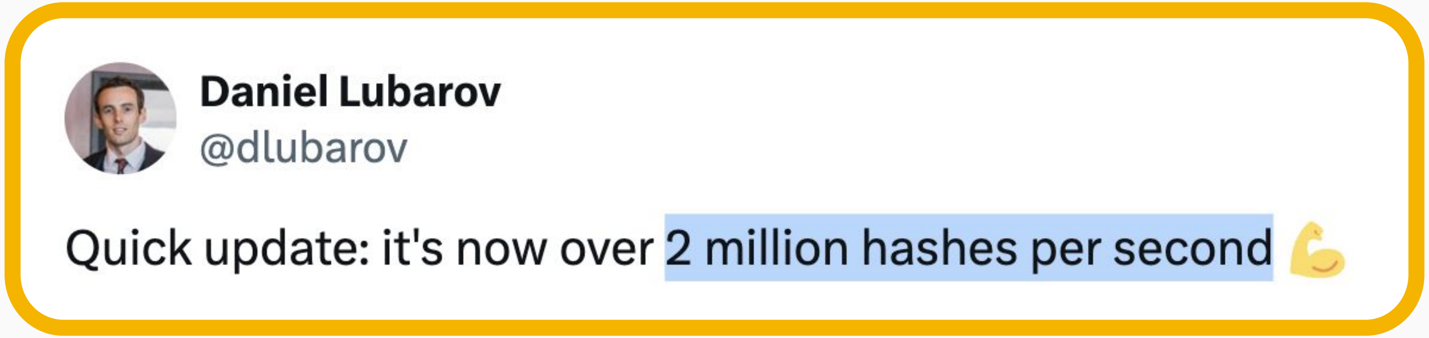
Daniel Lubarov
@dlubarov

Quick update: it's now over 2 million hashes per second 💪

reuse infrastructure

libp2p

SSZ

Simple**S**eriali**Z**e

reuse infrastructure

libp2p

PySpec

Python executable **Spec**

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ProtocolGuild

leverage existing teams

CL devs

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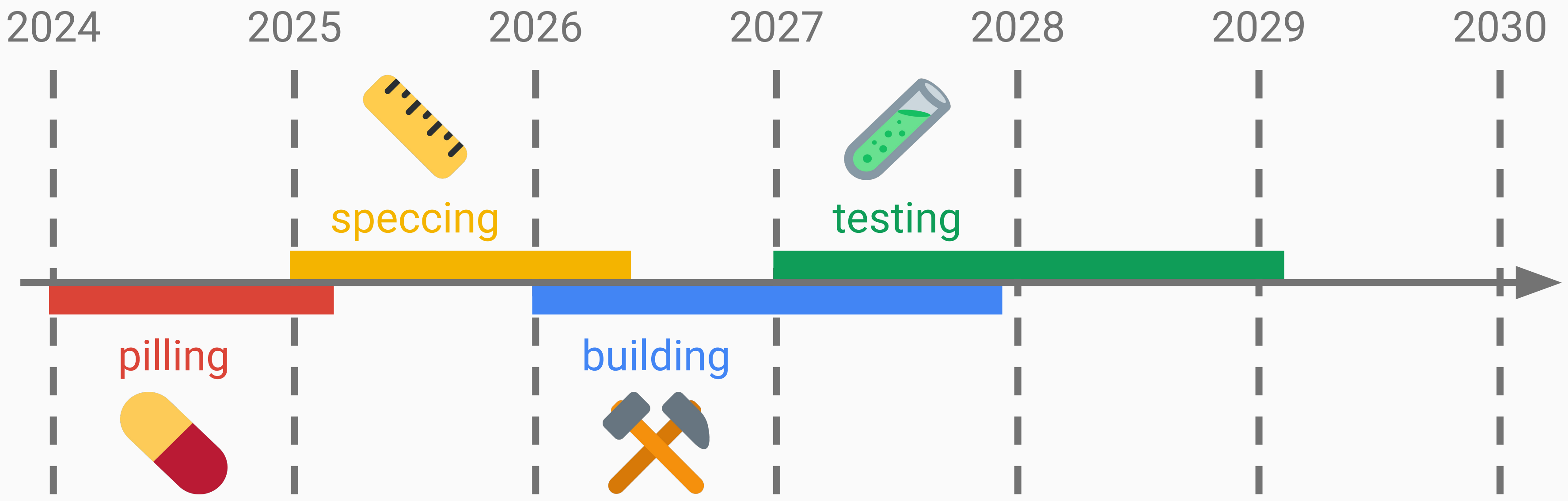
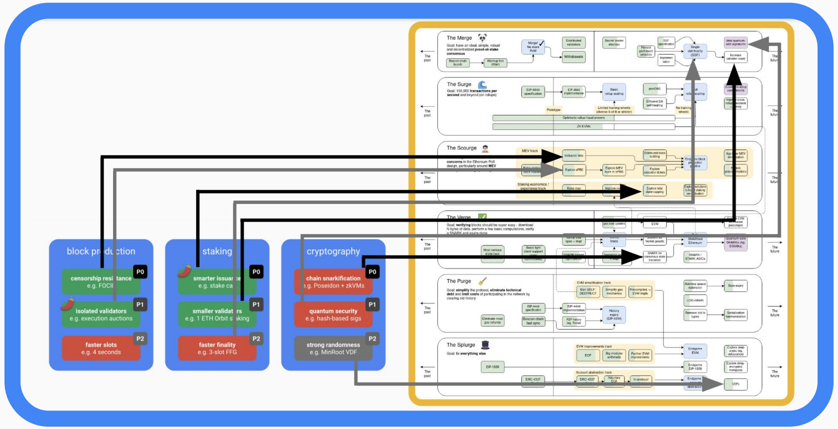
strawman timeline



2025 mission—"executable roadmap"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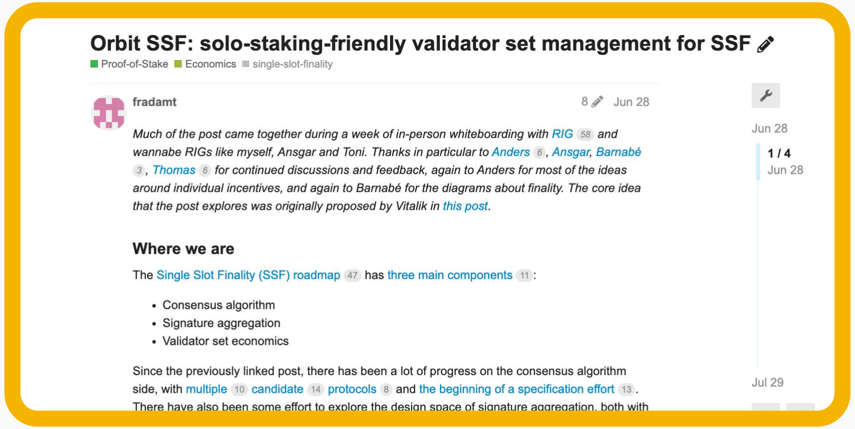
isolated validators e.g. execution auctions
P1
faster slots e.g. 4 seconds
P2
staking
smarter issuance e.g. stake cap
P0
smaller validators e.g. 1 ETH Orbit staking
P1
faster finality e.g. 3-slot FFG
P2
cryptography
chain snarkification e.g. Poseidon + zkVMs
P0
quantum security e.g. hash-based sigs
P1
strong randomness e.g. MinRoot VDF
P2
The Merge
The Surge
The Scourge
The Verge
The Purge
The Splurge

pixels



Orbit SSF: solo-staking-friendly validator set management for SSF

Proof-of-Stake Economics single-slot-finality

fradamt 8 Jun 28

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Where we are

The Single Slot Finality (SSF) roadmap 47 has three main components 11:

- Consensus algorithm
- Signature aggregation
- Validator set economics

Since the previously linked post, there has been a lot of progress on the consensus algorithm side, with multiple 10 candidate 14 protocols 8 and the beginning of a specification effort 13.

There have also been some effort to explore the design space of signature aggregation, both with

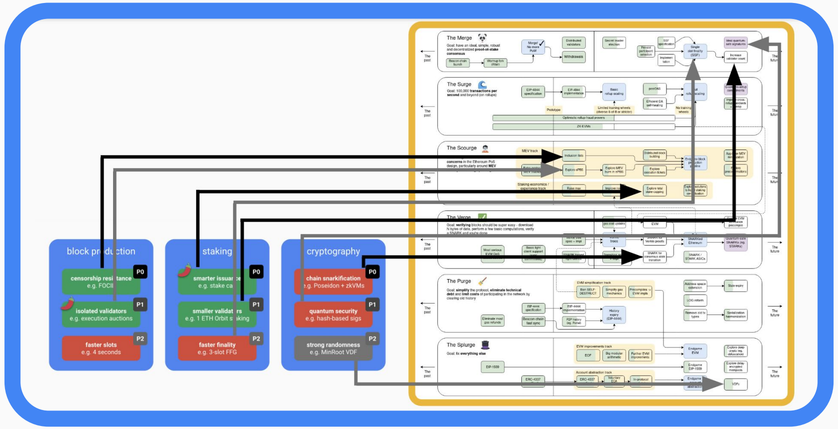
Jun 28

1 / 4
Jun 28

Jul 29

words

2025 mission—"executable roadmap"


block production
censorship resistance e.g. FOCIL
P0
isolated validators e.g. execution auctions
P1
faster slots e.g. 4 seconds
P2
staking
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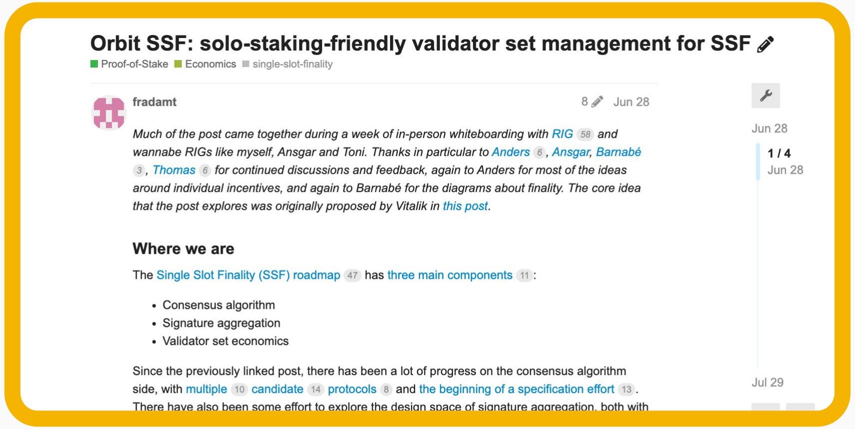

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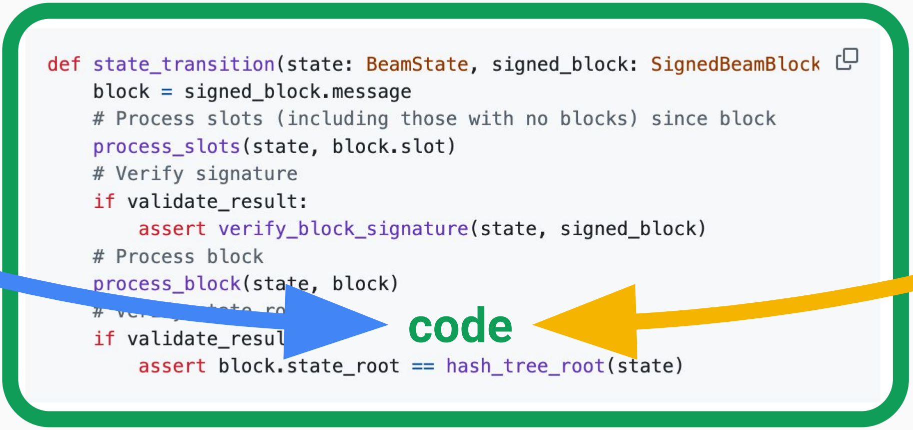
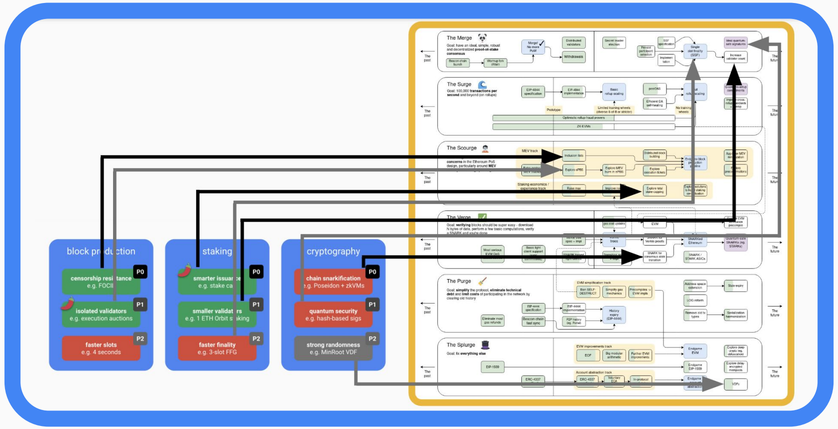
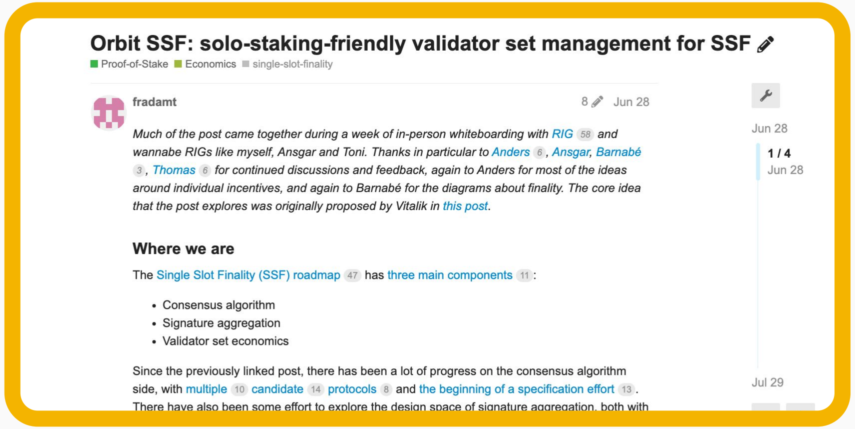


```
def state_transition(state: BeamState, signed_block: SignedBeamBlock
    block = signed_block.message
    # Process slots (including those with no blocks) since block
    process_slots(state, block.slot)
    # Verify signature
    if validate_result:
        assert verify_block_signature(state, signed_block)
    # Process block
    process_block(state, block)
    # Ver[illegible]tate ro[illegible]
    if validate_resul[illegible]
        assert block.state_root == hash_tree_root(state)
```

code

2025 mission—"executable roadmap"





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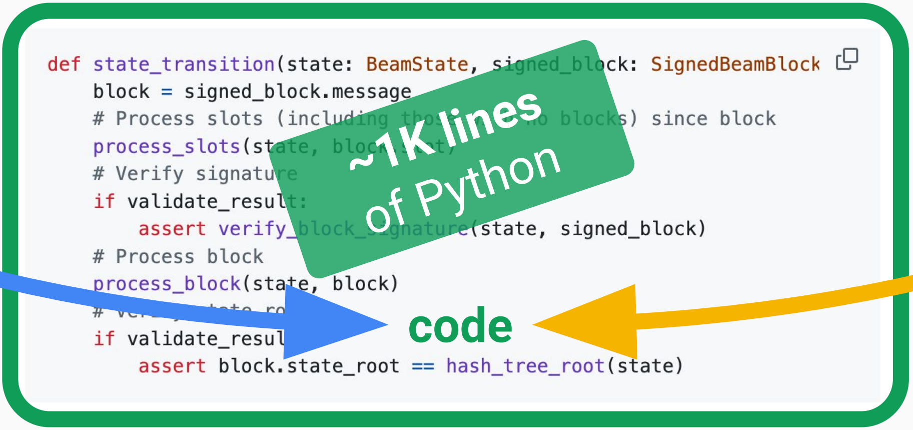

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    # Process block
    process_block(state, block)
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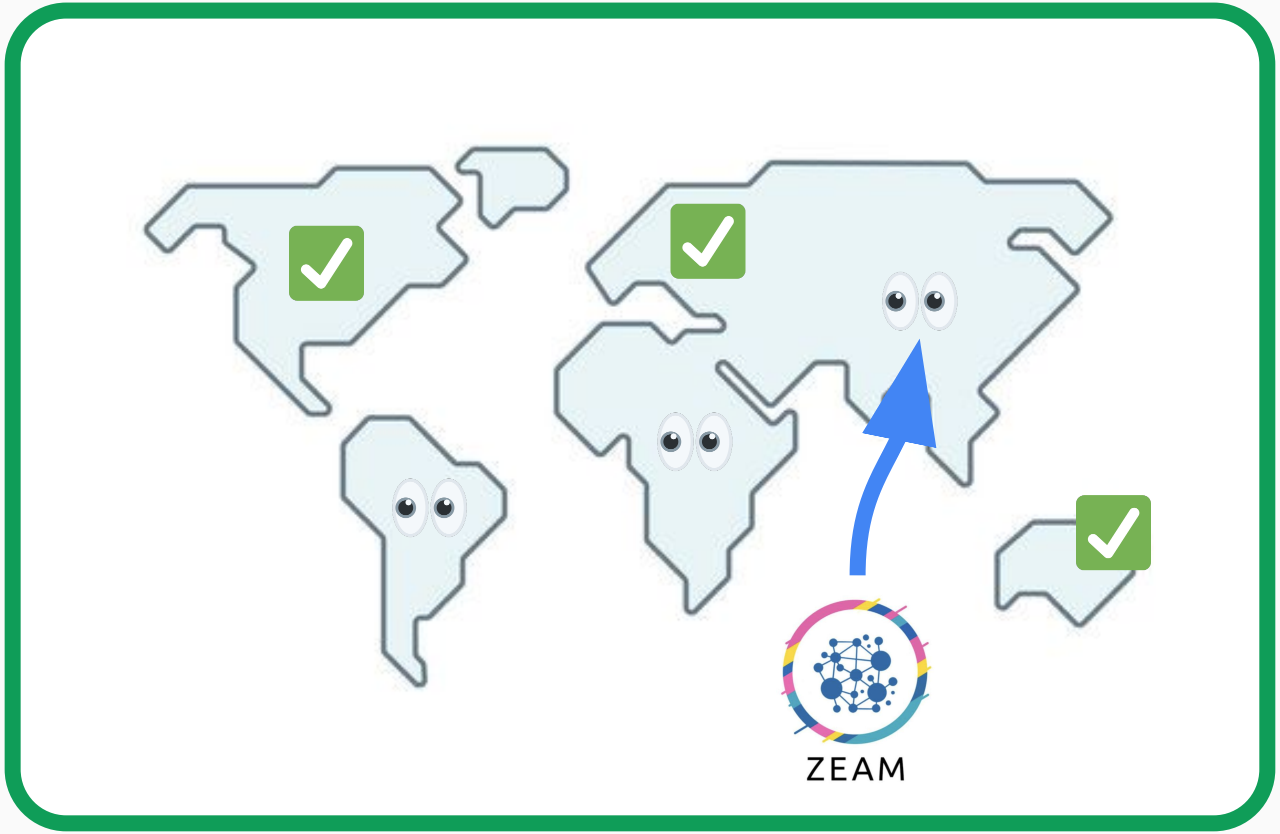
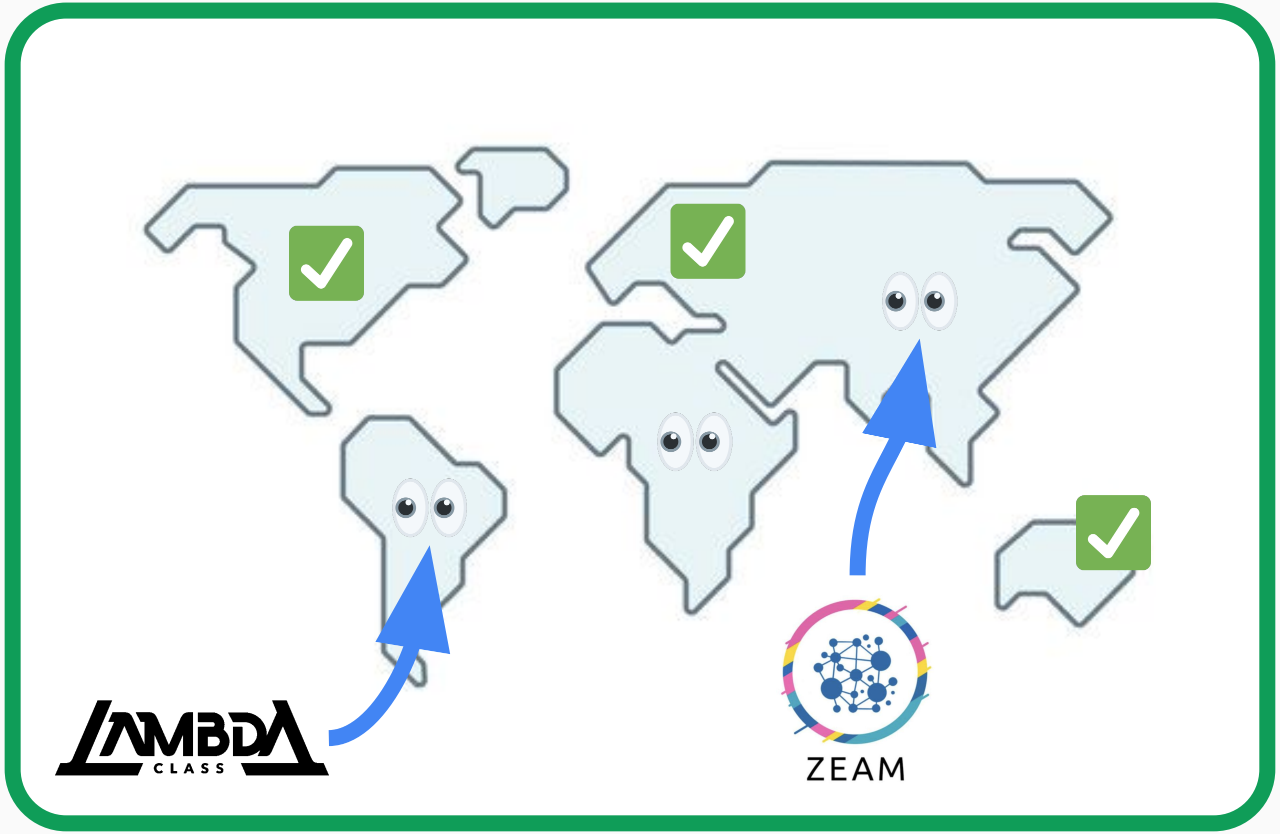
    if validate_result:
        assert block.state_root == hash_tree_root(state)
```

onboarding opportunity

onboarding opportunity



onboarding opportunity



beam up

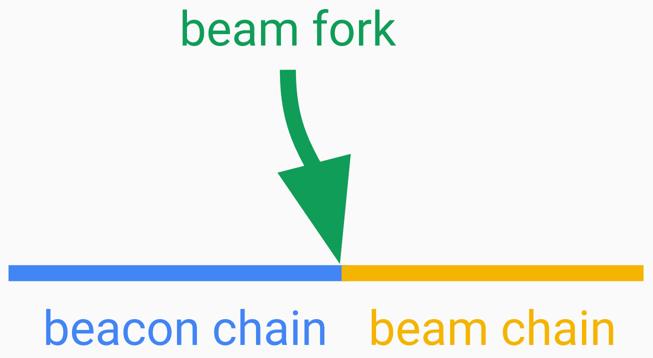
- speccing
- networking
- coordination
- snarks
- client devs

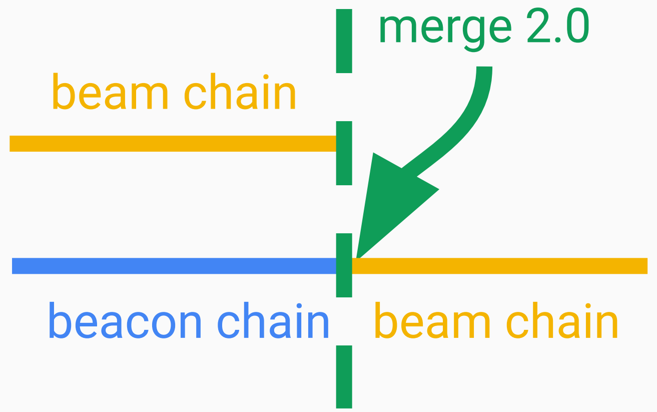
beam.chain@ethereum.org

thank you :)

beam.chain@ethereum.org

to merge or not to merge?





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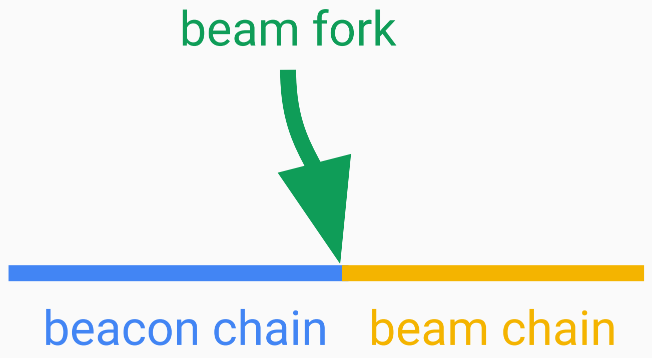
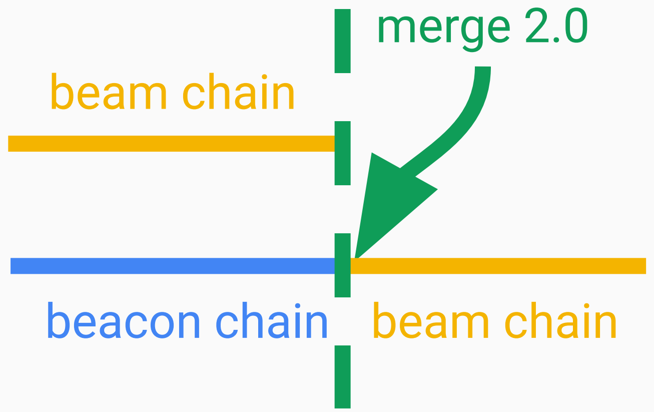


- same validator set
- same issuance curve
- day-1 withdrawals
- simpler, speedier
- compute light
- reuse client shell
- tax friendly?



- "incentivised testnet"
- available if required

beam staking

zen staking

execution auctions

- no relays
- no timing games
- no MEV spikes
- no preconfs

fish staking

Orbit staking

- 1 ETH validators
- millions of vals
- less pooling

feather staking

chain snarkification

- synchless
- stateless
- computeless

RISC-V support

✓

- official
  - RV64
- tinygo
  - RV32?

- OpenJDK
  - RV64

G extension

- integer (I)
- floating (F, D)
- mul/div (M)
- atomic (A)

embrace incrementalism—political derisking

block production

EIP-7805

censorship resistance
e.g. FOCIL

isolated validators
e.g. execution auctions

- no MEV for stakers
- no execution self-building
- agentic vs deterministic

staking

EIP soon™

smarter issuance
e.g. stake cap

cryptography

consensus devs wanted