# Sharding

and other things

# About us

Bowen

- Core engineer at NEAR (built a lot of stuff we're covering)

Peter

- Developer experience and developer tooling
- Working on sustainable behavior on the side

# About NEAR Protocol

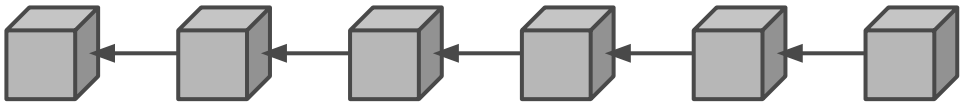
- Public Sharded Blockchain
- Emphasis on usability,
- (specifically Developer Usability)

- A bunch of ex-MemSQL and ex-Google
- A group of ACM ICPC gold medalists
- A grip of previous founders

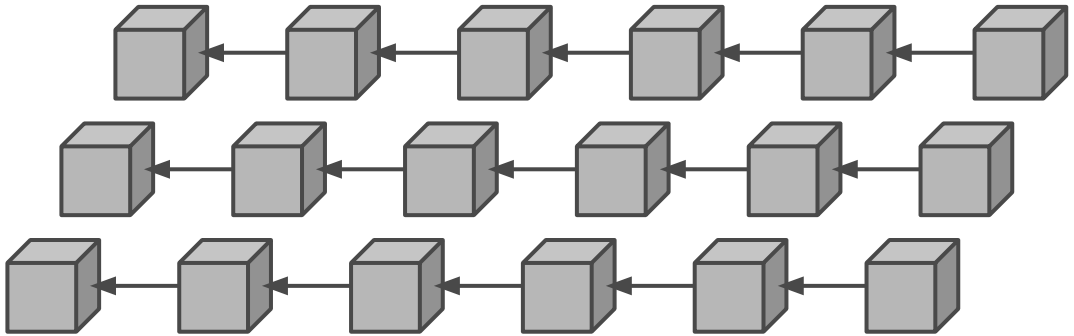
# What we’re talking about

1. Sharding, (in blockchains)
2. 10,000 ft view of crypto
3. Behavior (it relates to blockchain)

# Sharding Overview



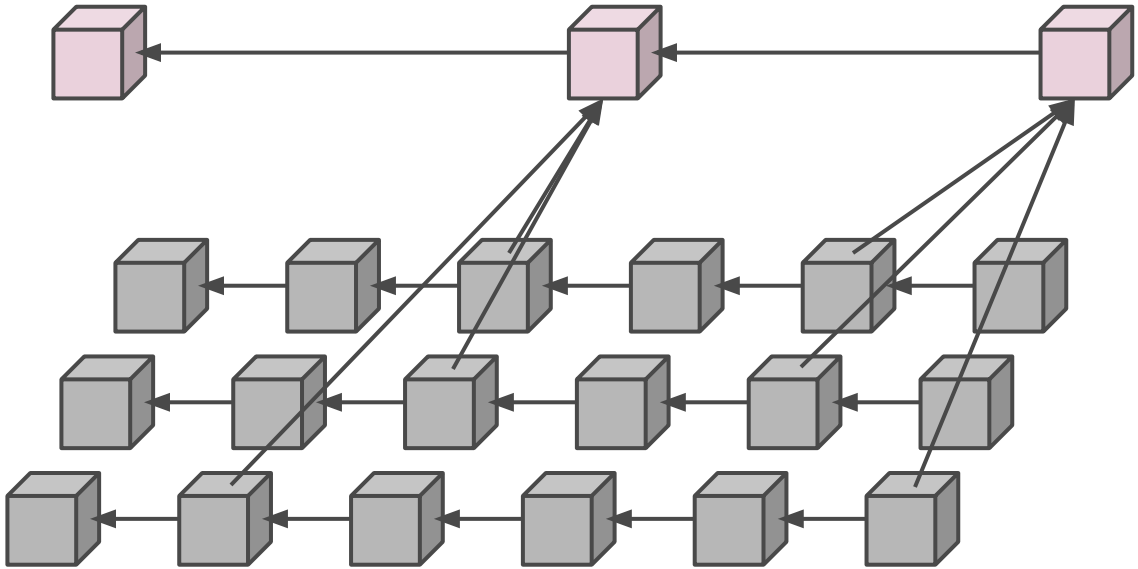
# Sharding Overview



# Sharding Overview

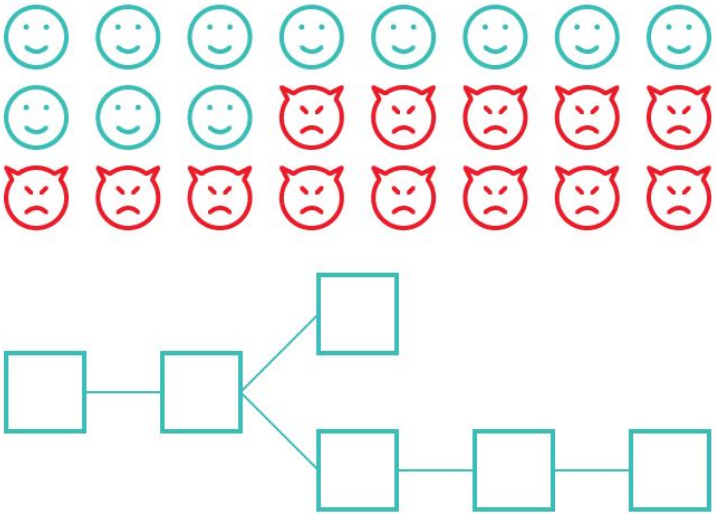
**Main Chain**
a.k.a.
Beacon Chain
Relay Chain
Hub

**Shard Chains**
a.k.a.
Parachains
Zones

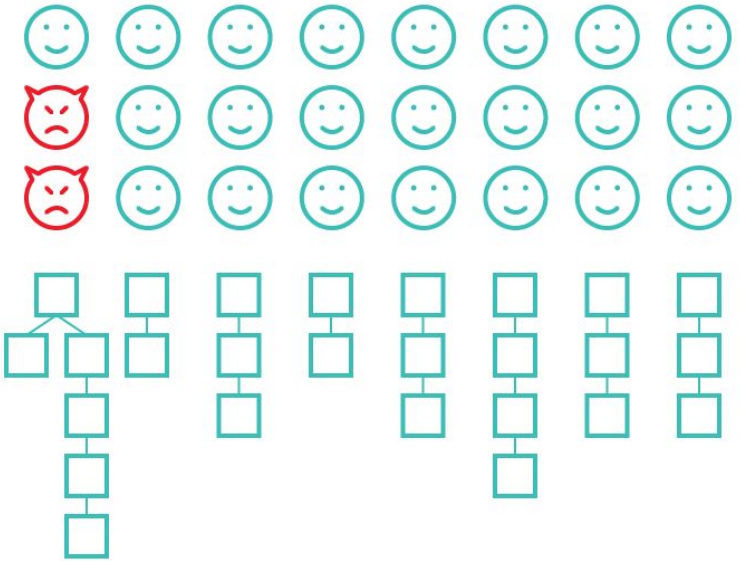


# Corrupting Validators

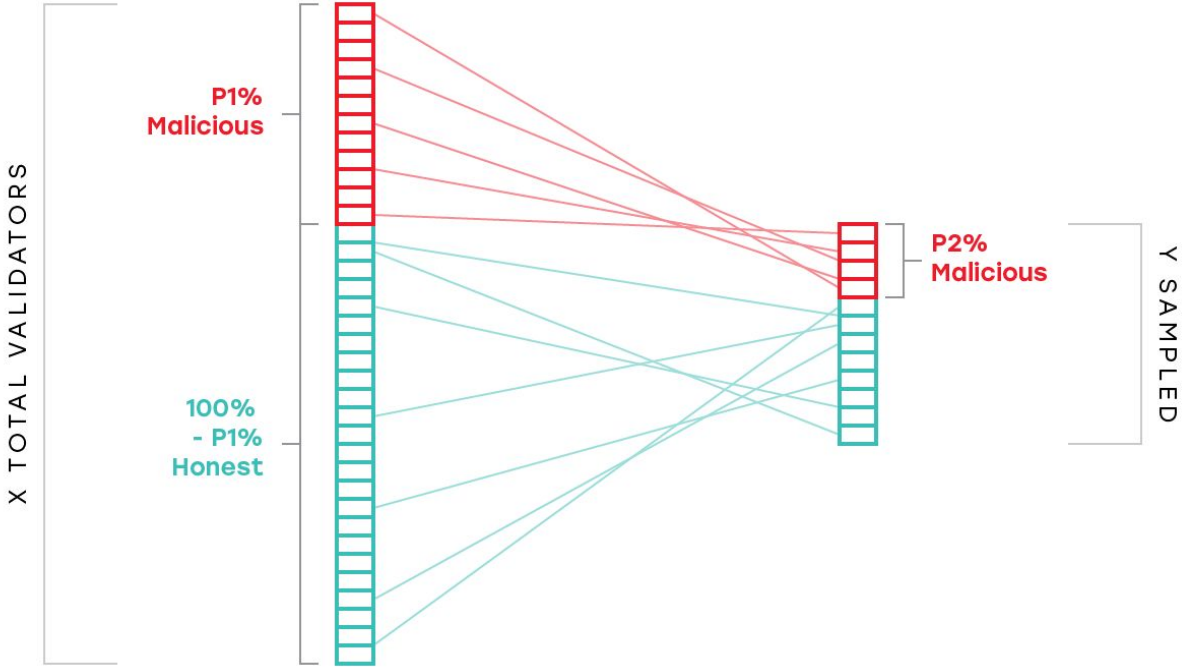
X validators building one chain.
**Need to corrupt 0.51x**



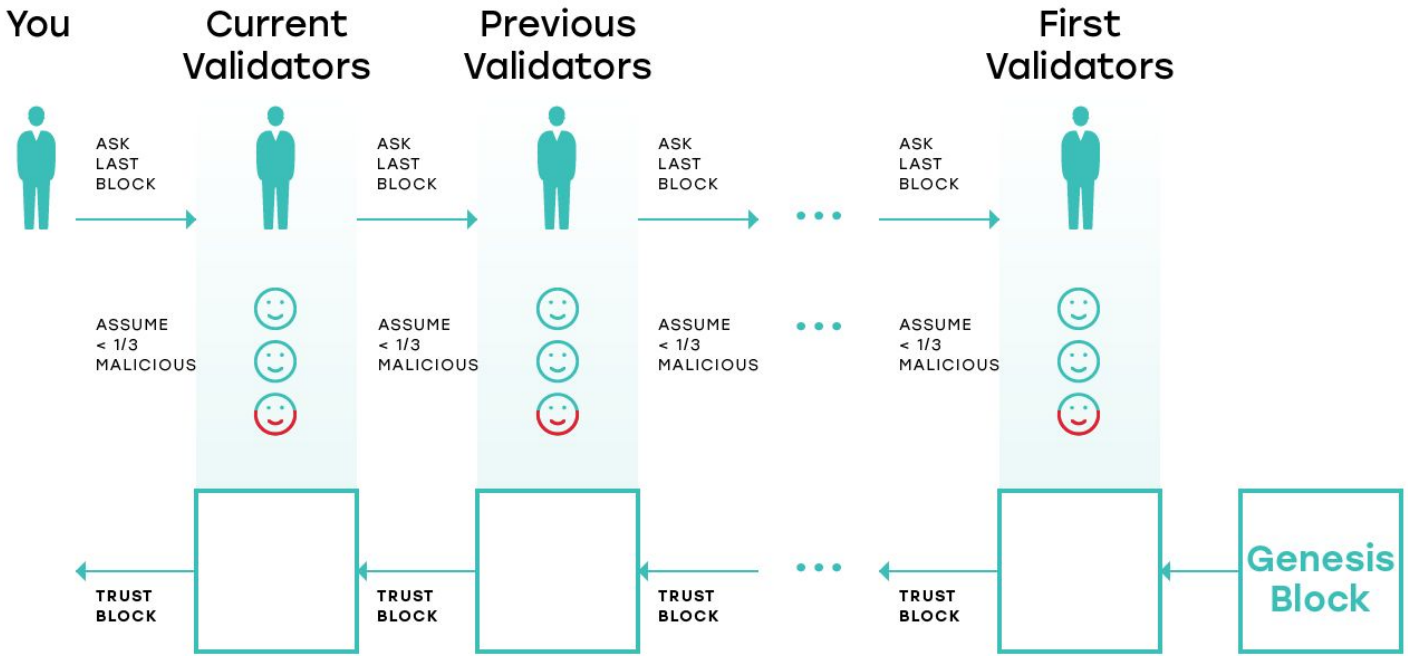
X validators building 10 chains
**Need to corrupt 0.051x**



# Sampling Validators



# Sampling Validators



# Malicious Behavior

Forking

Invalid State Transitions

# Invalid State Transition

Transaction X

| | |
|---|---|
| From: | **Alice** |
| To: | **Bob** |
| Amt: | **10** |

**Block A (Valid)**

| | |
|---|---|
| State Before: | **Alice: 10, Bob: 0** |
| Transactions: | **X** |
| State After: | **Alice: 0, Bob: 10** |

**Block A' (Invalid)**

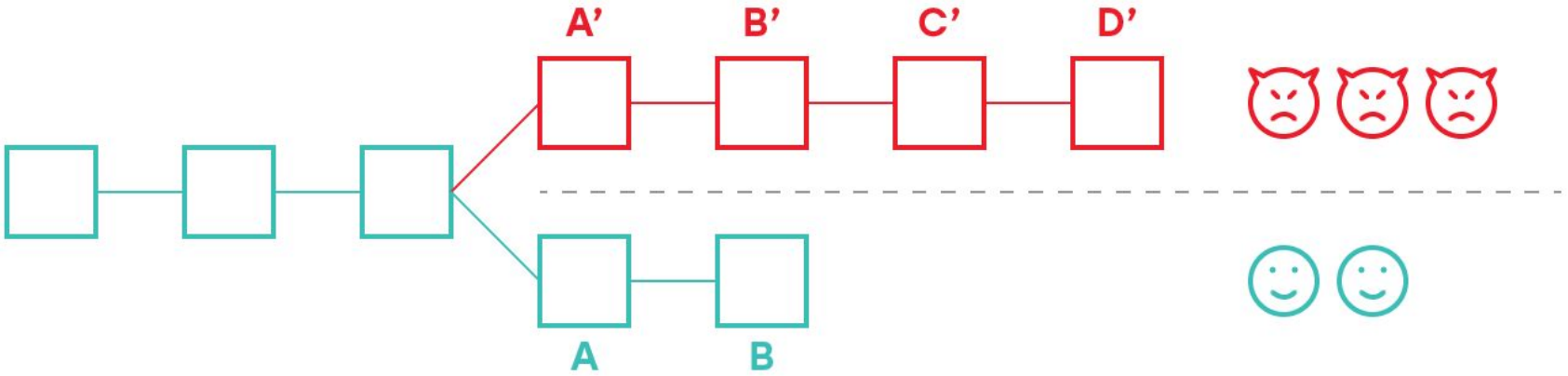
| | |
|---|---|
| State Before: | **Alice: 10, Bob: 0** |
| Transactions: | **X** |
| State After: | **Alice: 0, Bob: 1000** |

# Malicious Behavior **without** Sharding

✓ Forking

✗ Invalid State Transitions

# Malicious Behavior **without** Sharding



# Malicious Behavior **with** Cross-Shard Transactions

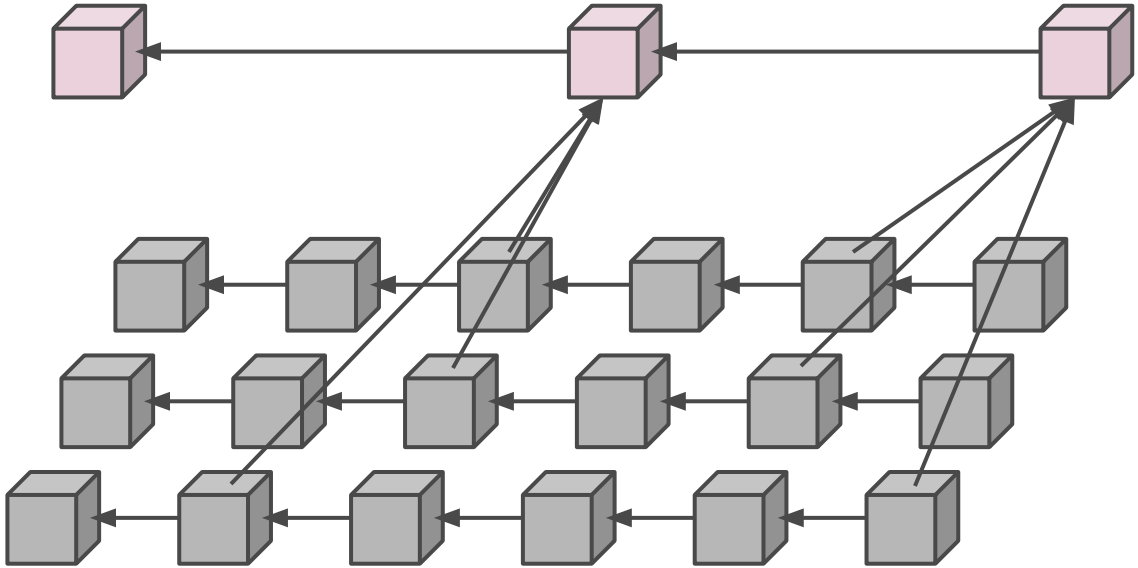
✓ Forking

✓ Invalid State Transitions

# Cross-shard Communication

**Main Chain**
a.k.a.
Beacon Chain
Relay Chain
Hub

**Shard Chains**
a.k.a.
Parachains
Zones



# Cross-shard Communication

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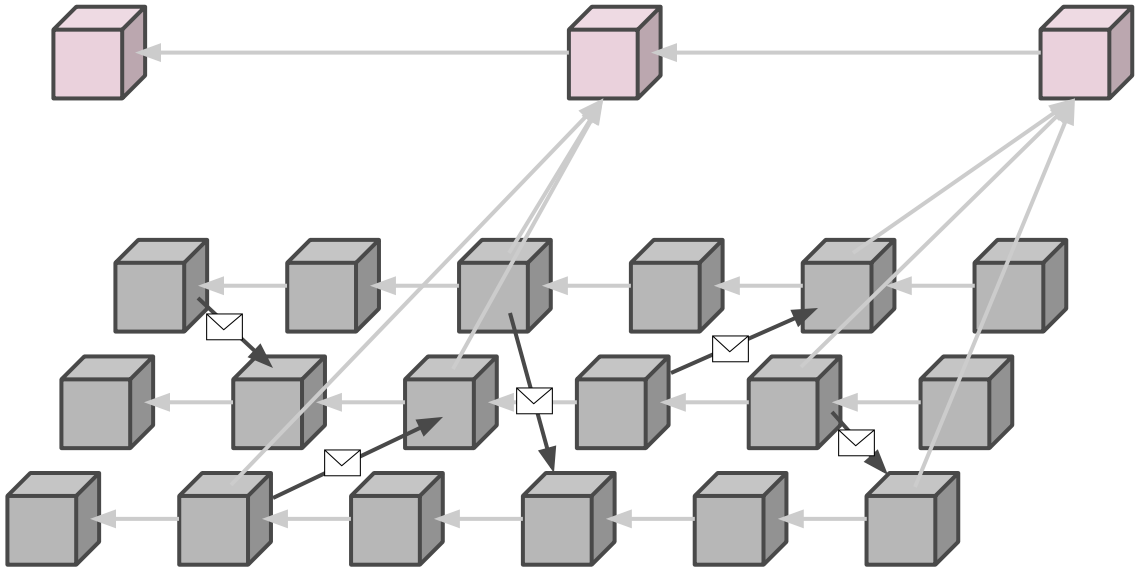
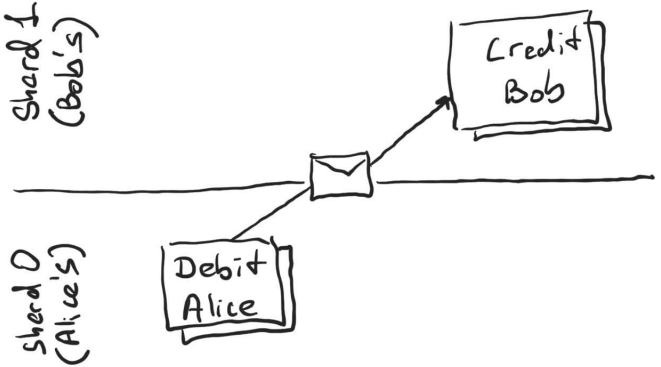
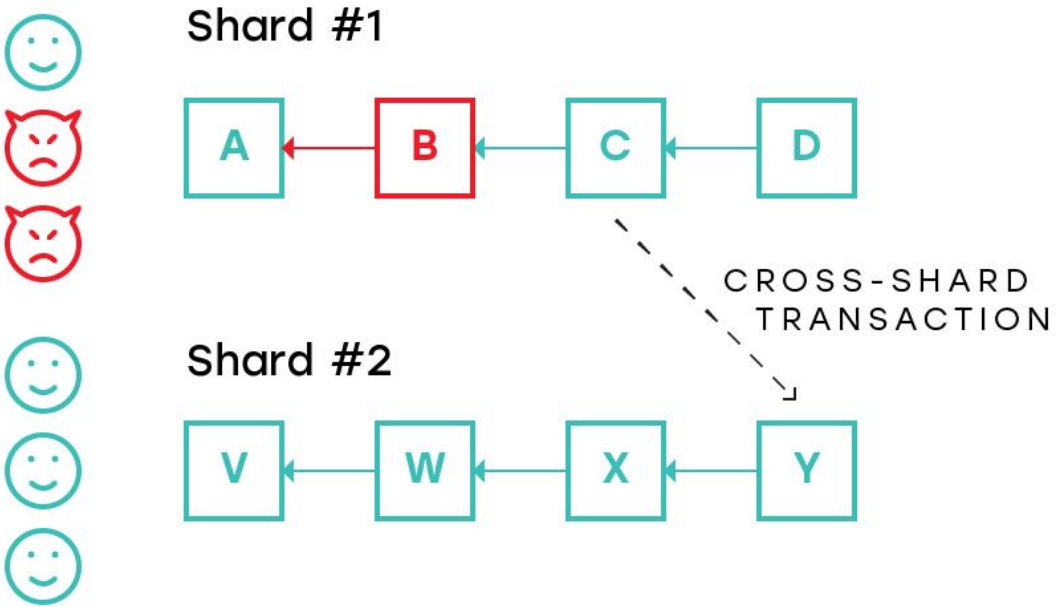


# Cross-shard Communication: Receipts

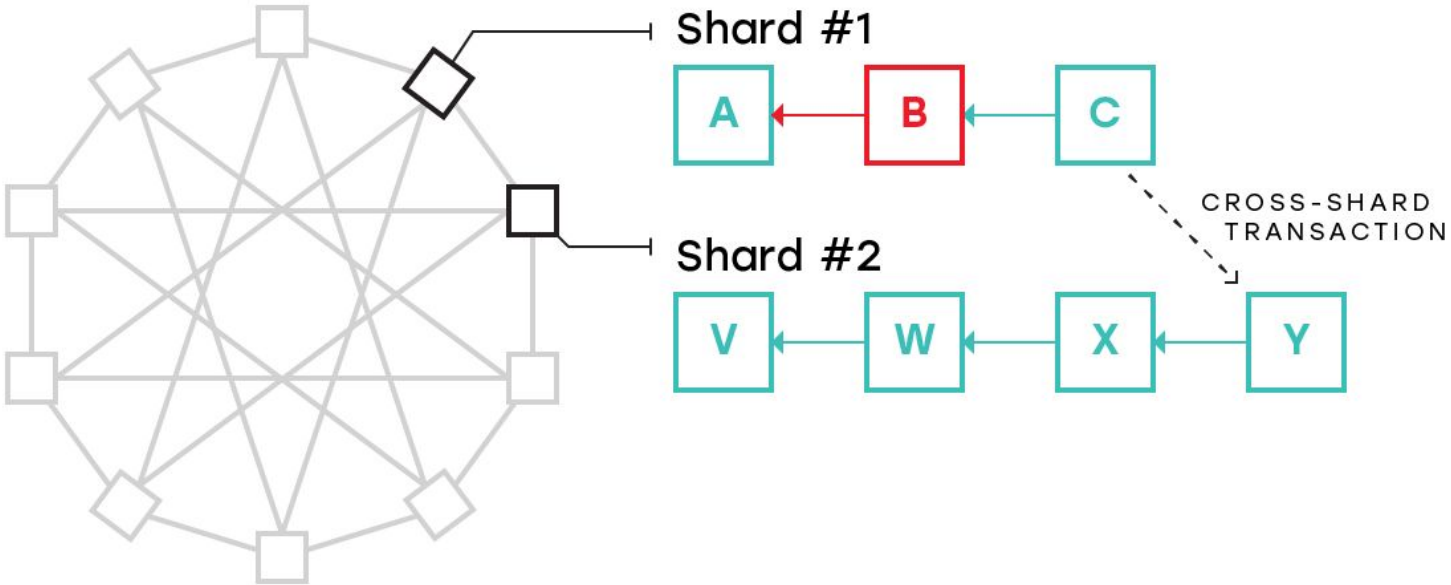
- Alice from Shard#1 sends money to Bob on Shard#2;
- A tx that debits Alice's account is executed on Shard#1;
- A proof of execution (Receipt) is created and sent to Shard#2;
- A tx that credits Bob's account is executed on Shard#2.



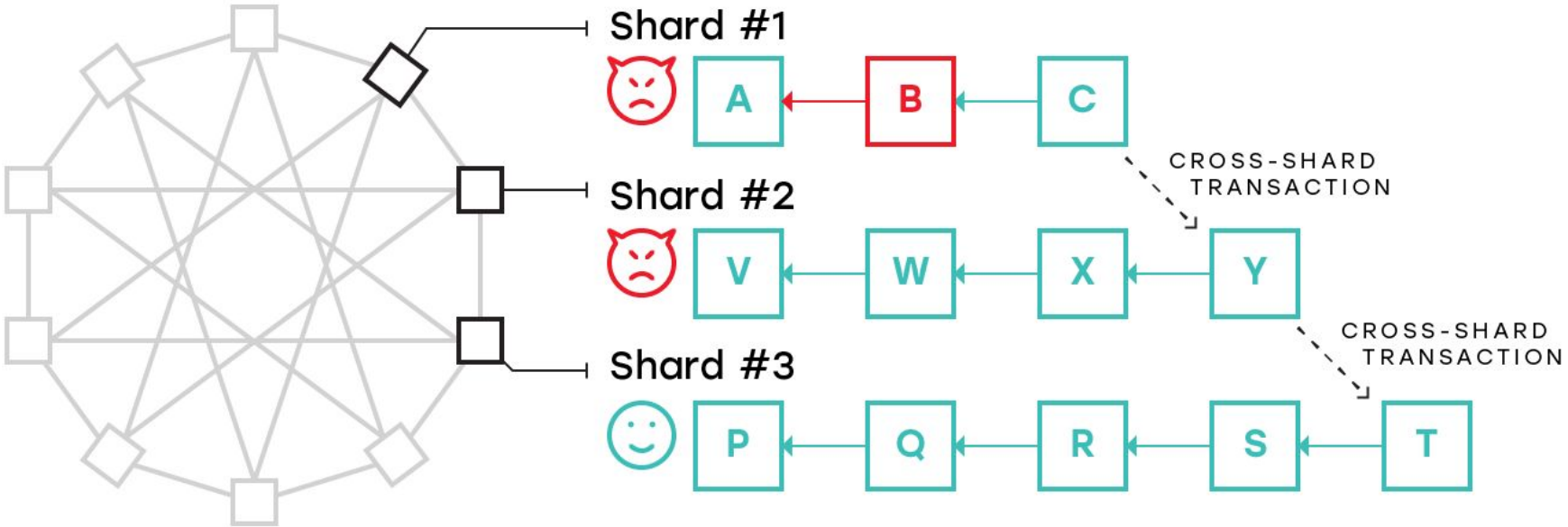
# State Validity



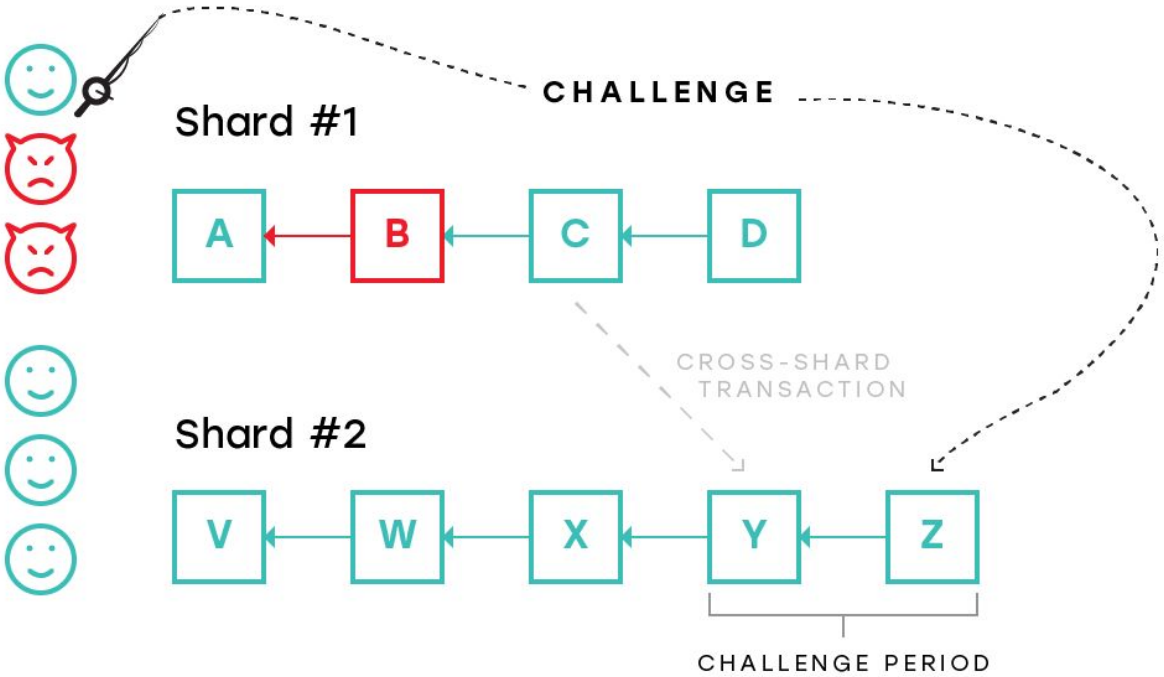
# State Validity



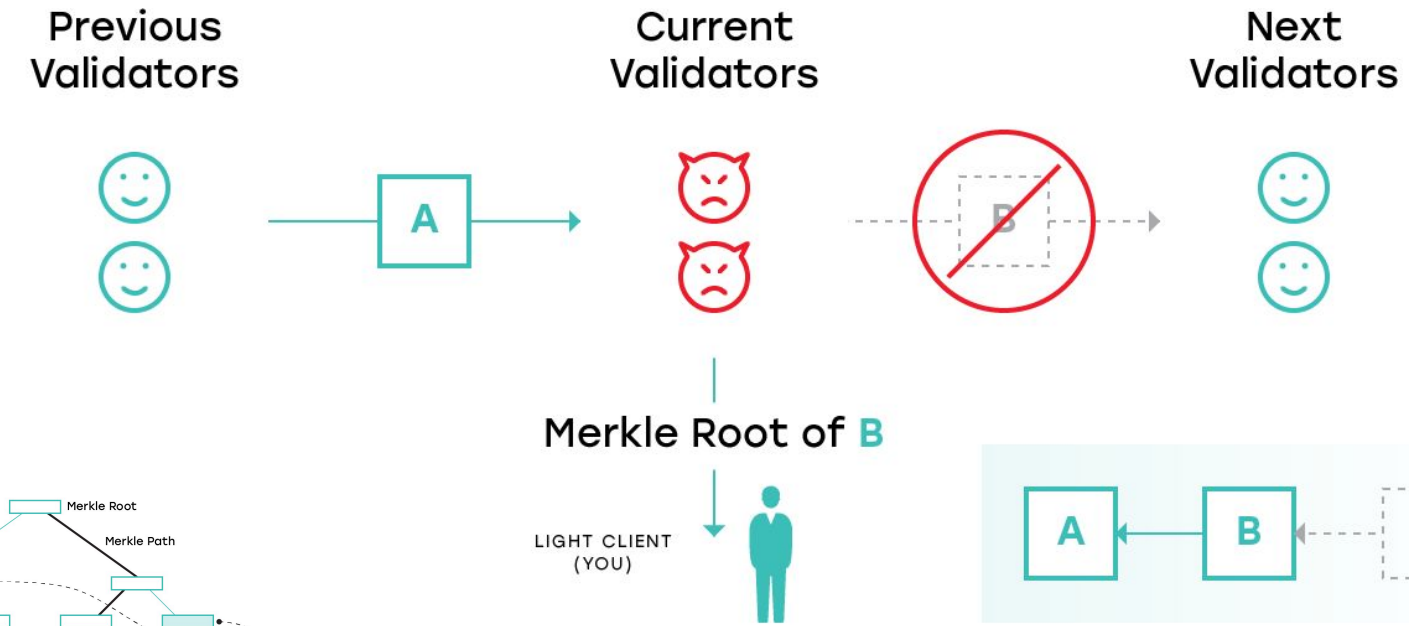
# State Validity

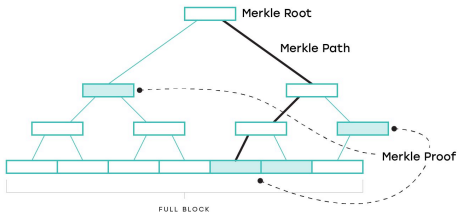


# Fisherman


CHALLENGE
Shard #1
A
B
C
D
CROSS-SHARD
TRANSACTION
Shard #2
V
W
X
Y
Z
CHALLENGE PERIOD

# Data Availability



# Data Availability

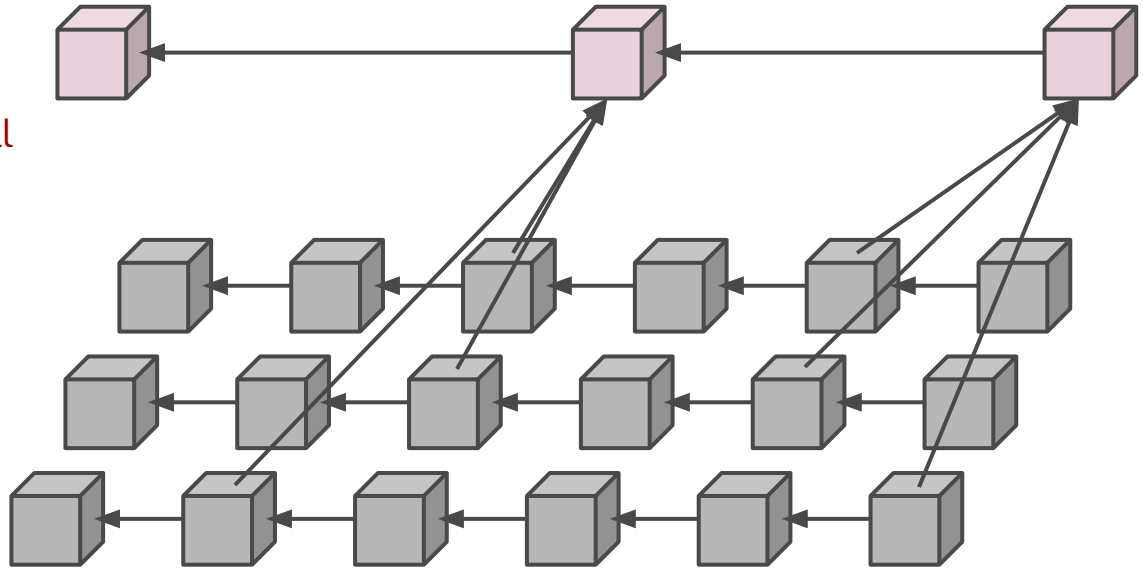
Main Chain

**Light Client**

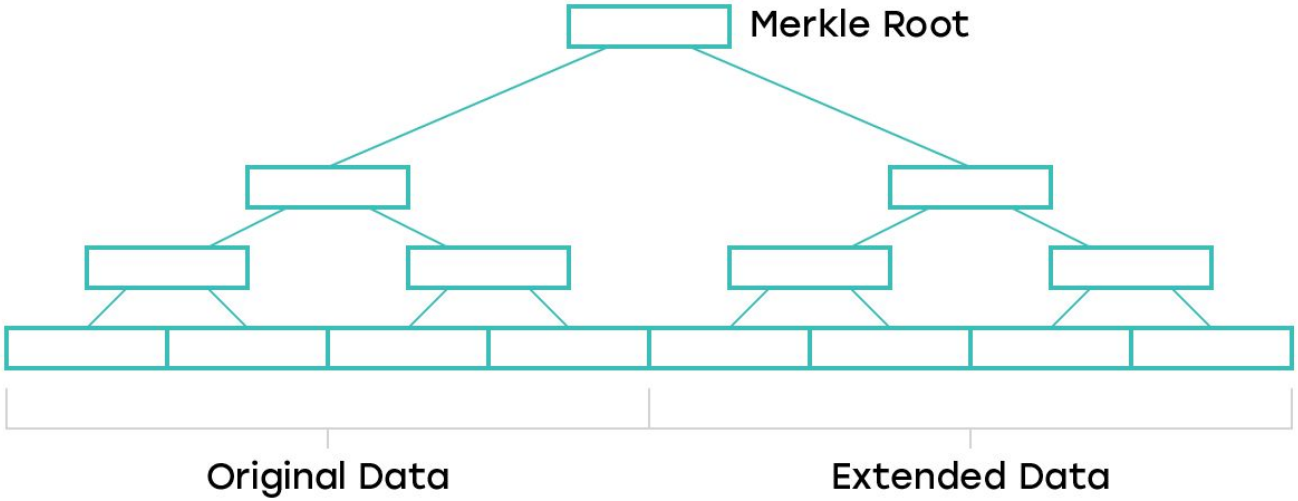
Can't download all the blocks from shard chains

Shard Chains

**Full Nodes**



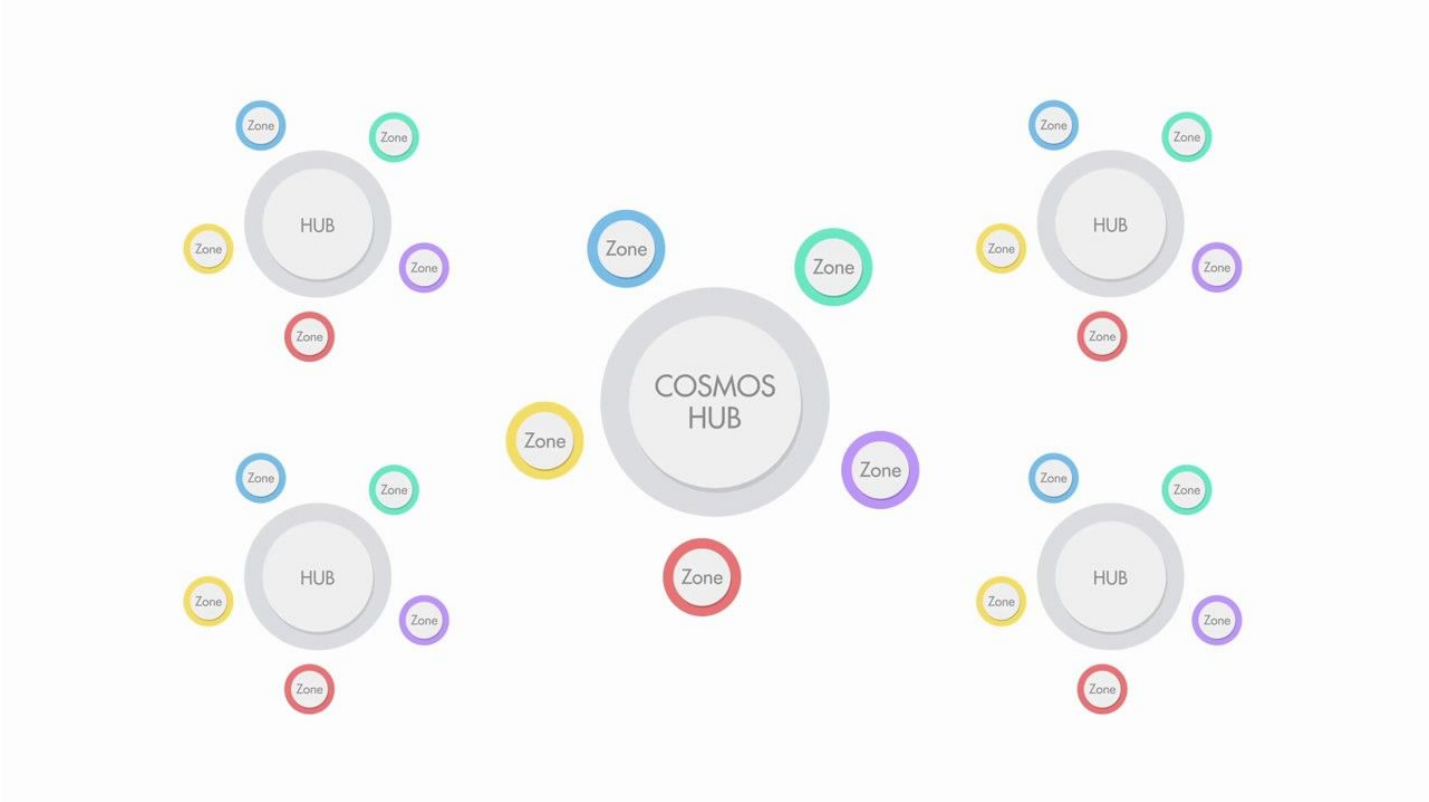
# Data Availability



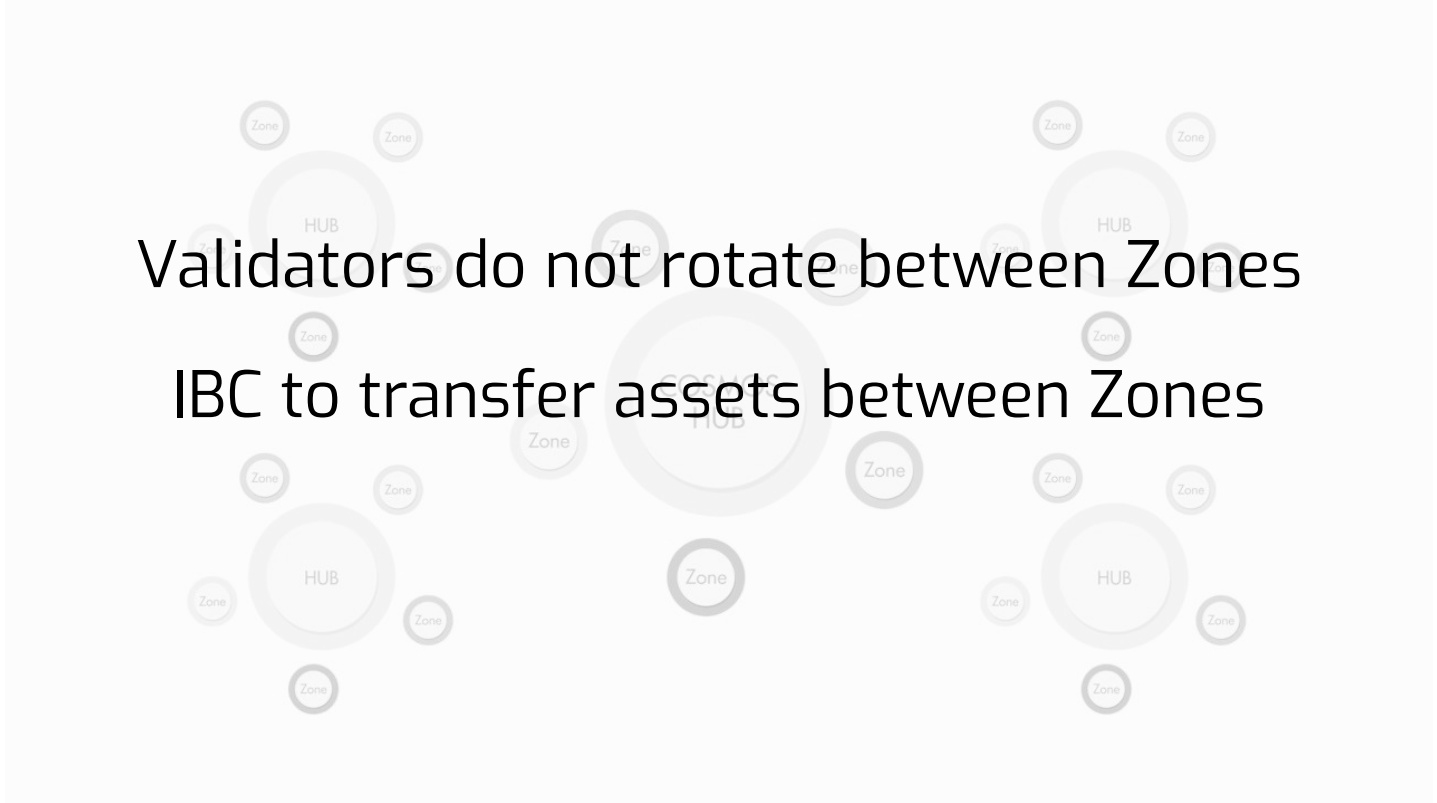

Any n out on 2n are sufficient to reconstruct

# Proposed Protocols

# Cosmos



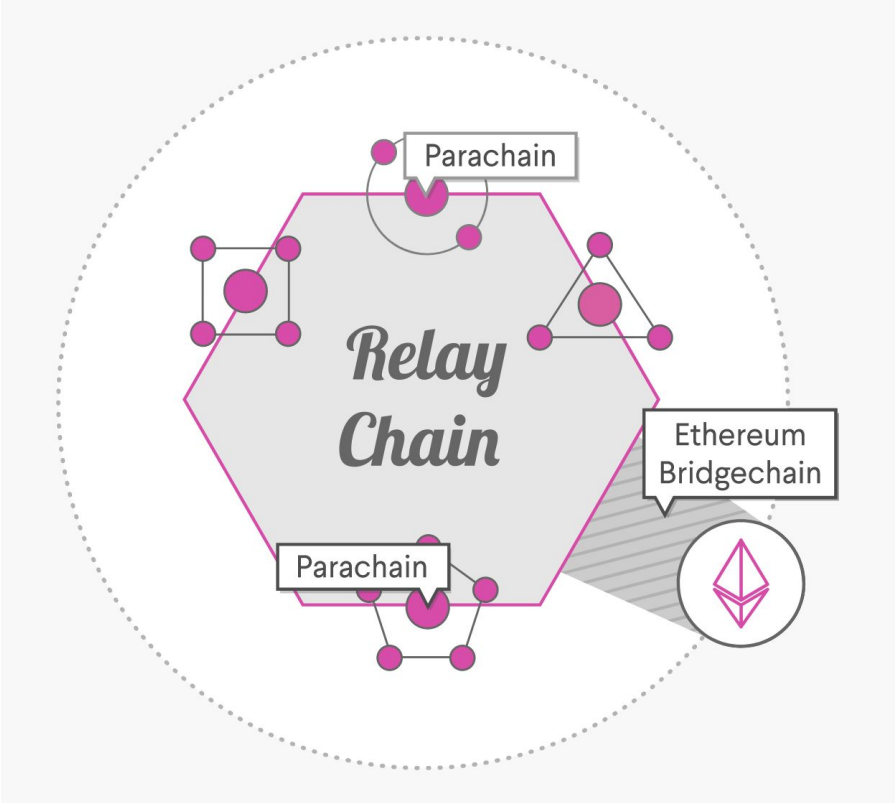
# Cosmos



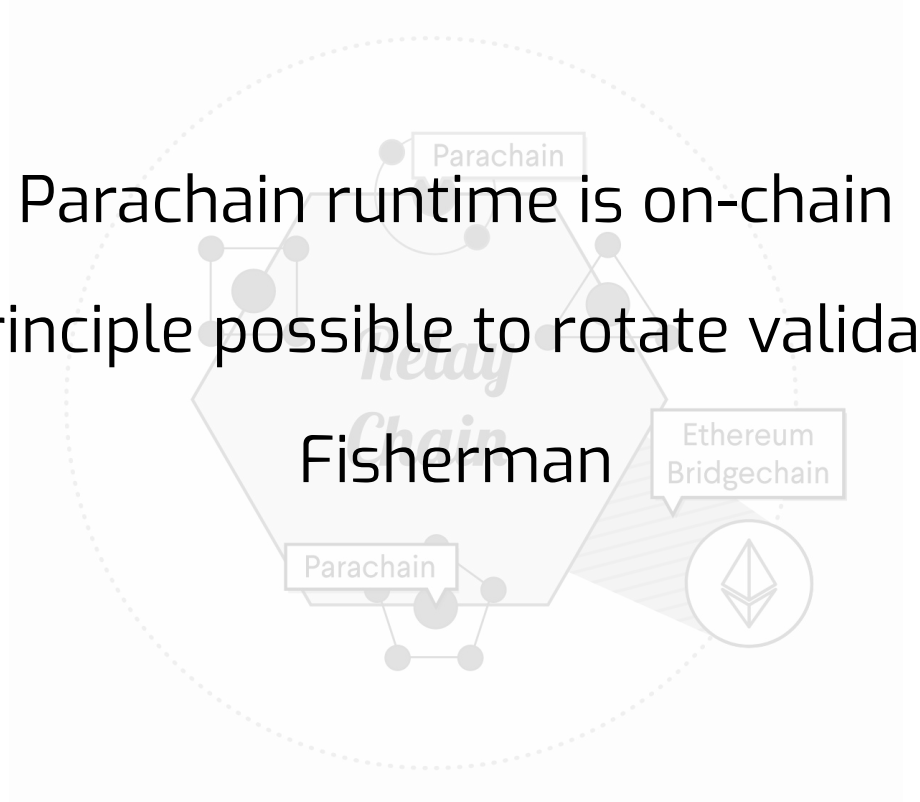

Validators do not rotate between Zones

IBC to transfer assets between Zones

# Polkadot



# Polkadot

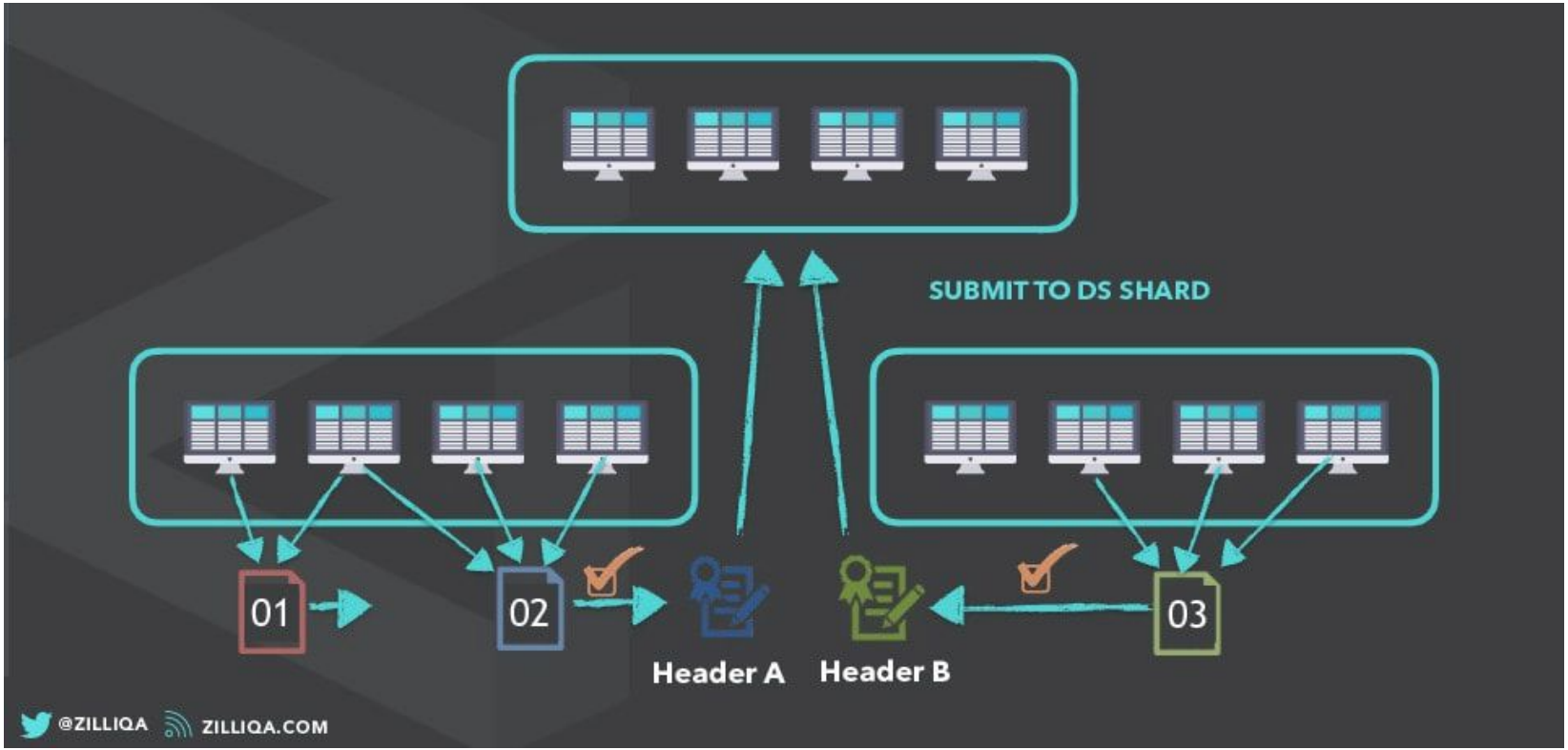



Parachain runtime is on-chain

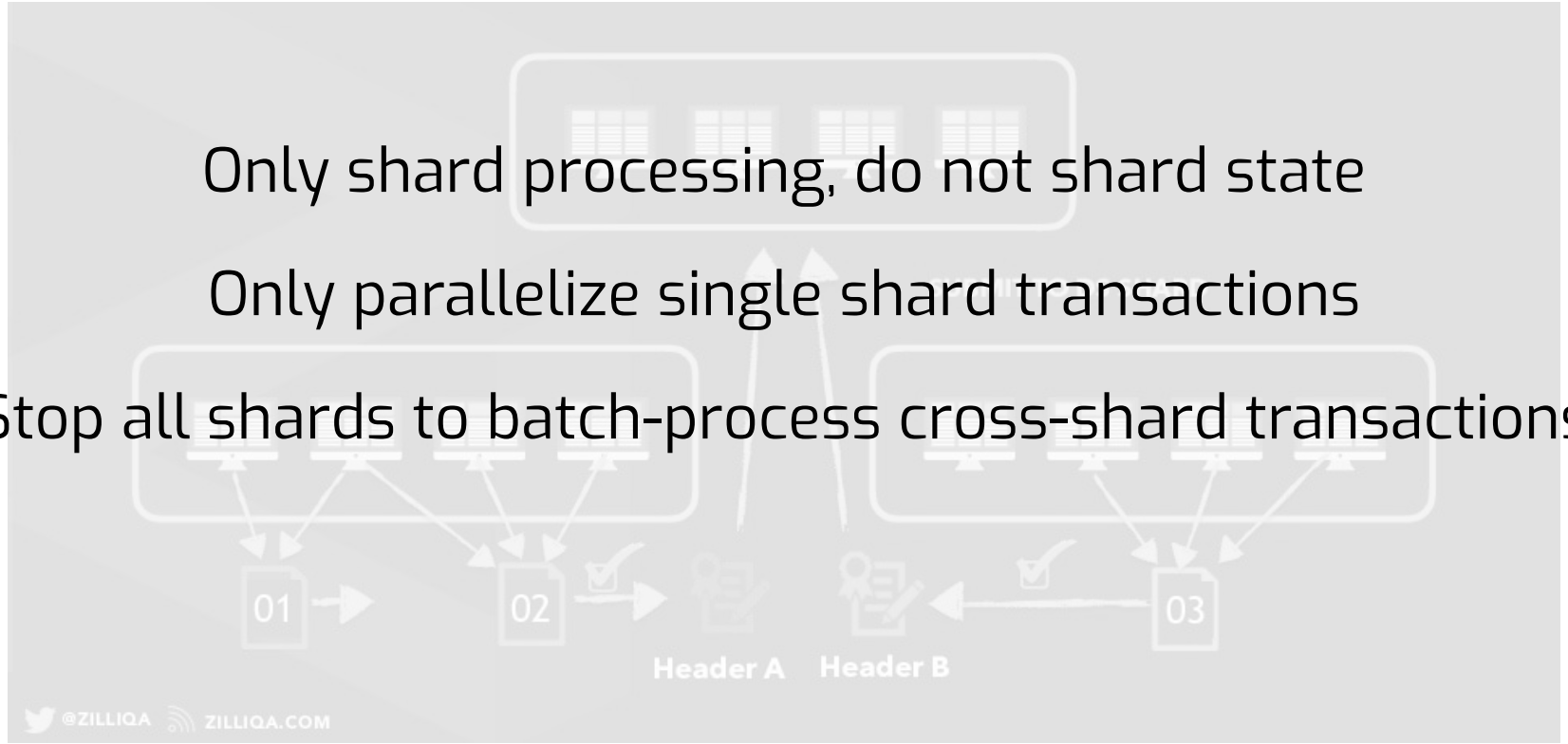
In principle possible to rotate validators

Fisherman

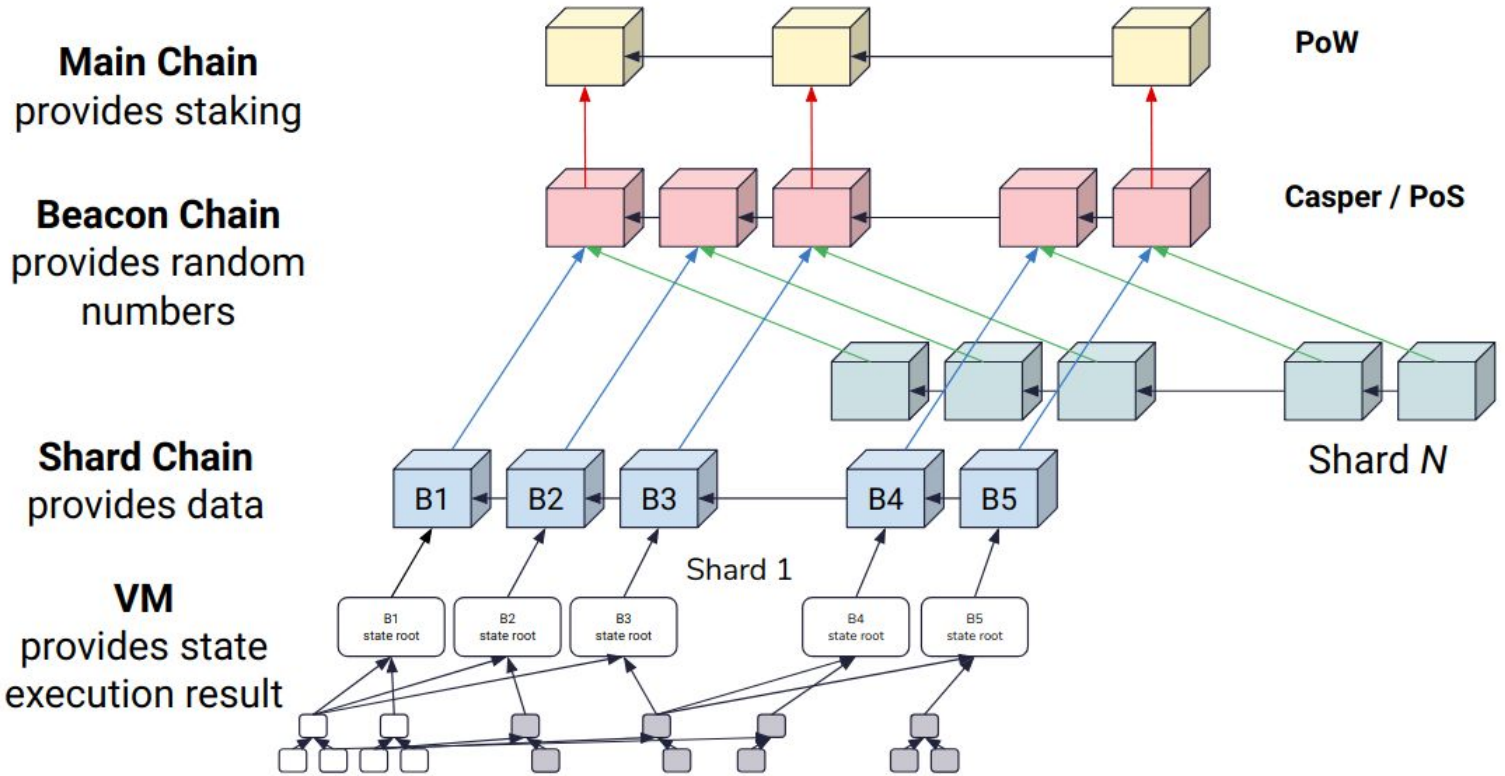
# Zilliqa


SUBMIT TO DS SHARD
01
02
03
Header A
Header B
@ZILLIQA
ZILLIQA.COM

# Zilliqa


Only shard processing, do not shard state
Only parallelize single shard transactions
Stop all shards to batch-process cross-shard transactions
01
02
03
Header A
Header B
@ZILLIQA
ZILLIQA.COM

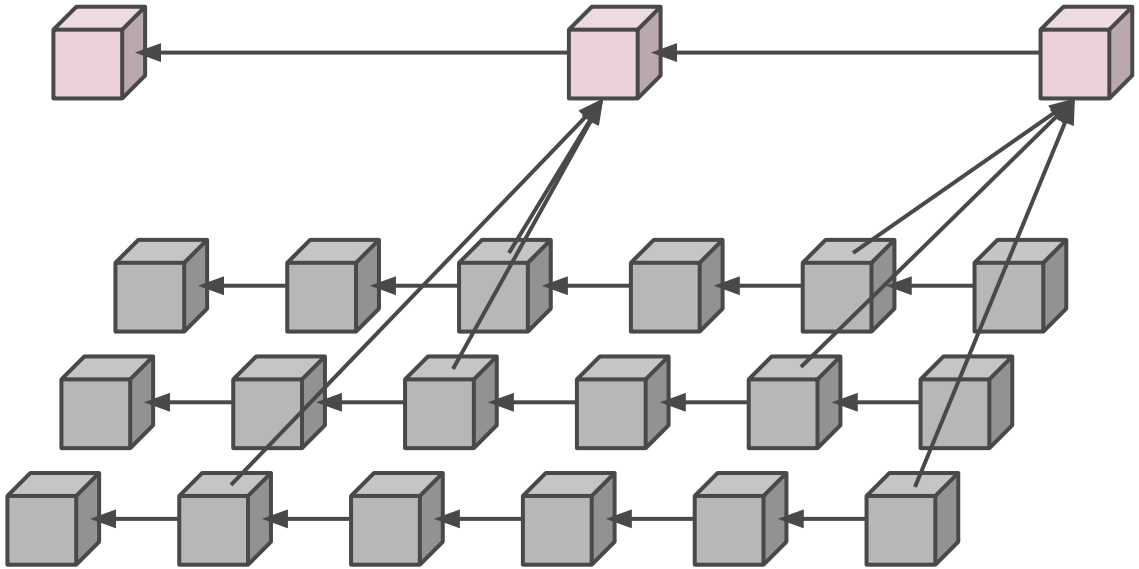
# Ethereum Serenity



# Near Protocol

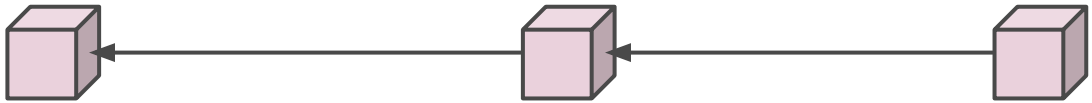
**Main Chain**

**Shard Chains**



# Near Protocol vs Ethereum Serenity

**Main Chain**



Ethereum: **GHOST** + Casper FFG among **all validators**

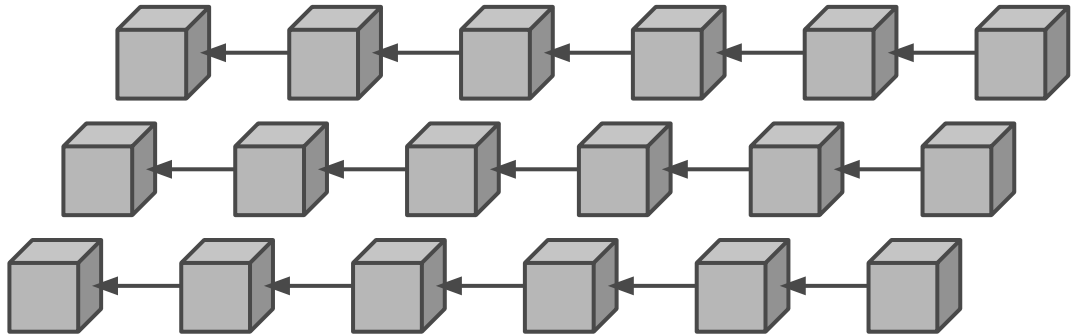
Near: **Doomslug**, validators rotate every epoch, (it's a setting)

# Near Protocol vs Ethereum Serenity

Ethereum: Proposers + Attesters + Cross-linking

Near: Fast finality (roughly 3 seconds)

**Shard Chains**



# Crypto/business

# Why are we doing any of this in the first place?

- PoW → PoS → DPoS → Sharded DPoS
- Locking value? Insurance? Supply chain?
- Interesting promises from early Eth
  - DAOs
  - Programmable Money
  - New business models

# Behavior

As it relates to crypto

# Behavior

As it doesn’t relate to crypto

# Thank You

Check out code

- http://near.dev -- example apps
- http://github.com/nearcore -- core chain code

Whiteboard Series (Cosmos, Solana, Ontology, more to come...)

- http://near.ai/youtube

Code is open, all the discussions are public

- http://near.chat
- Nightshade: https://near.org/papers/nightshade/ and https://nomicon.io/ChainSpec/Consensus.html