

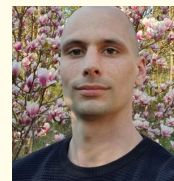
Kudzu

Fast and Simple High-Throughput BFT

Yann Vonlanthen
Ethereum Foundation



Victor Shoup
Offchain Labs

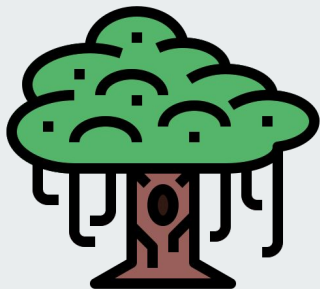


Jakub Sliwinski
Anza

last year at IC3
winter retreat

Banyan: Fast Rotating Leader BFT

Yann Vonlanthen, Jakub Sliwinski, Massimo Albarello, and Roger Wattenhofer



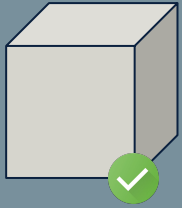


Atomic Broadcast

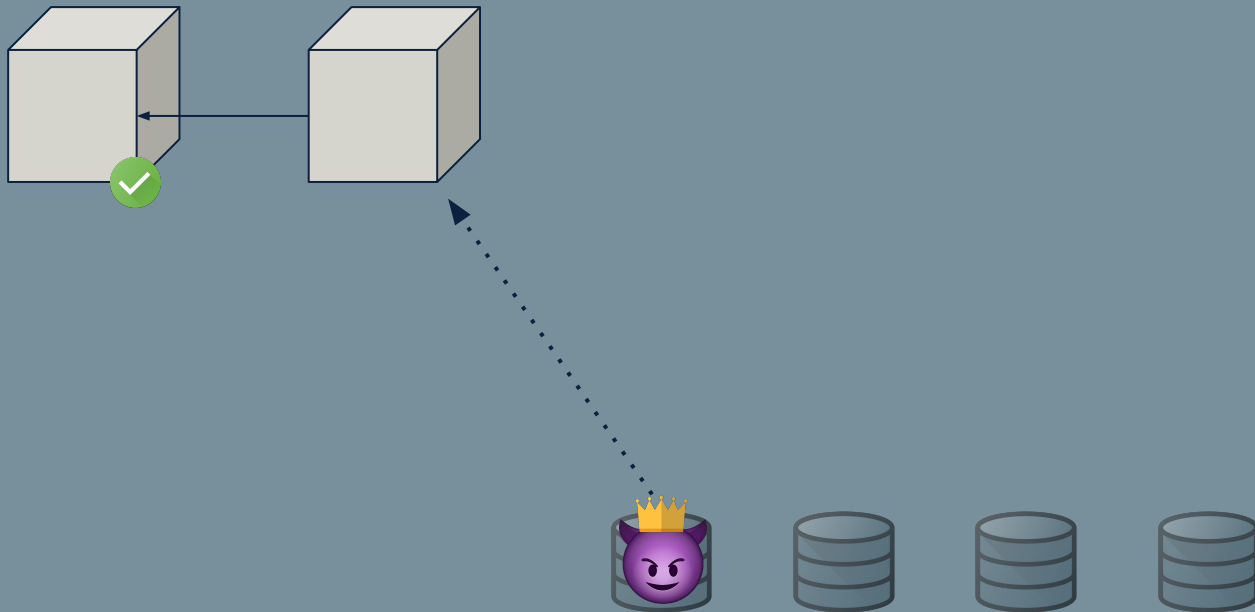


$$n \geq 3f + 1$$

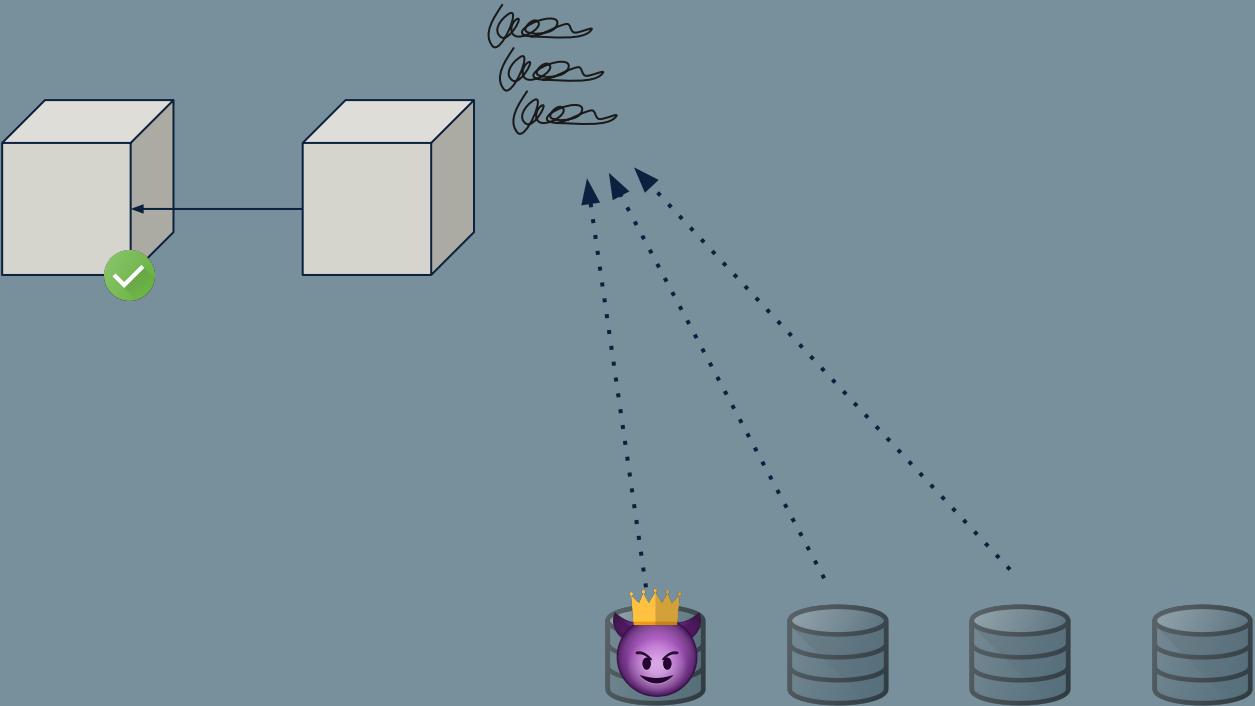
Simplex



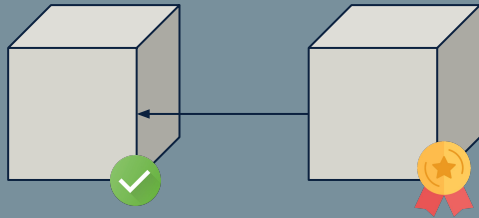
Simplex



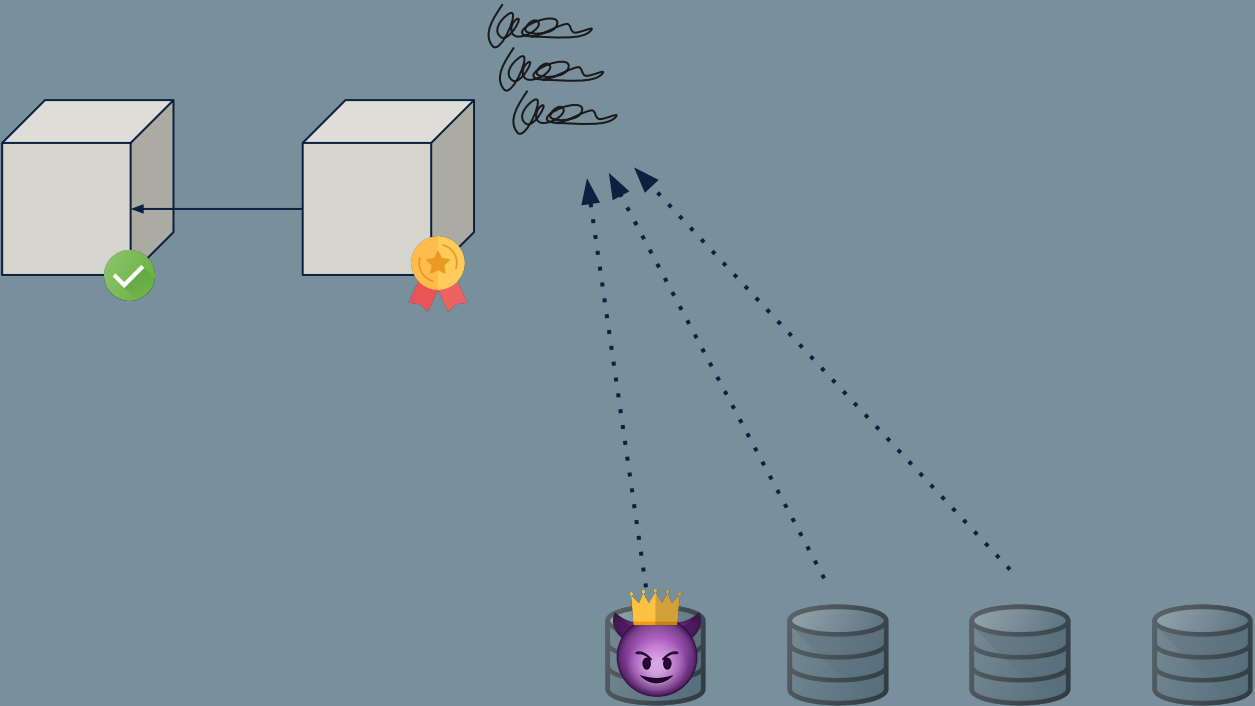
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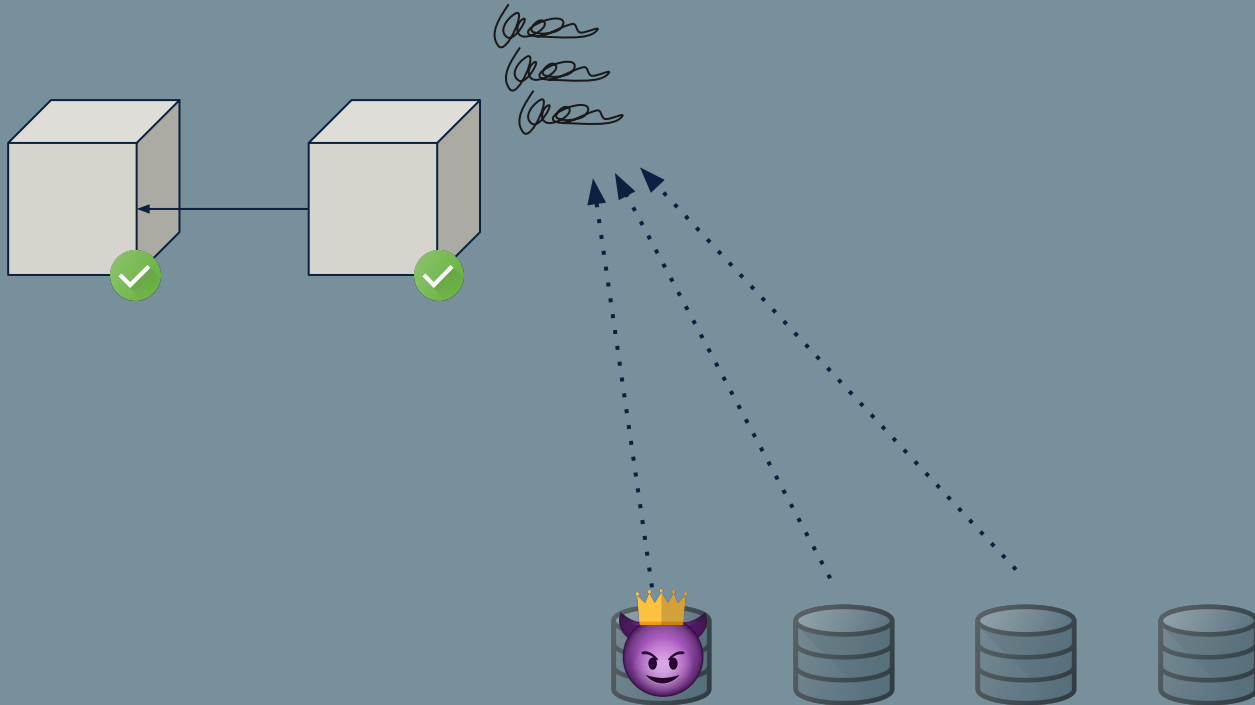
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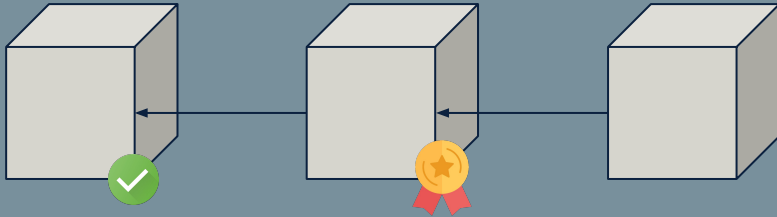
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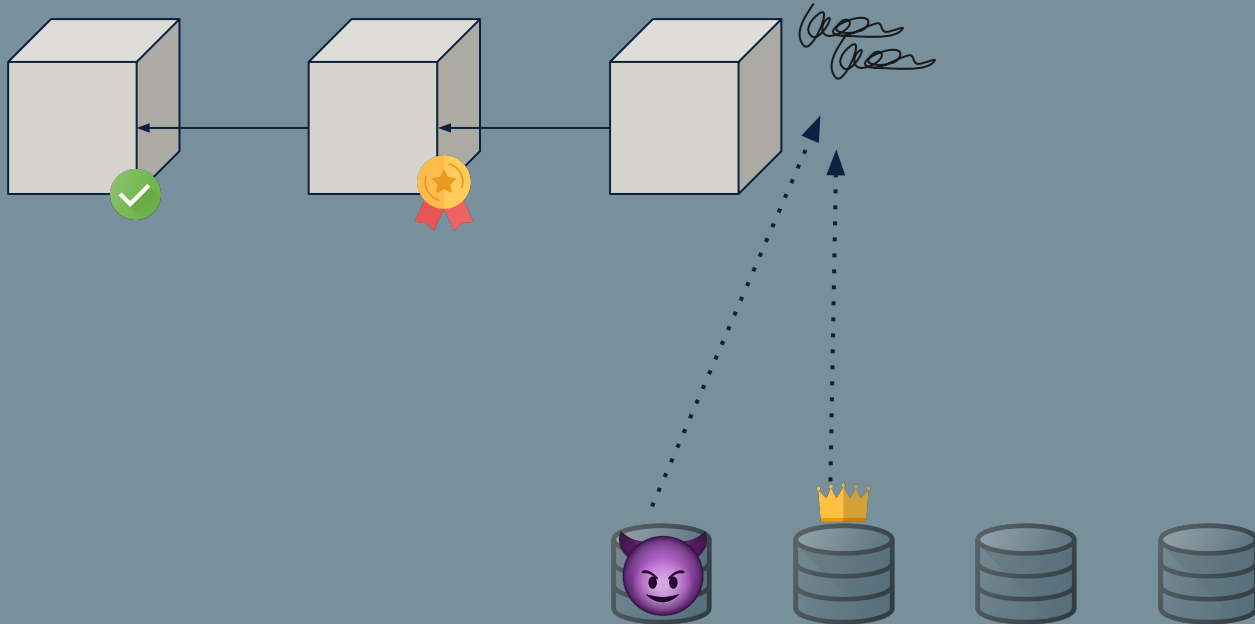
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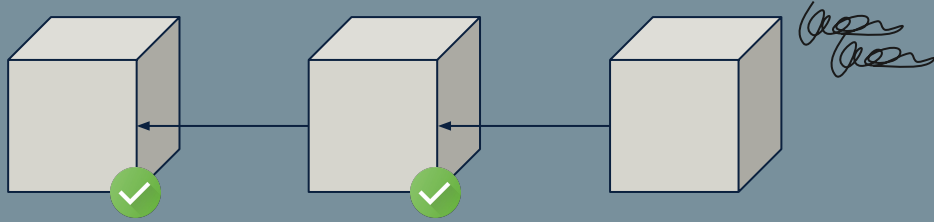
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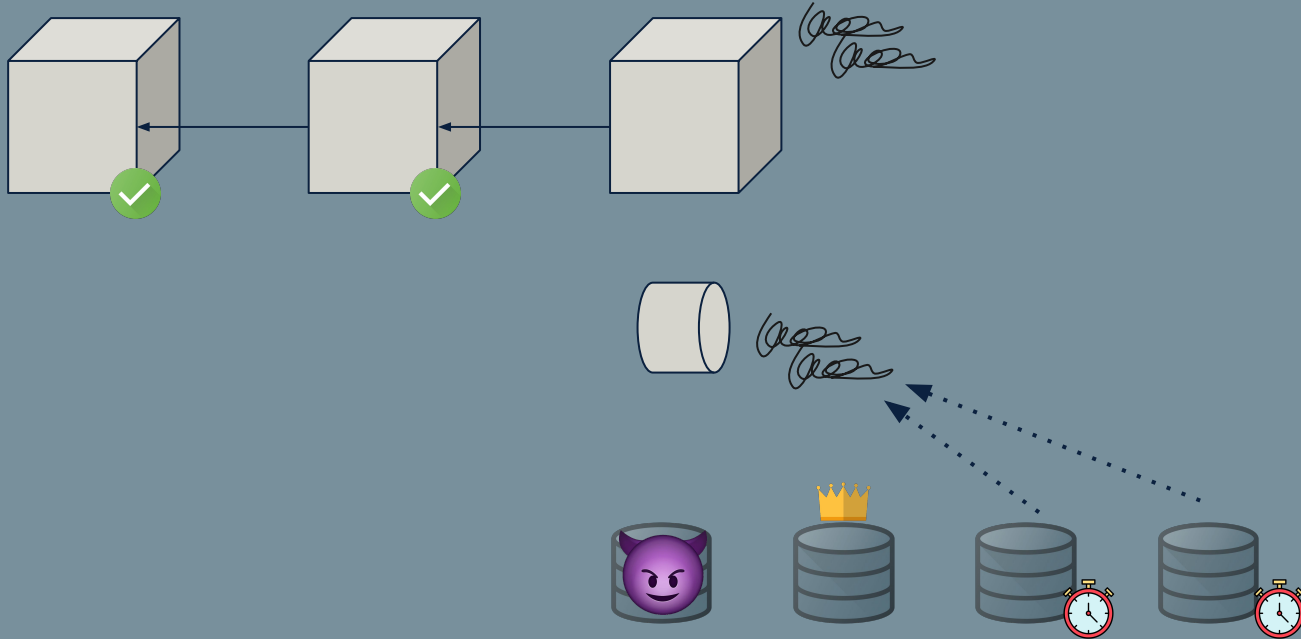
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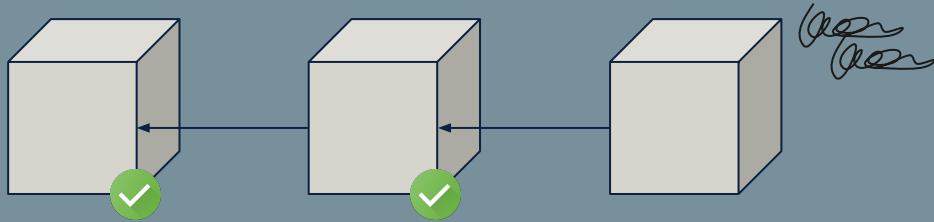
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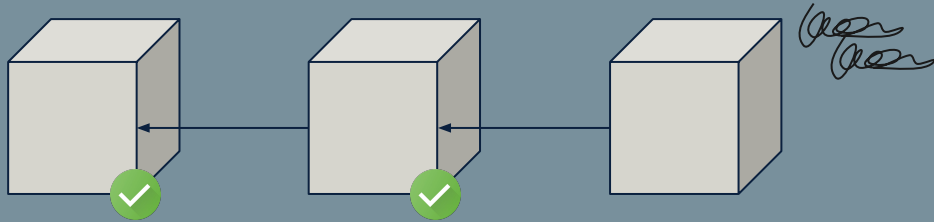
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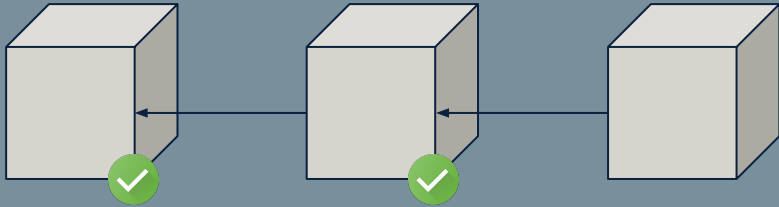
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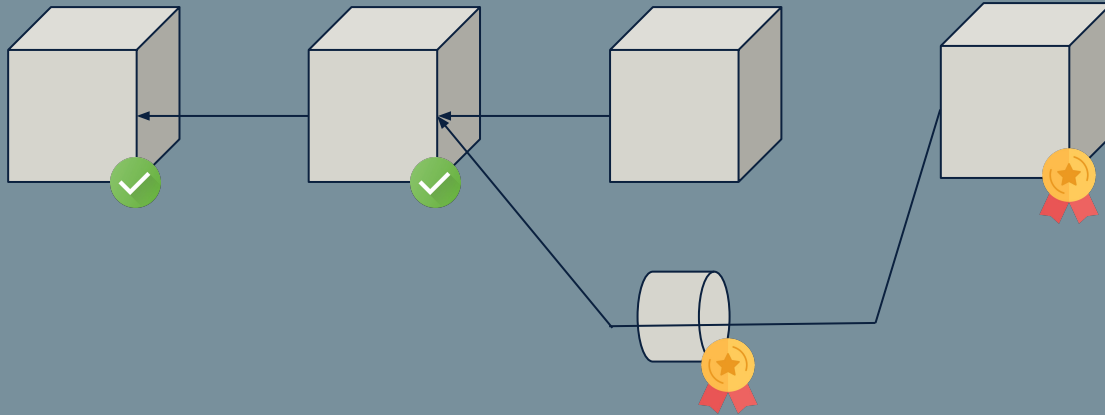
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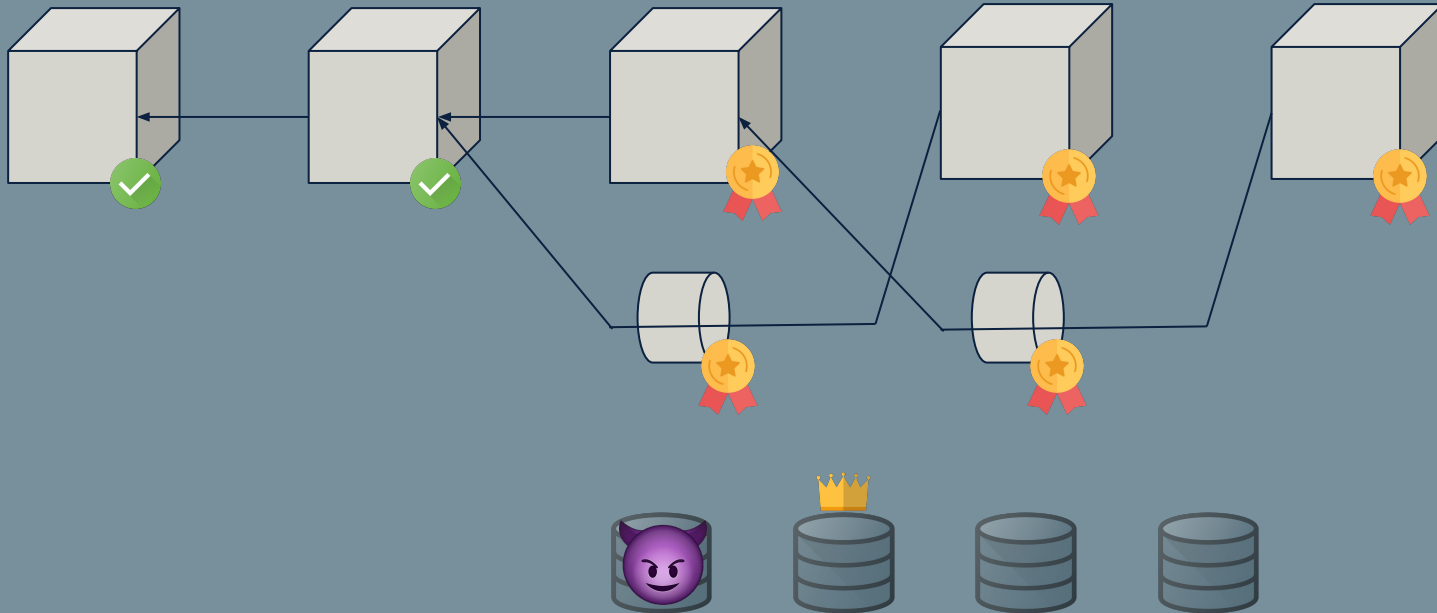
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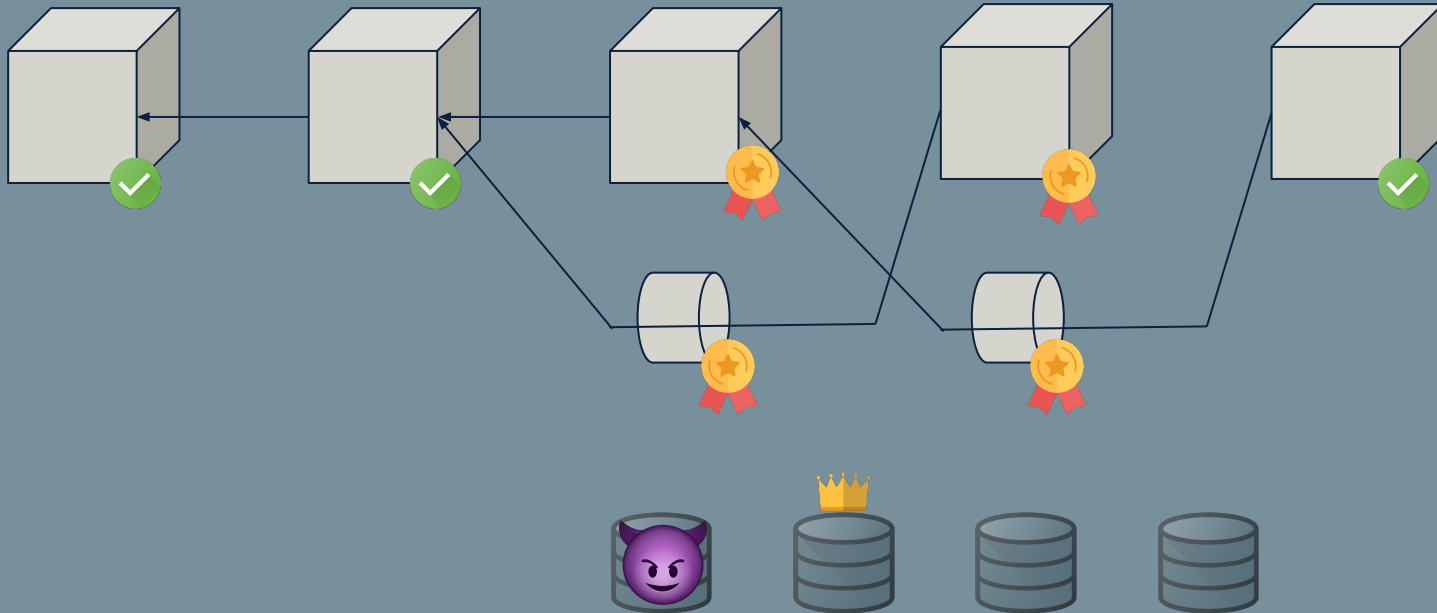
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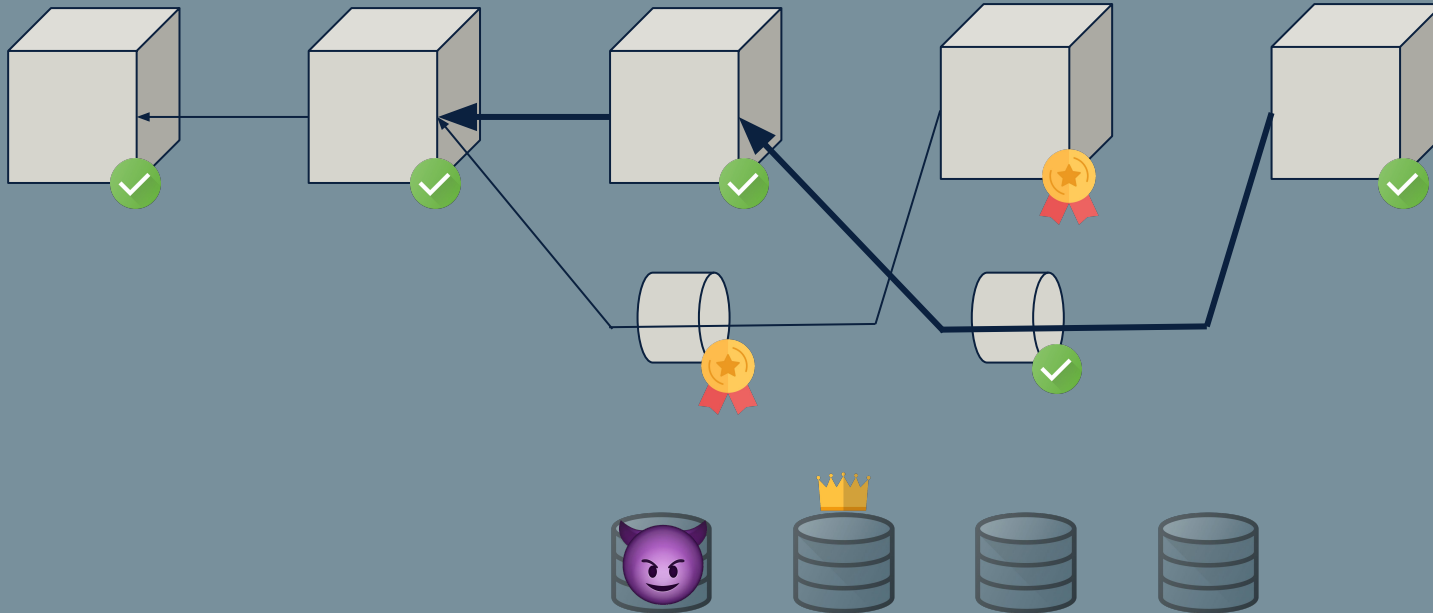
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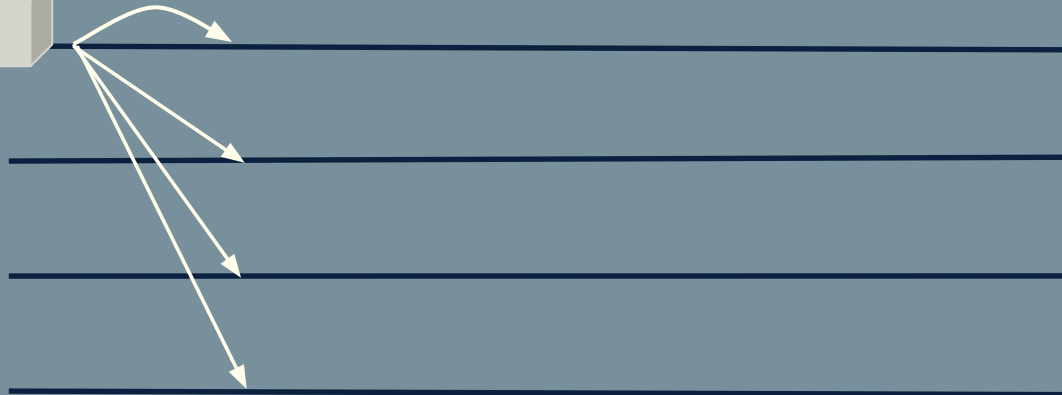


Simplex

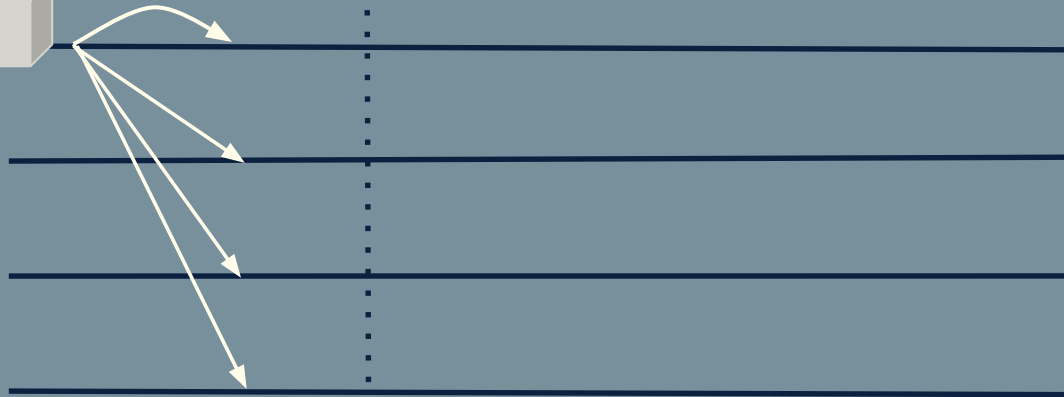


Simplex

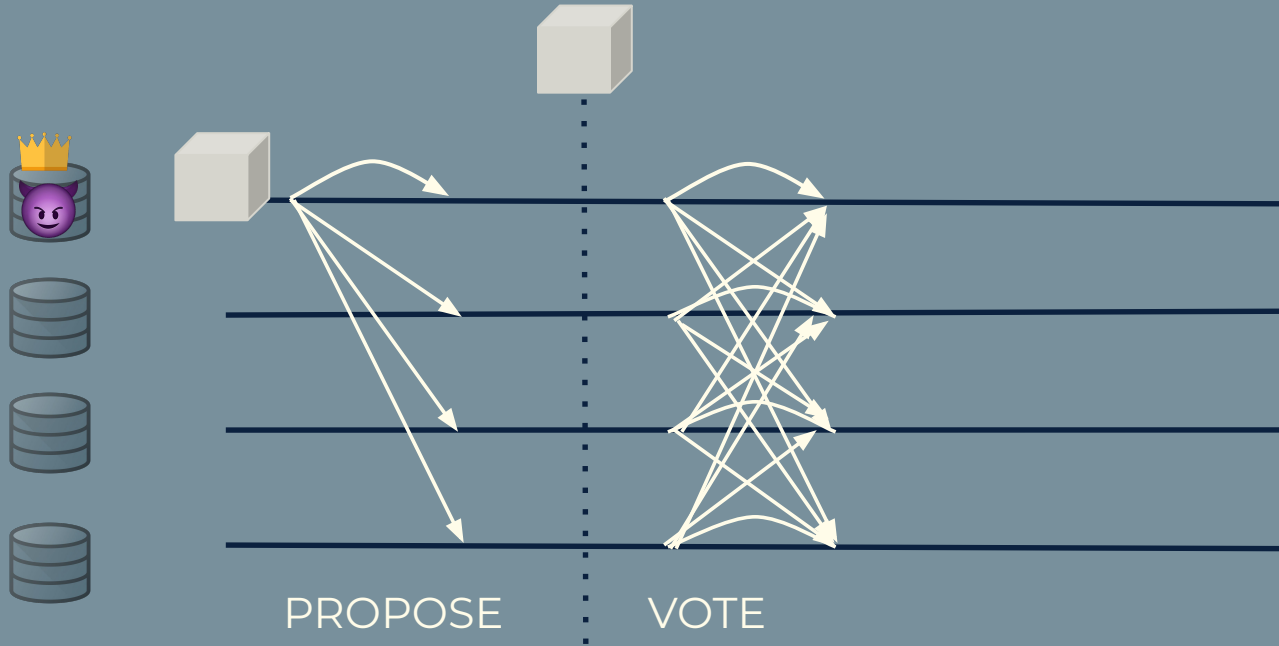




PROPOSE

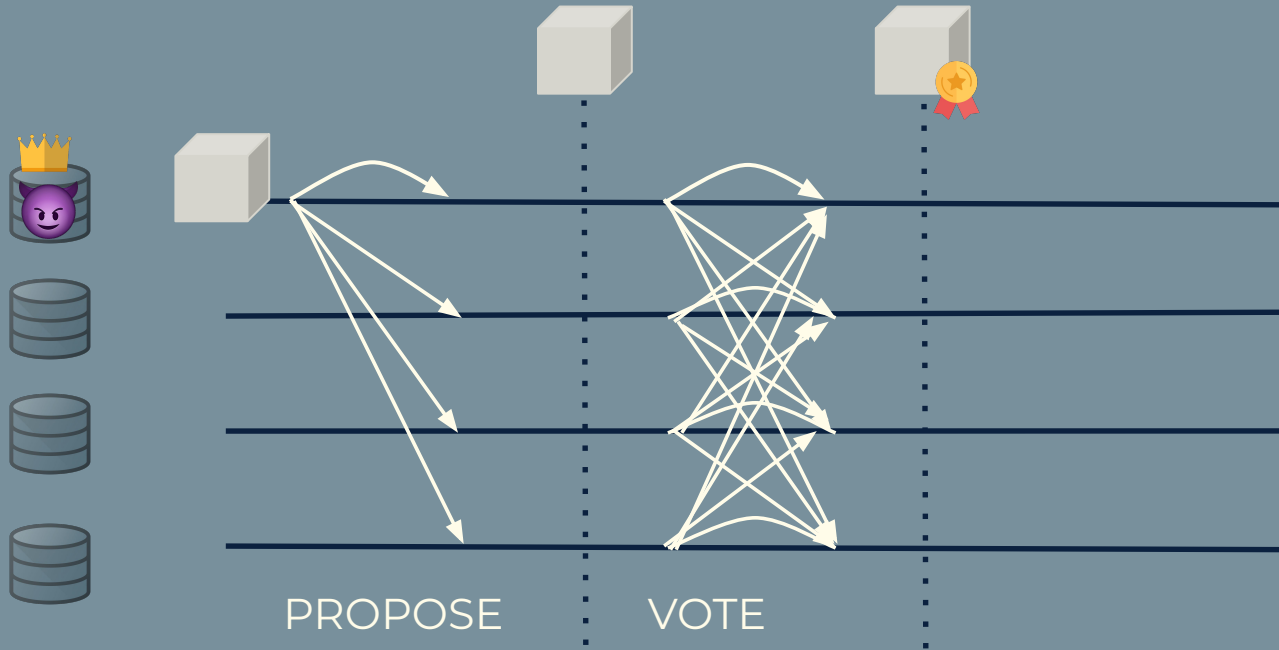


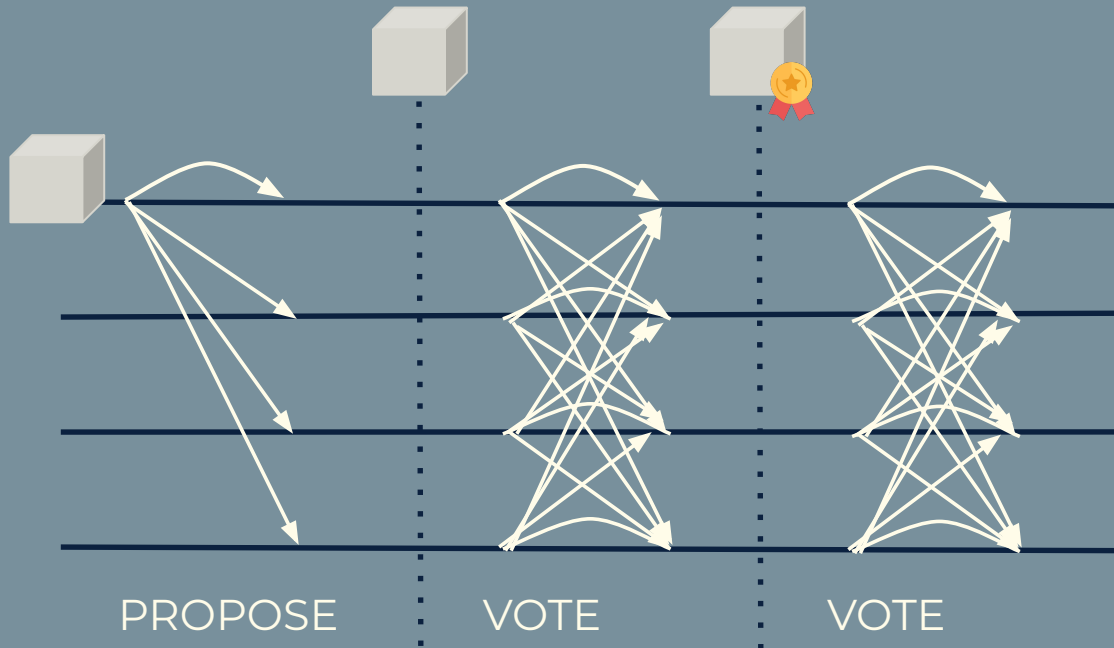
PROPOSE

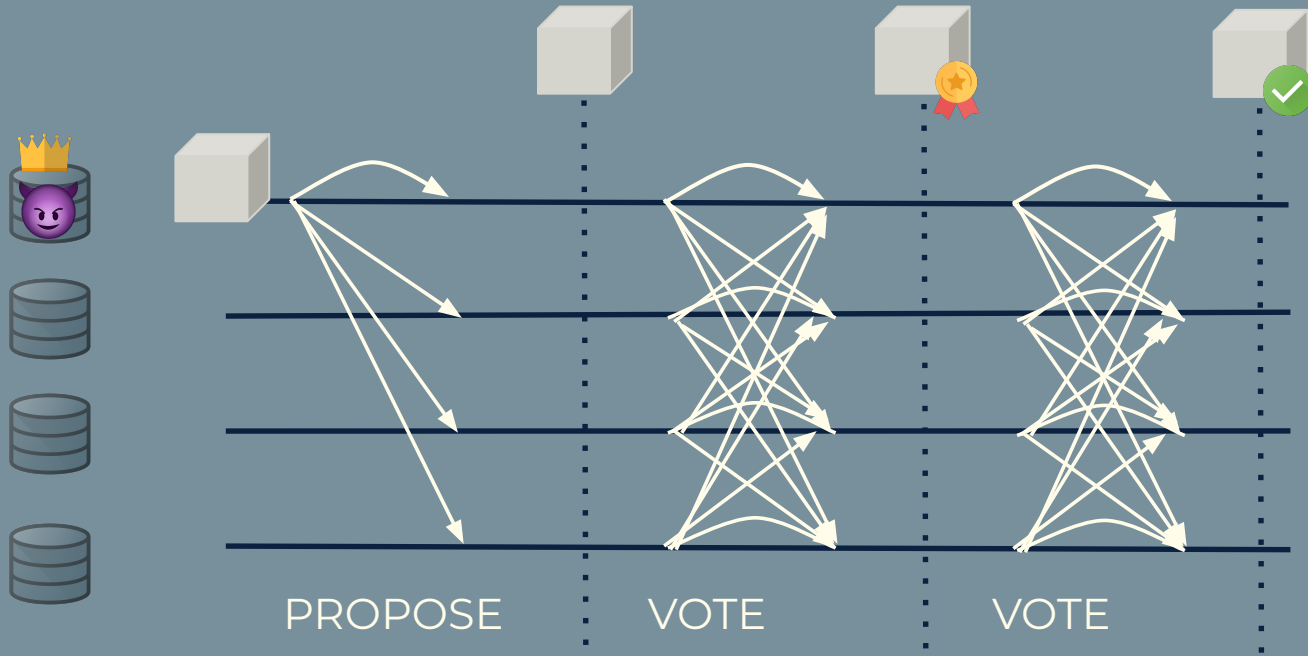


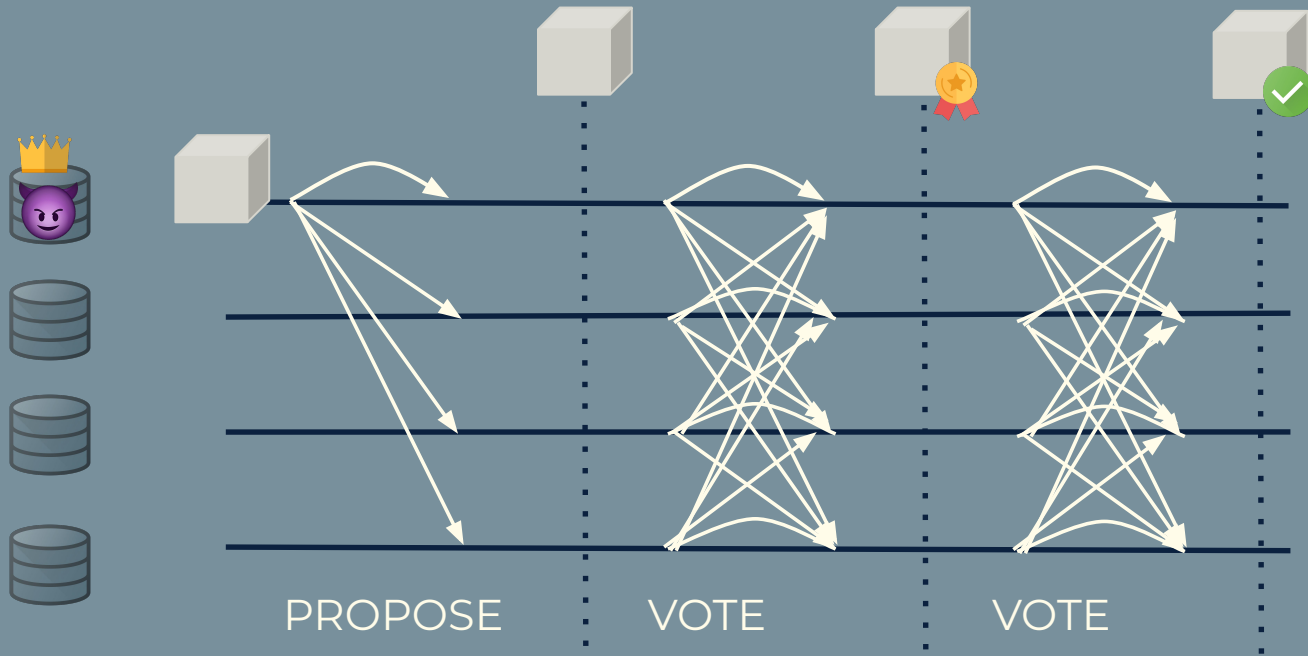
PROPOSE

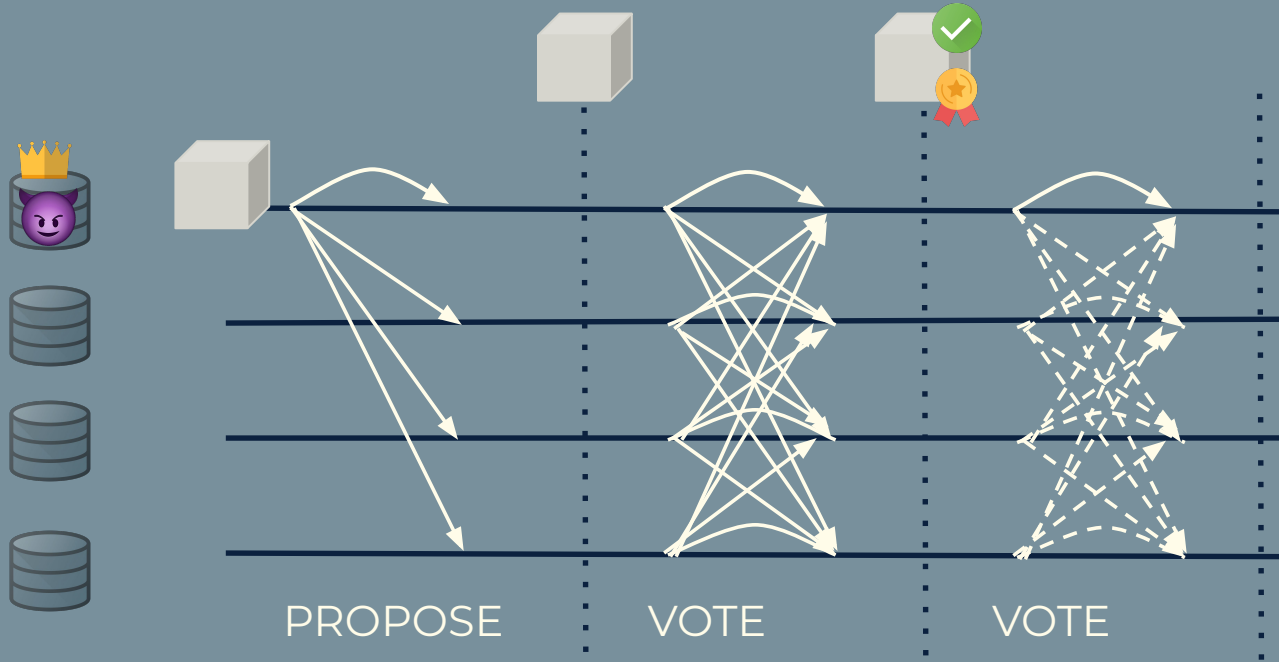
VOTE

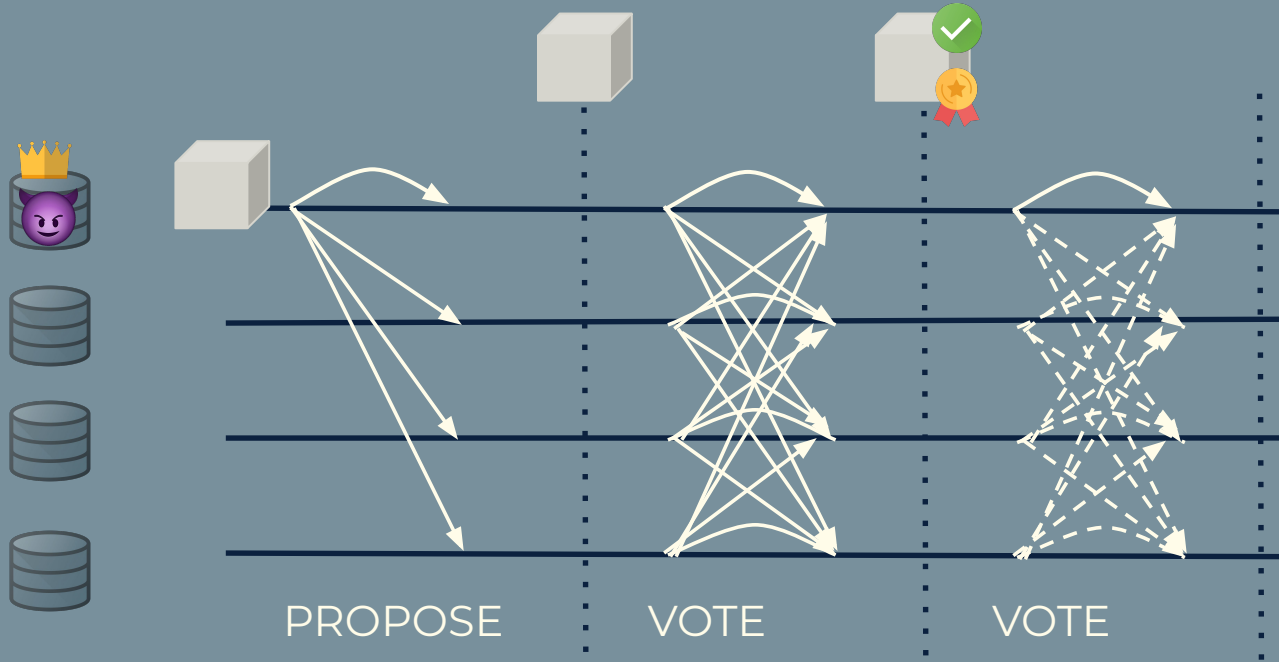












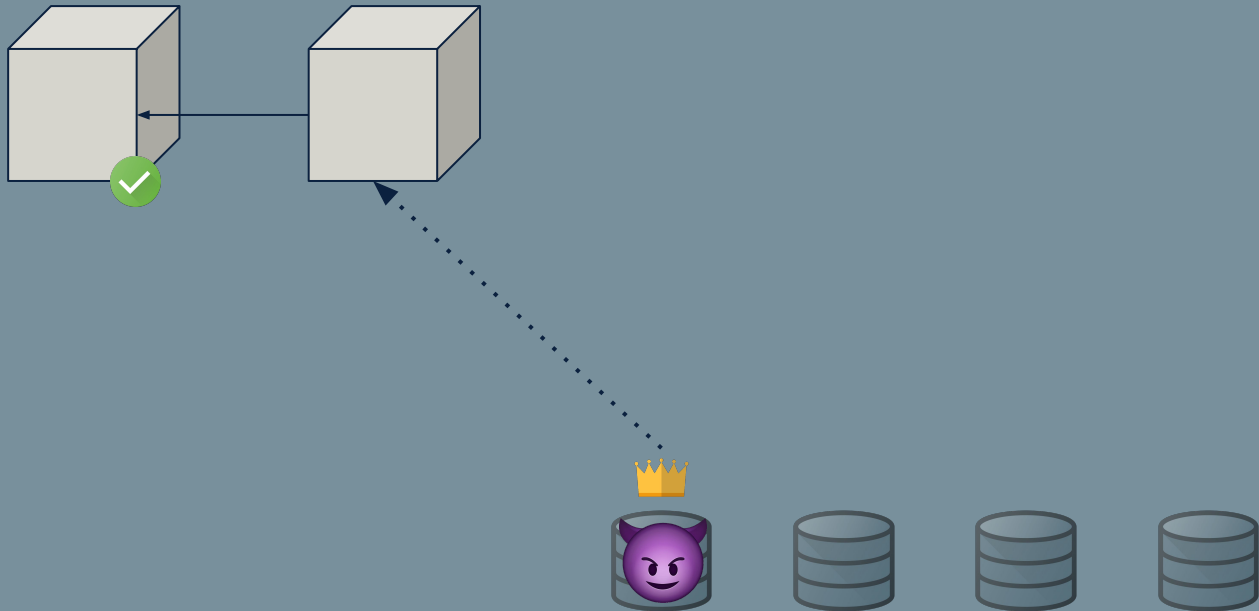
2-step finality!



$$n \geq 3f + 2p + 1$$

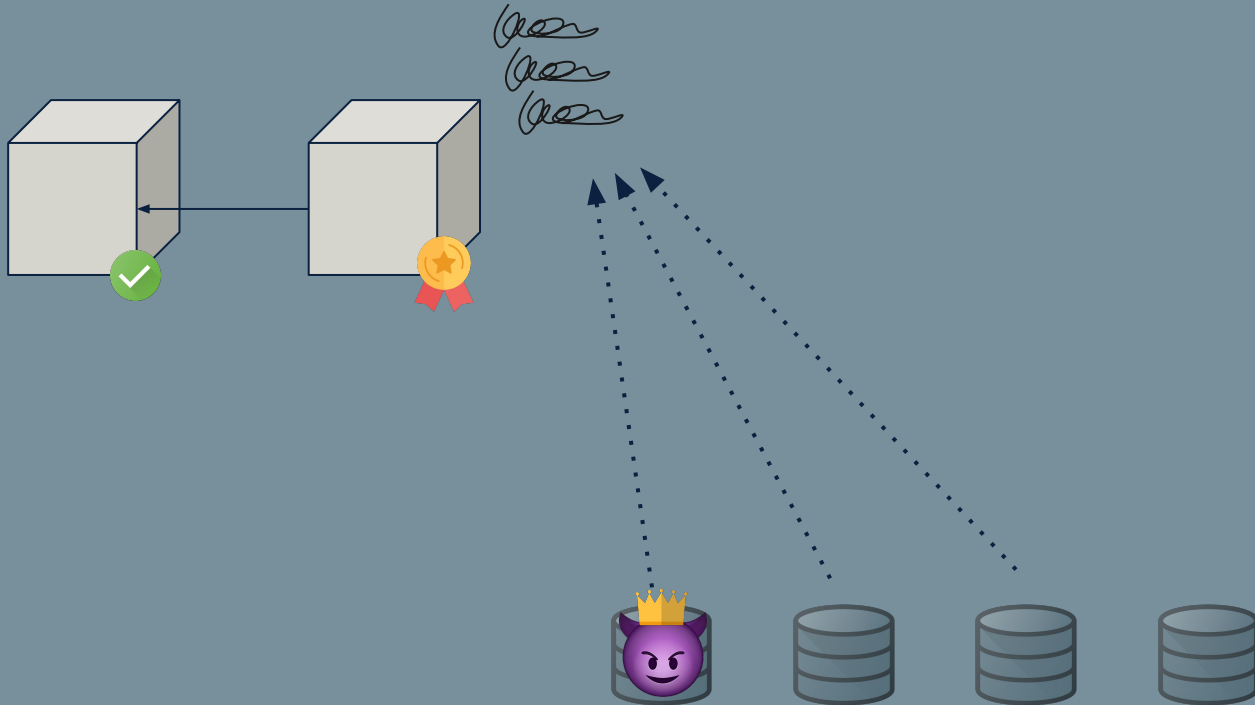
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 └──┬──┘ └──┬──┘
 👹 ⚡

Kudzu



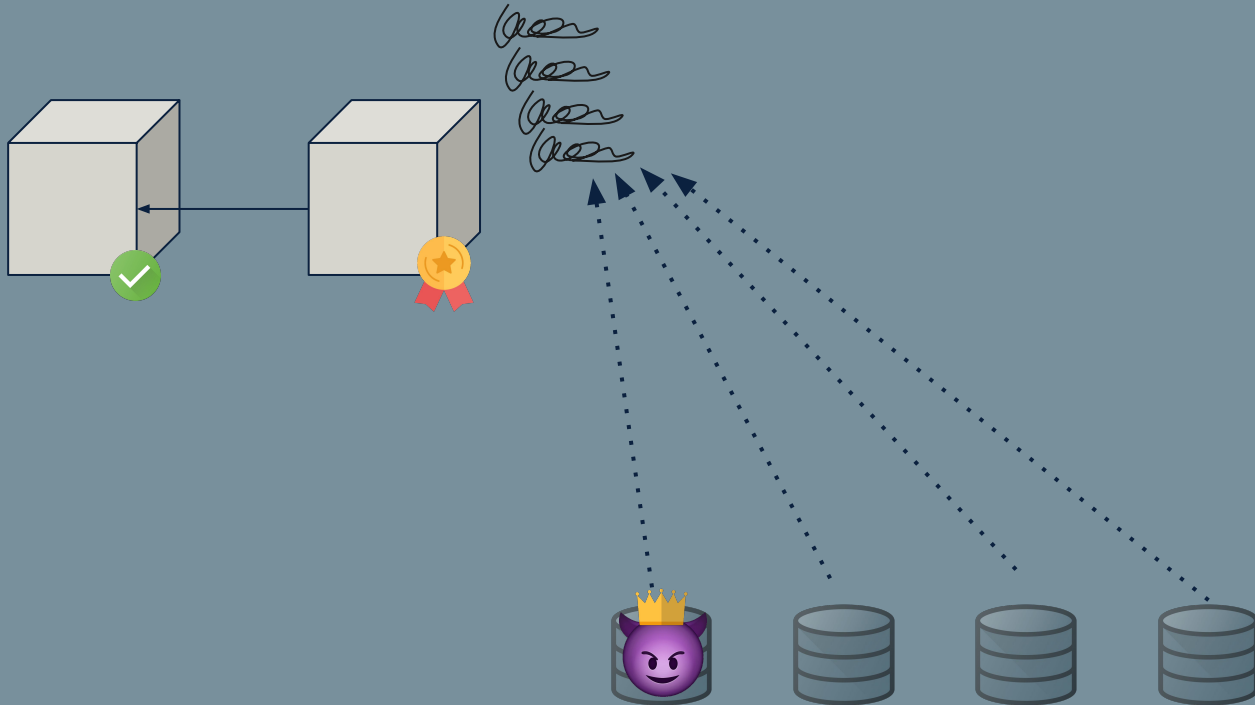


Kudzu

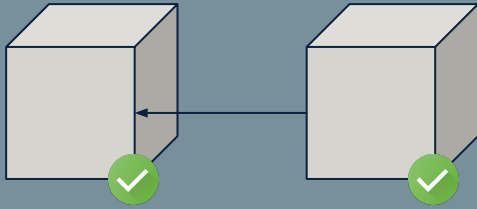




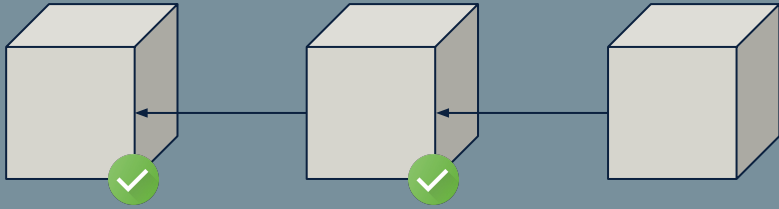
Kudzu



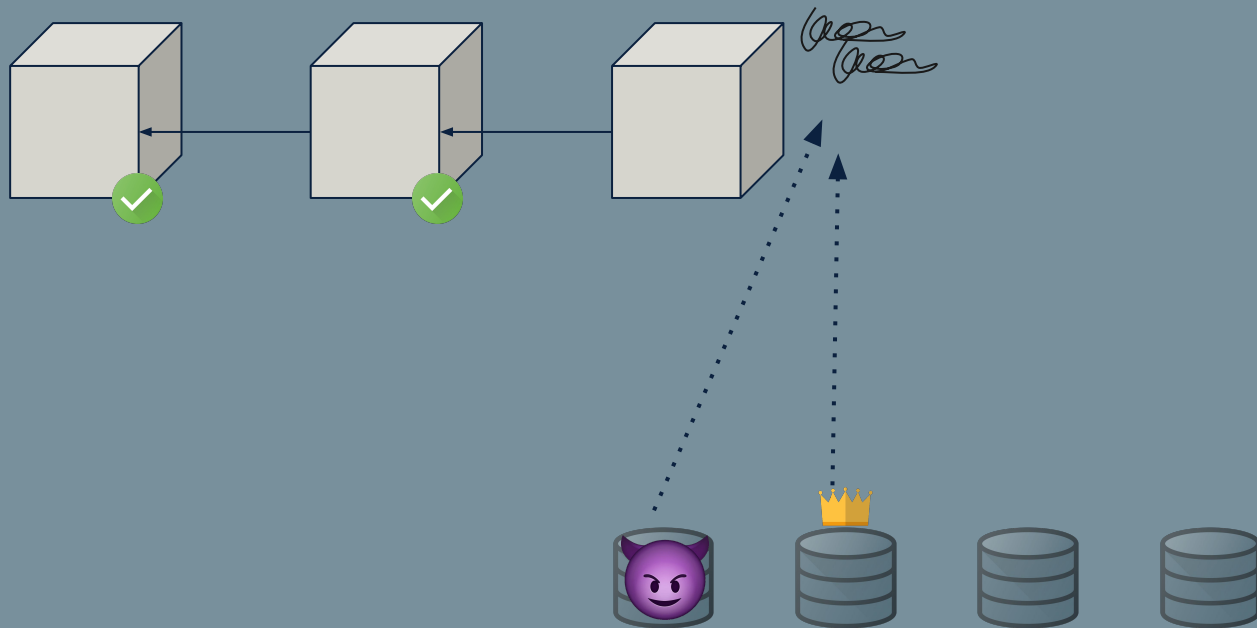
Kudzu



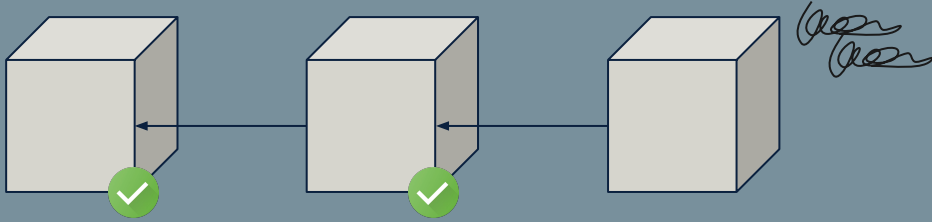
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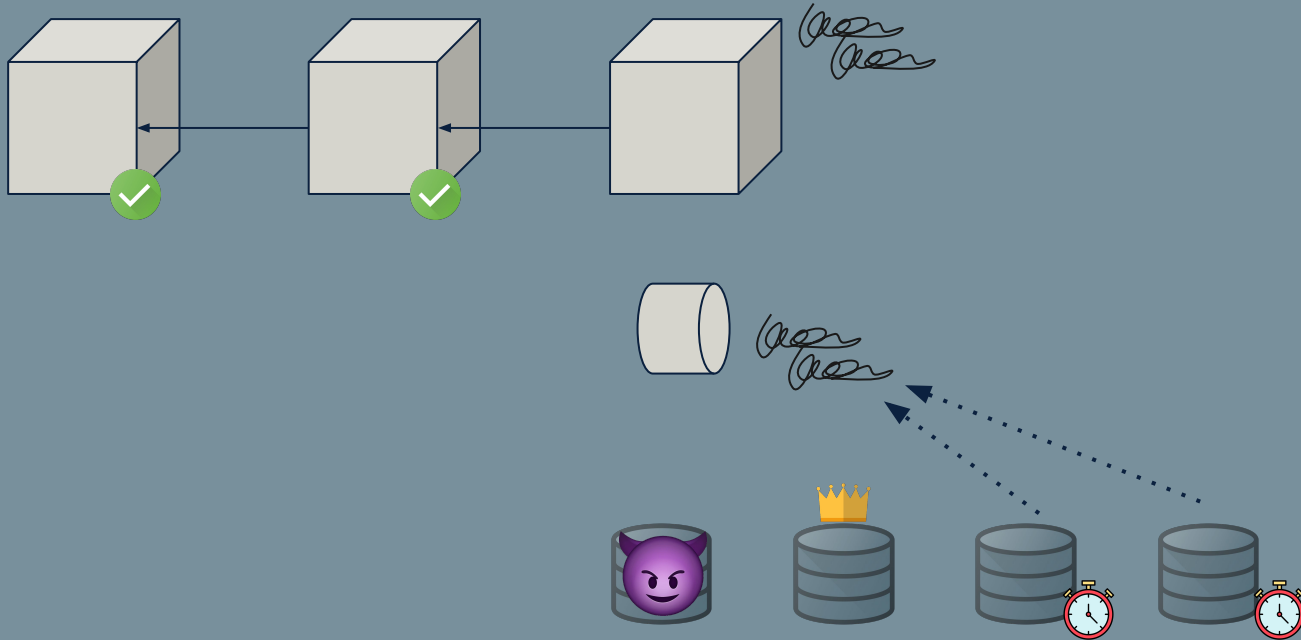
Kudzu



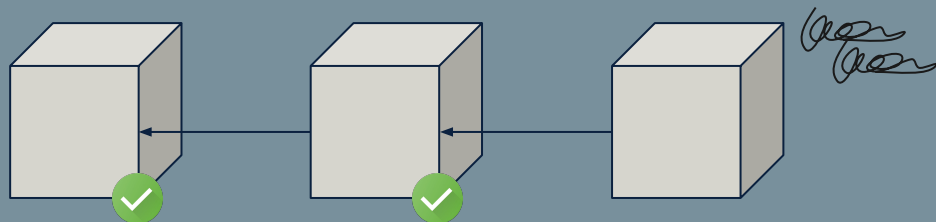
Kudzu



Kudzu

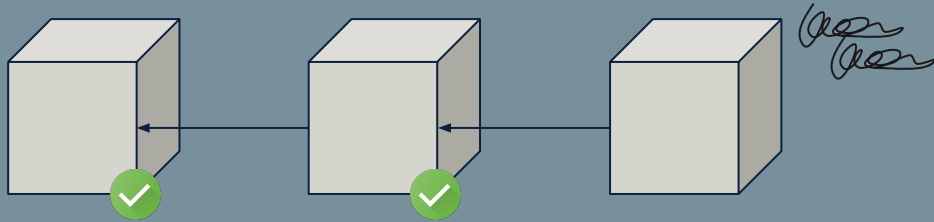


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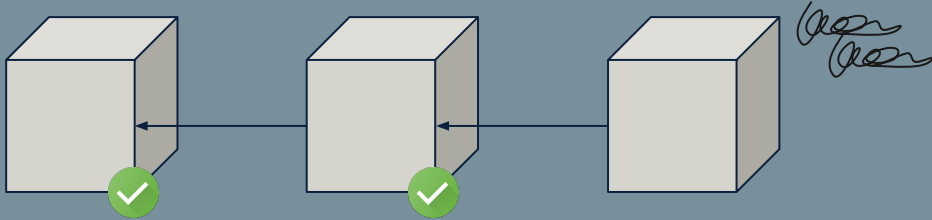




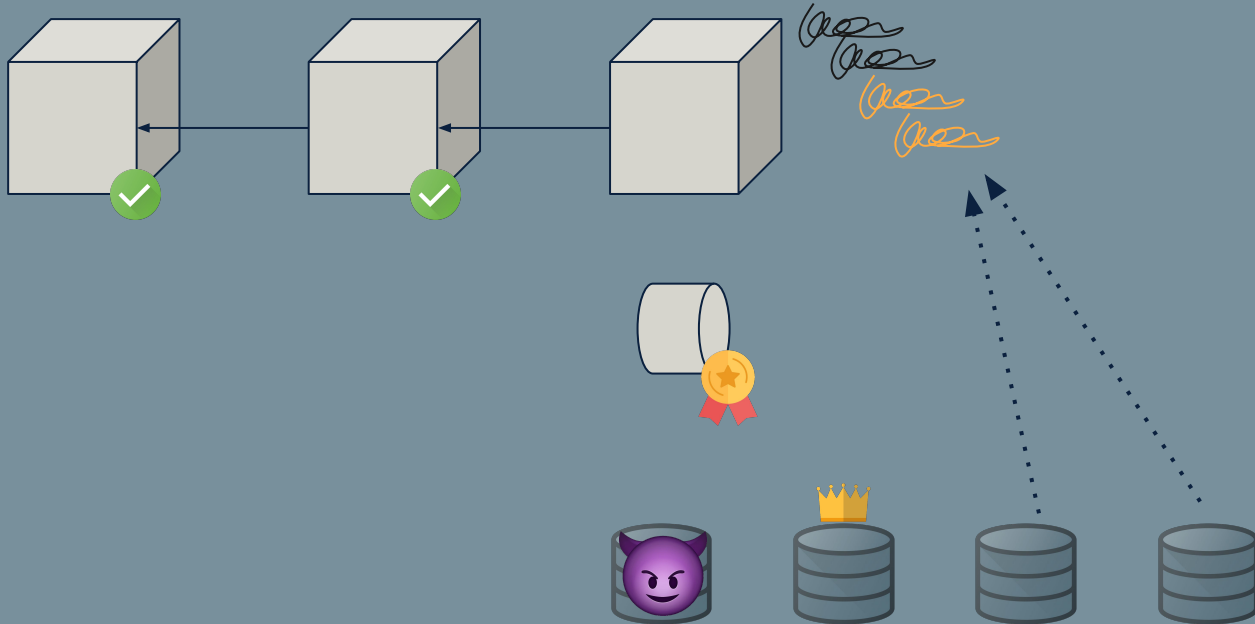
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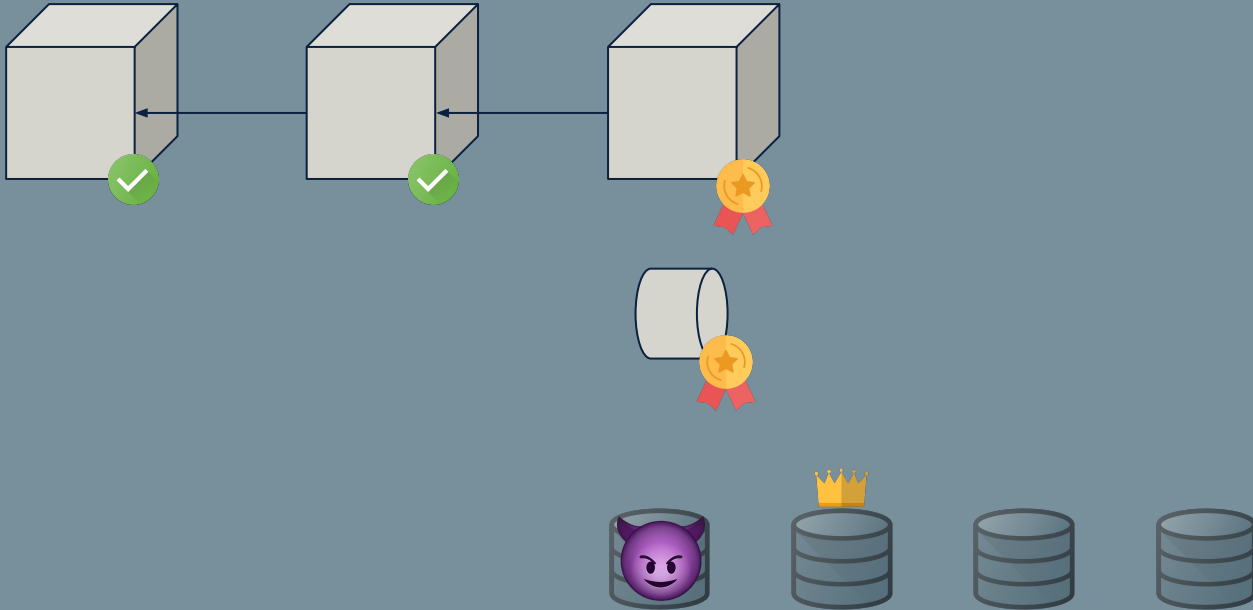
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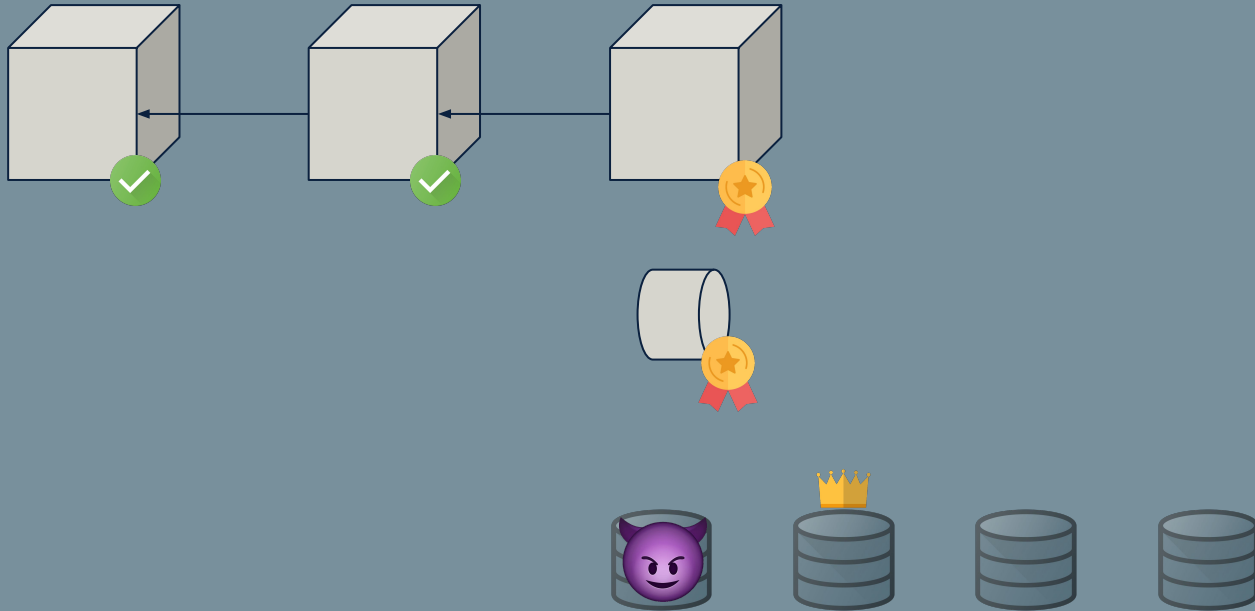
Kudzu



Kudzu

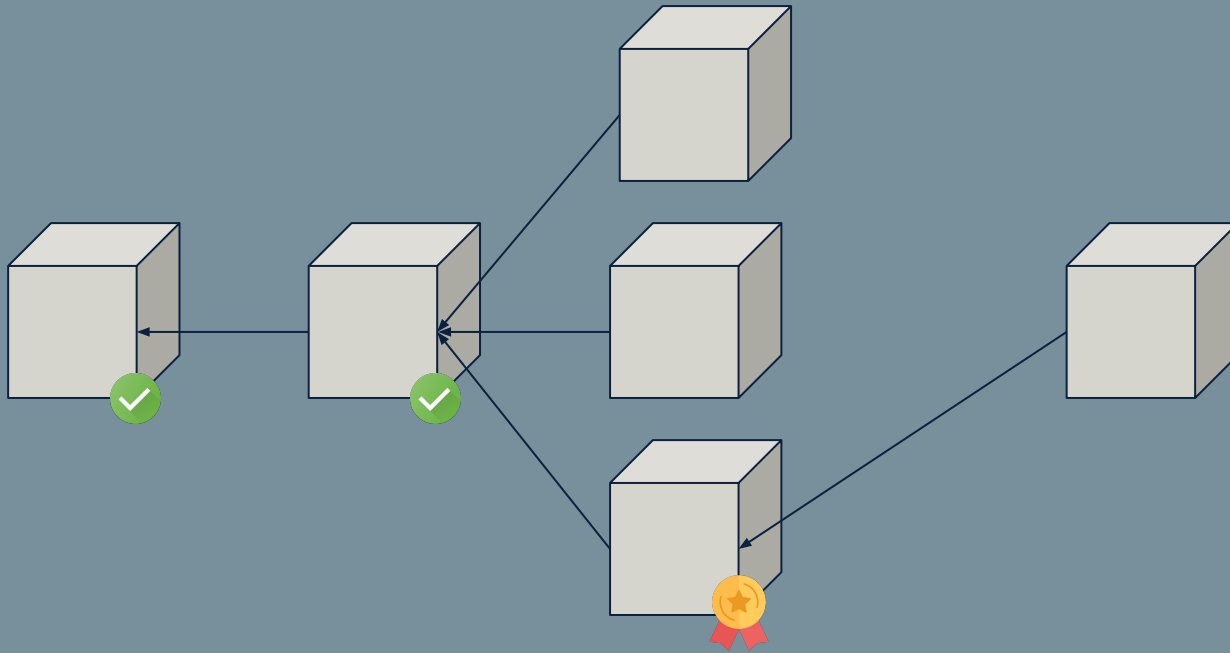


Kudzu





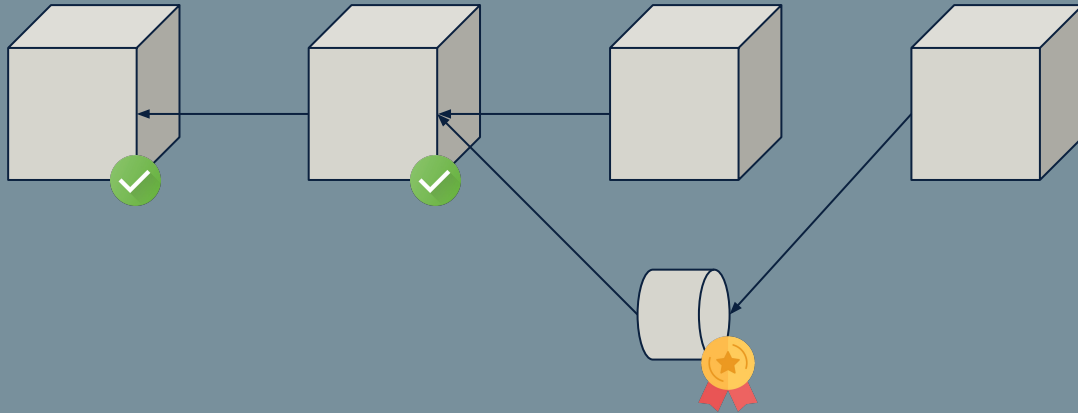
Banyan

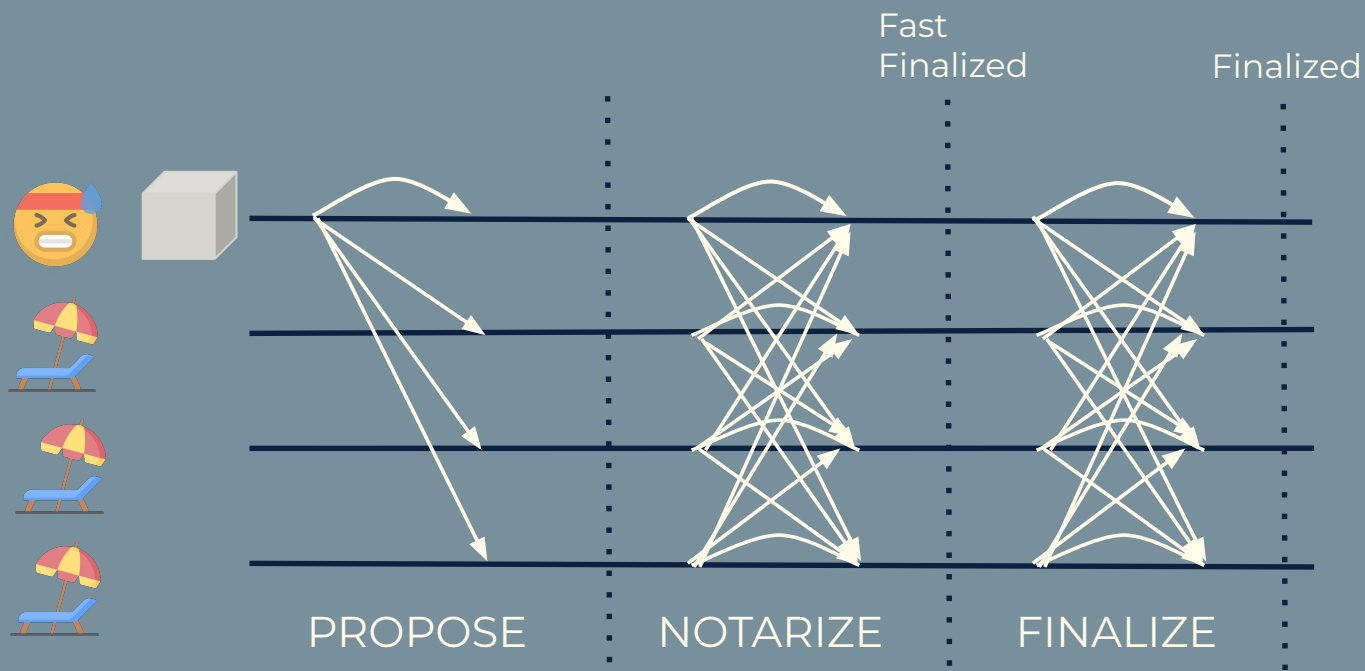




Kudzu

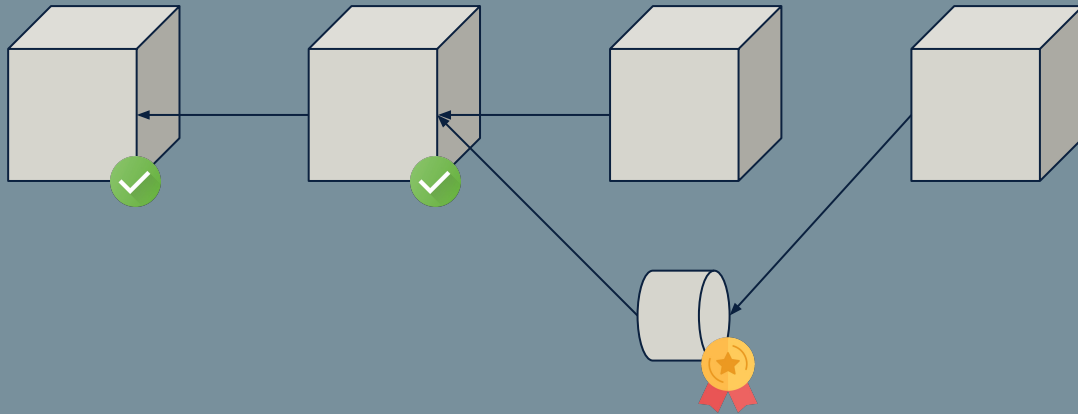
Improvement 1:
Simpler







Kudzu



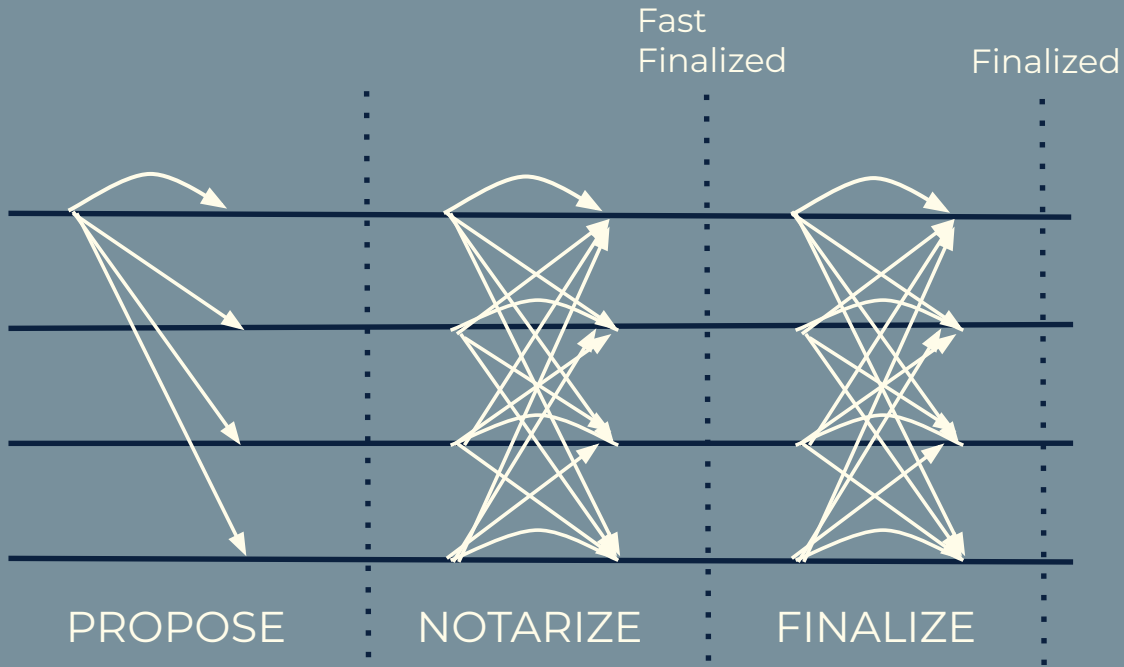
Improvement 1:
Simpler

Improvement 2:
Balanced
communication



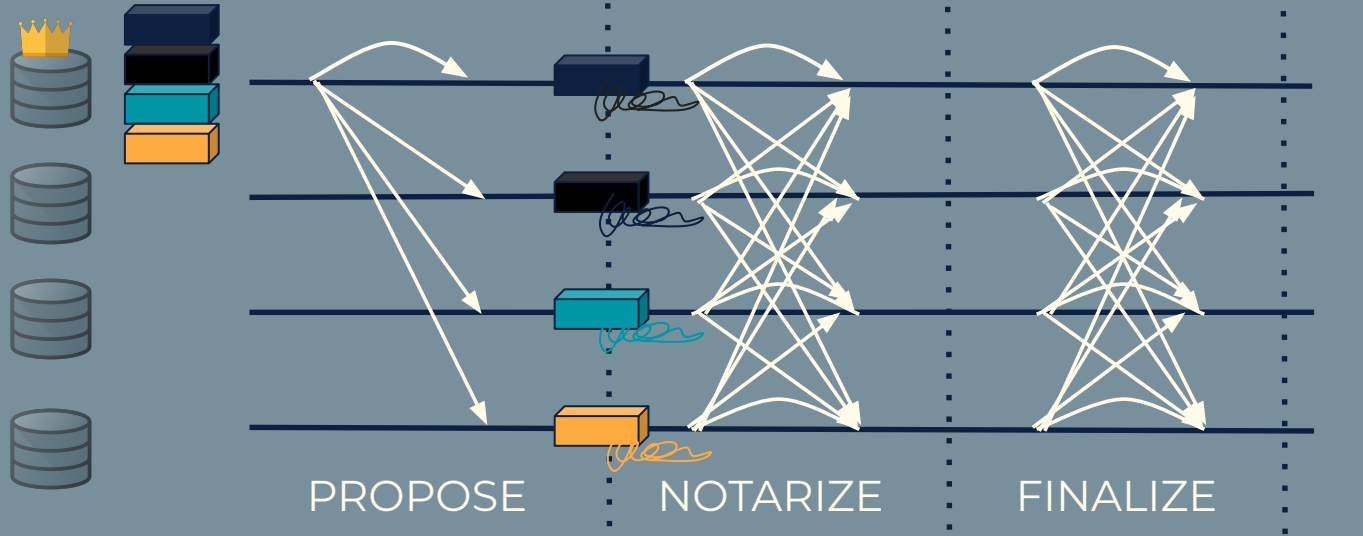


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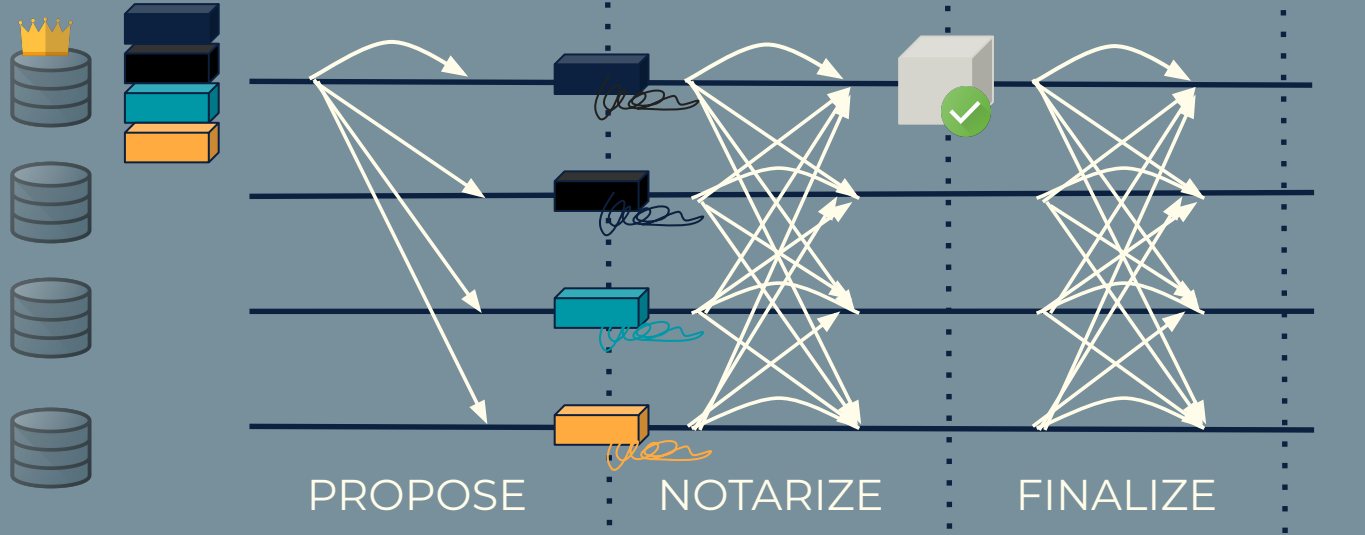


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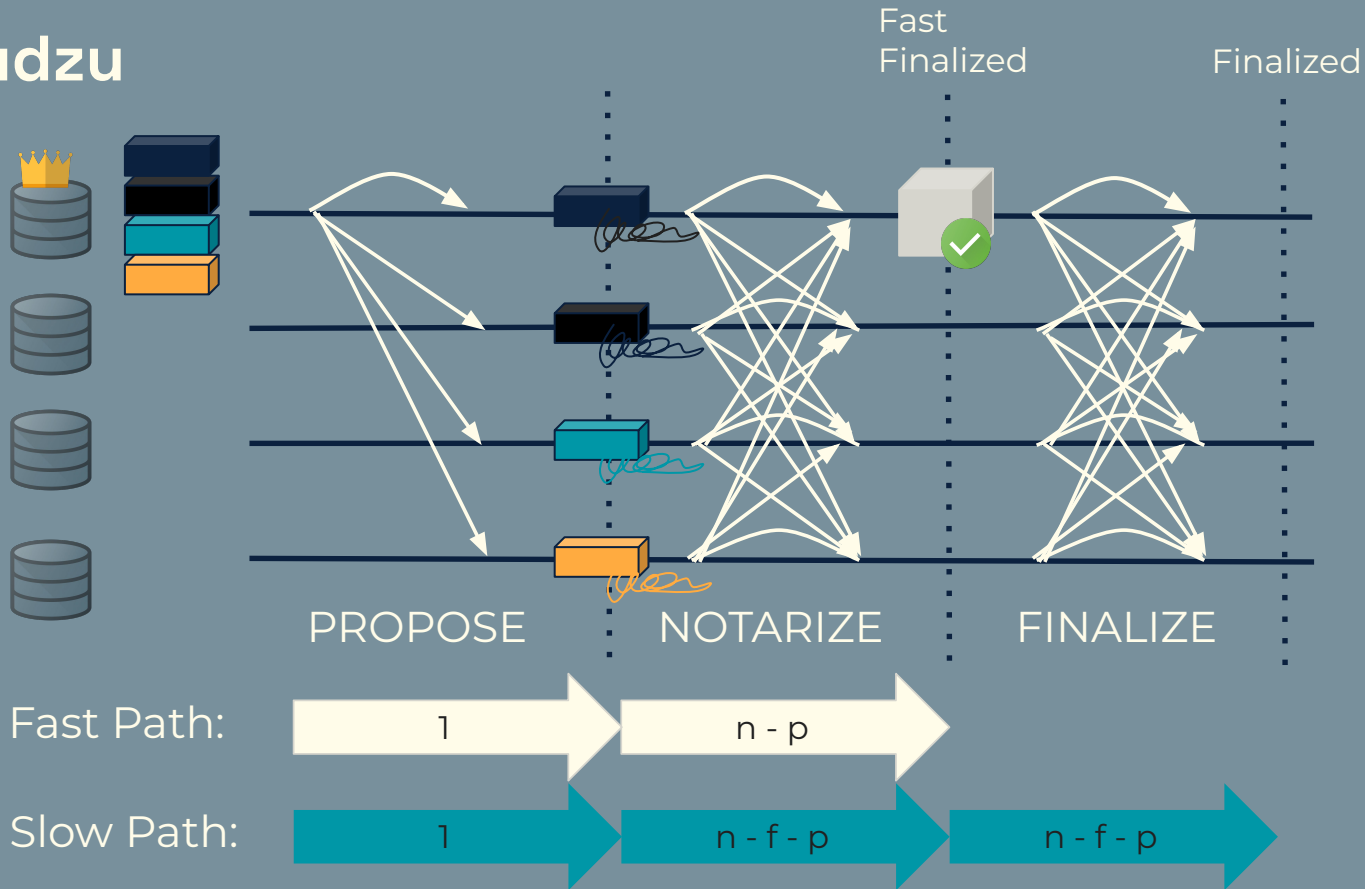


Kudzu





Kudzu



Fast Path:

1

n - p

Slow Path:

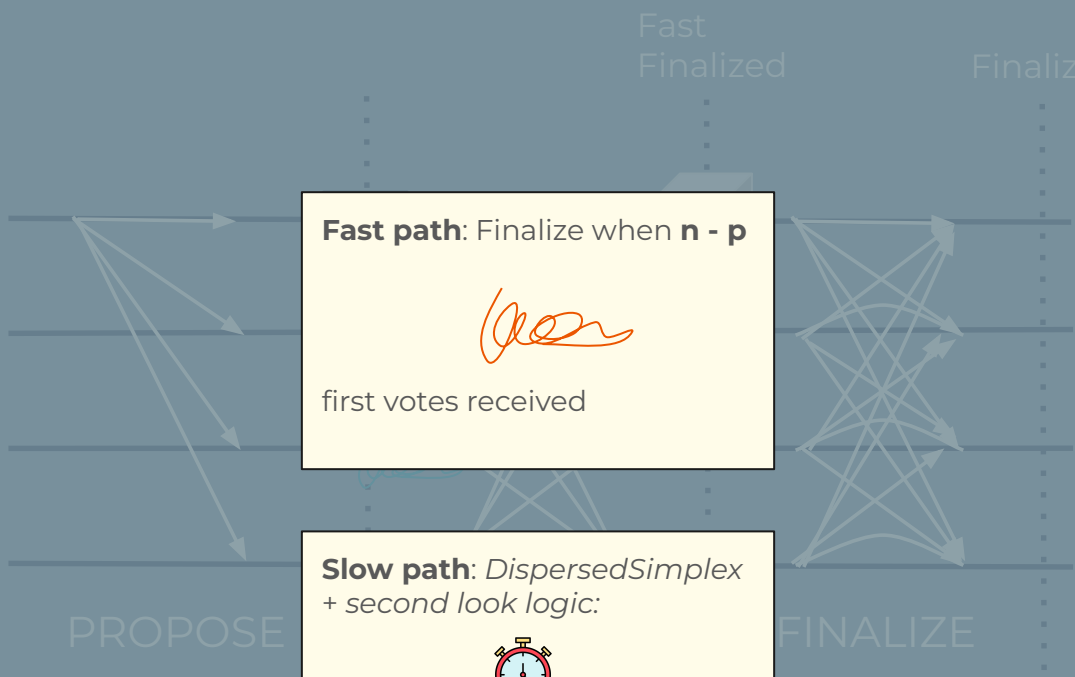
1

n - f - p

n - f - p



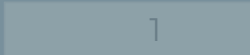
Kudzu



PROPOSE

FINALIZE

Fast Path:



Slow Path:



Fast path: Finalize when $n - p$



first votes received

Slow path: *DispersedSimplex*
+ *second look logic:*



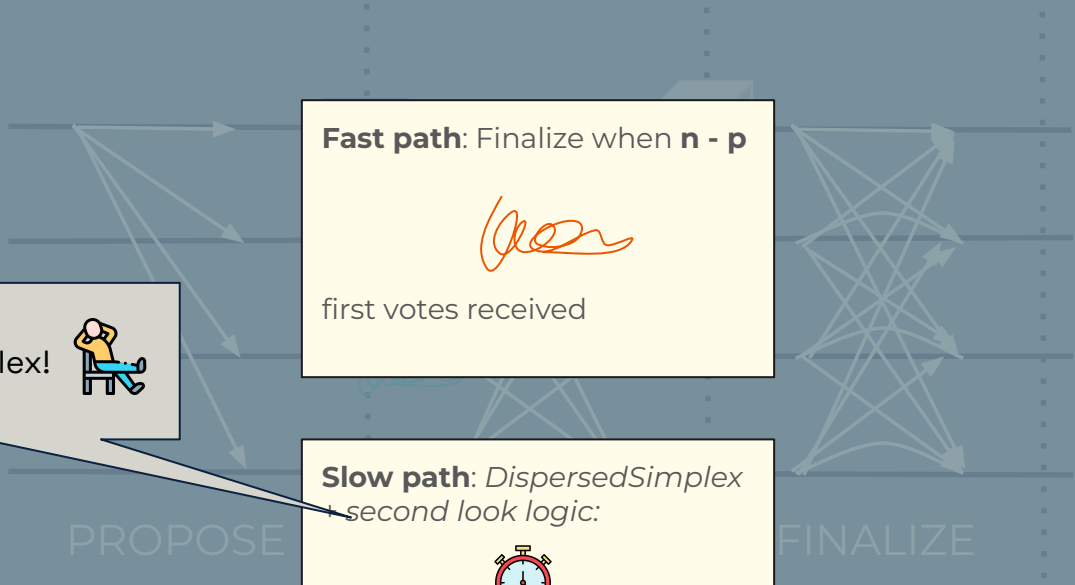
send a *second* vote if one of two conditions holds.



Kudzu


Fast
Finalized

Finalized




As **simple** as Simplex! 

Fast path: Finalize when $n - p$



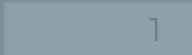
first votes received

Slow path: *DispersedSimplex*
second look logic:



send a *second* vote if one of two conditions holds.

Fast Path:



Slow Path:



PROPOSE


FINALIZE





Kudzu

Fast
Finalized

As **fast** as Banyan! ⚡

As **simple** as Simplex! 

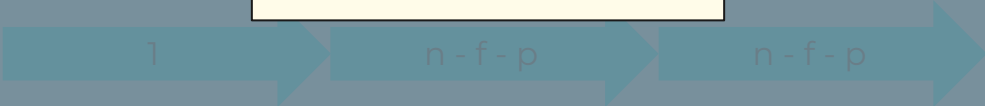
Fast path: Finalize when $n - p$

first votes received

Slow path: *DispersedSimplex*
second look logic:

send a *second* vote if one of two conditions holds.

Fast Path:



Slow Path:



PROPOSE

FINALIZE



As **fast** as Banyan! ⚡

Fast path: Finalize when $n - p$

(Handwritten signature)

first votes received

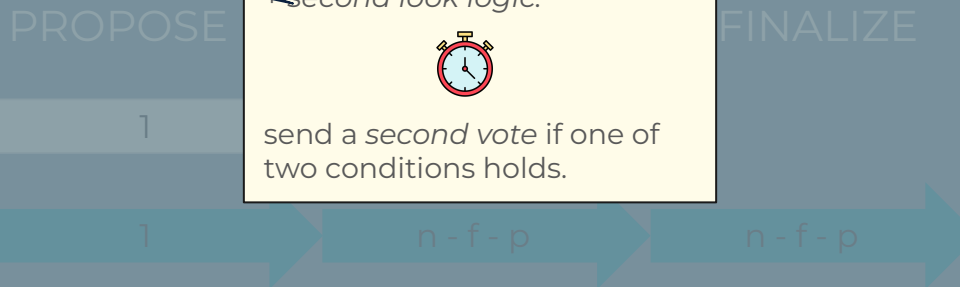
High-throughput like DispersedSimplex! 🚀

As **simple** as Simplex! 🧘

Slow path: *DispersedSimplex* second look logic:

🕒

send a *second vote* if one of two conditions holds.





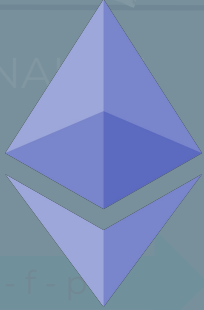
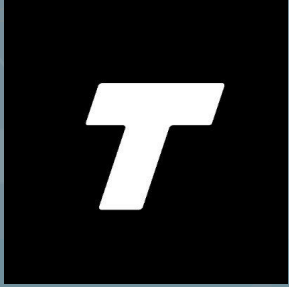
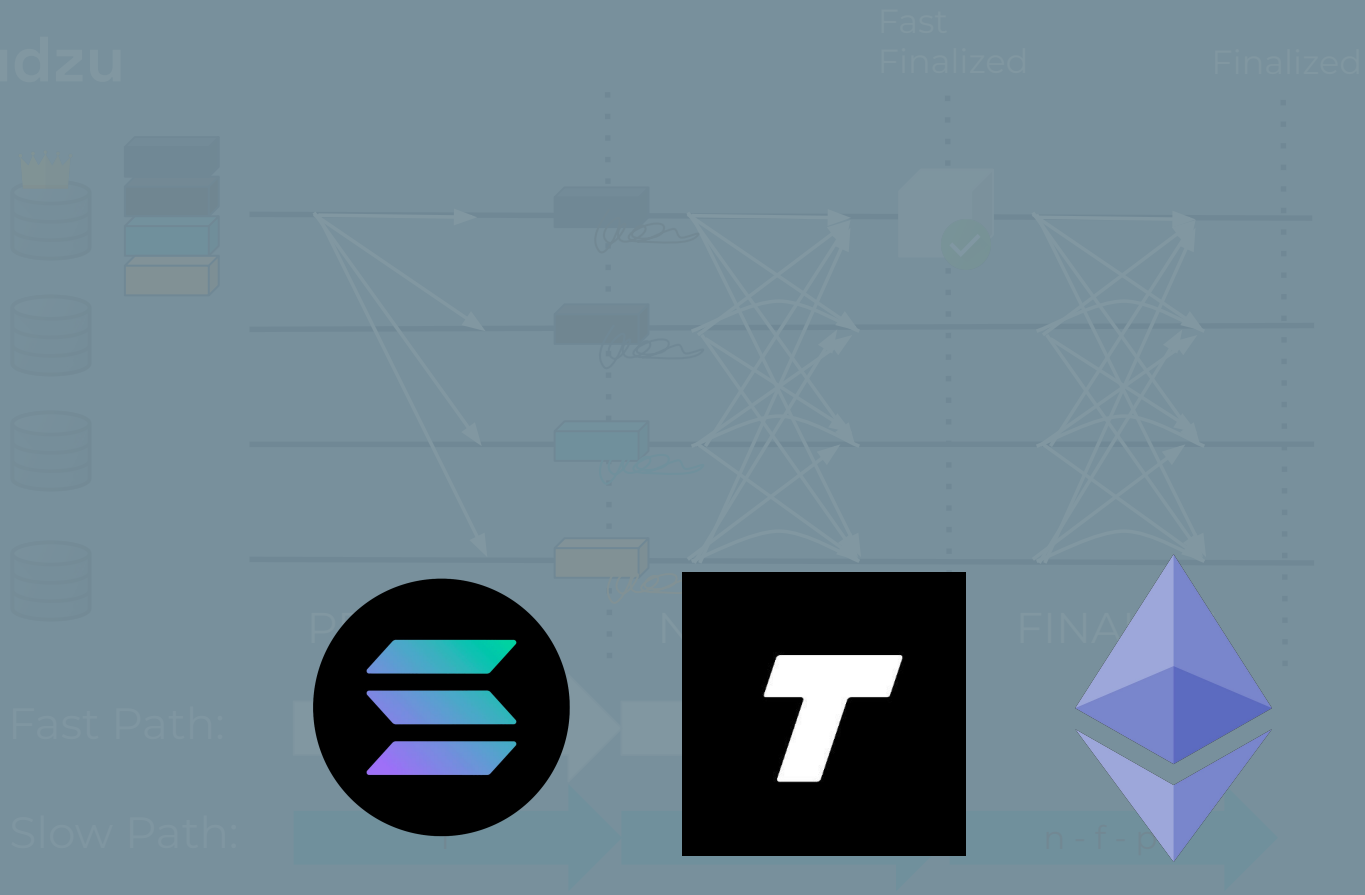
Banyan



Kudzu



Mangrove



Thank you!

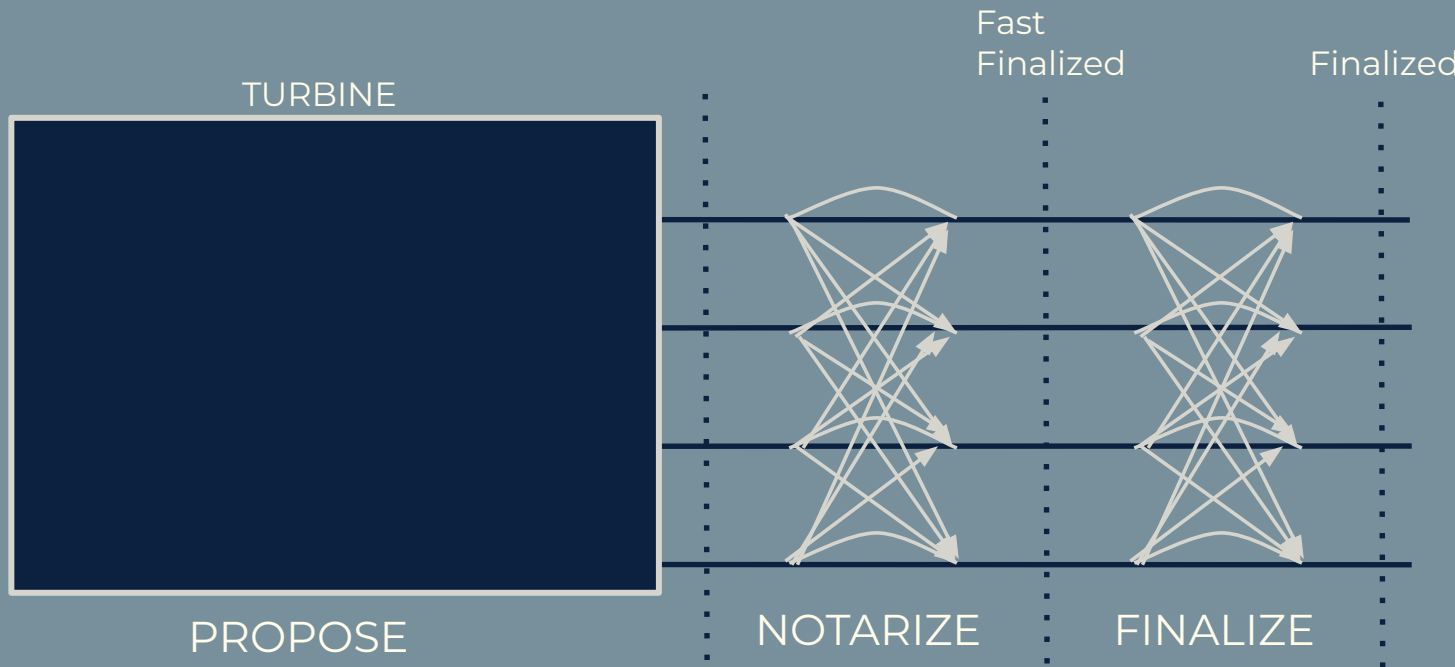


Alpenglow

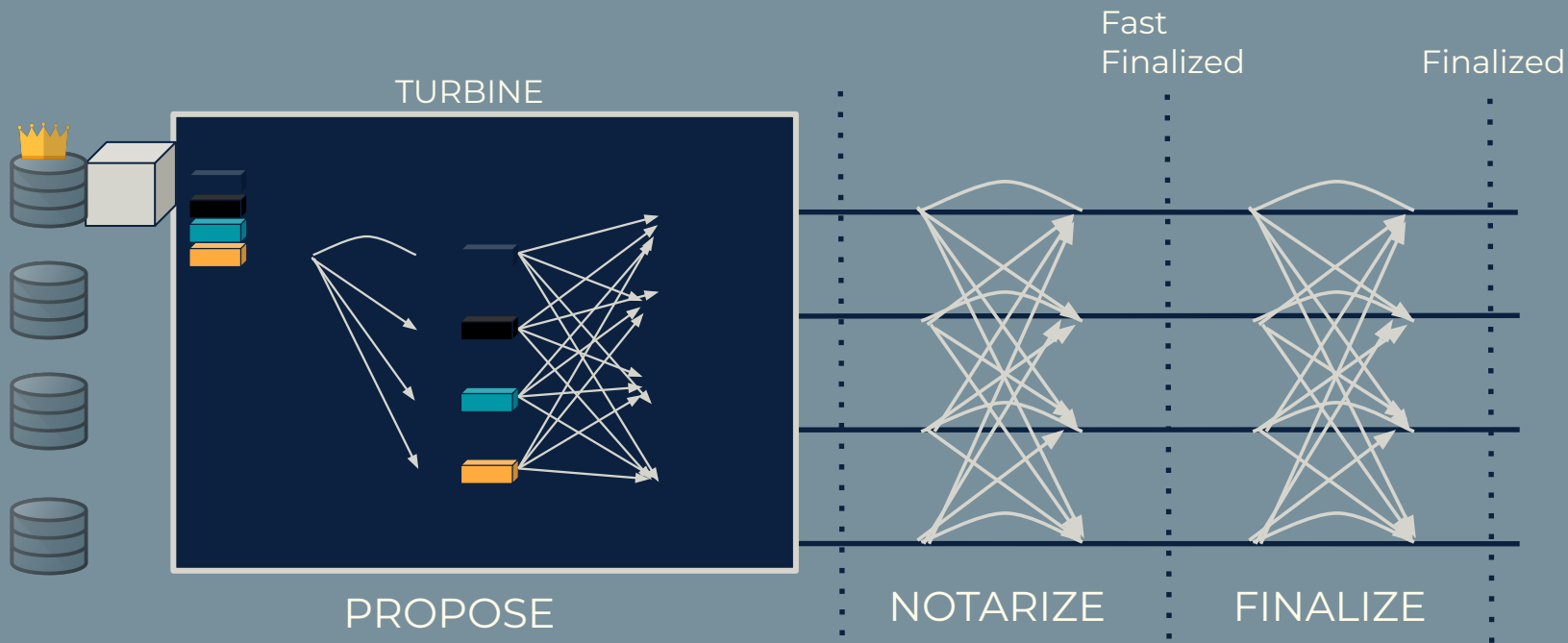
Solana Alpenglow Consensus
Increased Bandwidth, Reduced Latency

Quentin Kniep Jakub Sliwinski Roger Wattenhofer
Anza

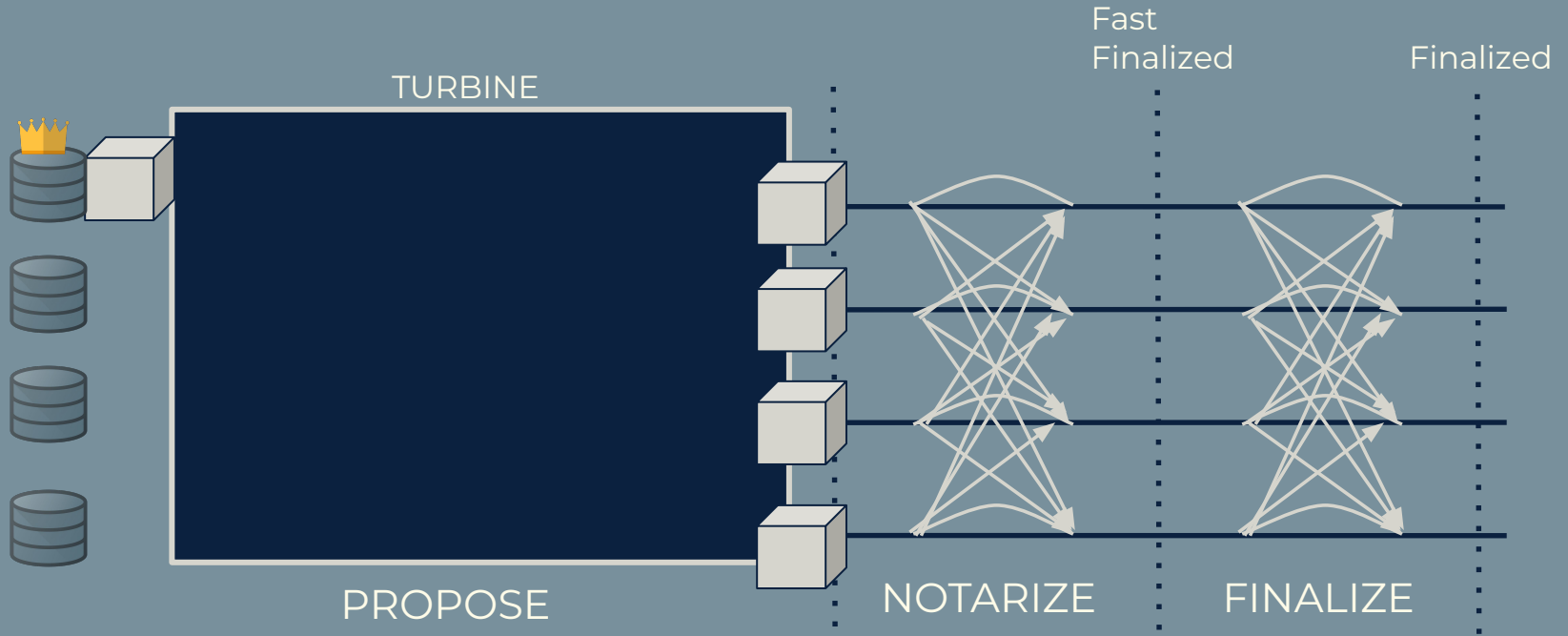
White Paper v1, May 19, 2025



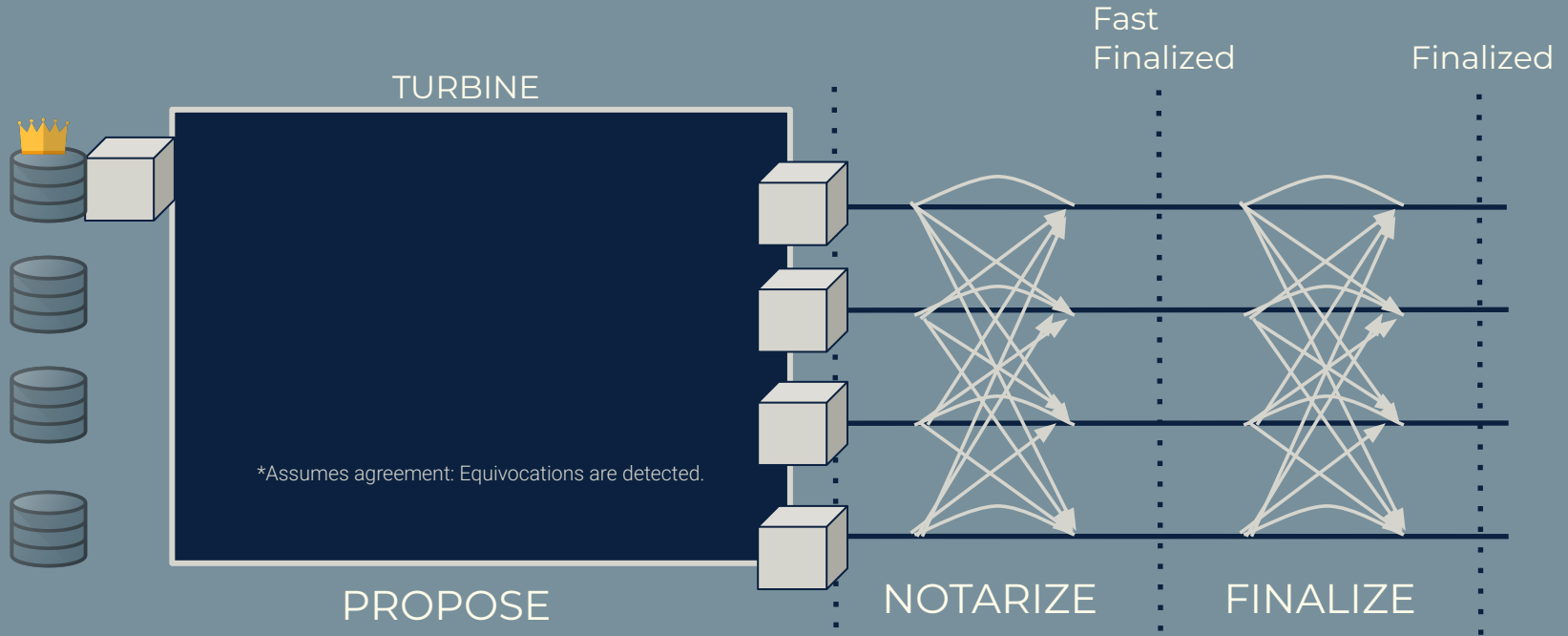
Alpenglow



Alpenglow

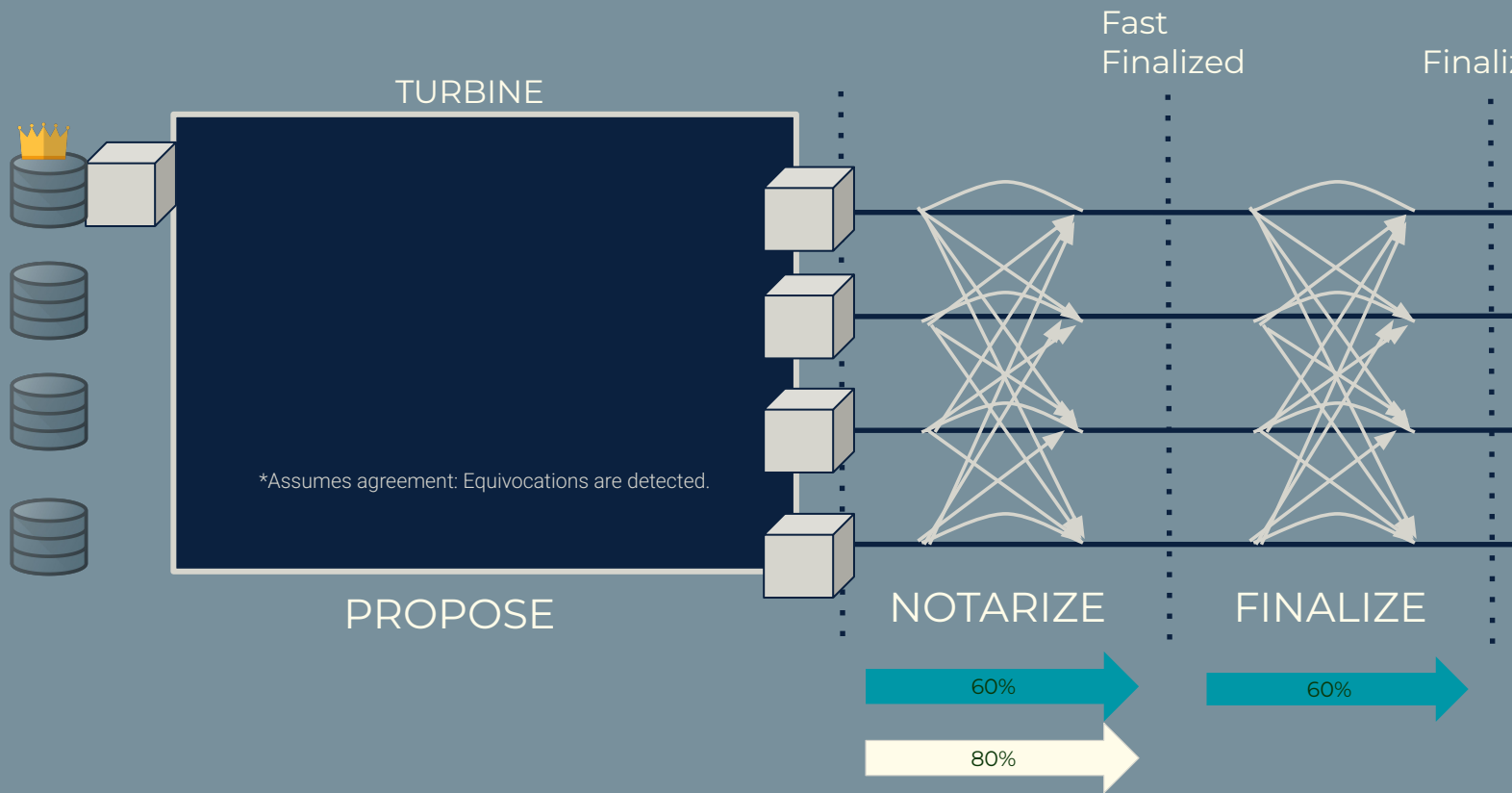


Alpenglow

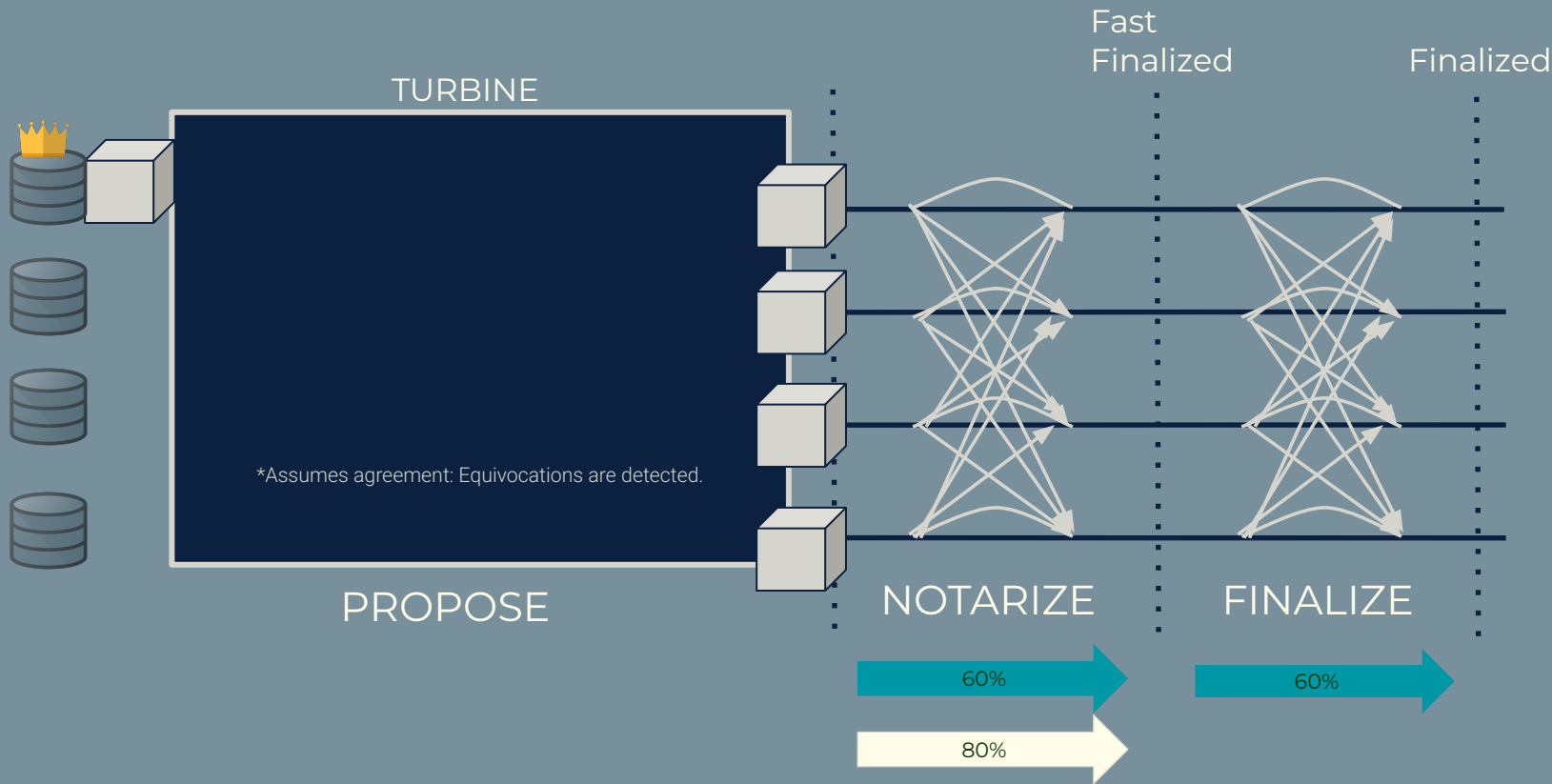


Alpenglow

f = 20%
c = 20%



Alpenglow

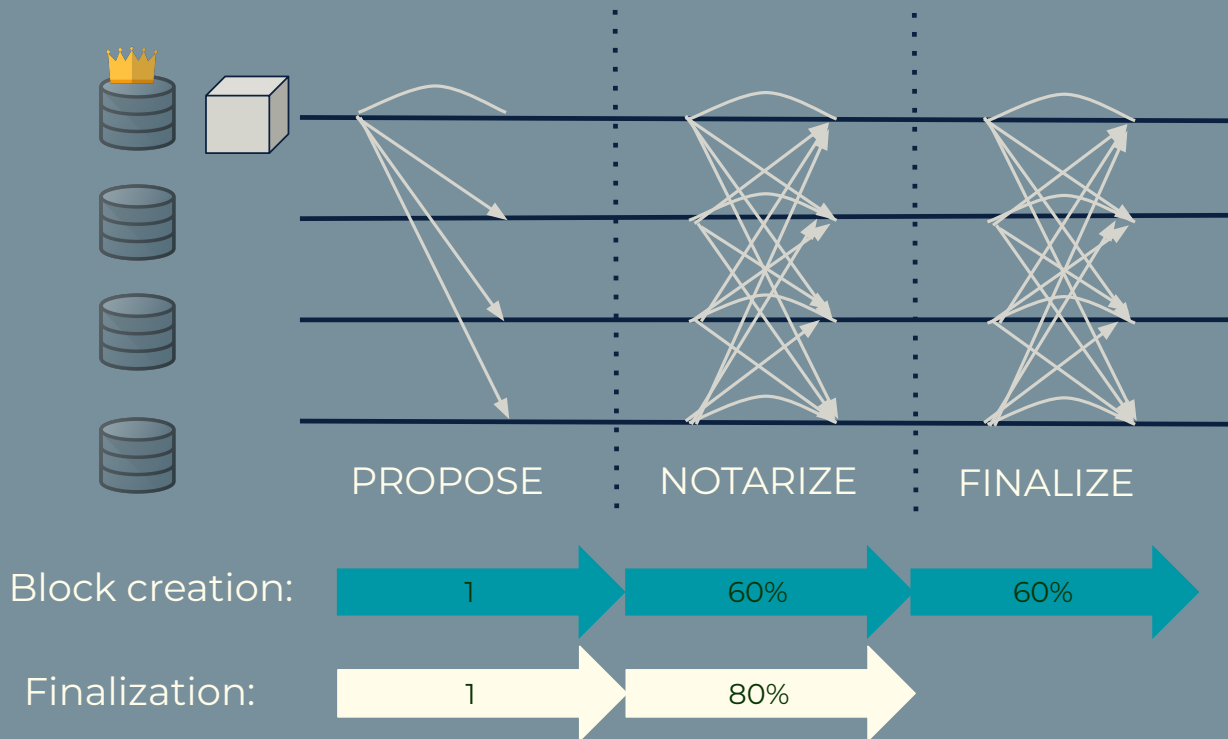


Minimit

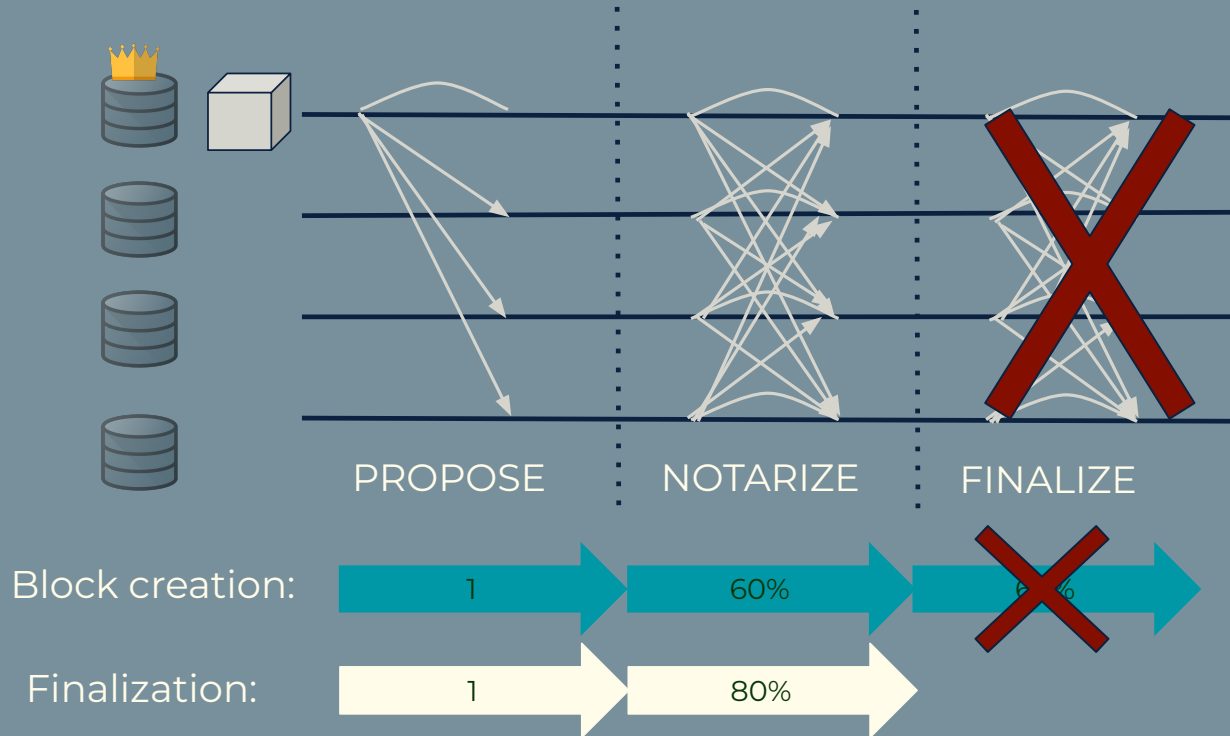
Minimit: Fast Finality with Even Faster Blocks

BRENDAN KOBAYASHI CHOU, Commonware, USA
ANDREW LEWIS-PYE, London School of Economics, UK
PATRICK O'GRADY, Commonware, USA

Minimit is a new protocol for State-Machine-Replication (SMR) that extends the '2-round finality' approach of protocols such as Alpenglow to further reduce latency, by allowing for faster progression through 'views'. This preliminary draft provides motivation and pseudocode, together with proofs of consistency and liveness. An updated draft with a proof of optimistic responsiveness, suggested optimizations, and experiments, is to follow.

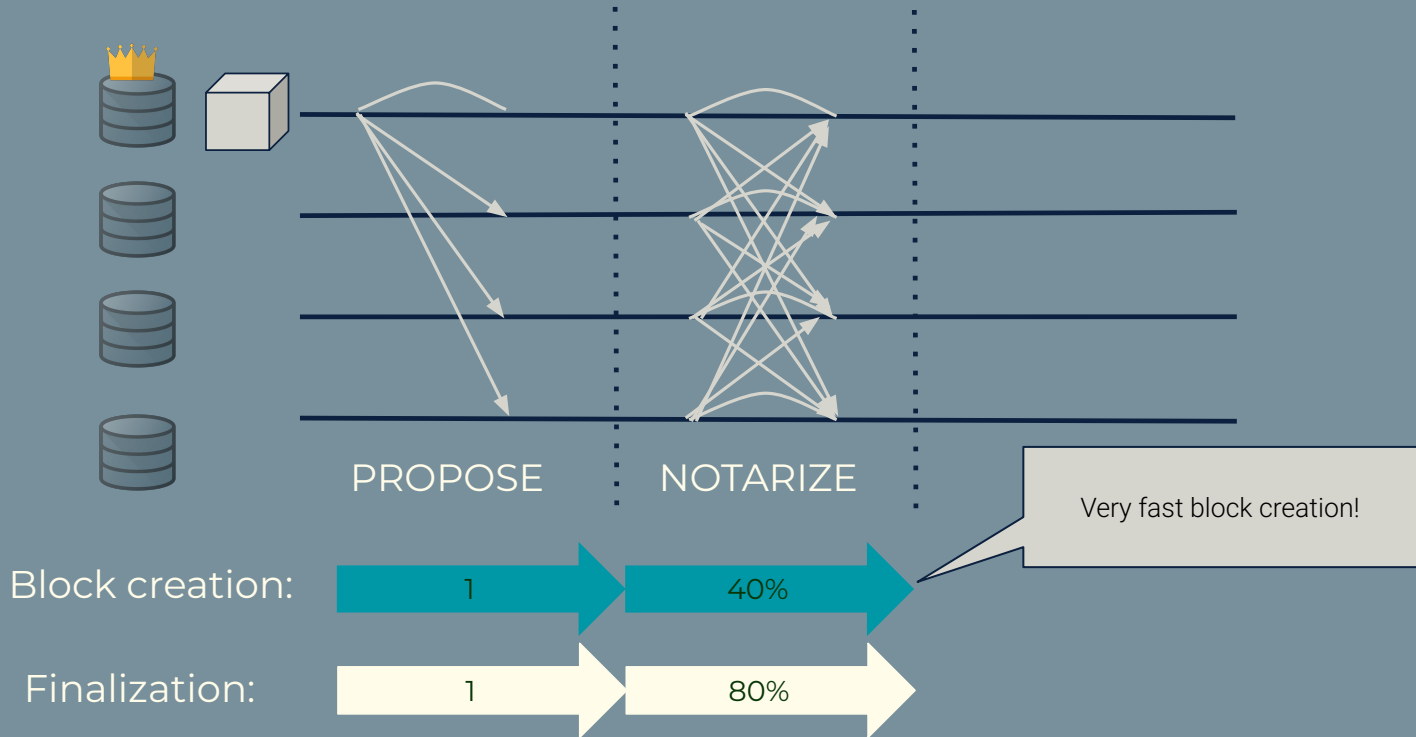


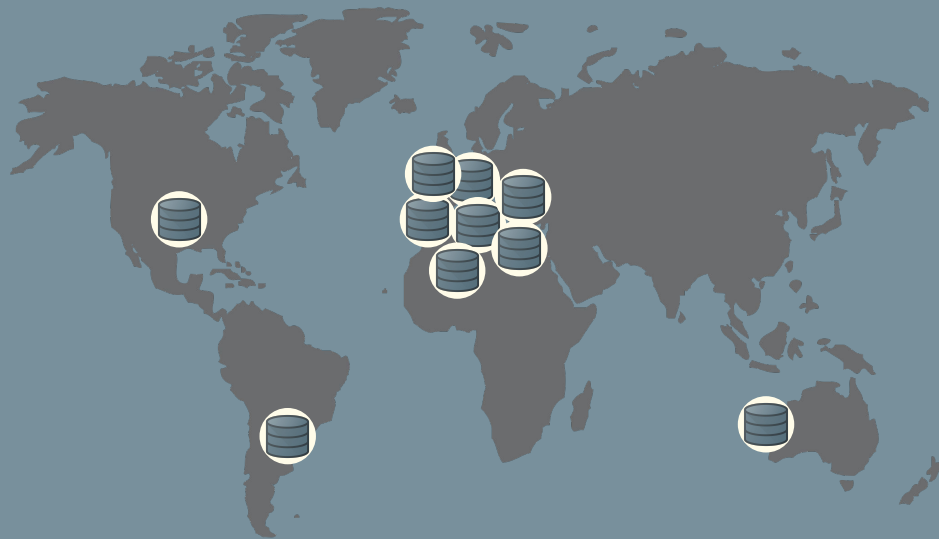
Minimmit

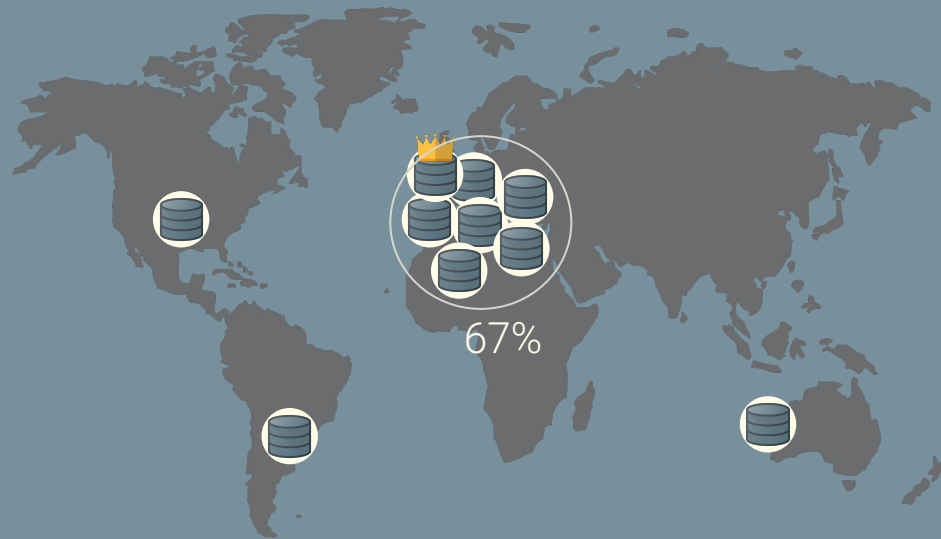


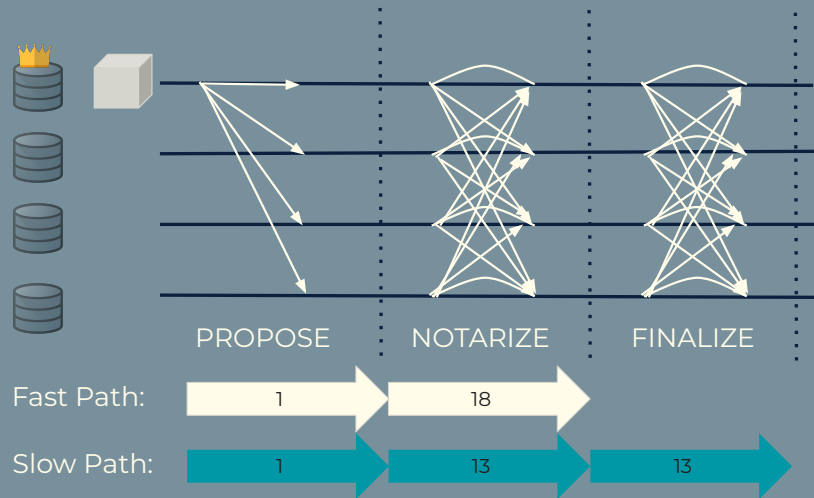
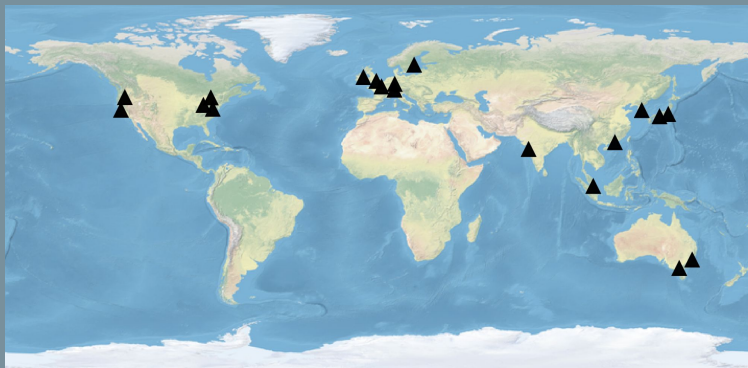
Minimmit

f = 20%









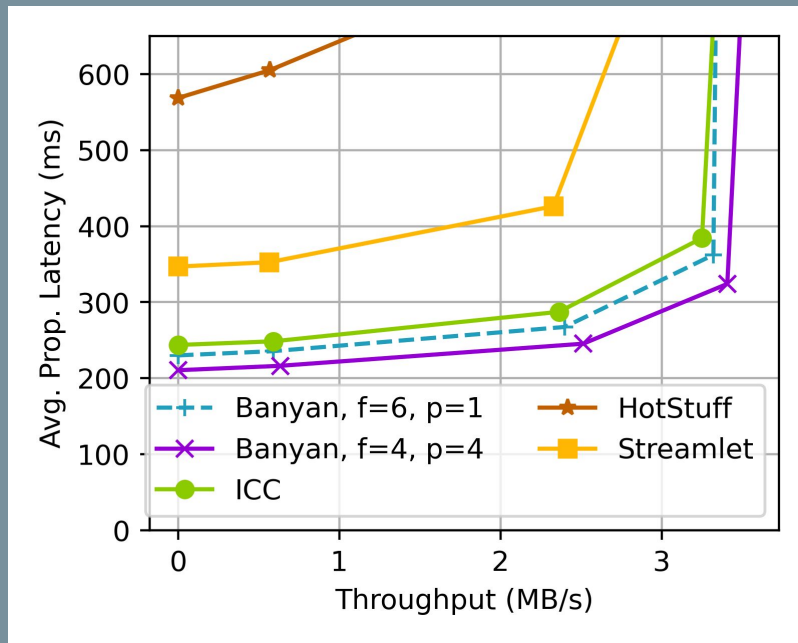
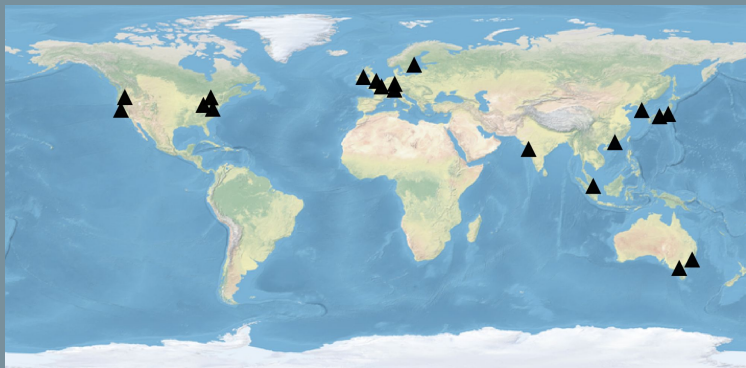
$n = 19 \quad f = 6$



AWS t3.large



proposer latency



n = 19 f = 6



AWS t3.large



proposer latency



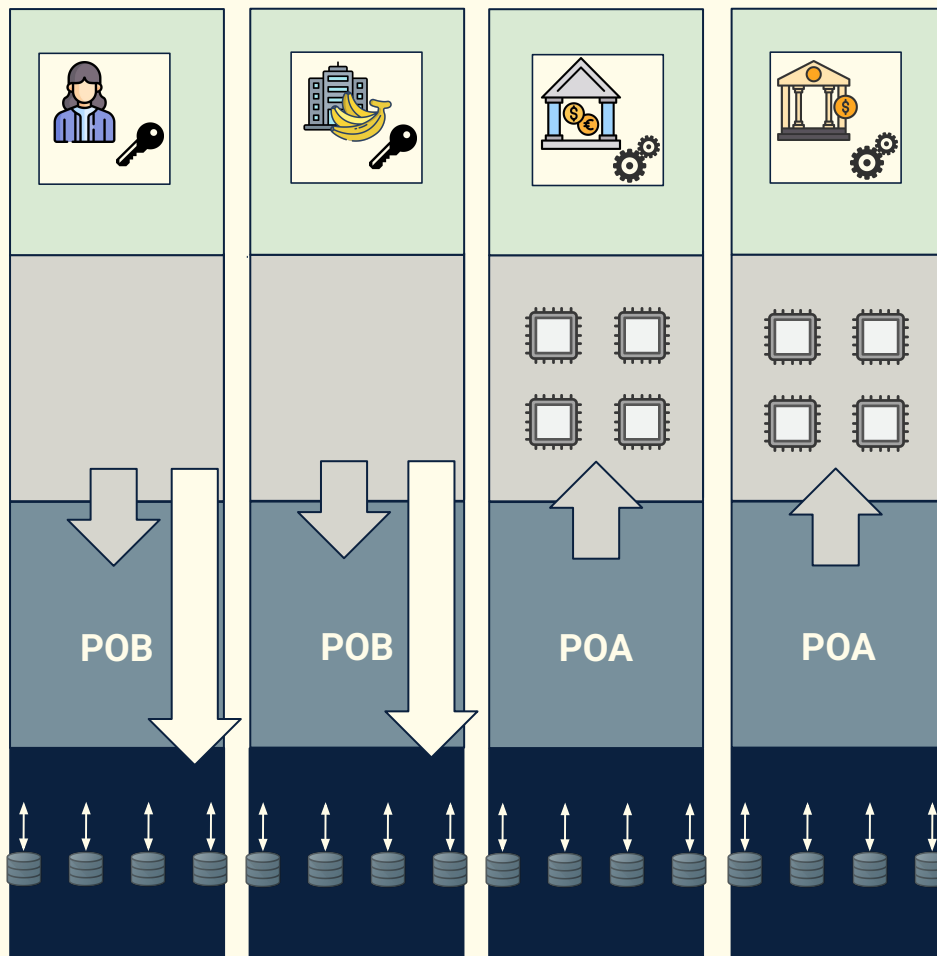
Banyan



Kudzu



Mangrove



Blockchain State

Execution Layer

Consensus Layer

Network Layer