Walrus

An Efficient Decentralised Storage Network

Alberto Sonnino

Distributed Storage

Distributed Storage

+ Incentives

Two Challenges

- Dynamic availability
- Conflate consensus with proof of storage

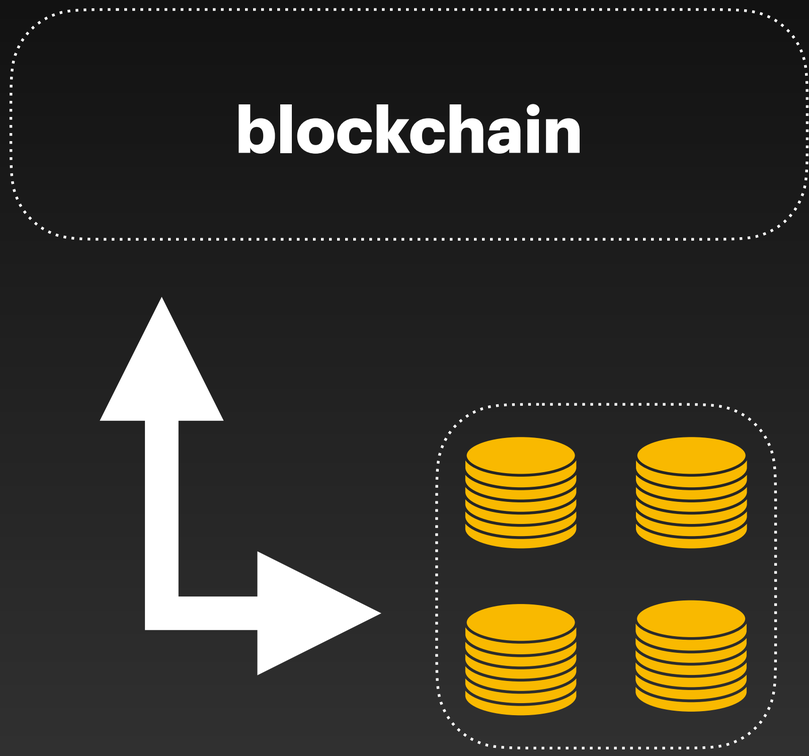
Two Challenges

- Dynamic availability
- Conflate consensus with proof of storage

- **Slow**
- **90% Junk blocks**

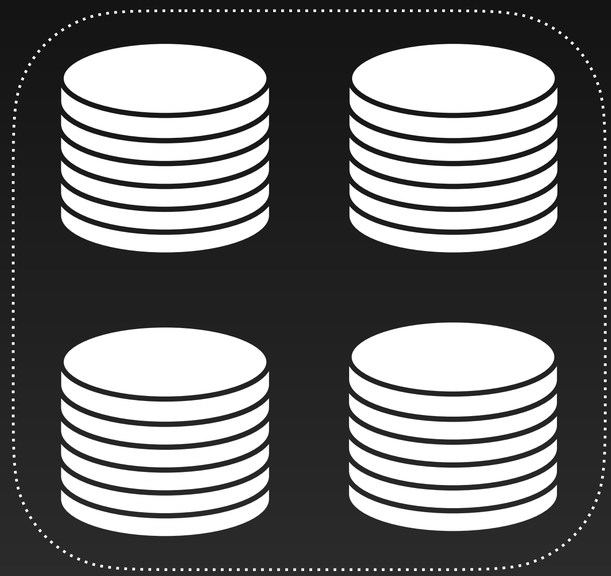
BFT Quorum

External Chain



data

user



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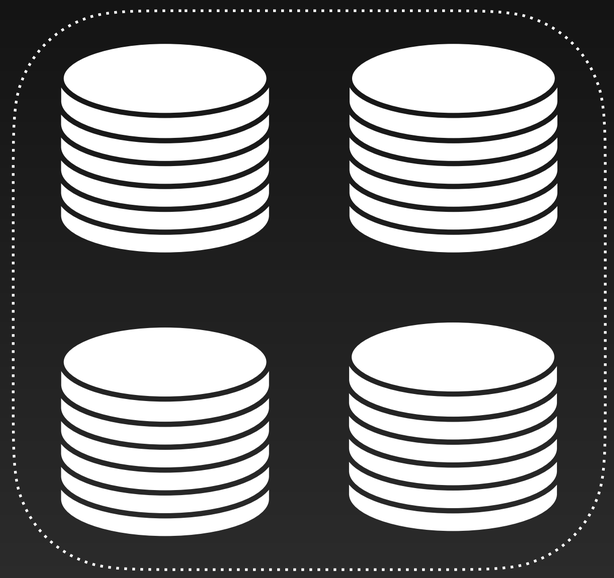
user



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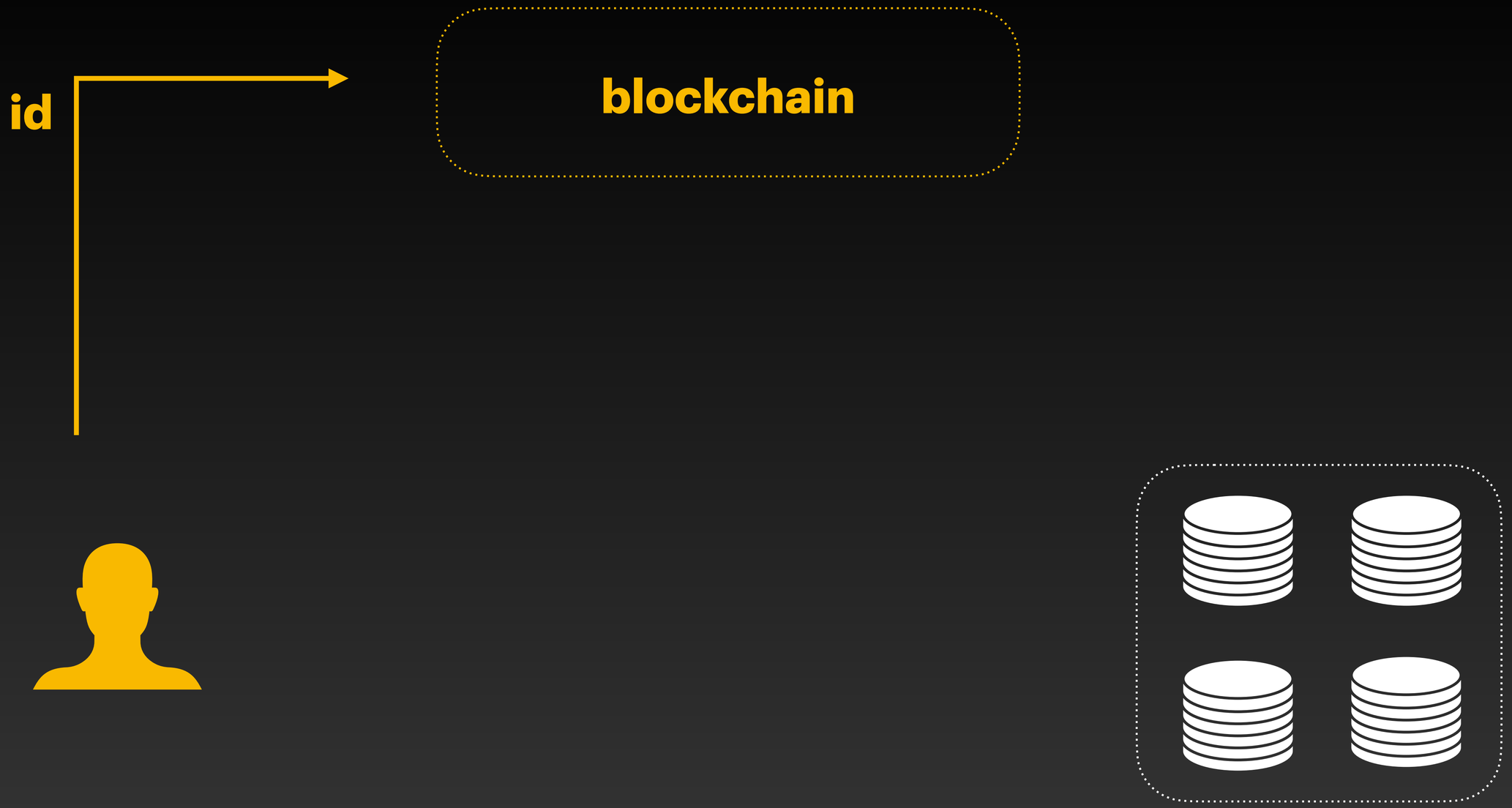
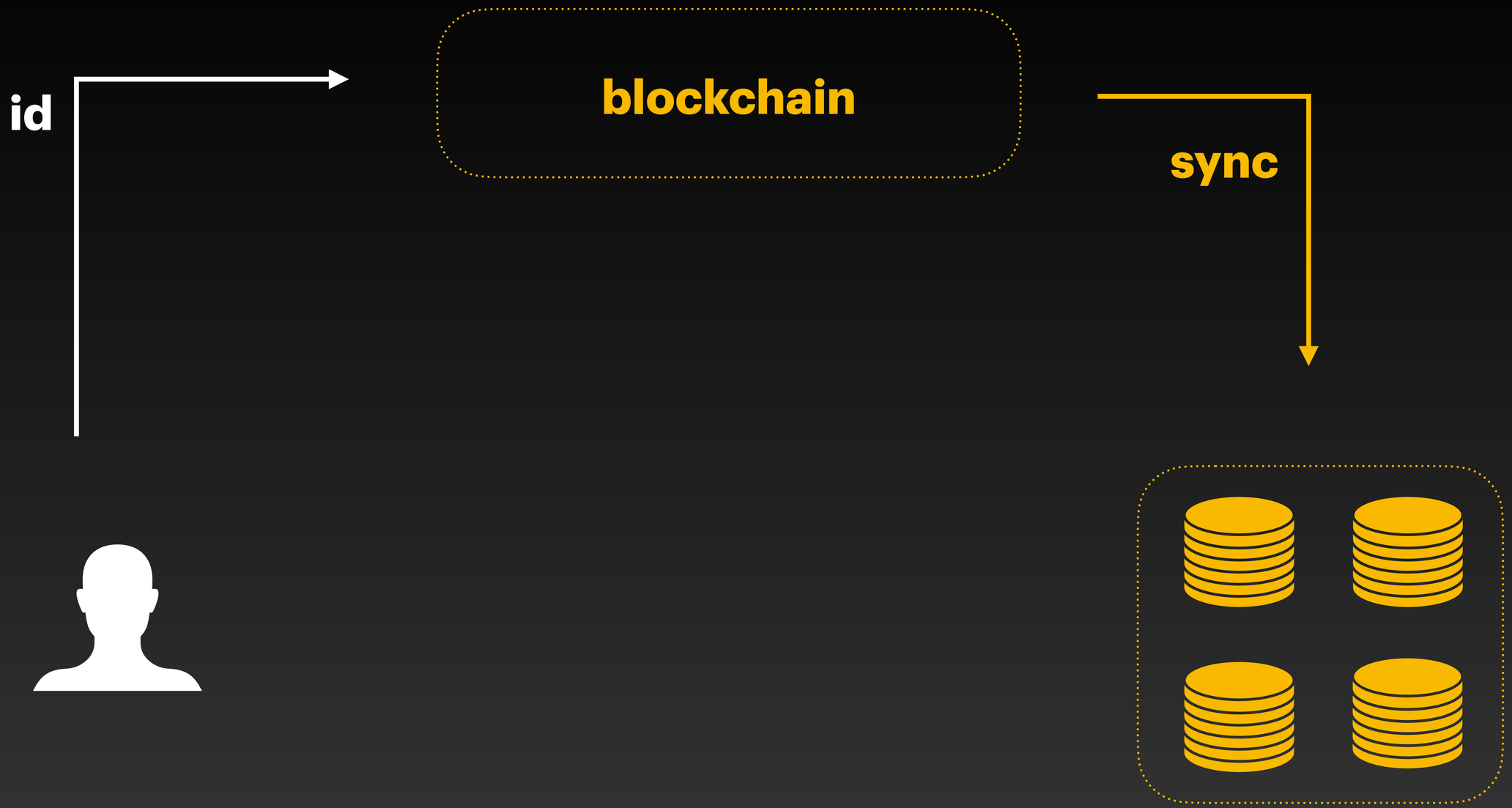
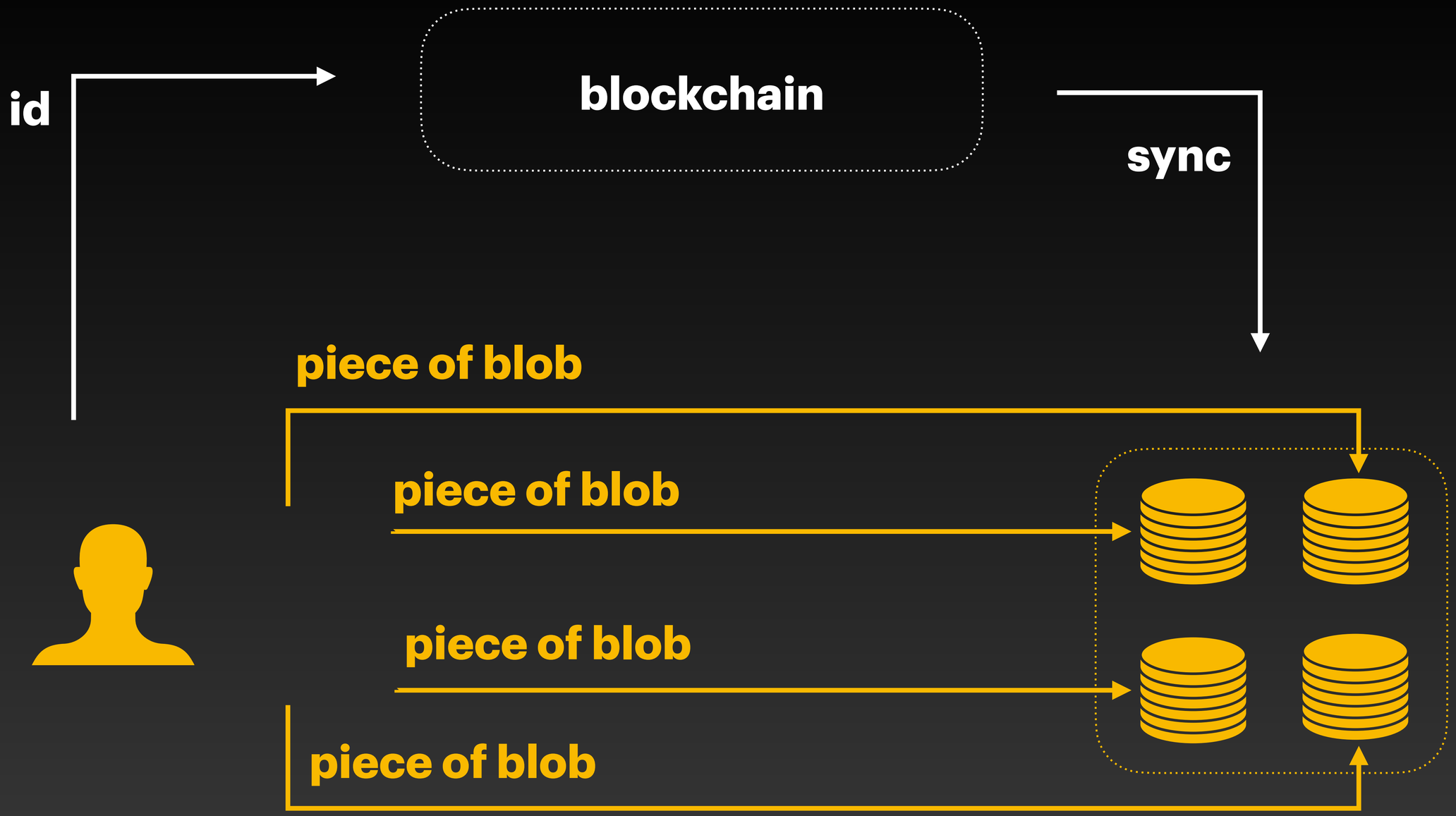
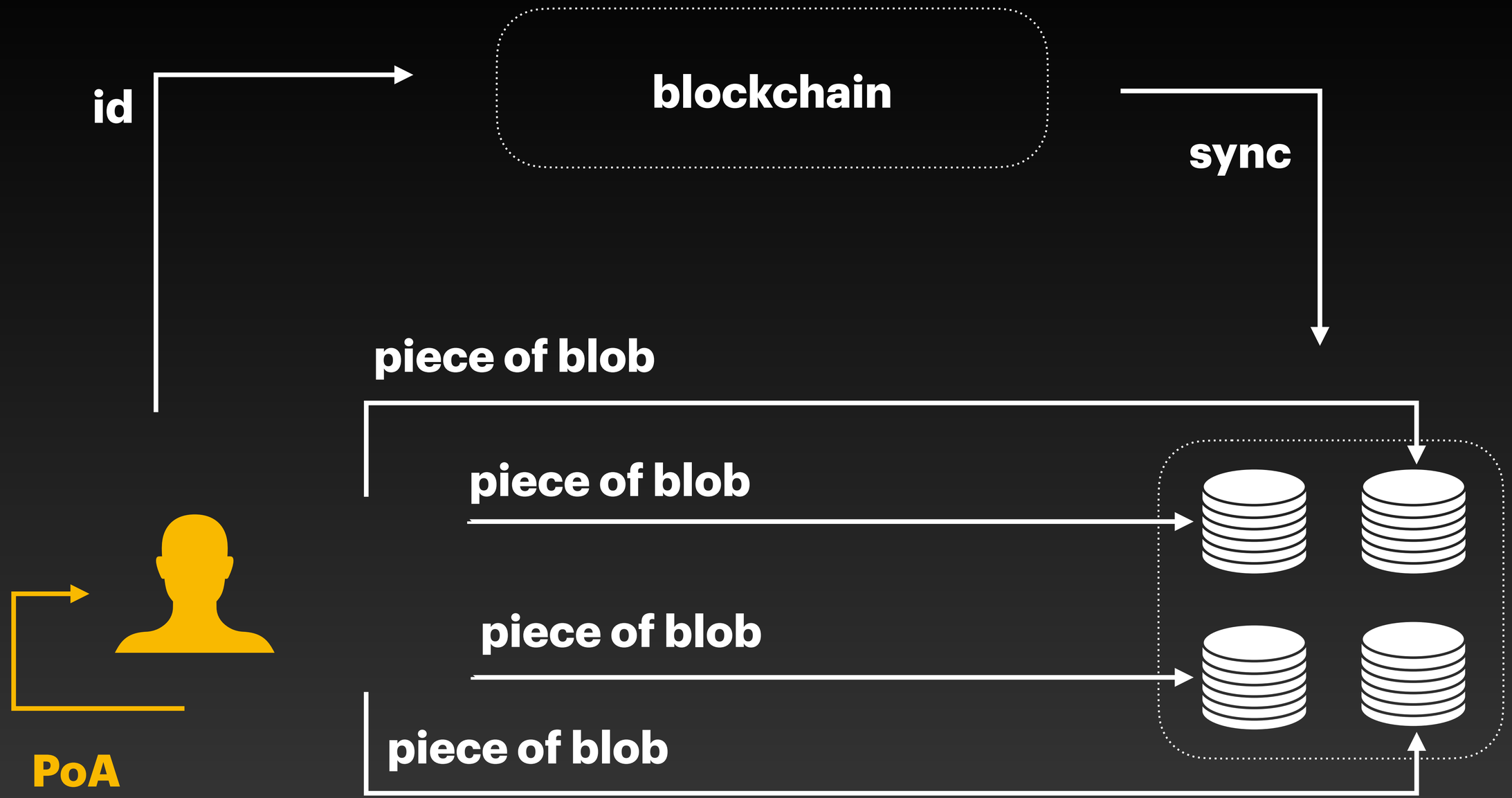
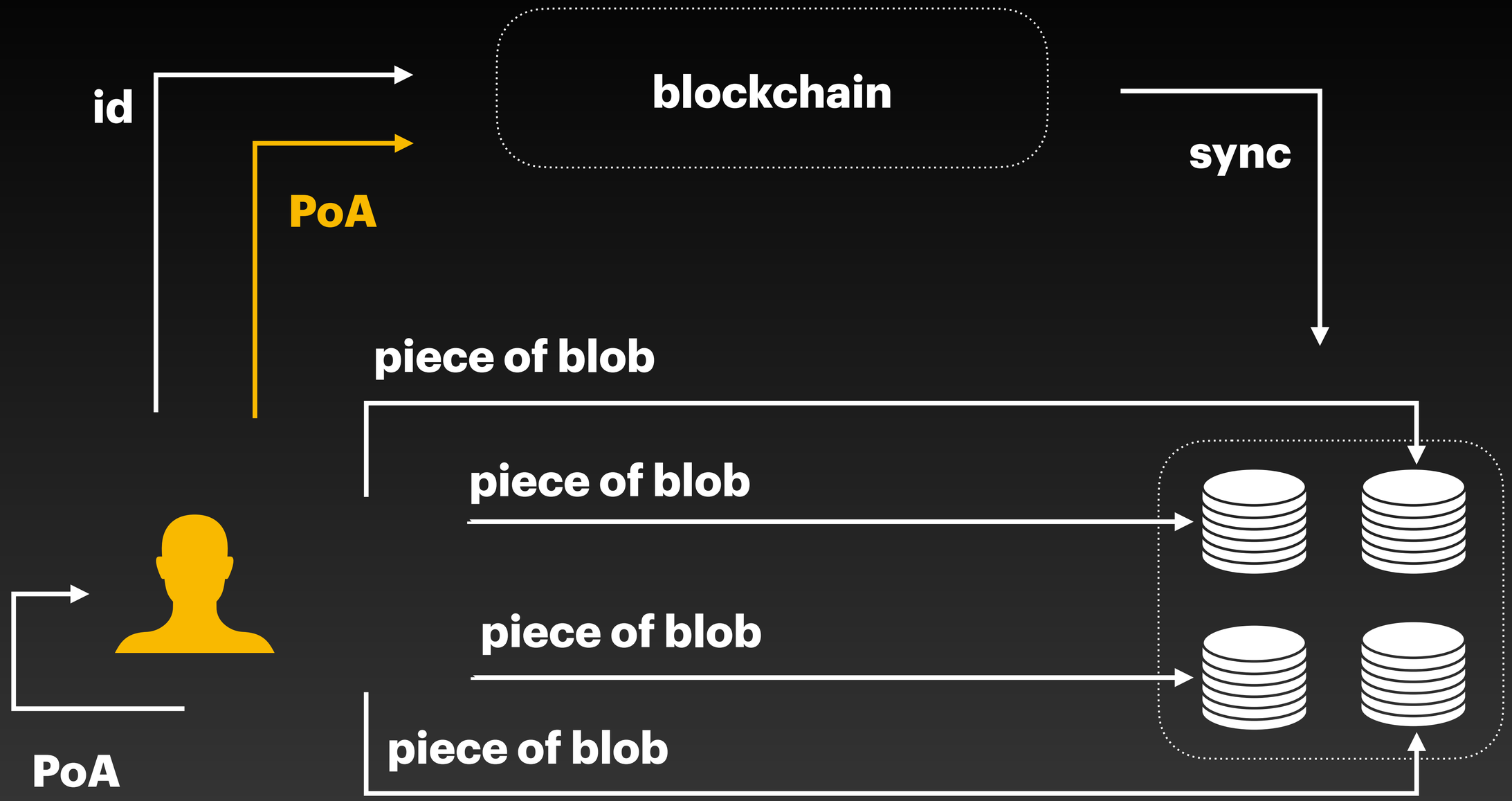
user
Walrus


id
blockchain


id
blockchain
sync


id
blockchain
sync
piece of blob
piece of blob
piece of blob
piece of blob

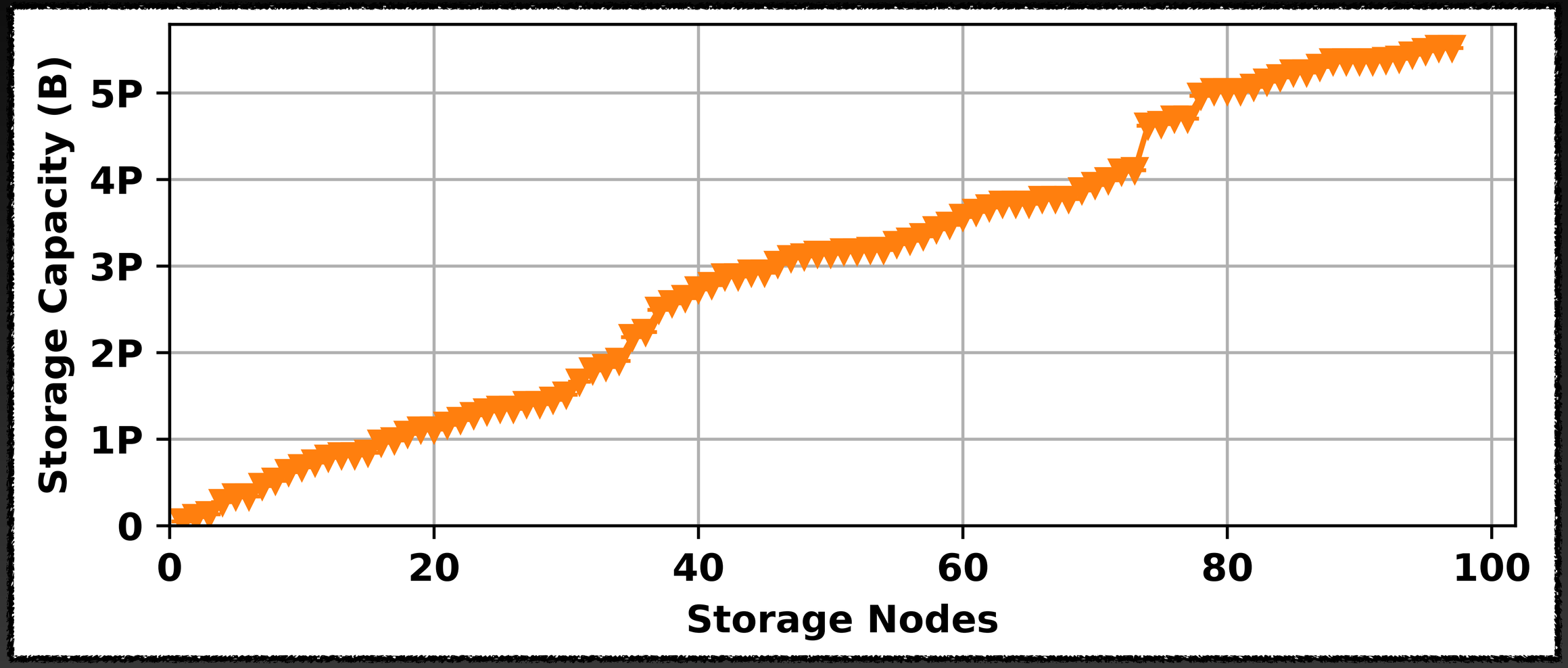

id
blockchain
sync
piece of blob
piece of blob
piece of blob
piece of blob
PoA

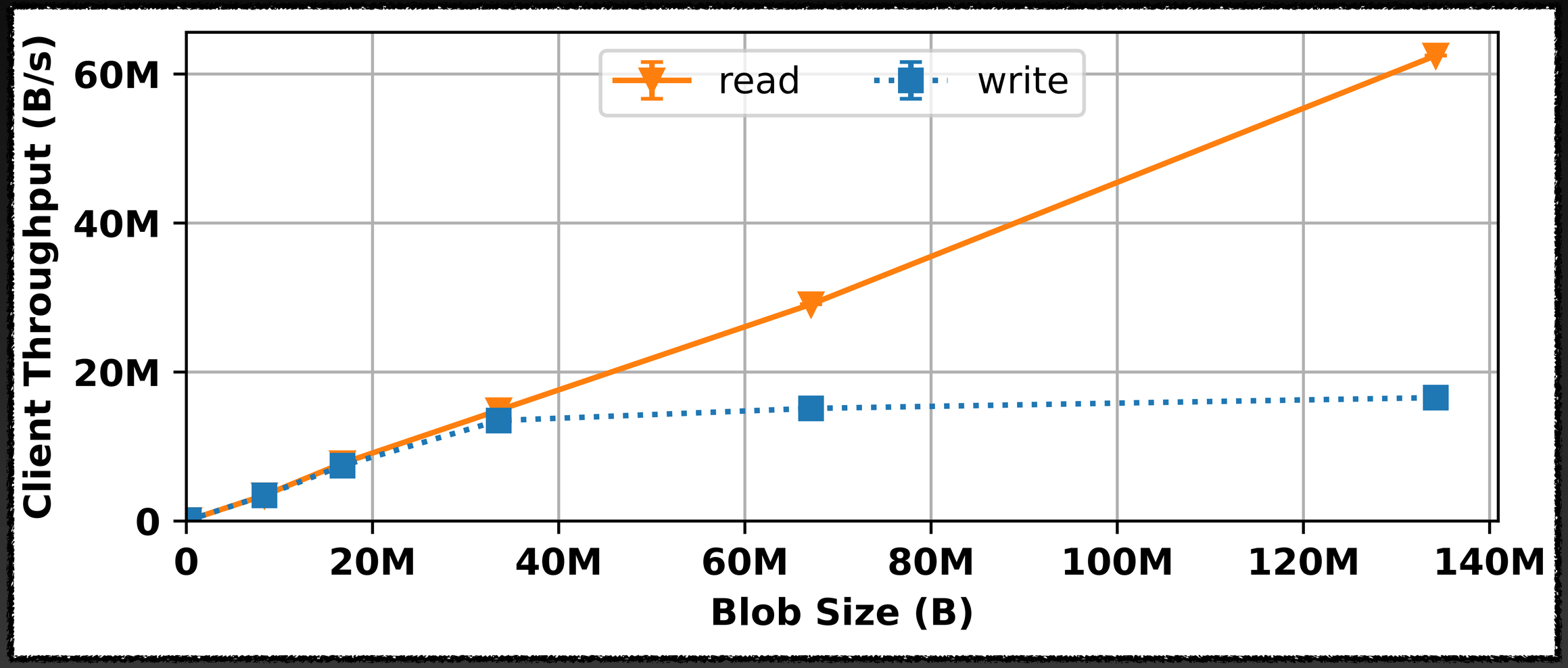

id
blockchain
sync
PoA
piece of blob
piece of blob
piece of blob
piece of blob
PoA

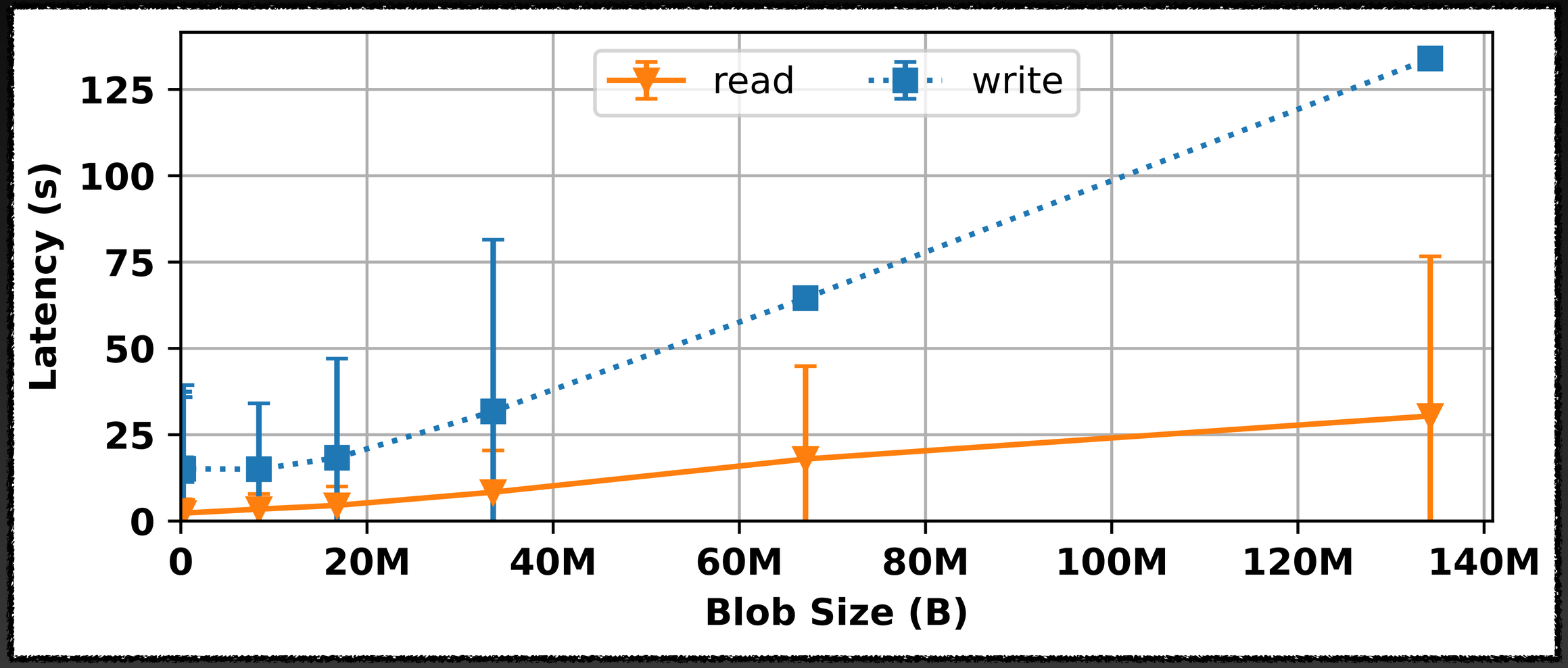
Properties

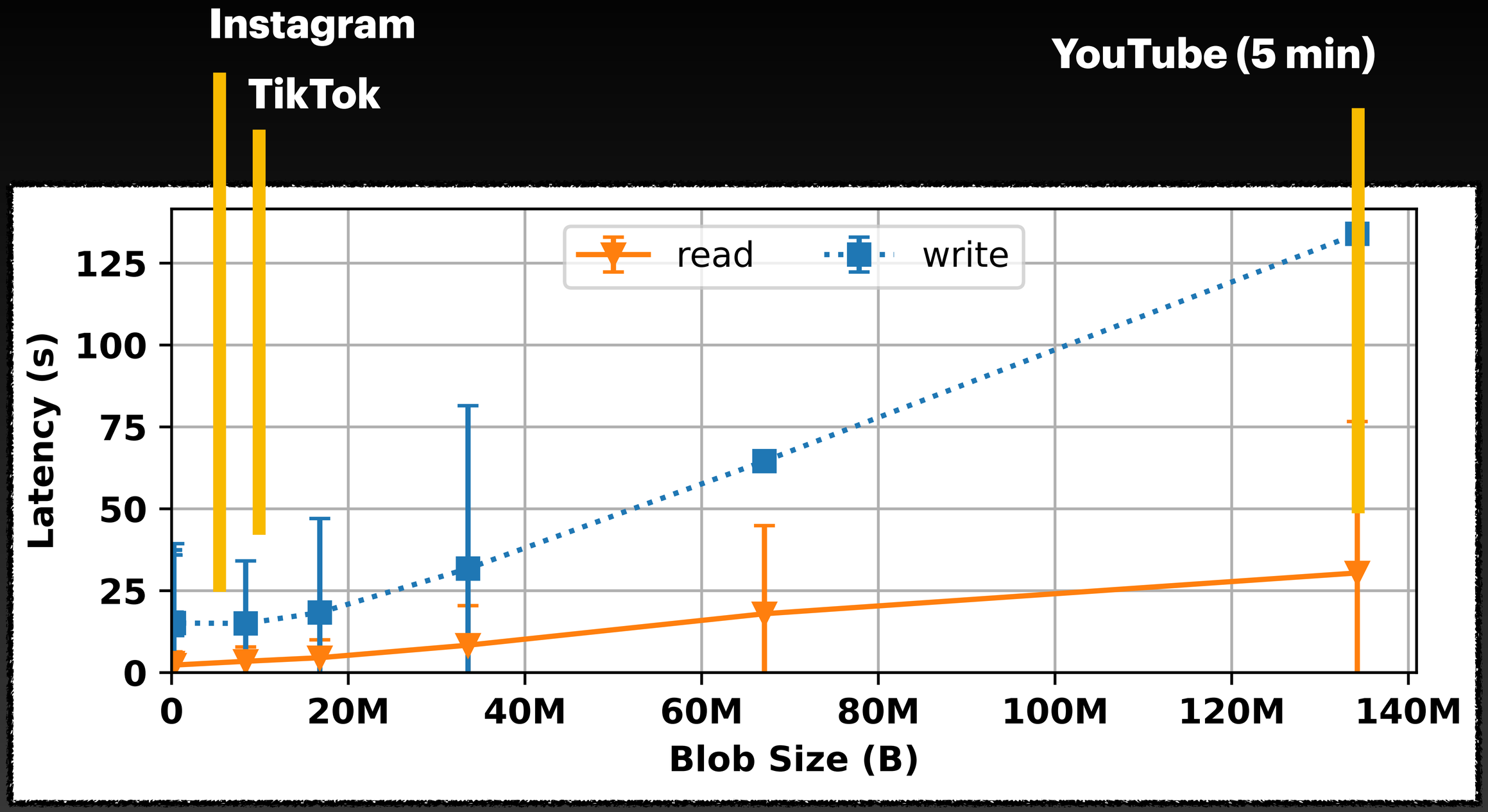
- Honest writer can obtain a **PoA**
- If honest writer writes **B**, then honest reader can read **B**
- If **PoA** exists, two honest readers either both read **B** or both read $\perp$

Each node adds ~55 TB




Client Throughput (B/s)
60M
40M
20M
0
read
write
0
20M
40M
60M
80M
100M
120M
140M
Blob Size (B)


read
write
Latency (s)
125
100
75
50
25
0
0
20M
40M
60M
80M
100M
120M
140M
Blob Size (B)


Instagram
TikTok
YouTube (5 min)
read
write
Latency (s)
0
25
50
75
100
125
0
20M
40M
60M
80M
100M
120M
140M
Blob Size (B)

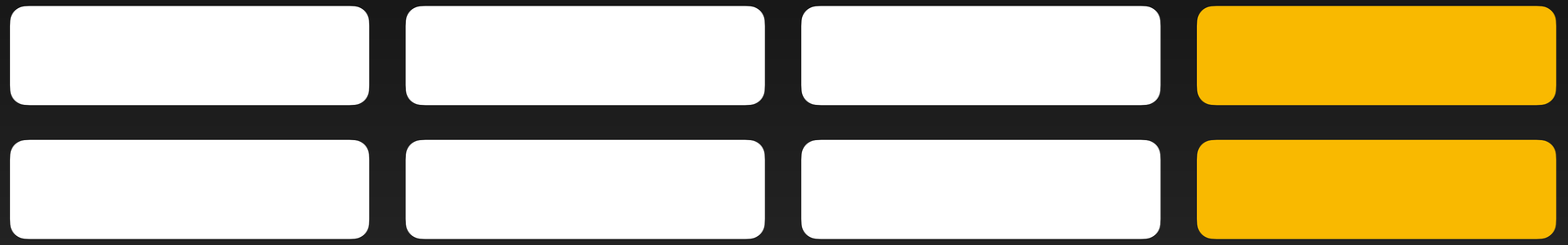
Erasure Codes

Efficient Recovery

- Clients can fail
- Nodes can be Byzantine
- Epoch change


2f+1
f+1

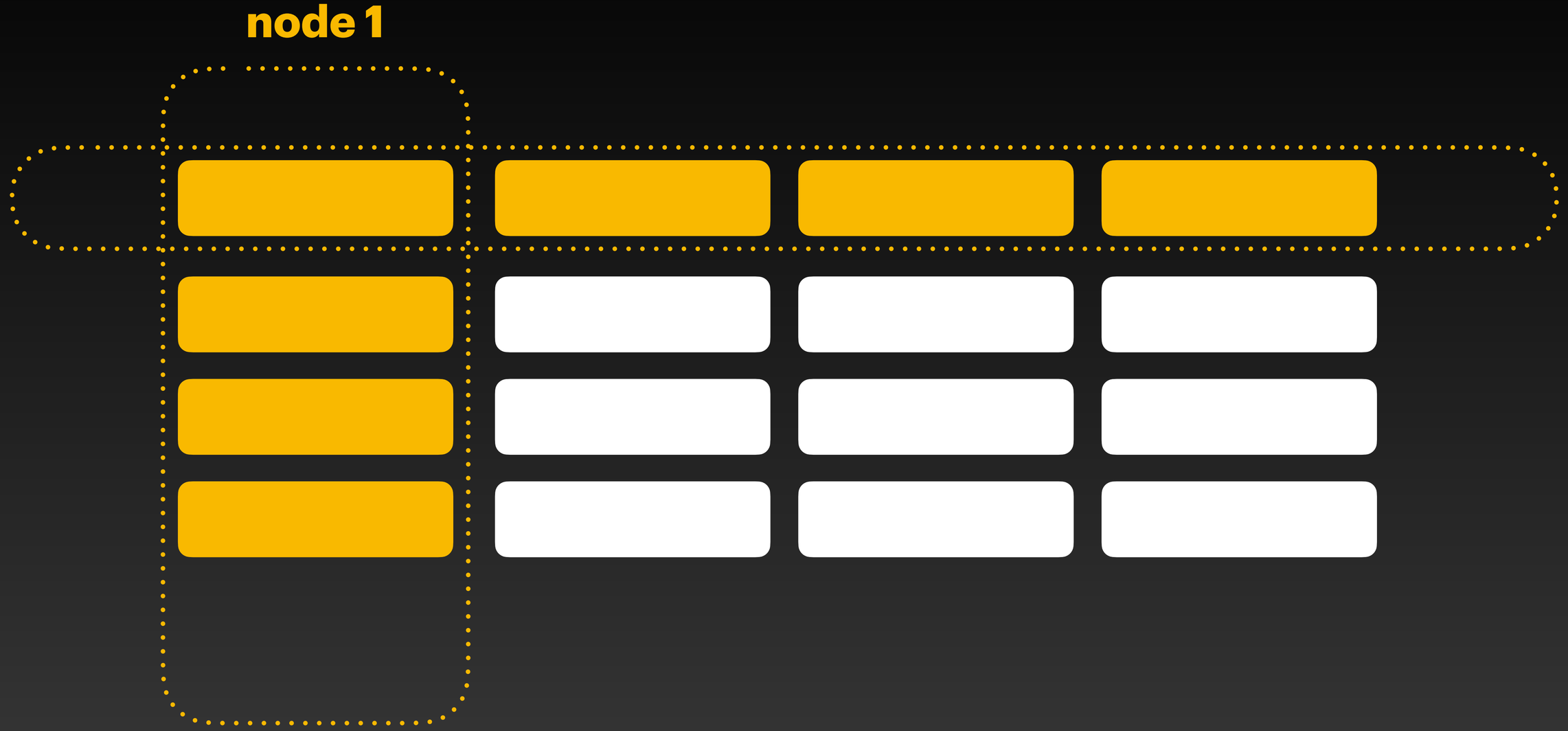
from 2f+1 to n

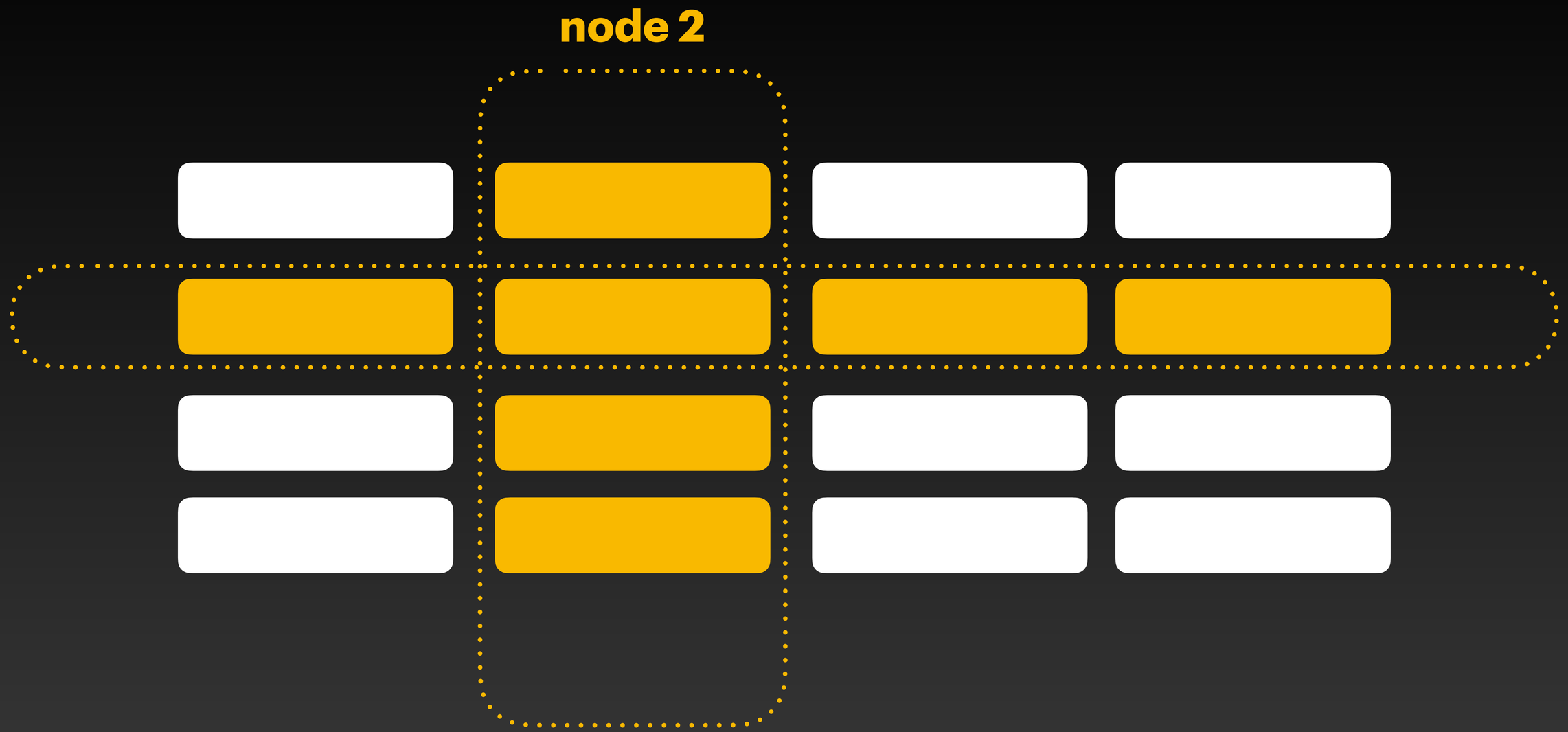


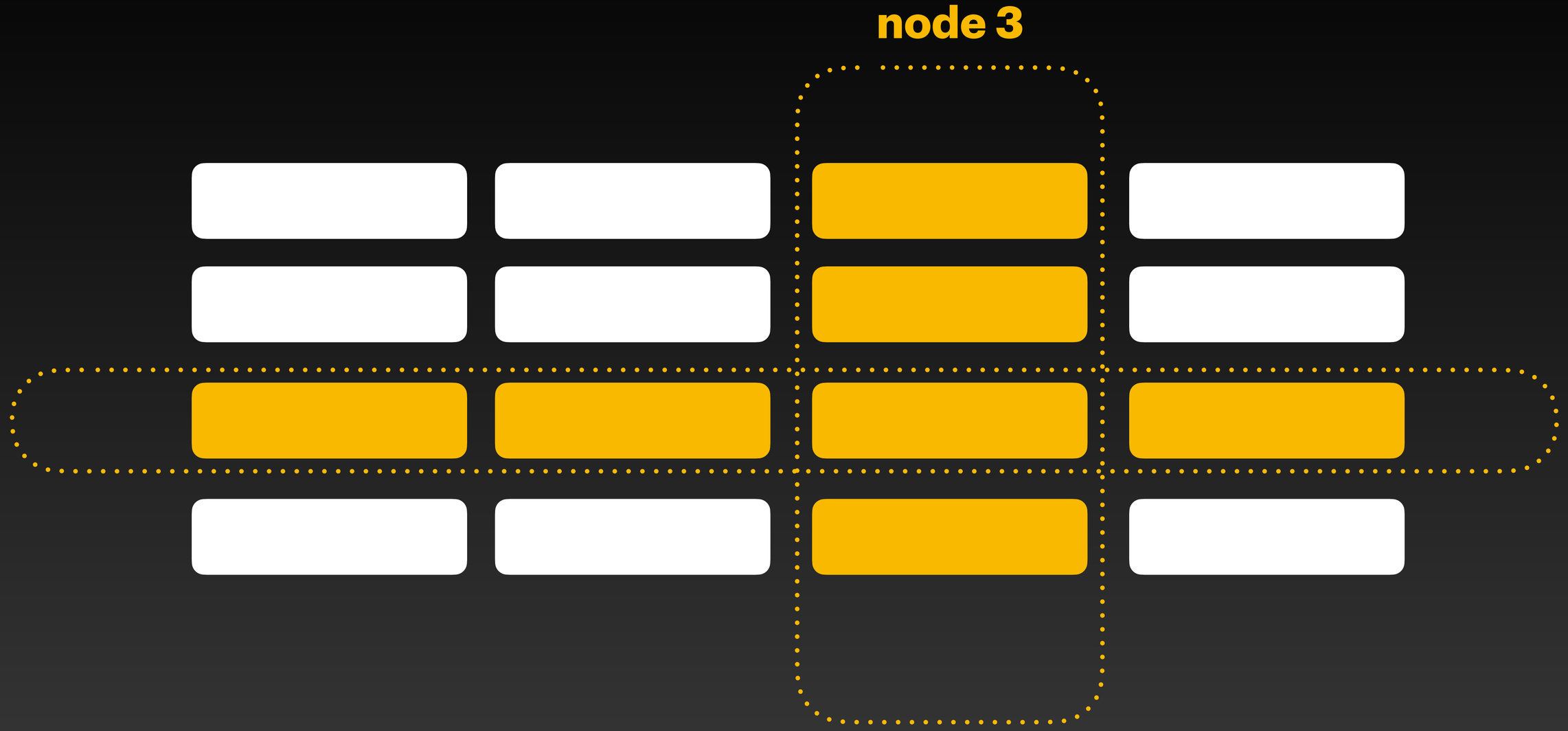
from f+1 to n

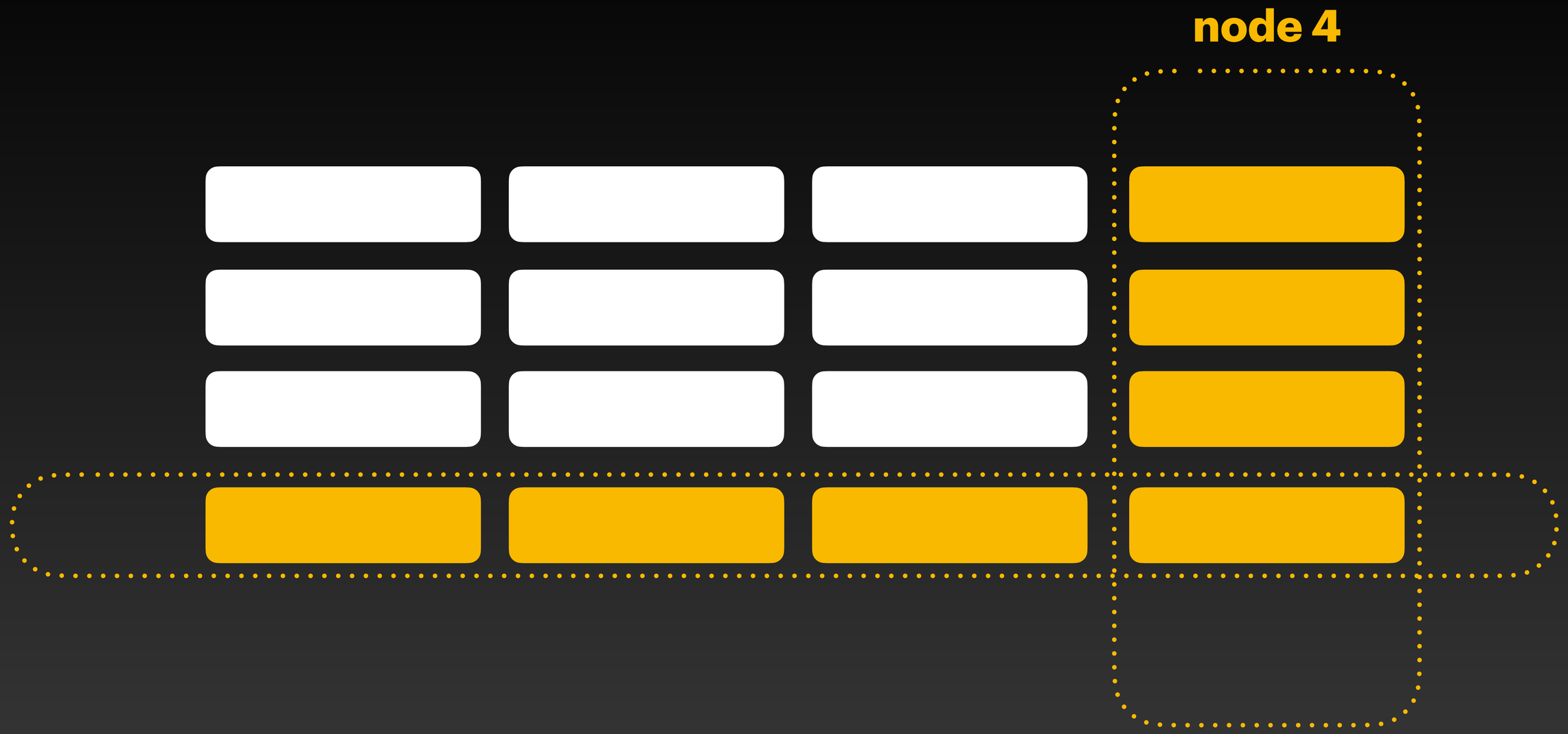
primary slivers

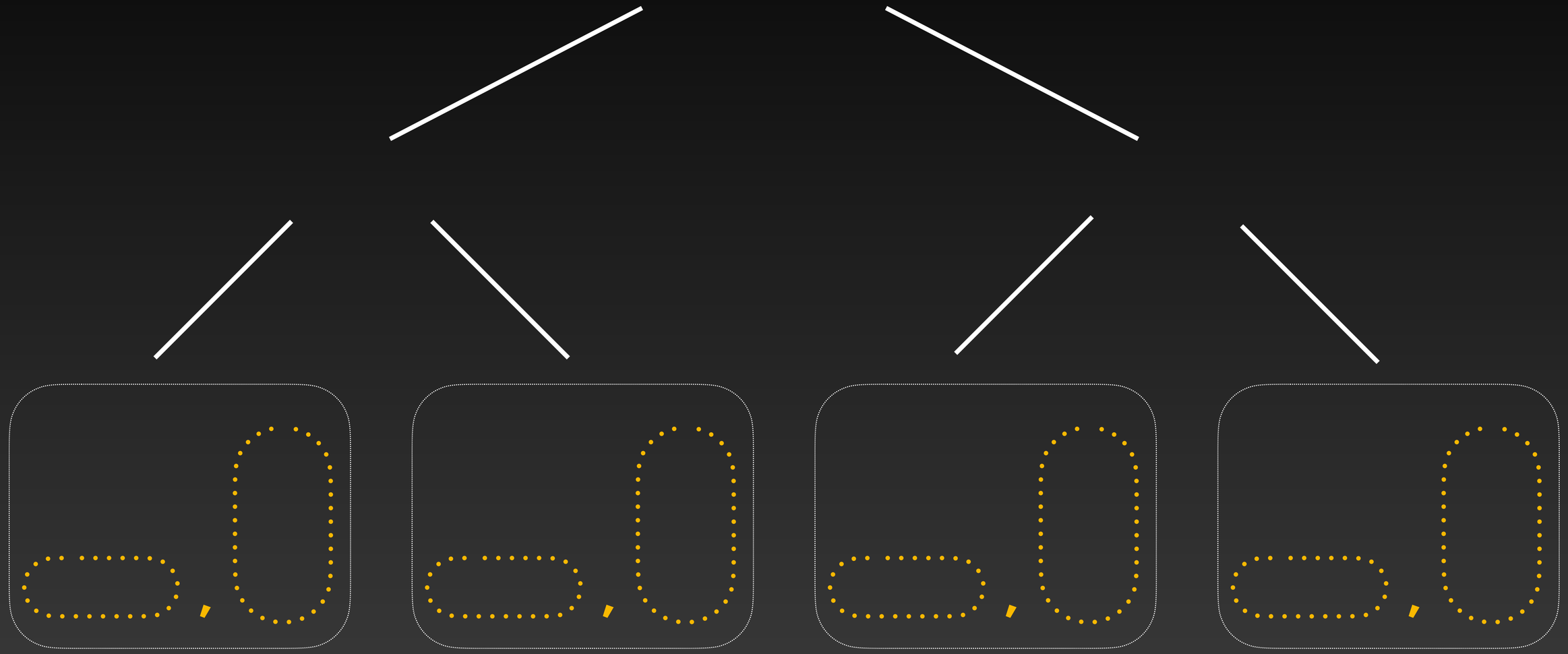
secondary slivers


node 1


node 2

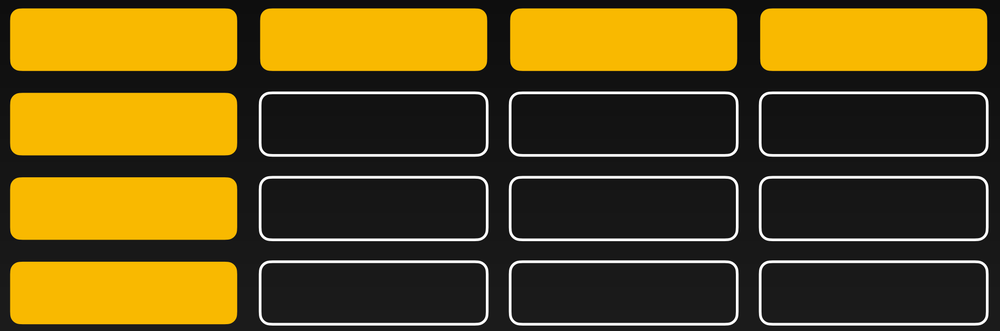

node 3


node 4


Blob id

Recovery

node 1

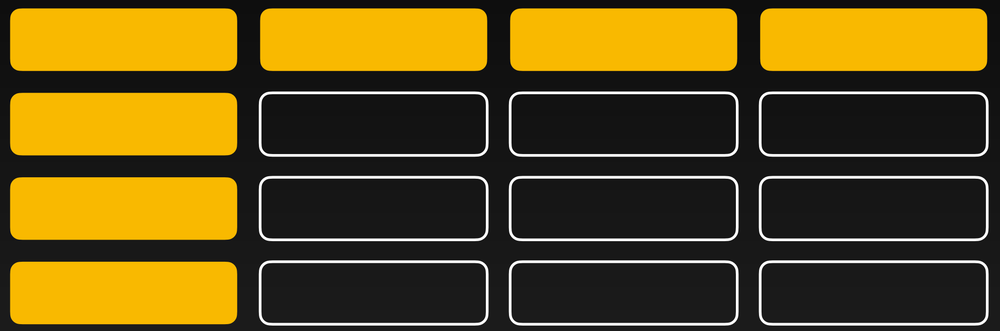


node 2

node 3

node 4

node 1

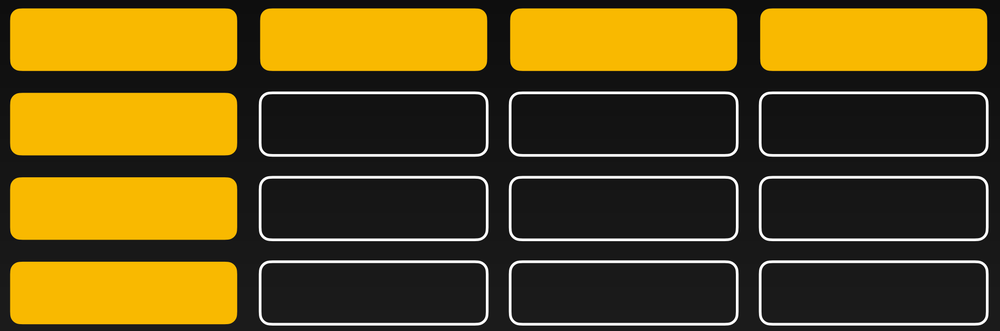


node 2

node 3

node 4

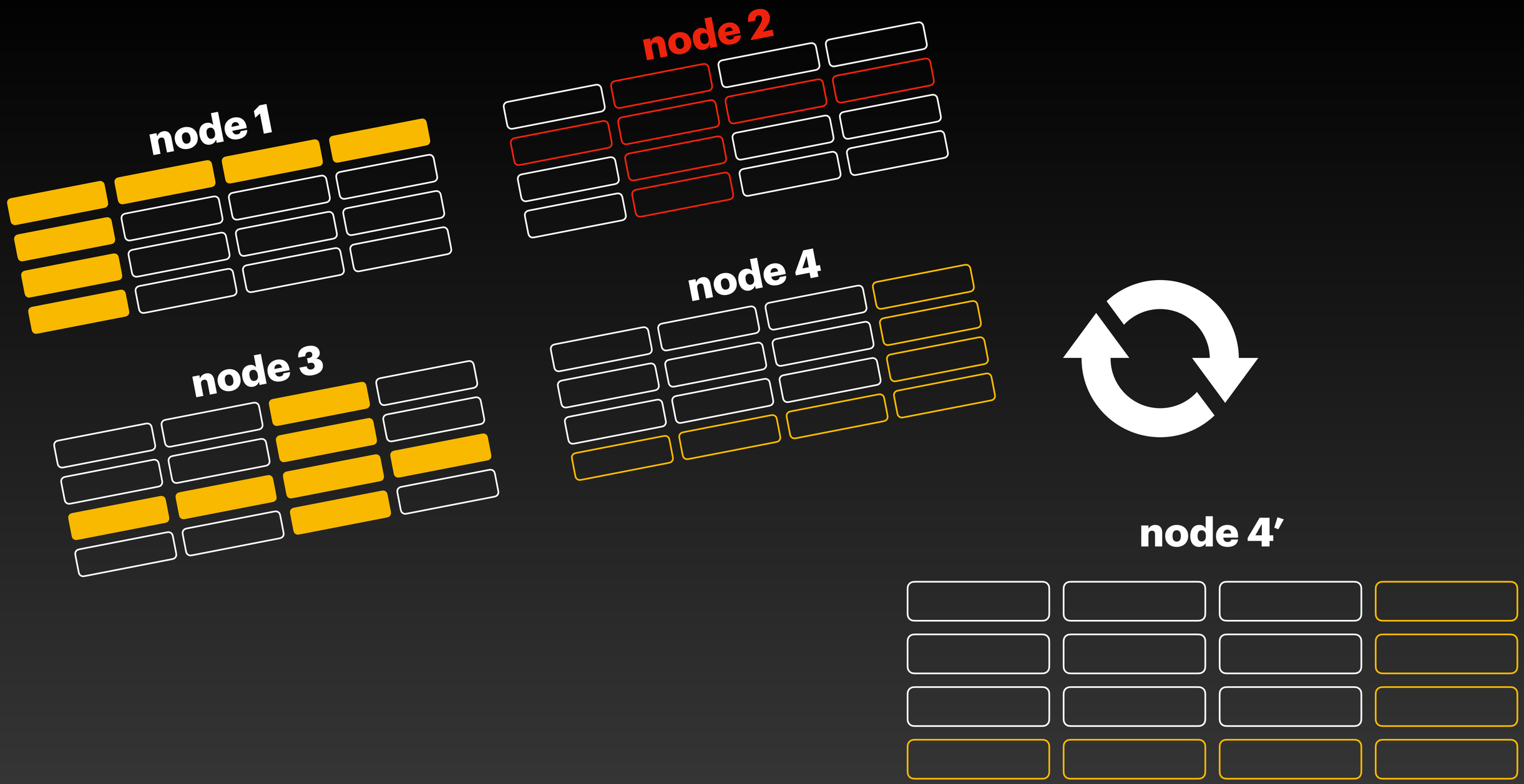
node 1



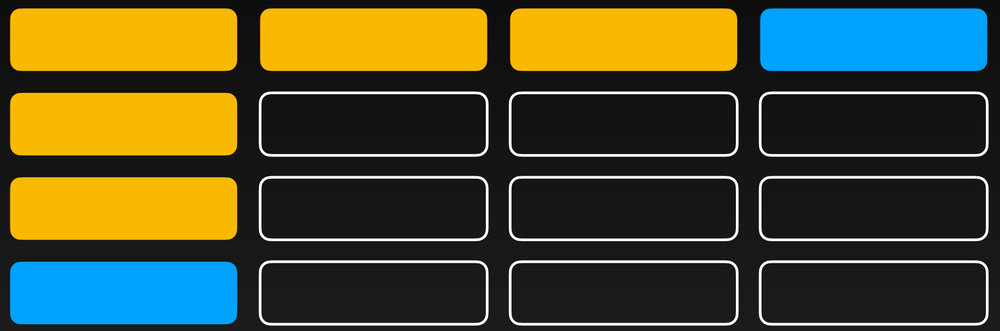
node 2

node 3

node 4


node 1
node 2
node 3
node 4
node 4’

node 1

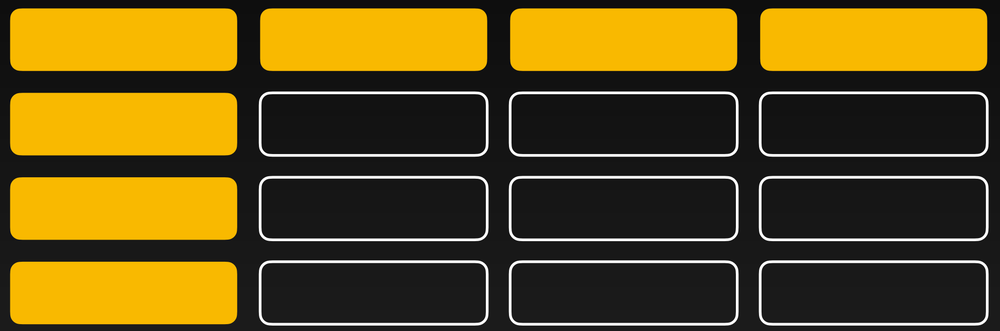


node 2

node 3

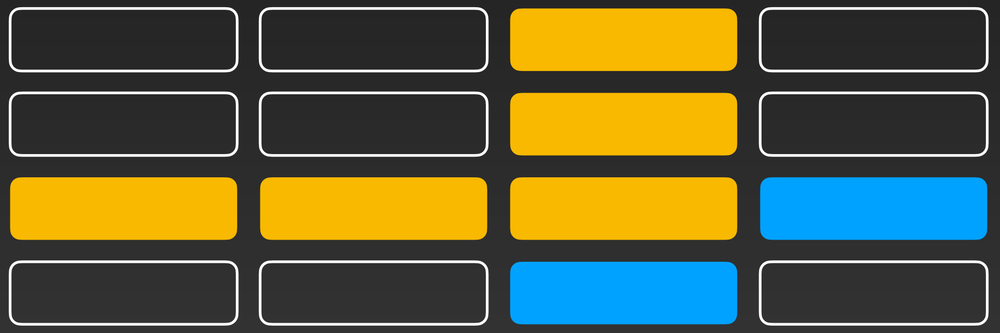
node 4

node 1



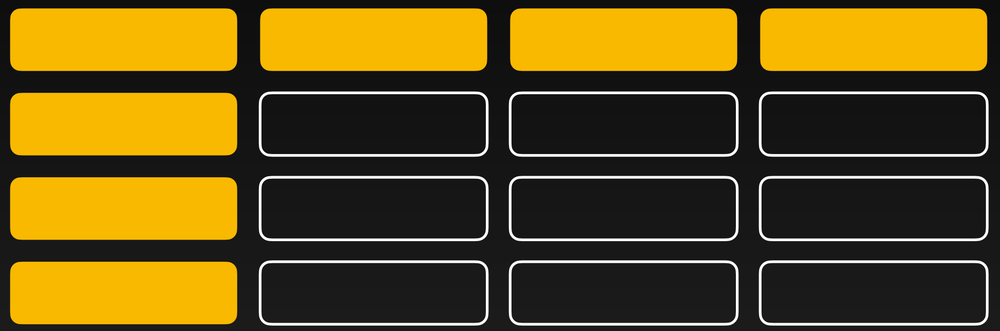
node 2

node 3



node 4

node 1

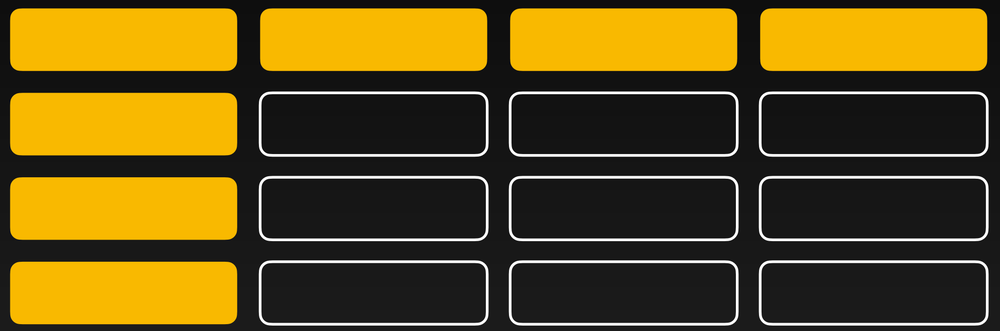


node 2

node 3

node 4

node 1



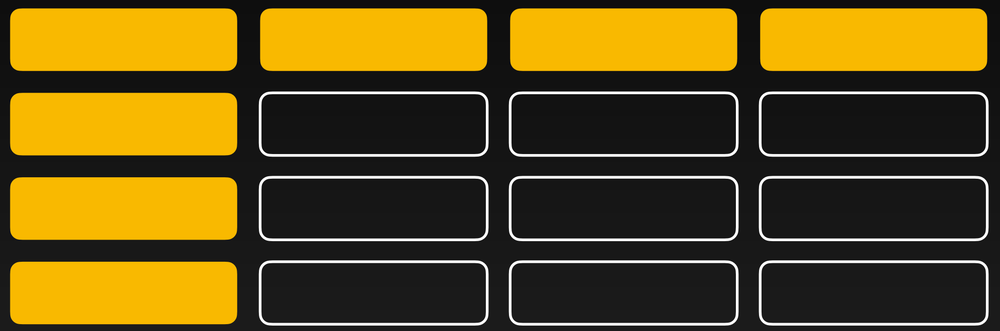
node 2

node 3

node 4

f+1

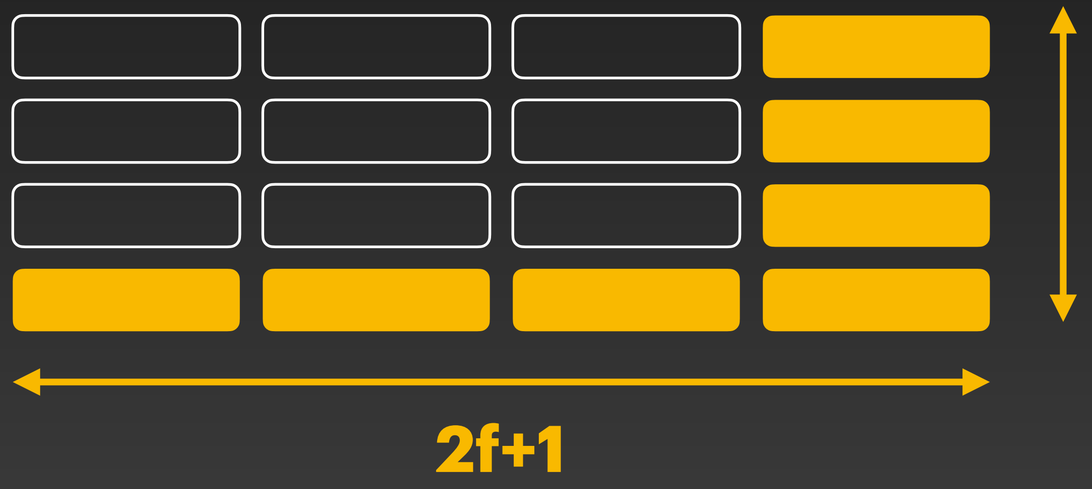
node 1



node 2

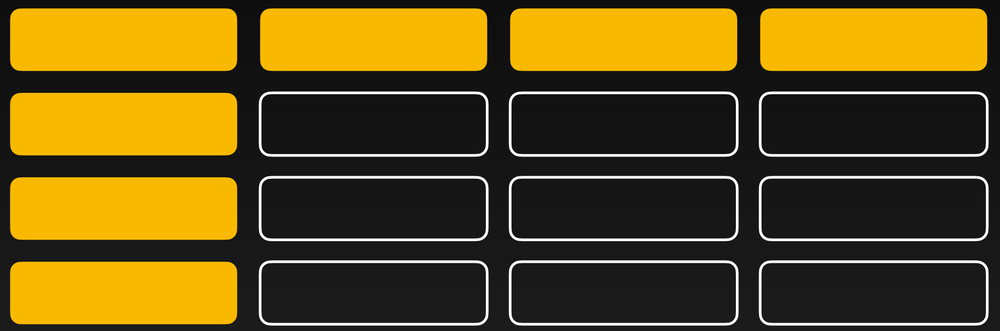
node 3

node 4



Storage Optimisation

node 1



node 2

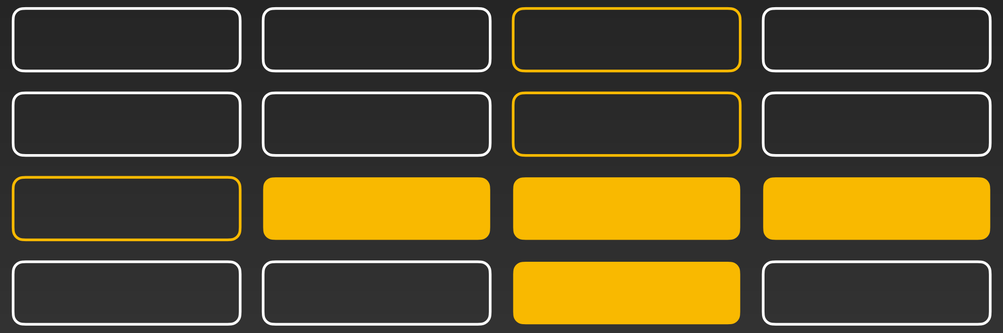
node 3

node 4

node 1

node 2

node 3



node 4

Storage Overhead

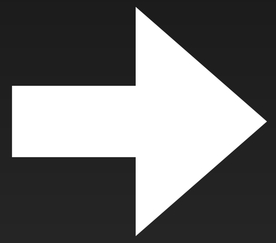
~100x

Blockchain System

Storage Overhead

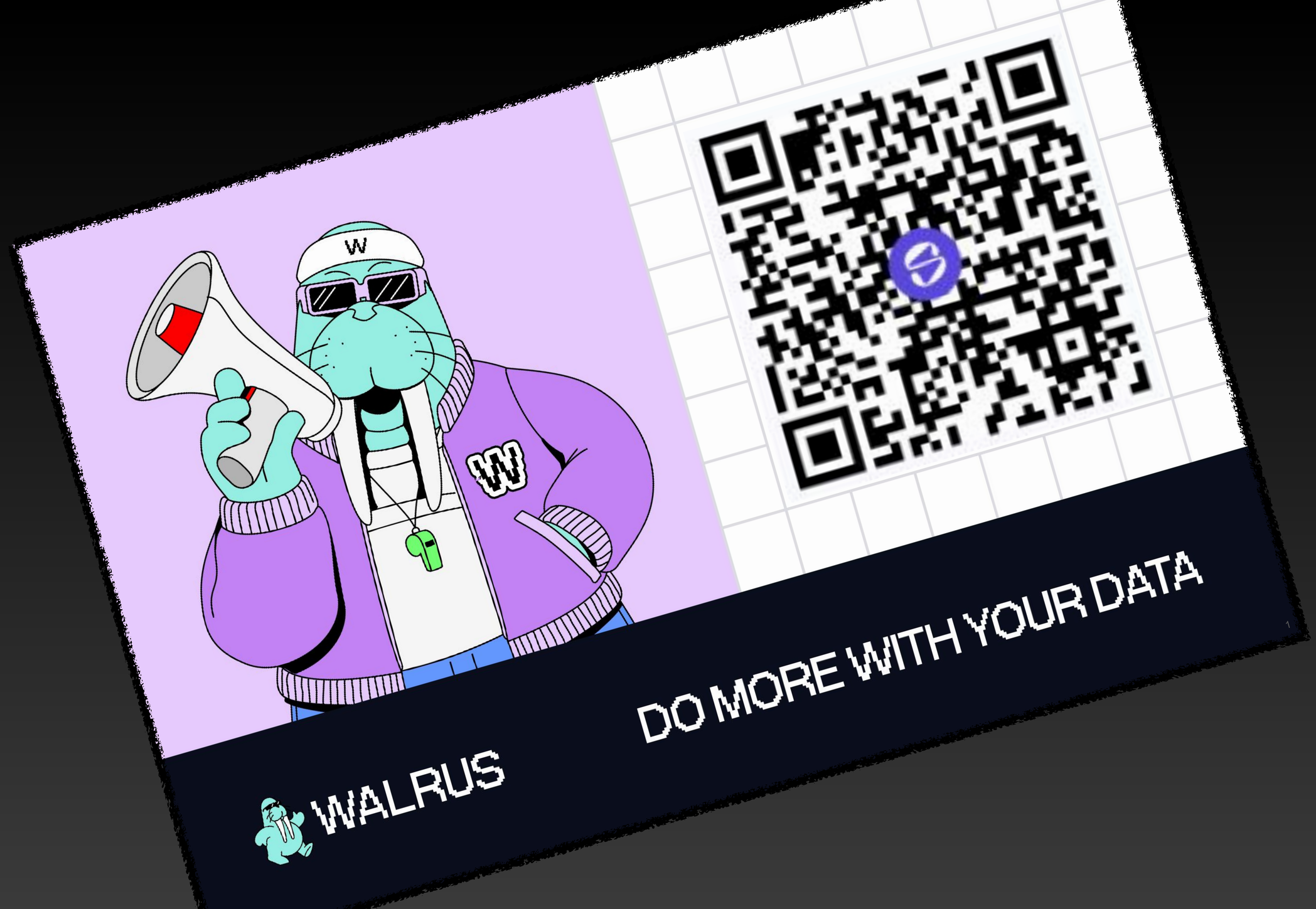
~100x

Blockchain System

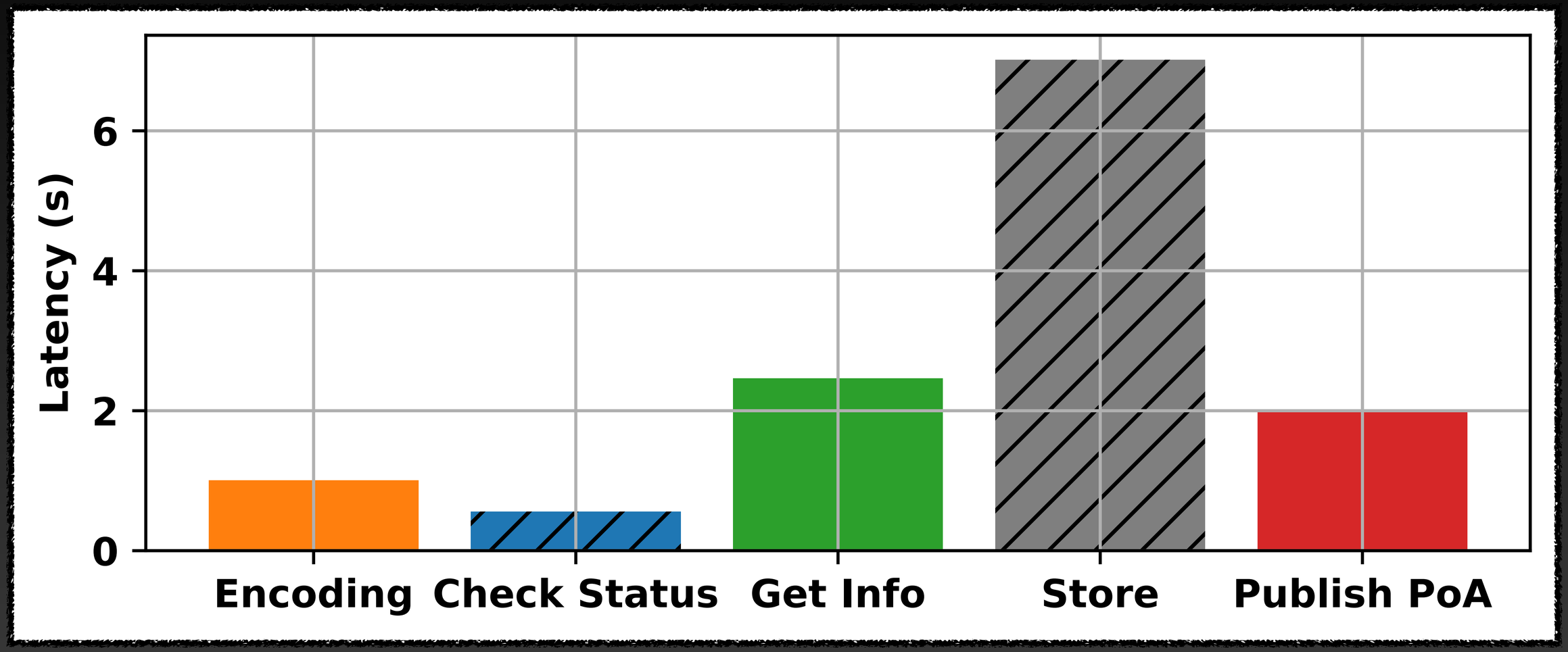


~4.5x

Walrus


WALRUS
DO MORE WITH YOUR DATA

Small Blob (1kB)



Large Blob (135MB)