

Walrus

An Efficient Decentralised Storage Network

Alberto Sonnino

Distributed Storage



**Distributed
Storage**



+ Incentives



Two Challenges

- Dynamic availability
- Conflate consensus with proof of storage

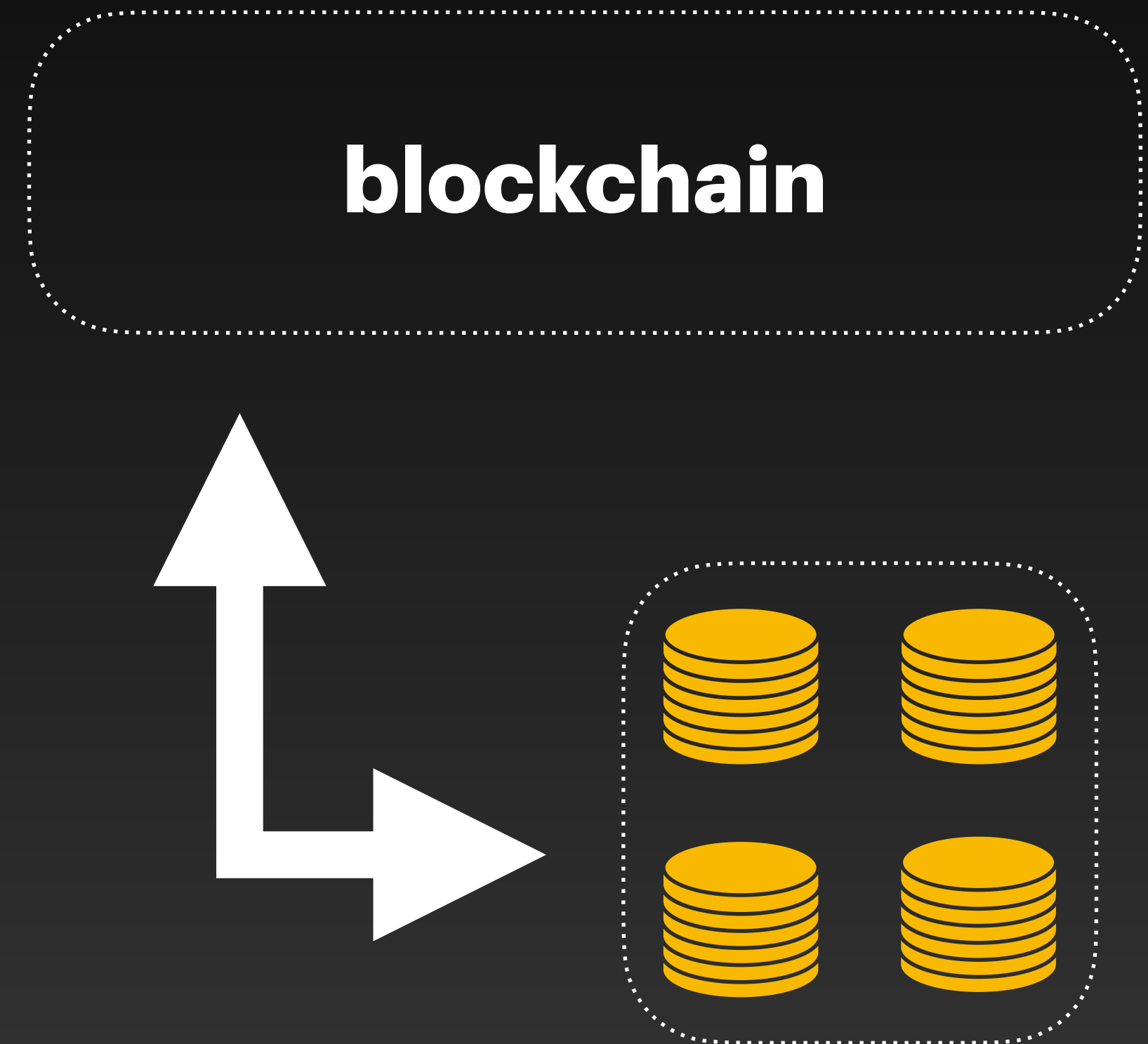
Two Challenges

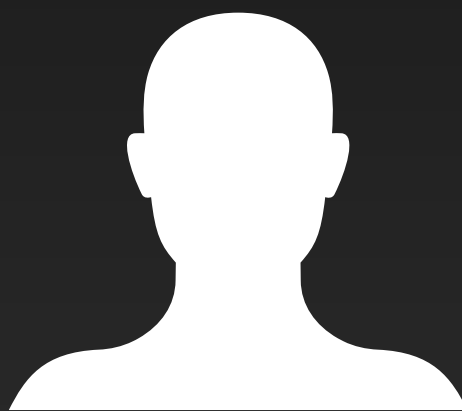
- Dynamic availability
 - Conflate consensus with proof of storage
-
- **Slow**
 - **90% Junk blocks**
 - **High replication factor (~100x)**

BFT Quorum

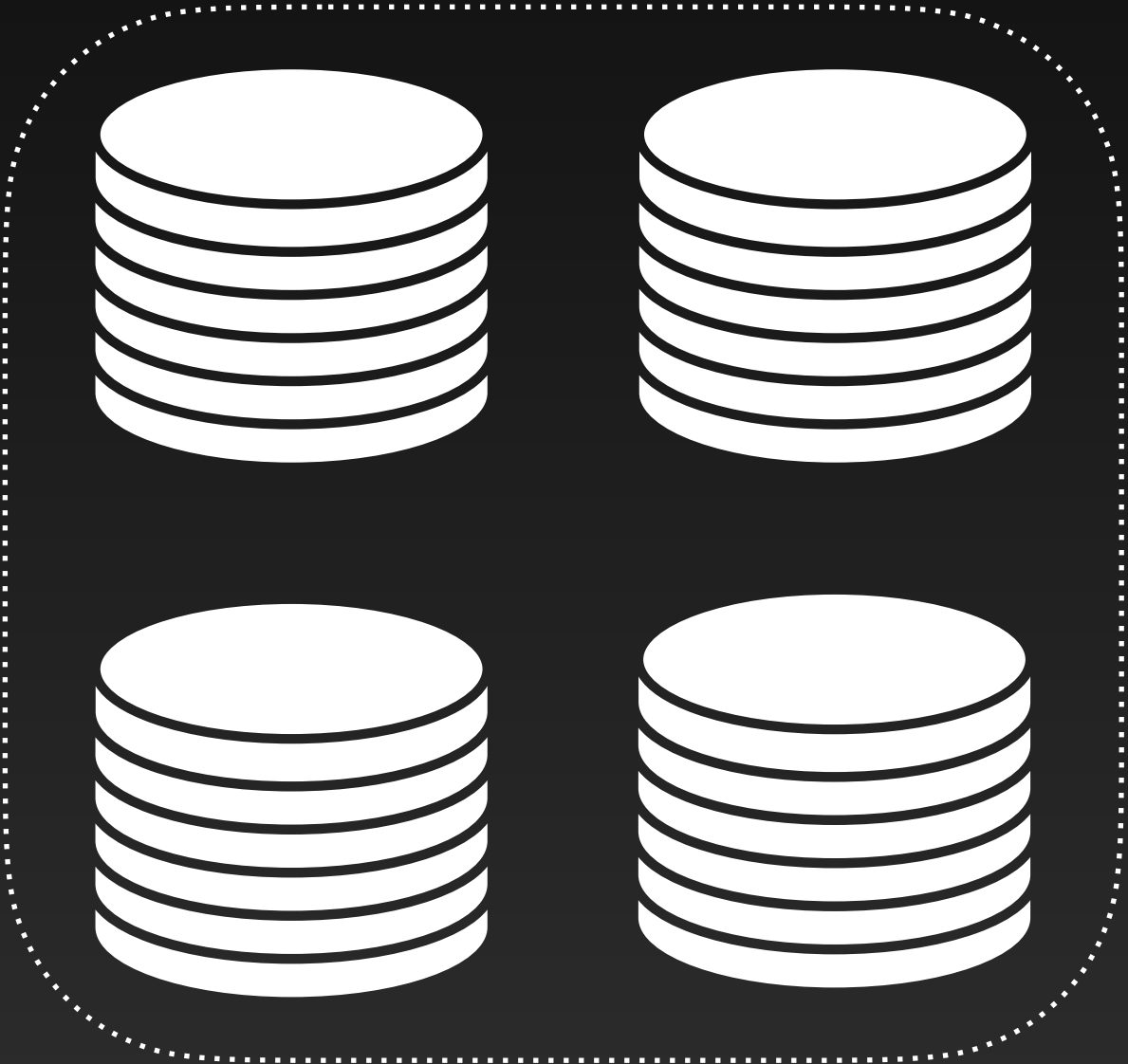


External Chain





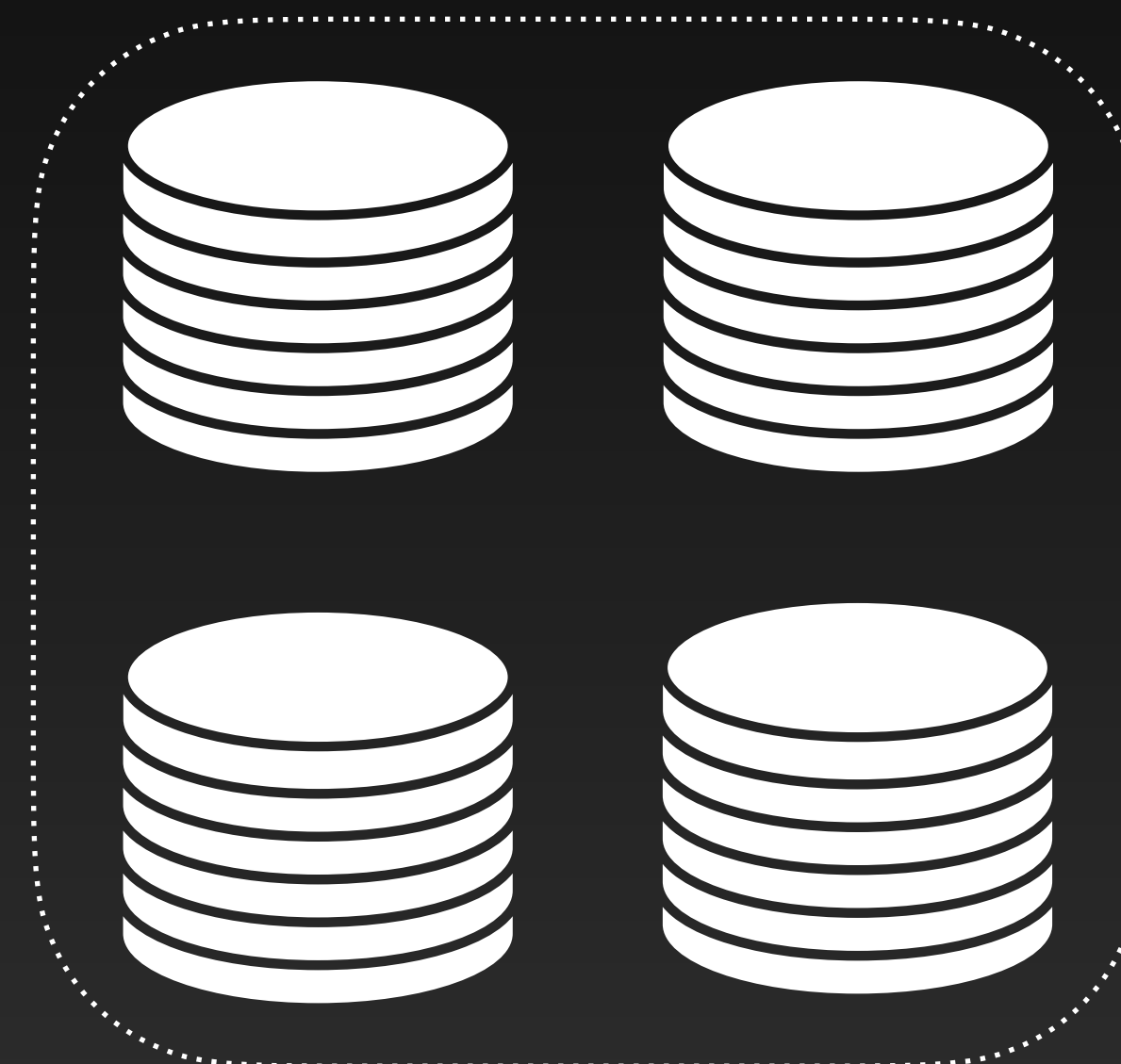
user



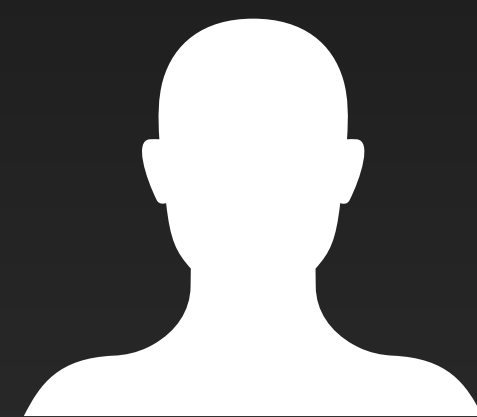
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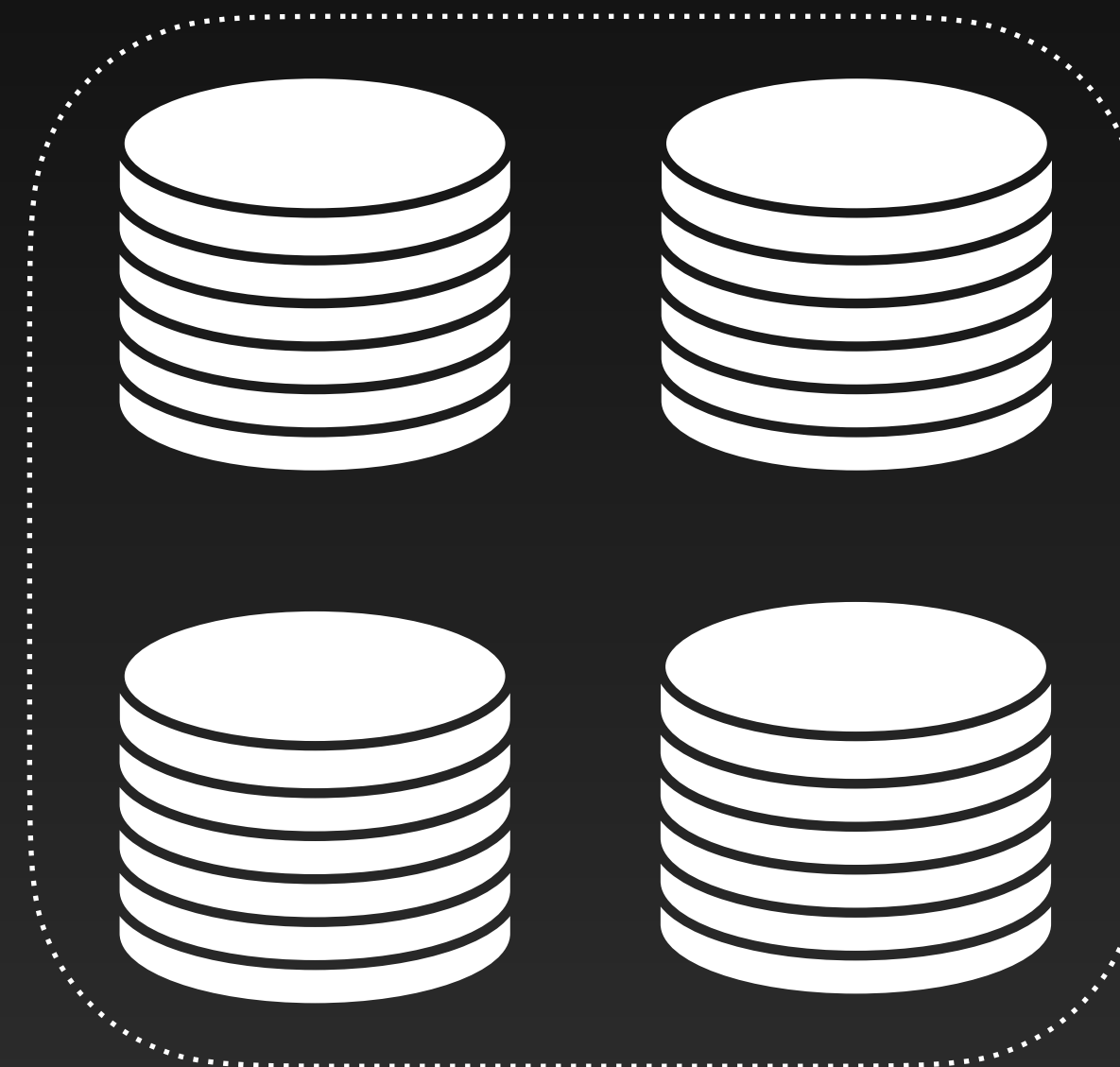
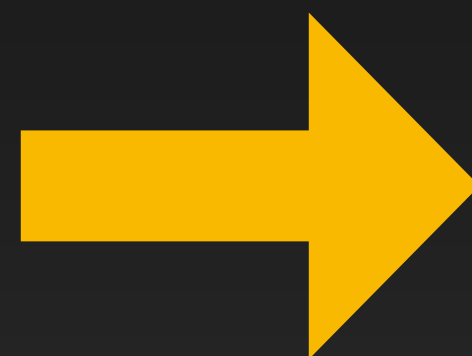
user



Walrus



user



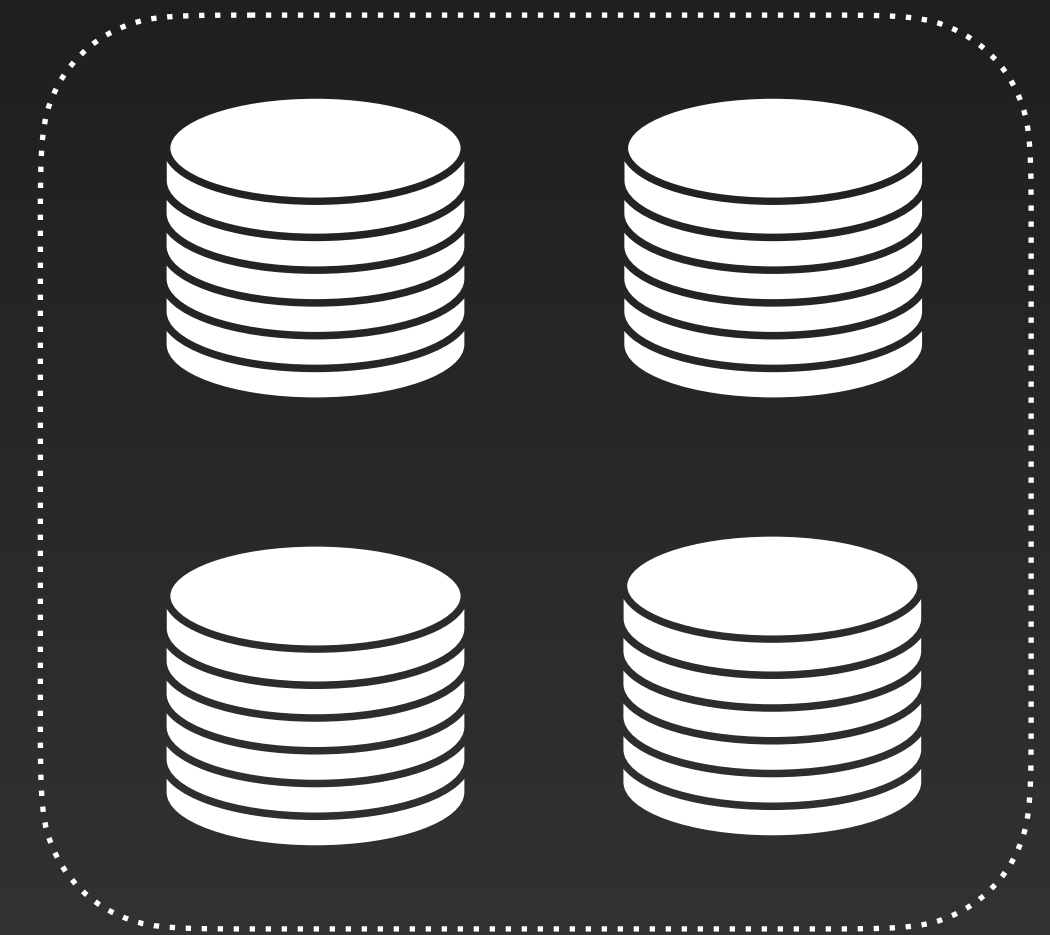
Walrus



id



blockchain

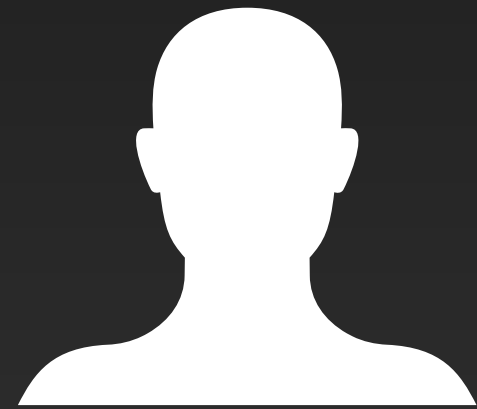


id



blockchain

sync



id

blockchain

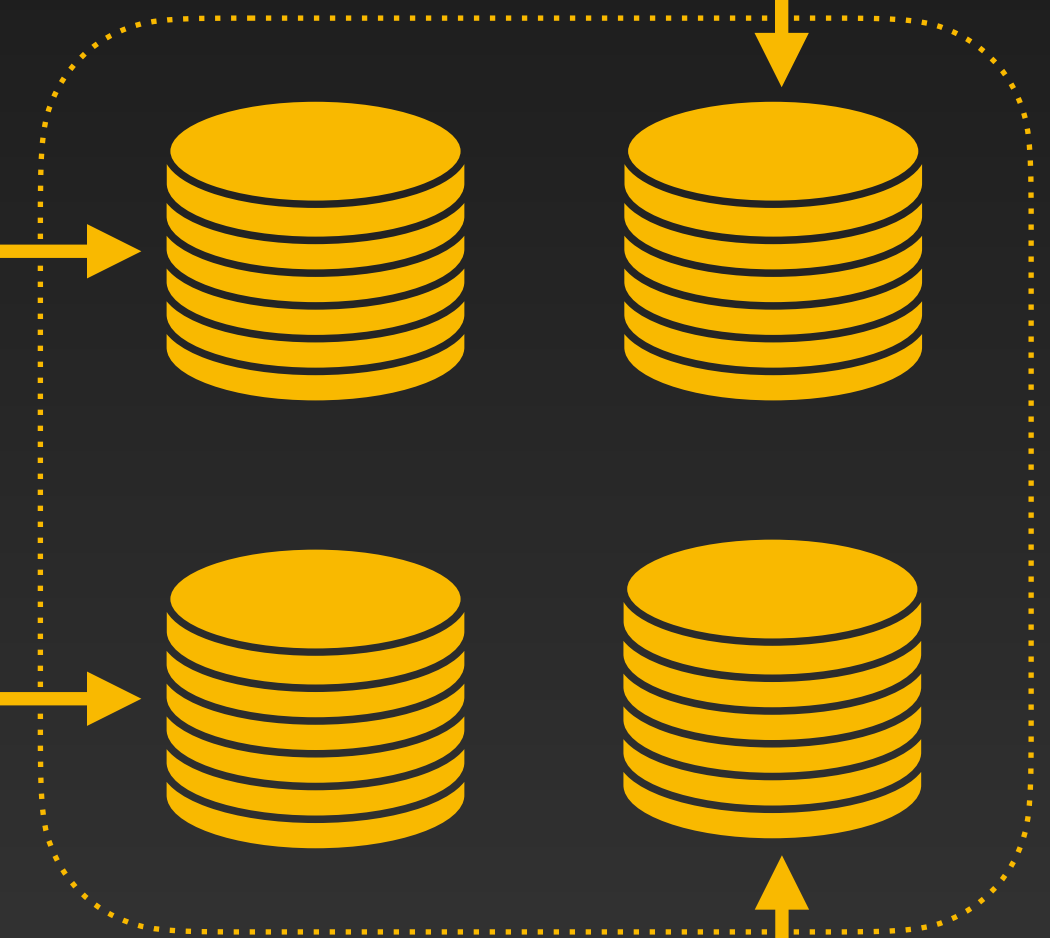
sync

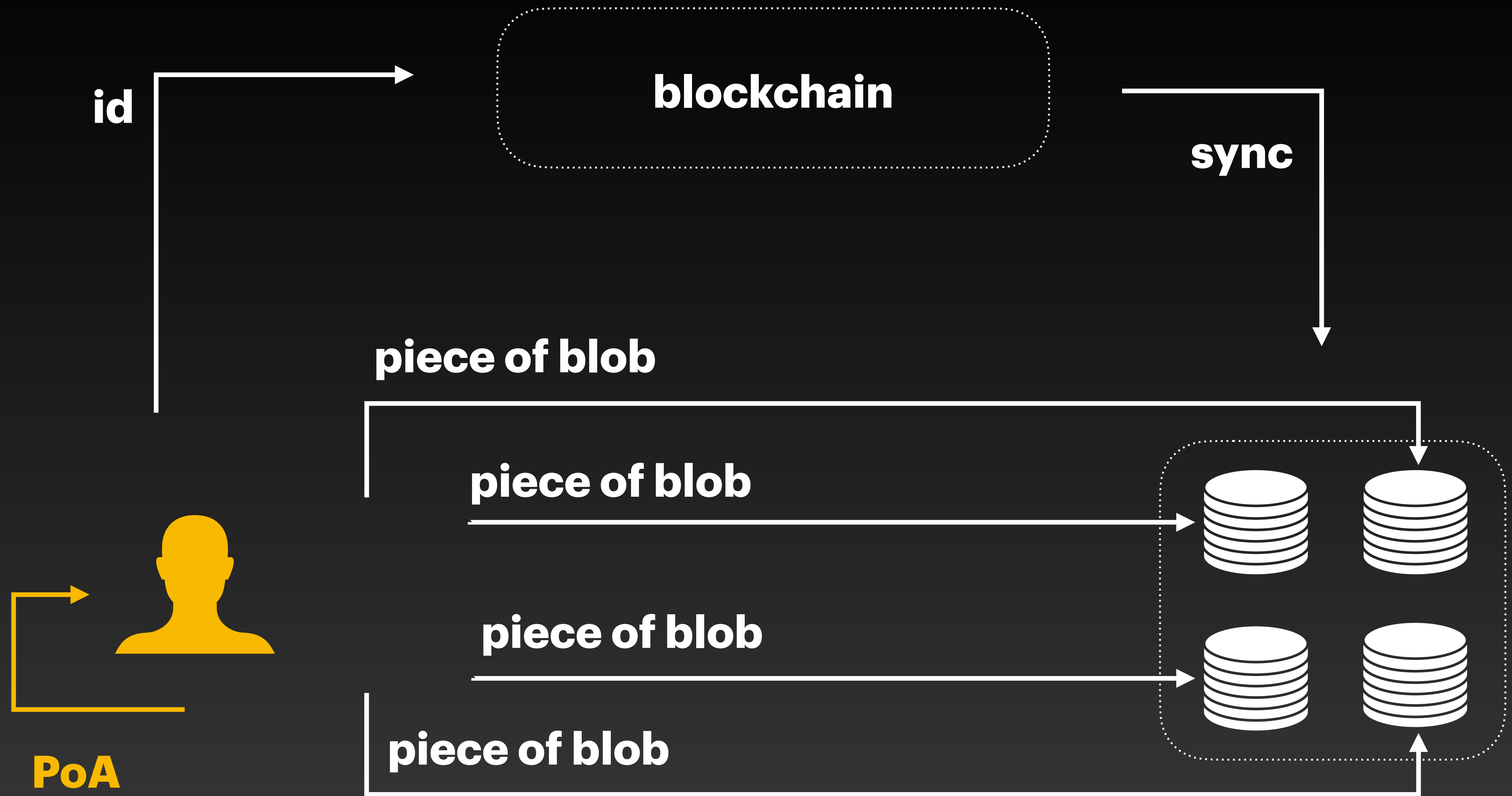
piece of blob

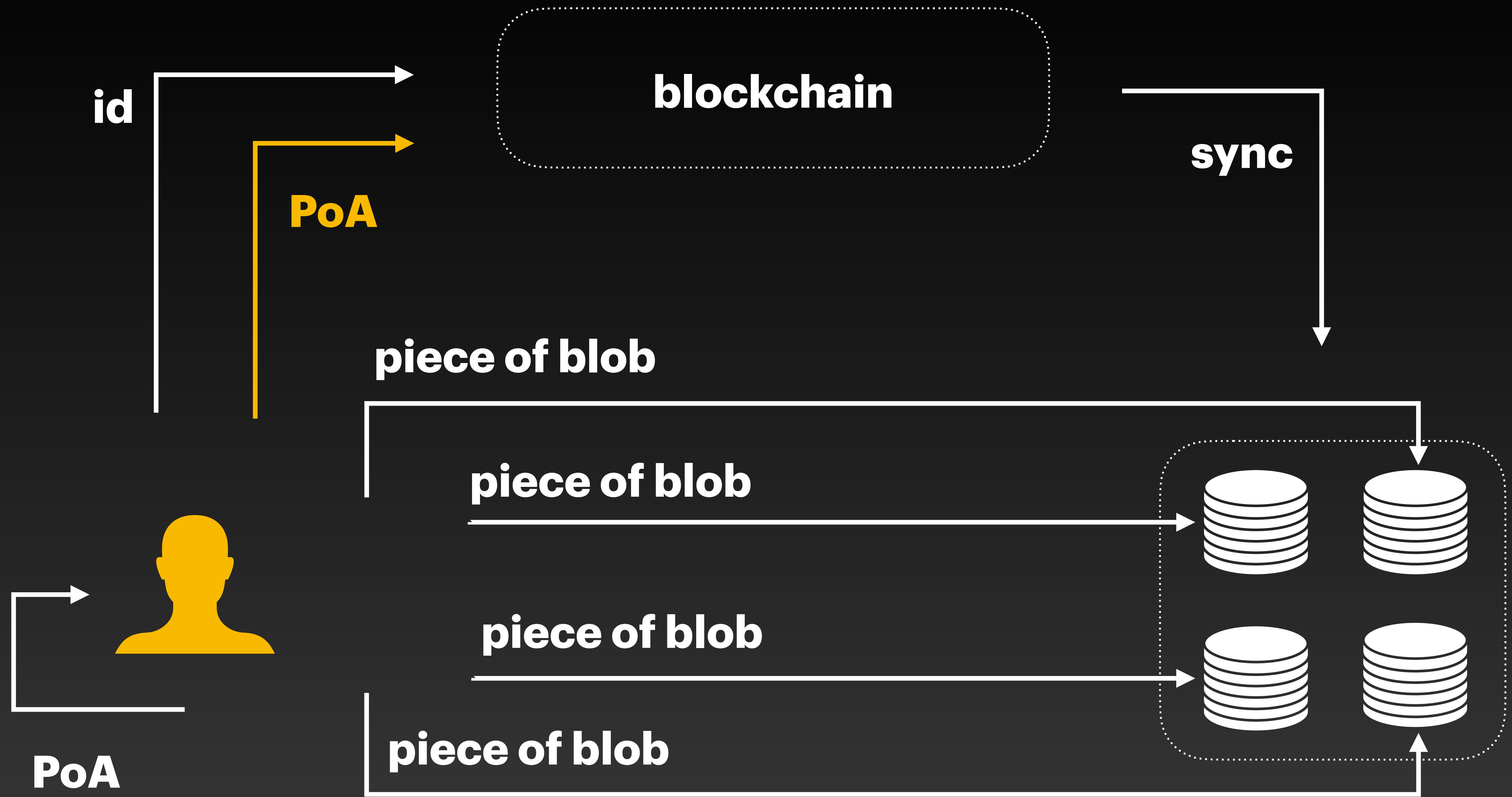
piece of blob

piece of blob

piece of blob



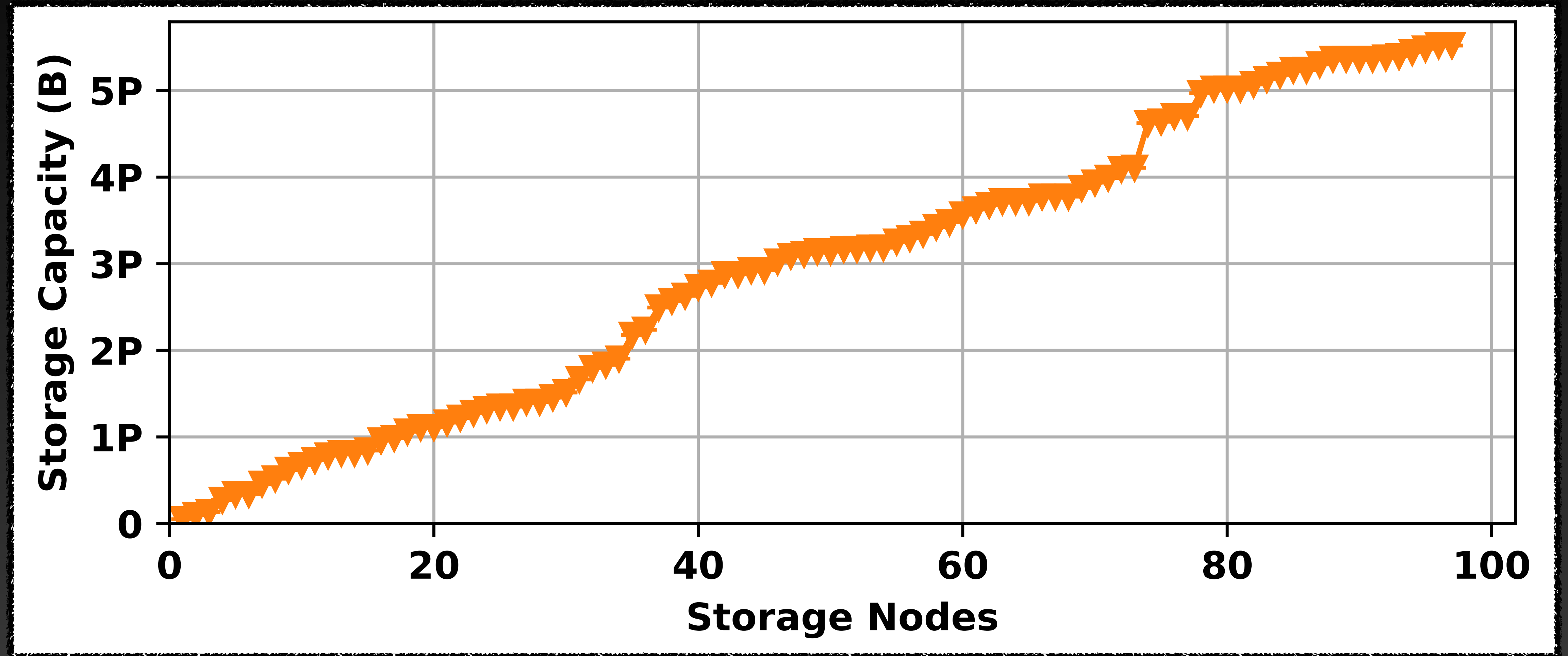


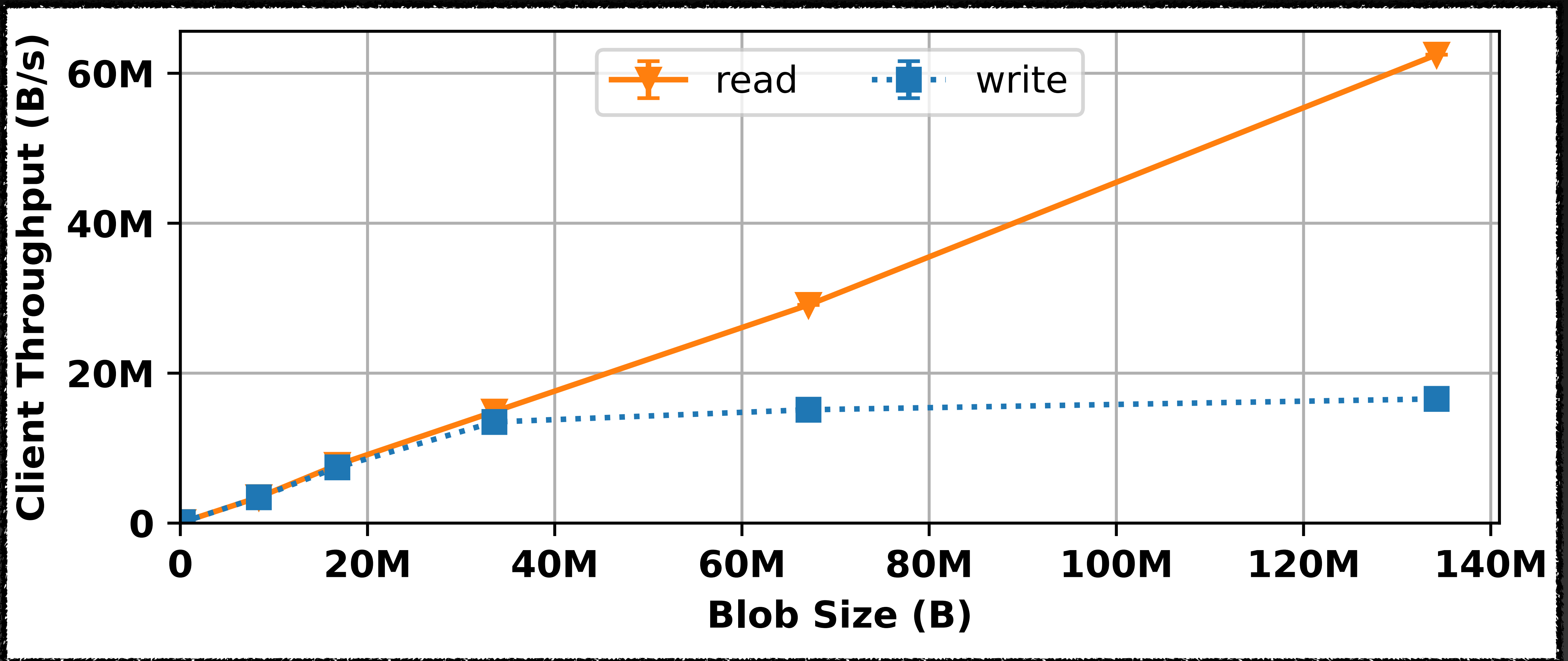


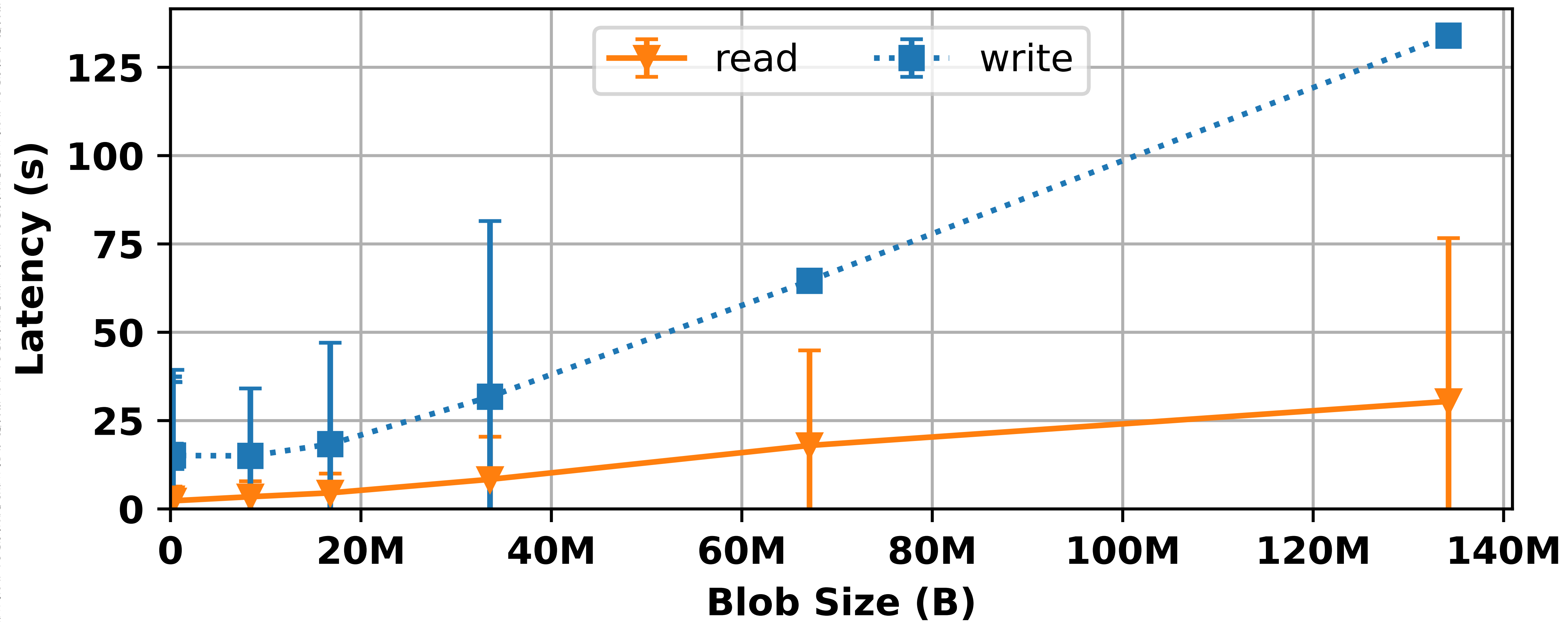
Properties

- 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



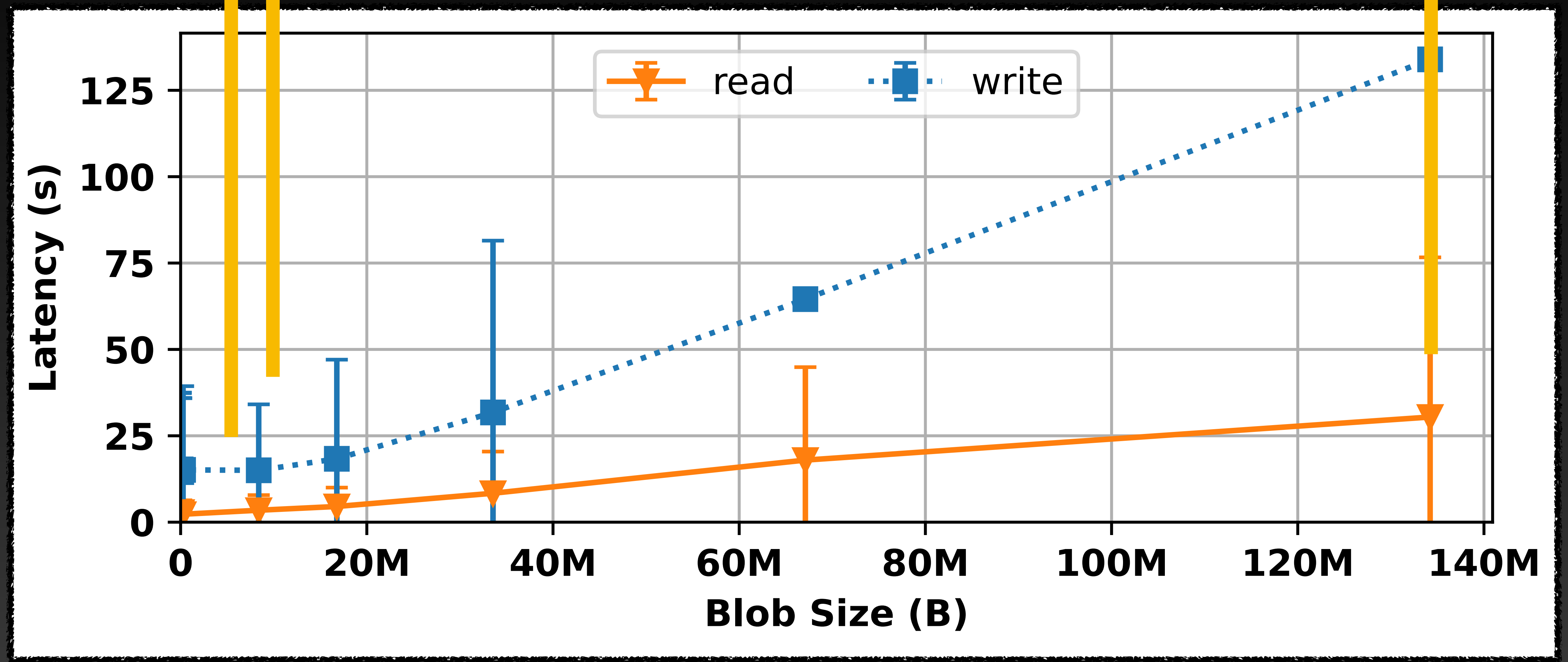




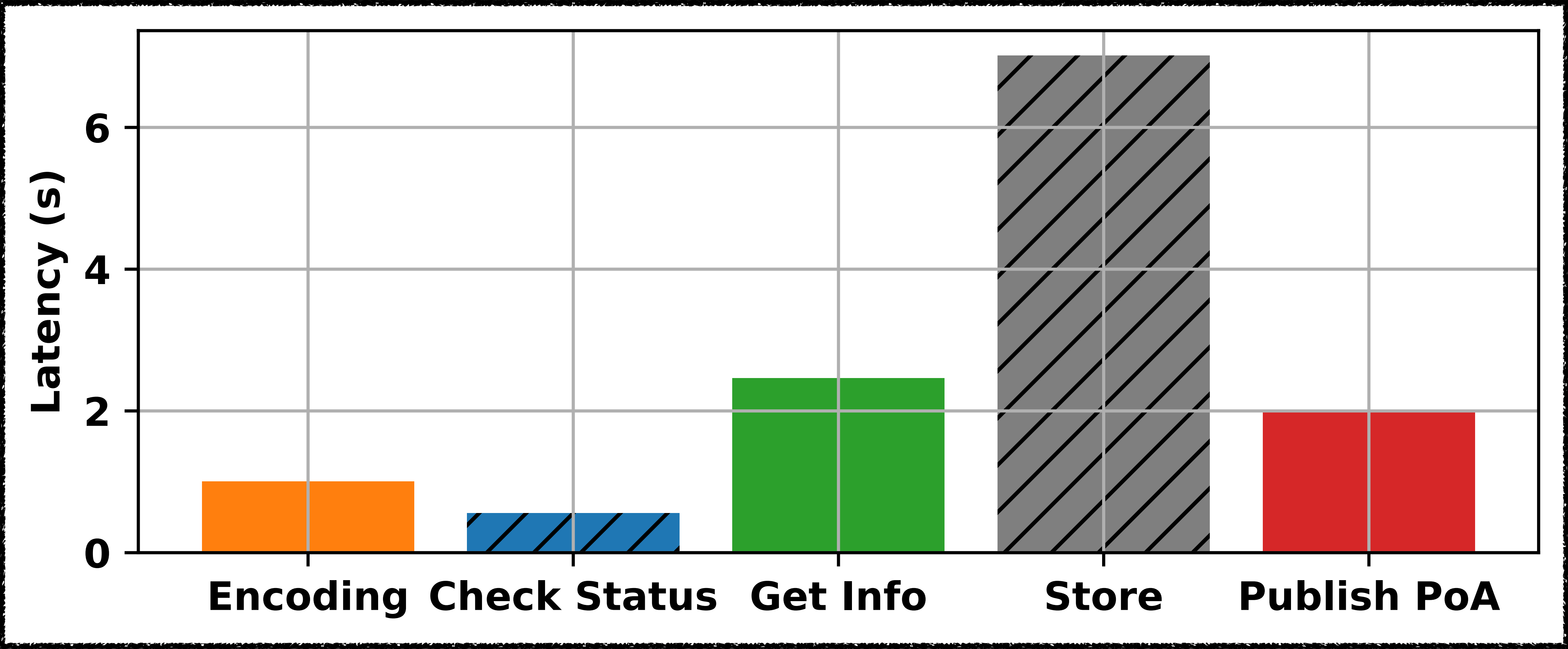
Instagram

TikTok

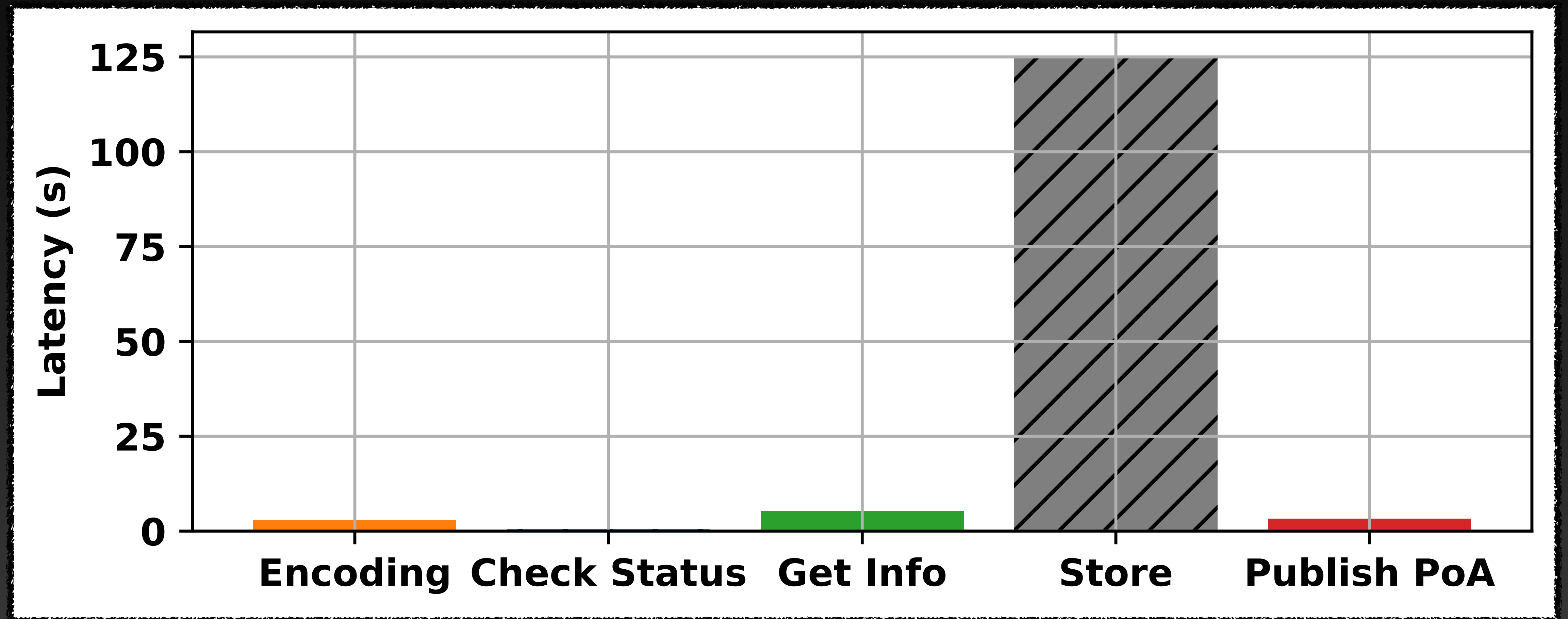
YouTube (5 min)



Small Blob (1kB)



Large Blob (135MB)



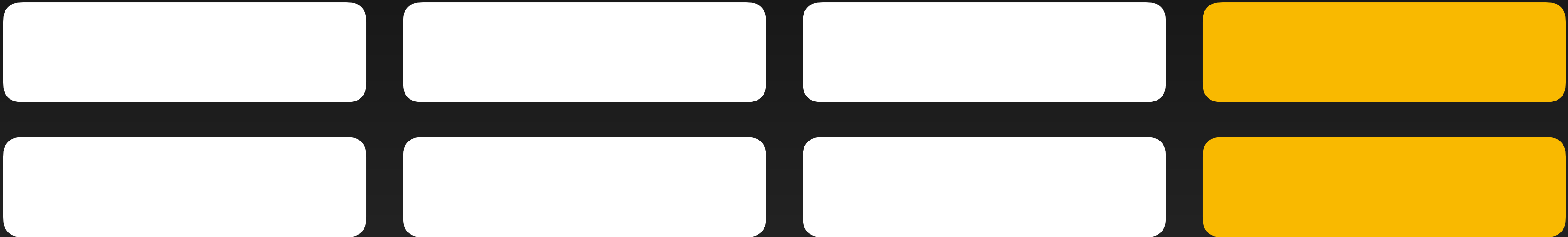
Erasure Codes

Easy Recovery

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



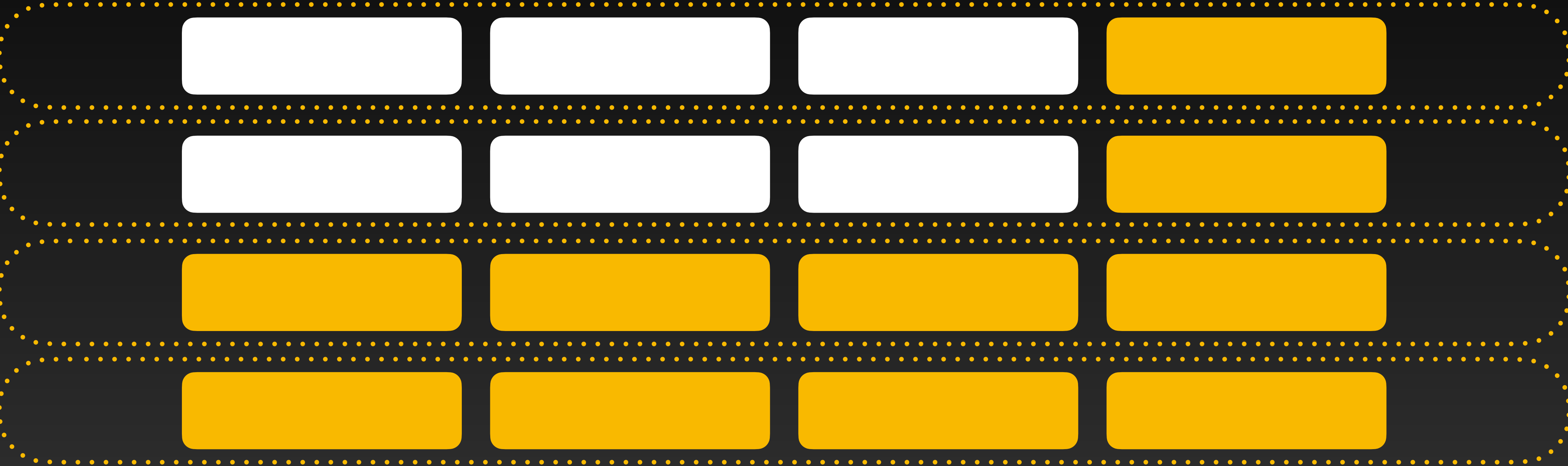
from $2f+1$ to n



from $f+1$ to n



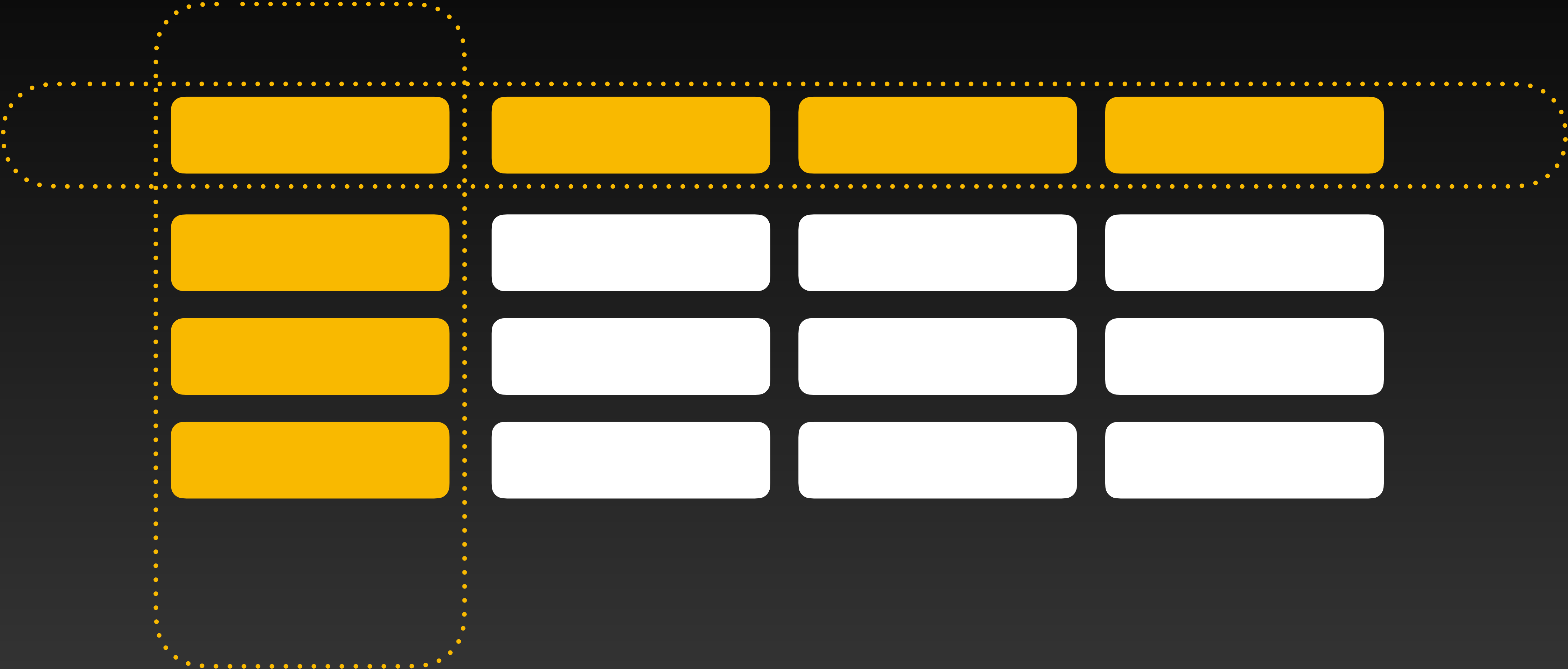
primary slivers



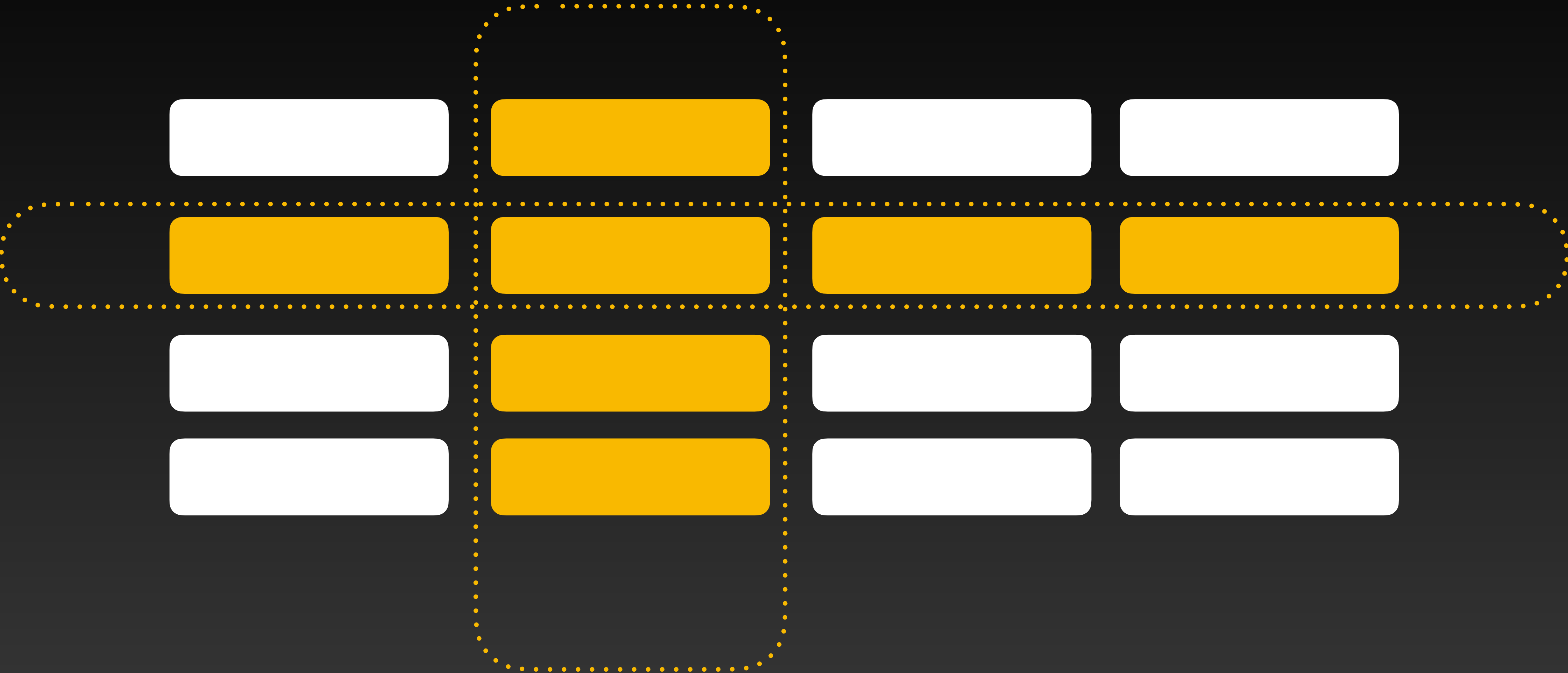
secondary slivers



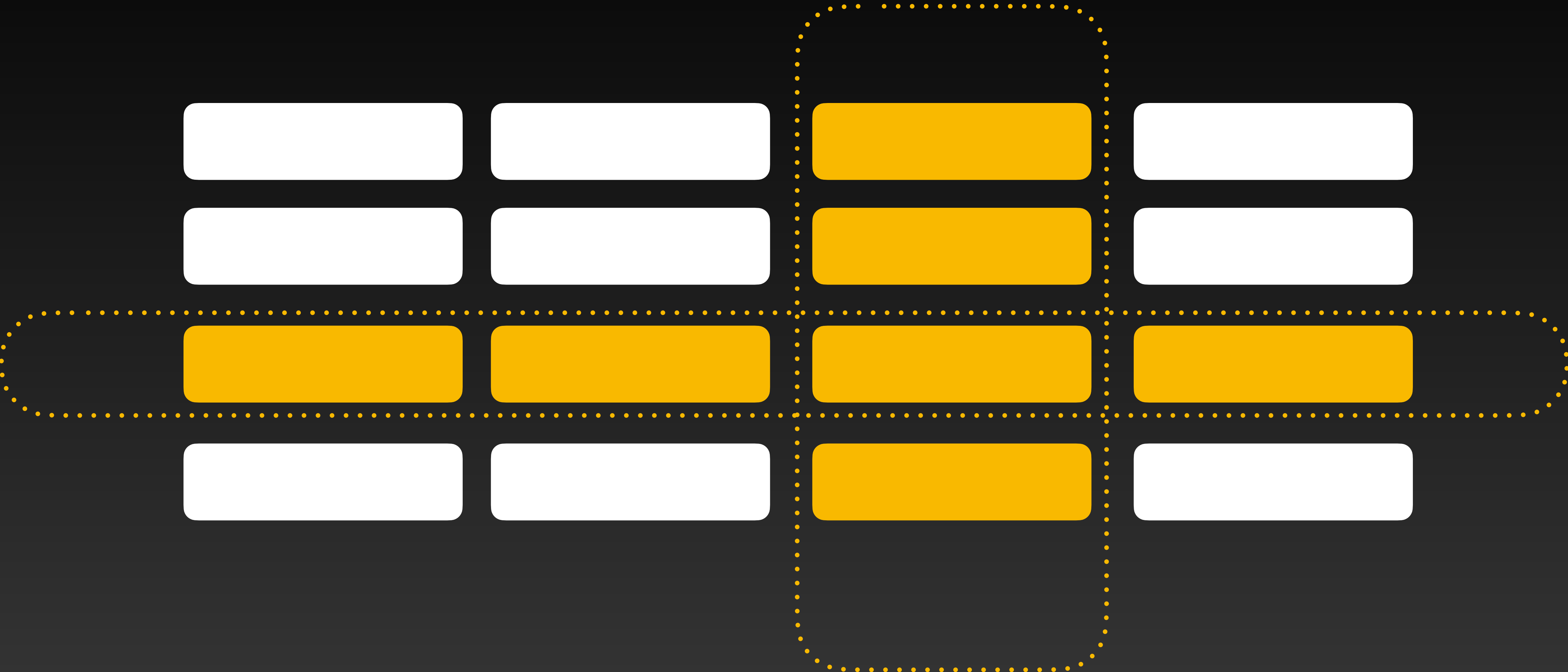
node 1



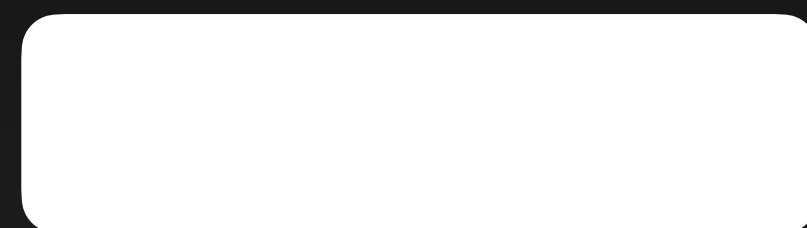
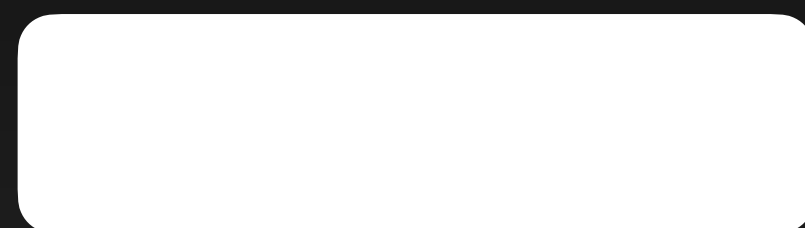
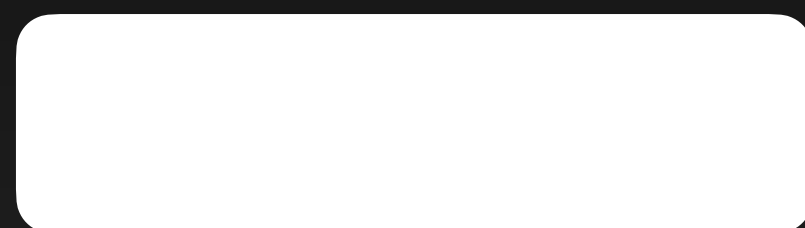
node 2



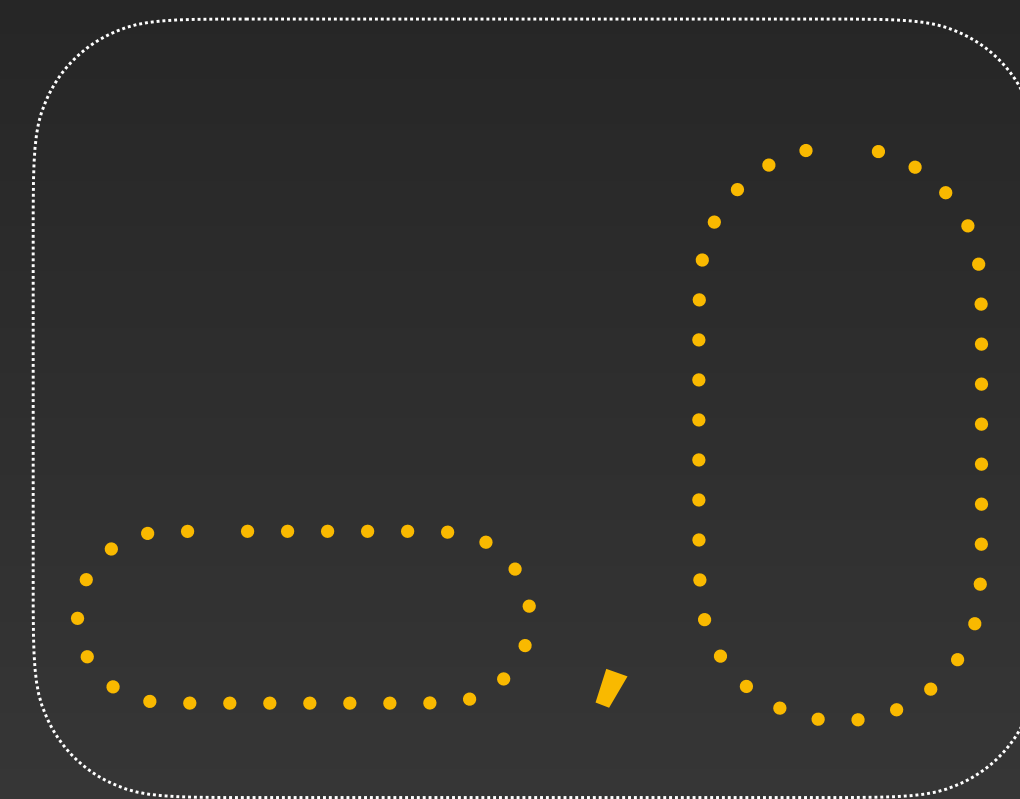
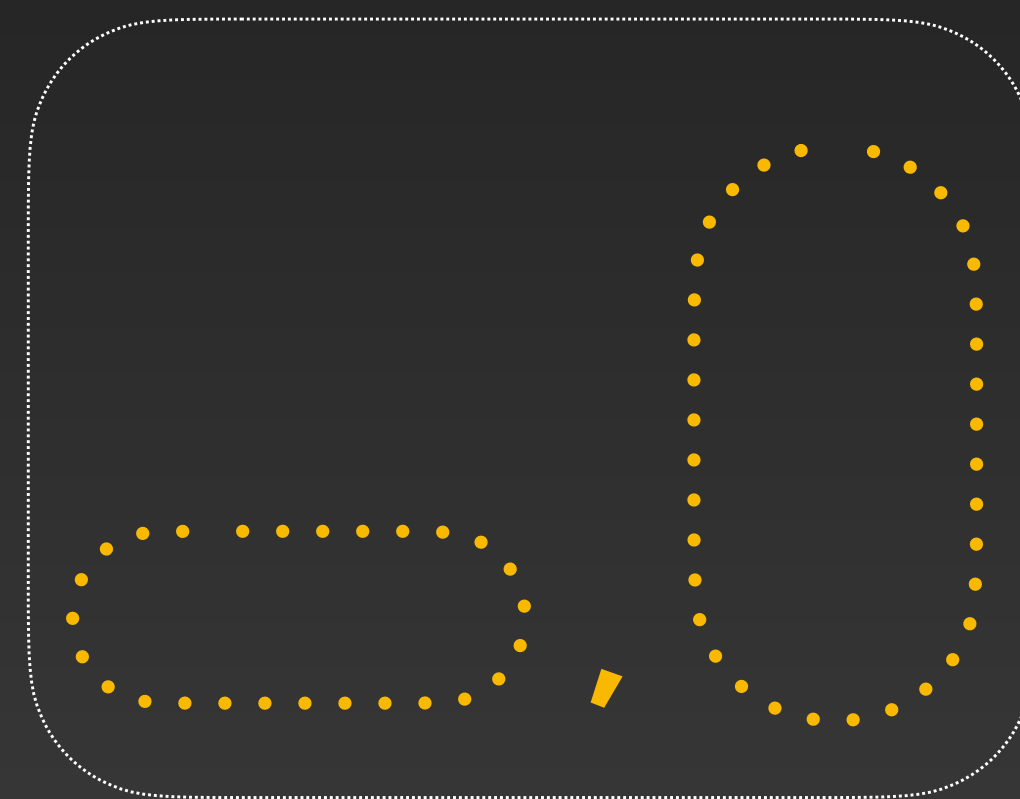
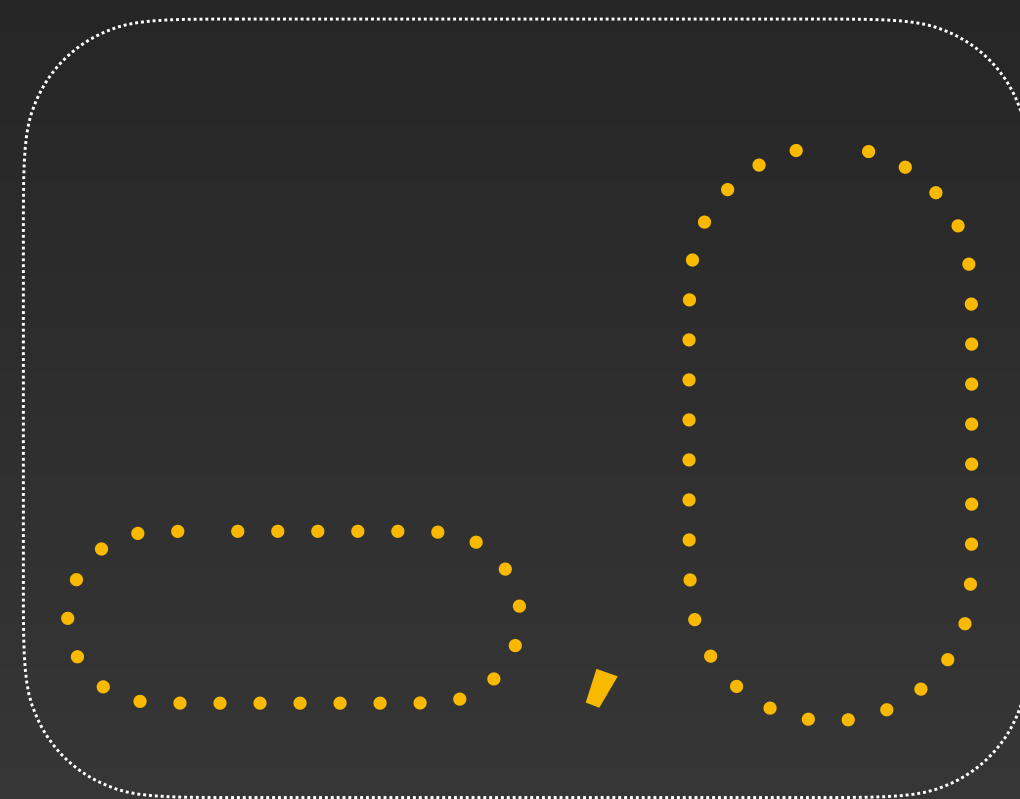
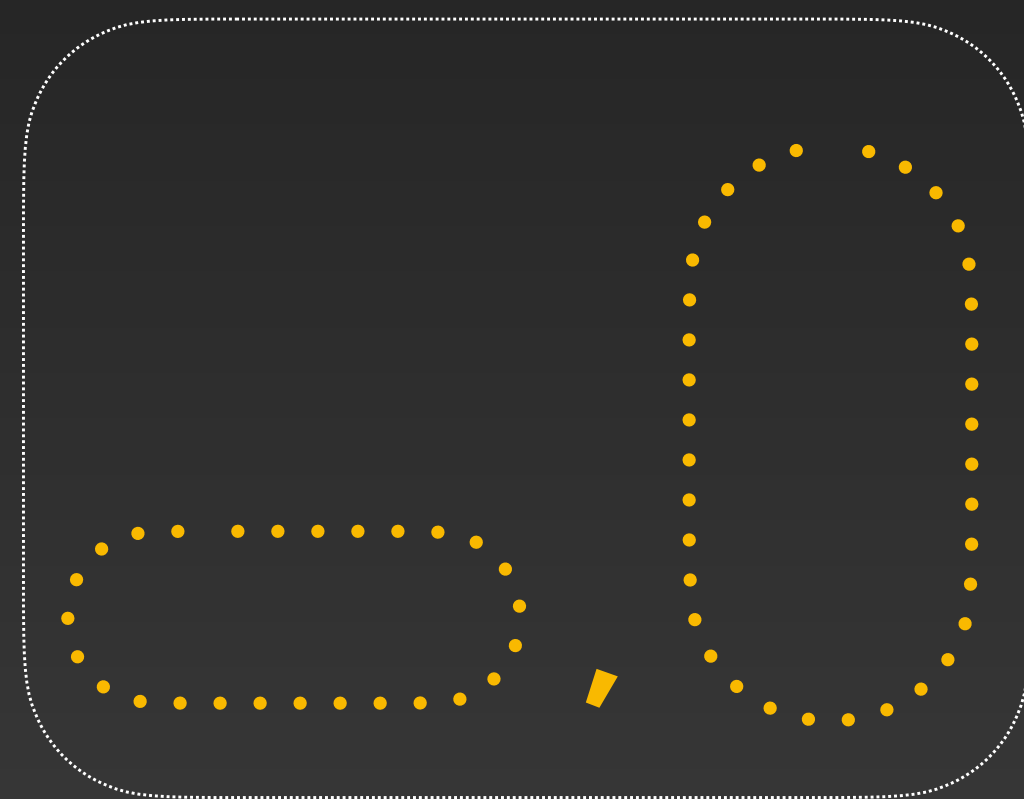
node 3



node 4



Blob id



Recovery

node 1

node 2

node 3

node 4

node 1

node 2

node 3

node 4

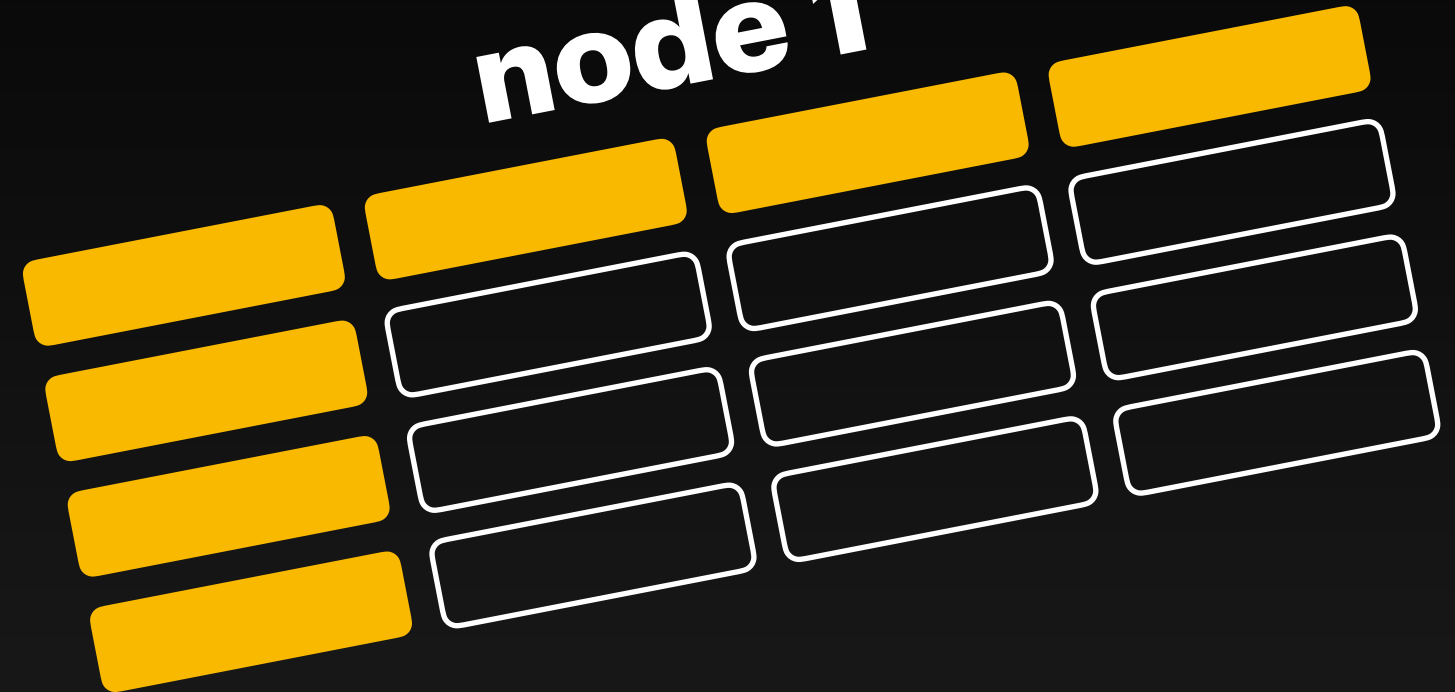
node 1

node 2

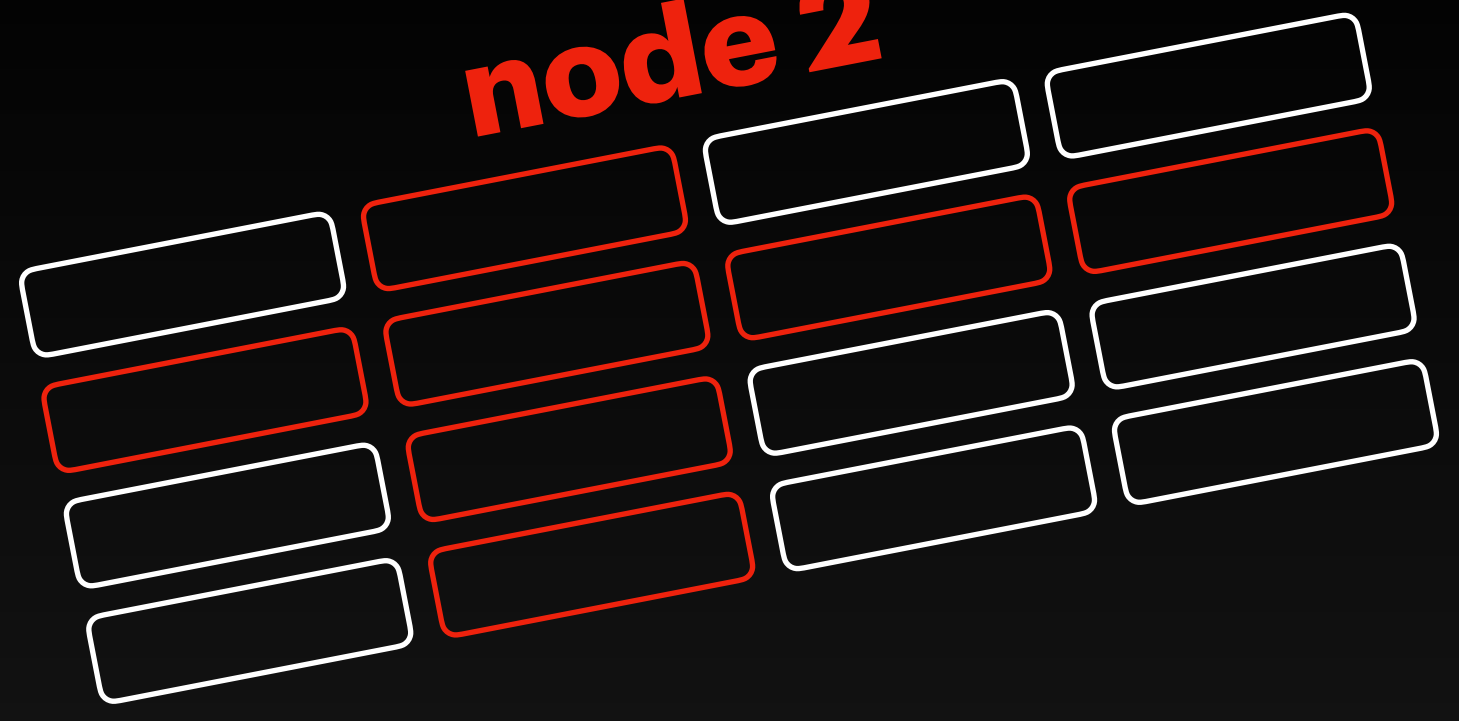
node 3

node 4

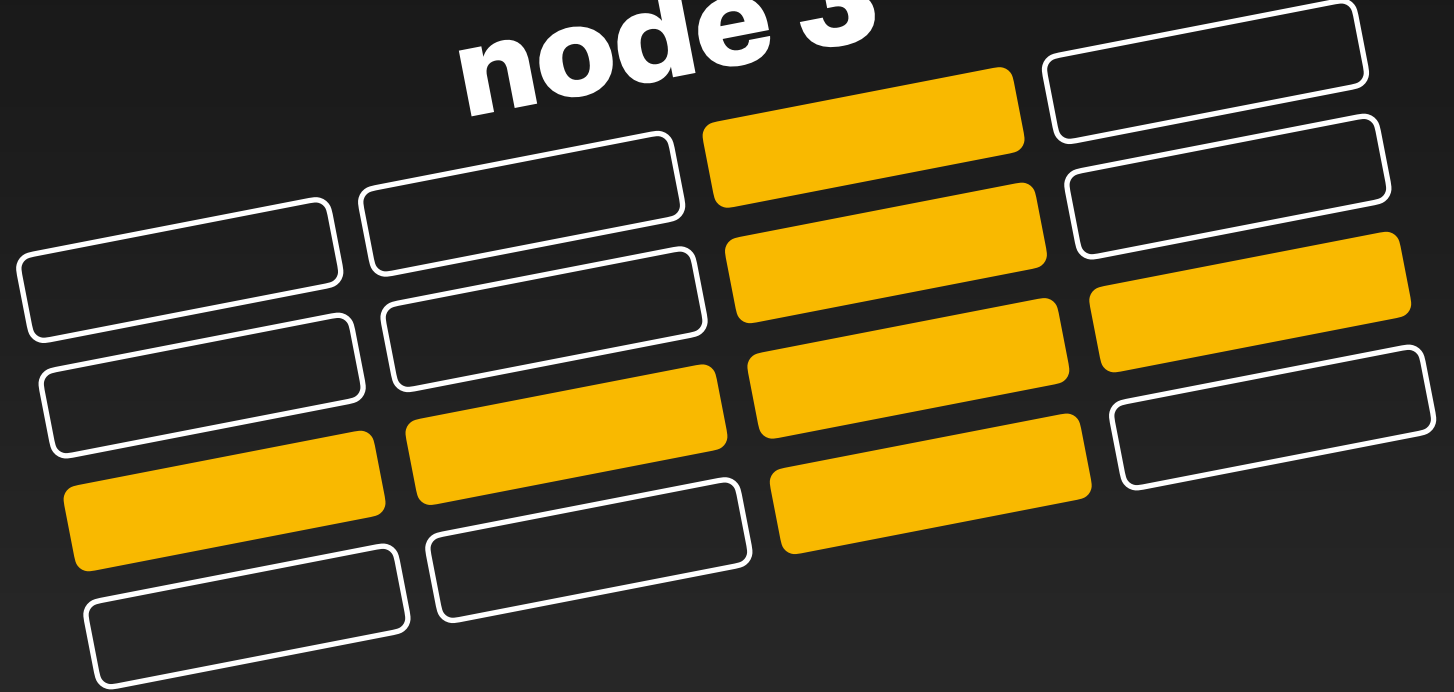
node 1



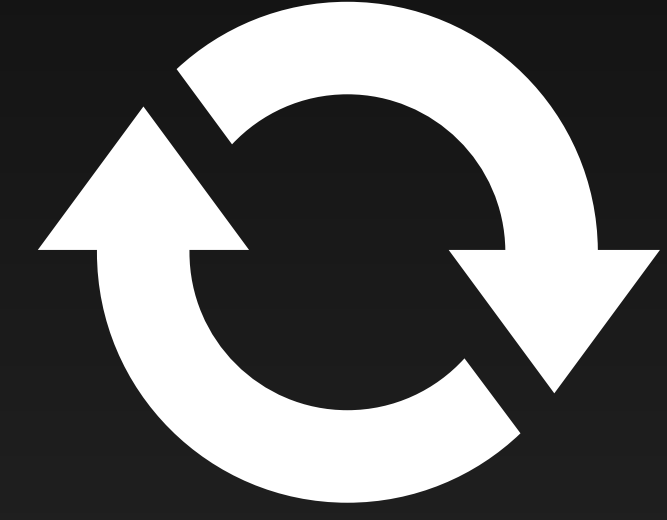
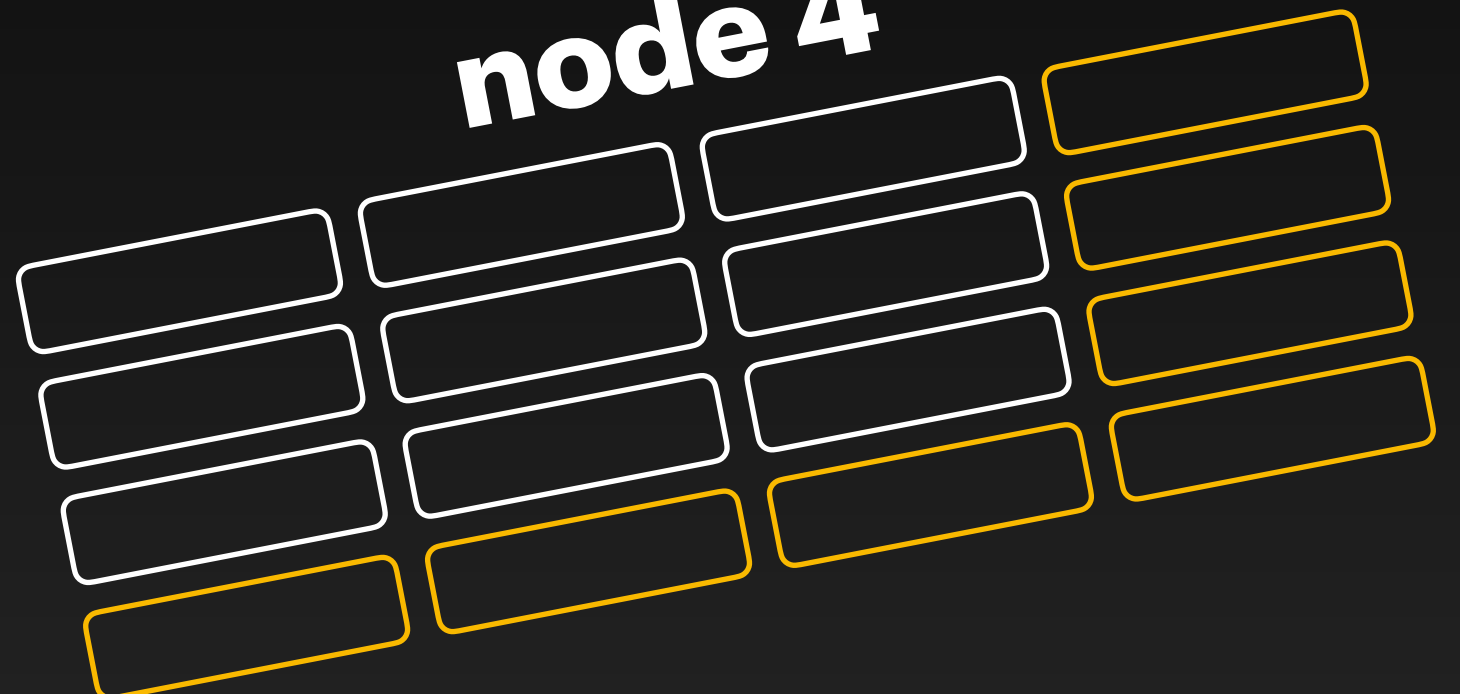
node 2



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

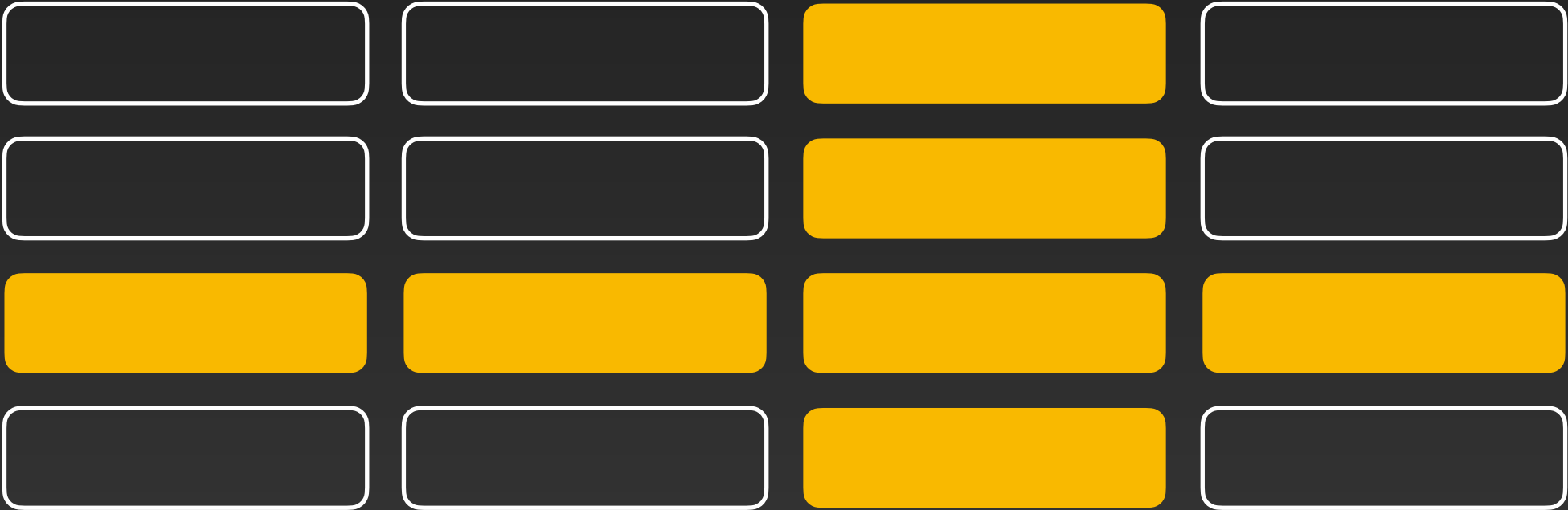
node 1



node 2



node 3



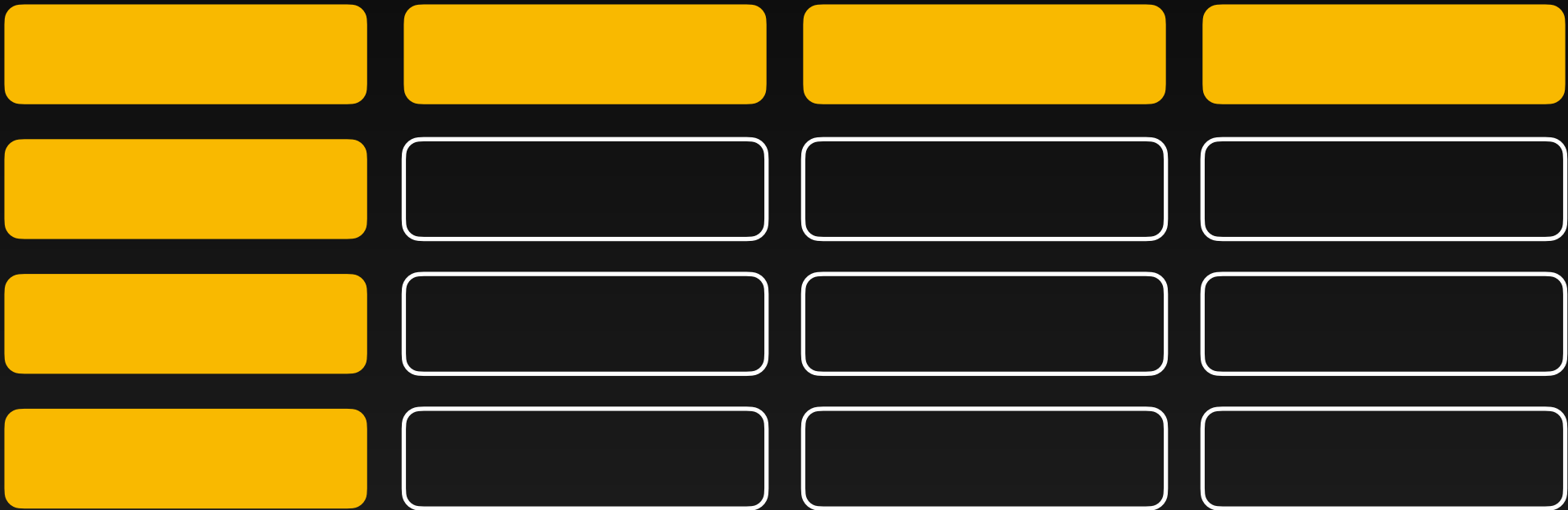
node 4



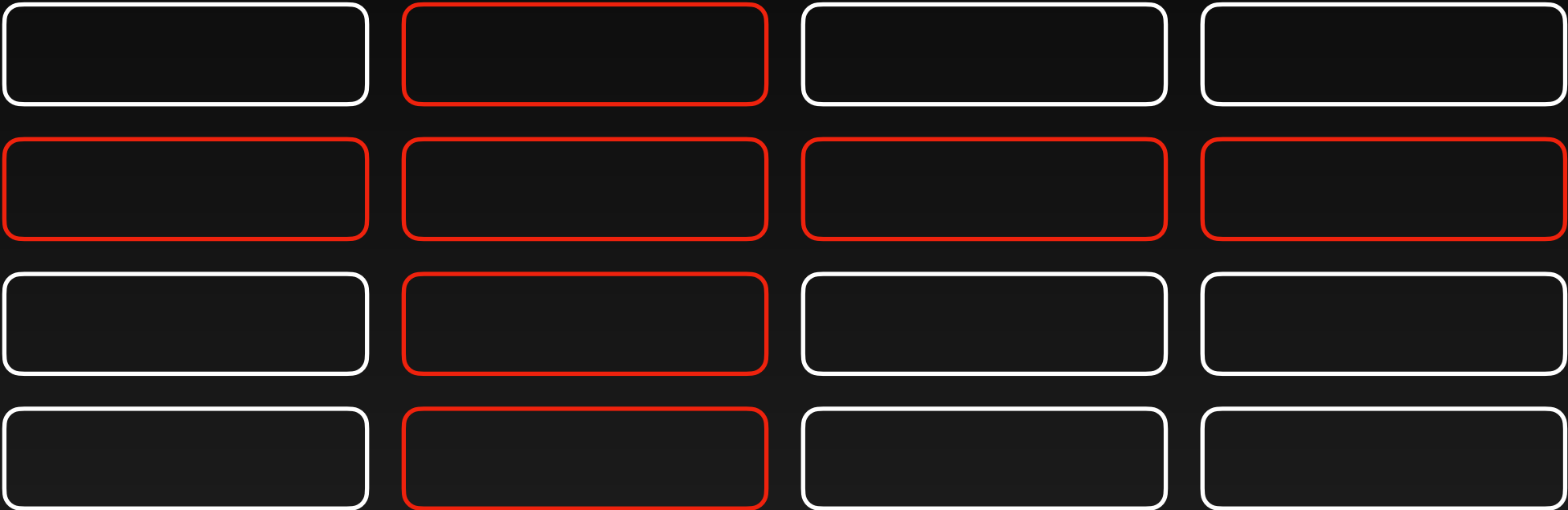
f+1



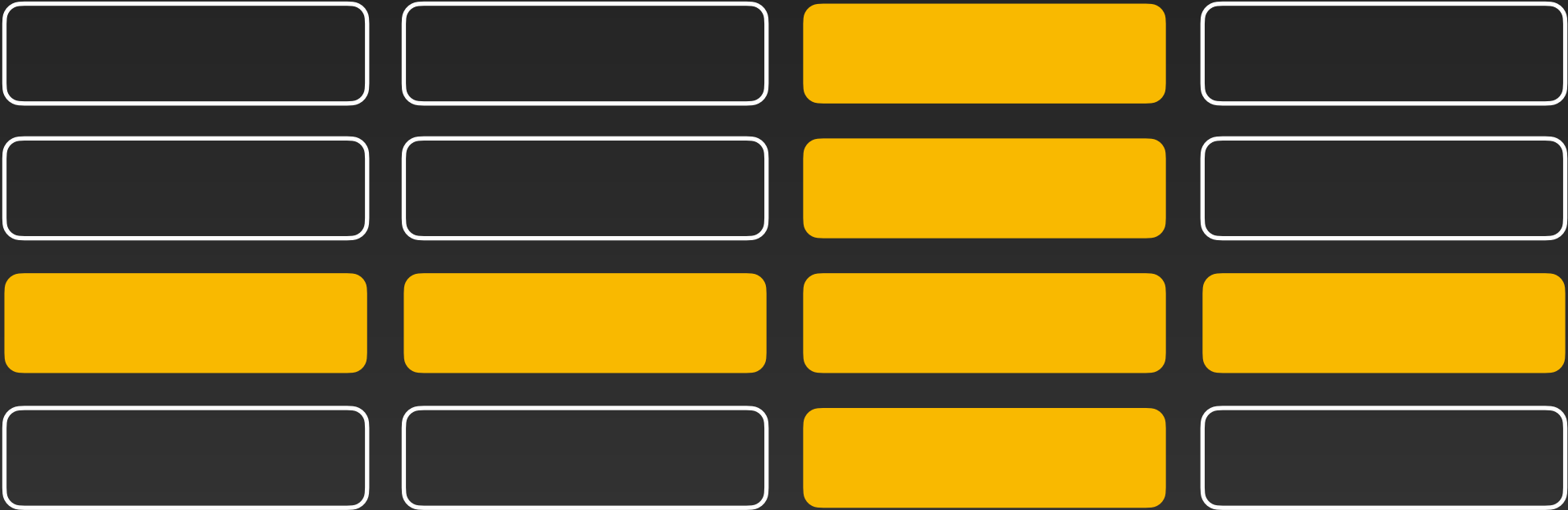
node 1



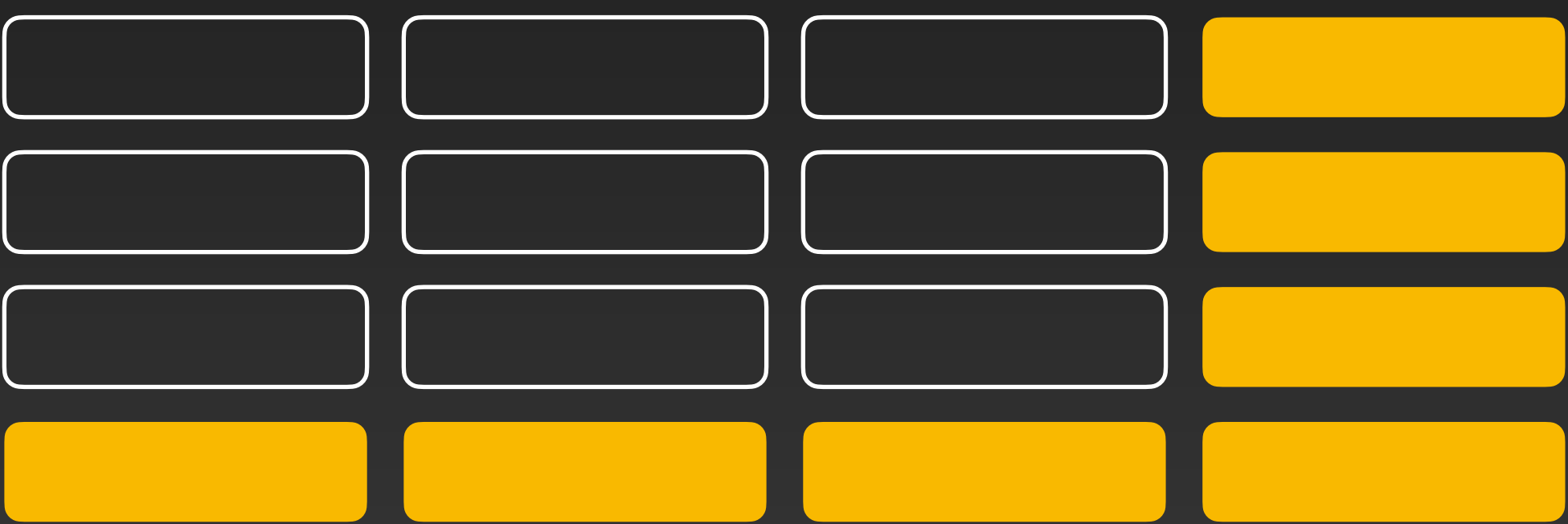
node 2



node 3



node 4



$2f+1$

Storage Optimisation

node 1

node 2

node 3

node 4

node 1

node 2

node 3

node 4

Storage Overhead

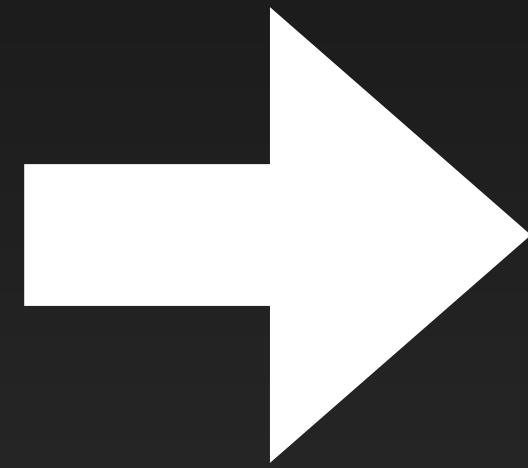
~100x

Blockchain System

Storage Overhead

~100x

Blockchain System



~4.5x

Walrus



DO MORE WITH YOUR DATA



WALRUS