Bullshark

DAG BFT Protocols Made Practical

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Acknowledgements

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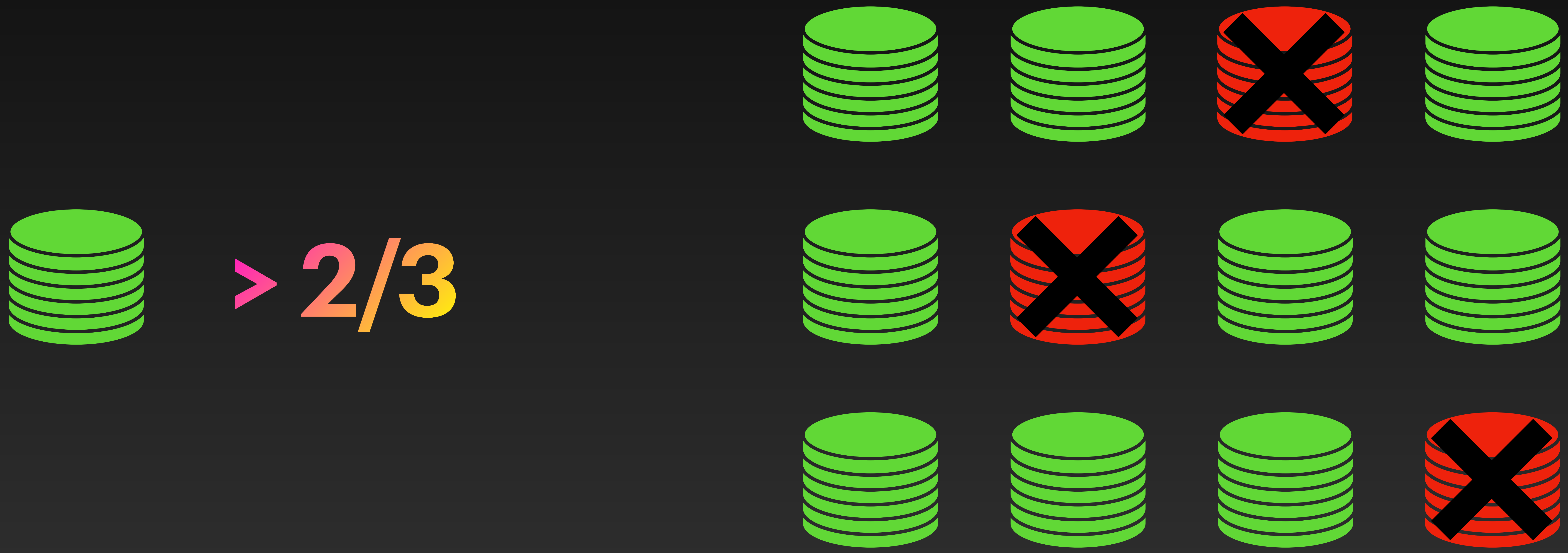
Work done at Facebook Novi

Byzantine Fault Tolerance



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Consensus on top of Narwhal

Goal of this project

Simple

- Zero-message overhead
- No view-change
- No common-coin

Performant

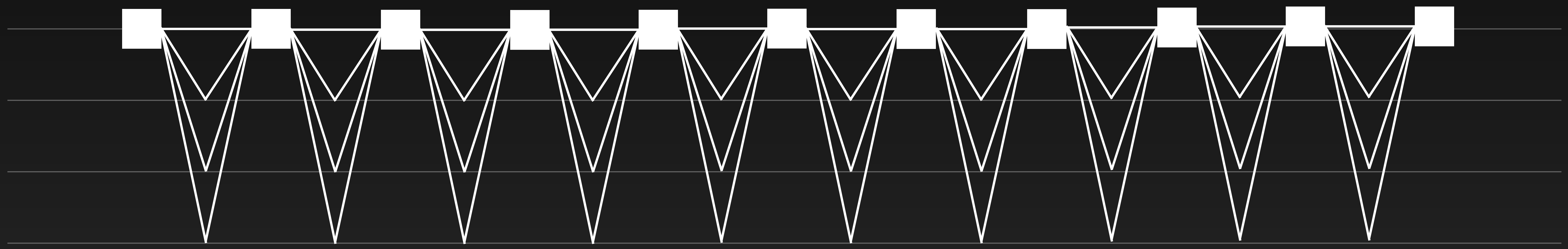
- Take advantage of Narwhal
- Exploit periods of synchrony

Current Designs

- Monolithic protocol sharing transaction data as part of the consensus
- Optimize overall message complexity of the consensus protocol
- Complex & Error-prone view-change protocol

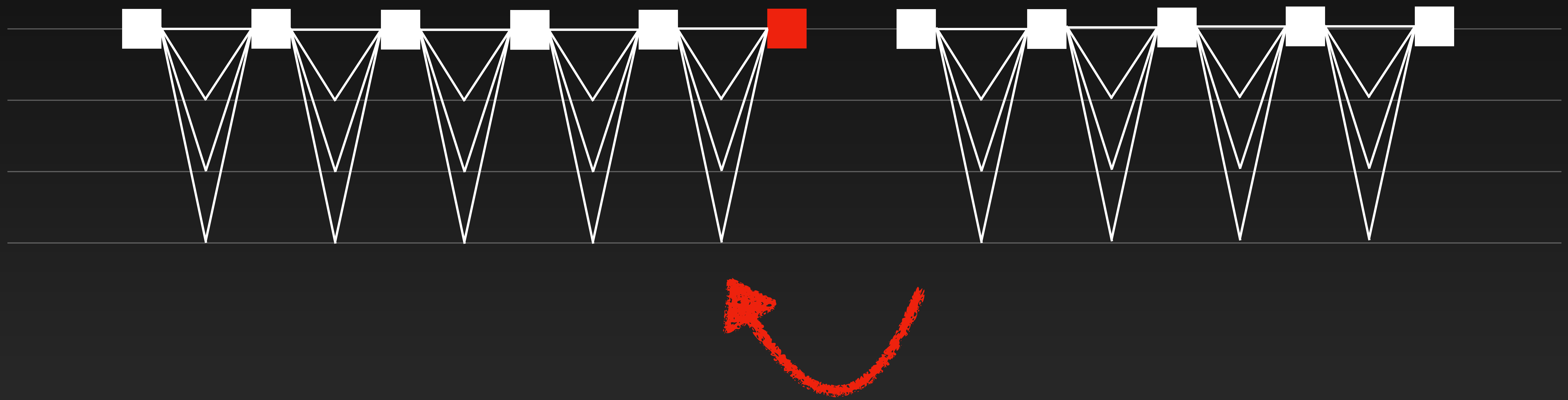
Current Designs

Typical leader-based protocols



Current Designs

Typical leader-based protocols



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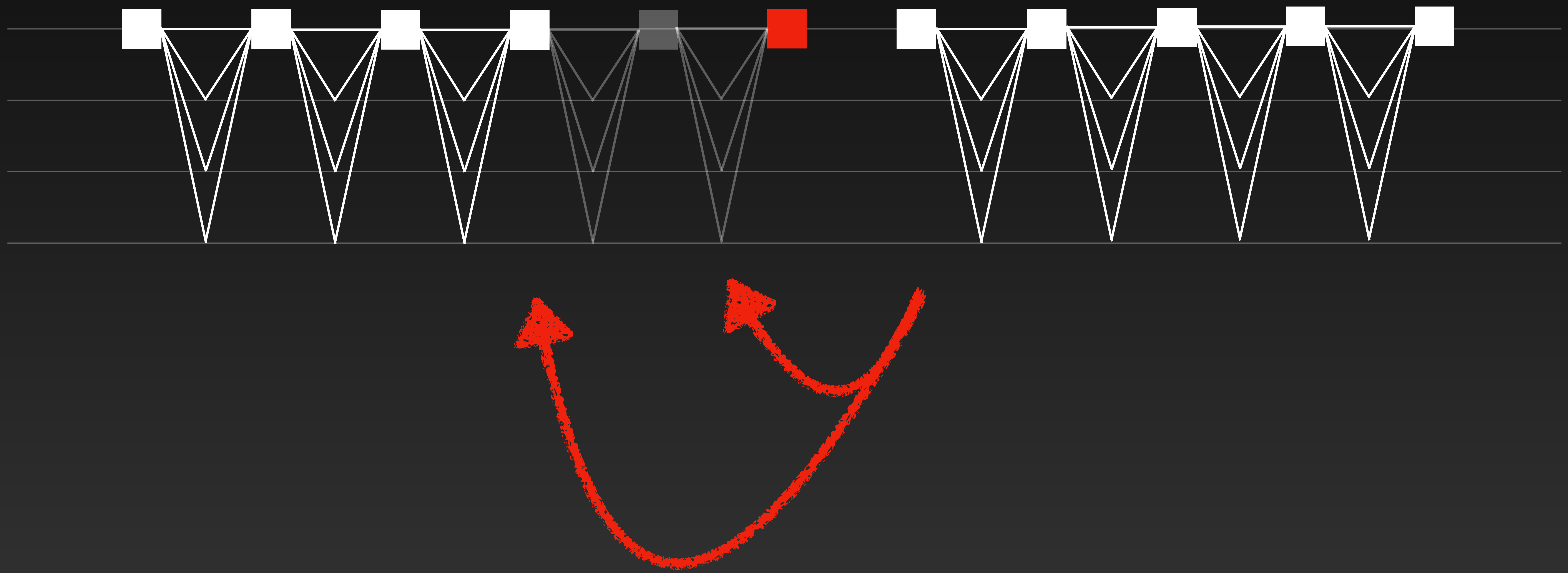


Narwhal

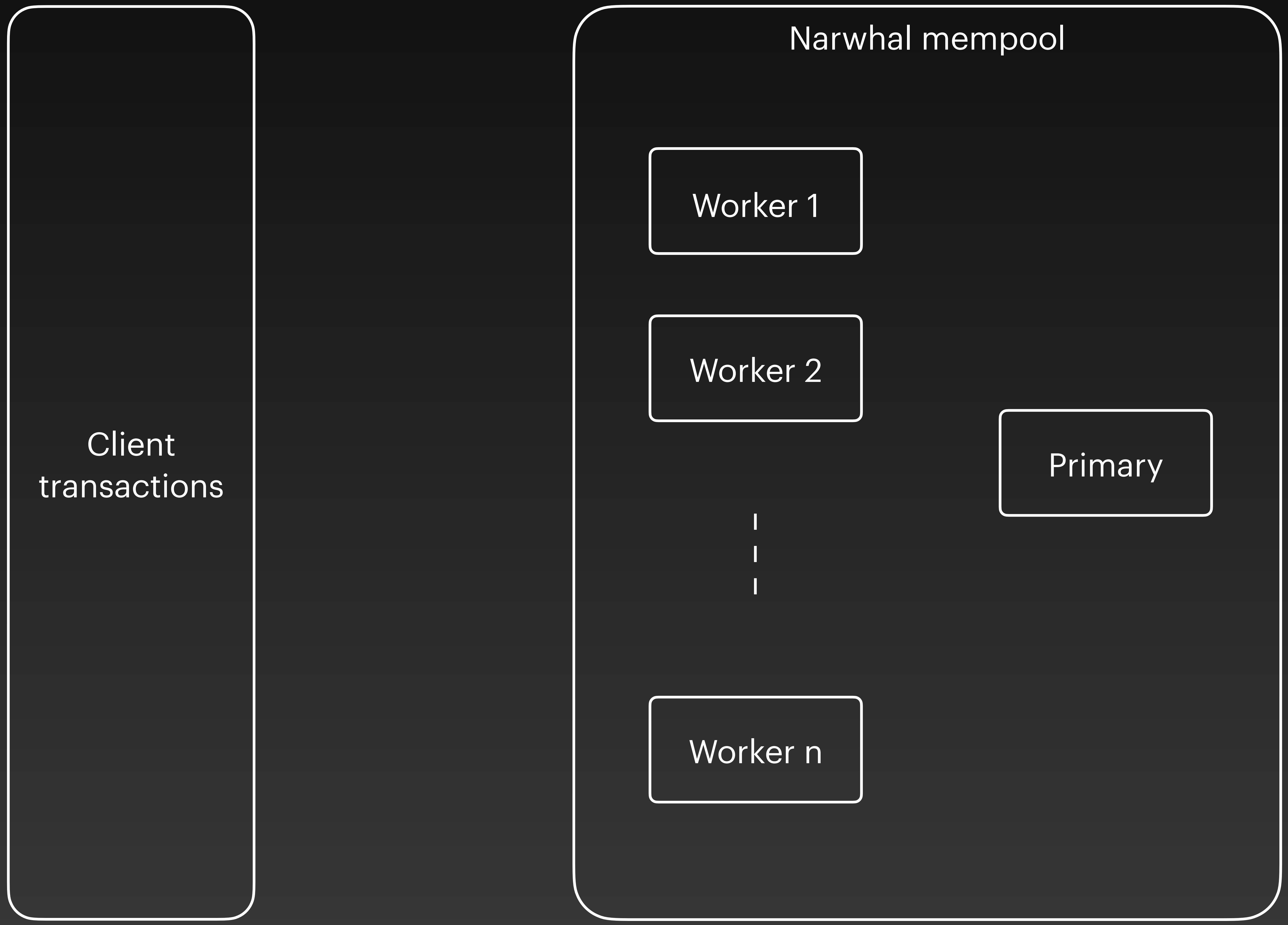
Dag-based mempool

The mempool is the key

Reaching consensus on metadata is cheap

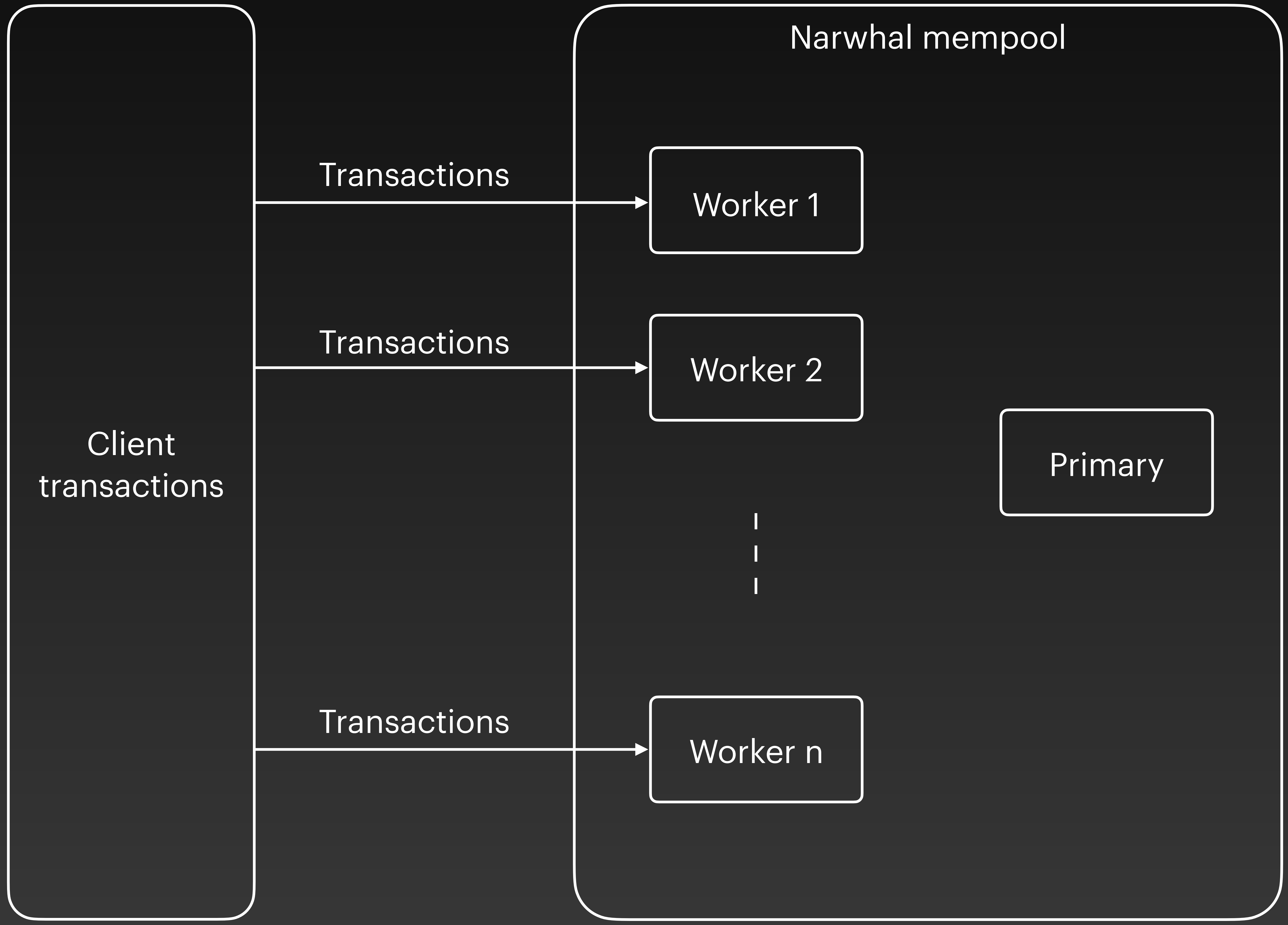
Narwhal

The workers and the primary



Narwhal

The workers and the primary



Narwhal

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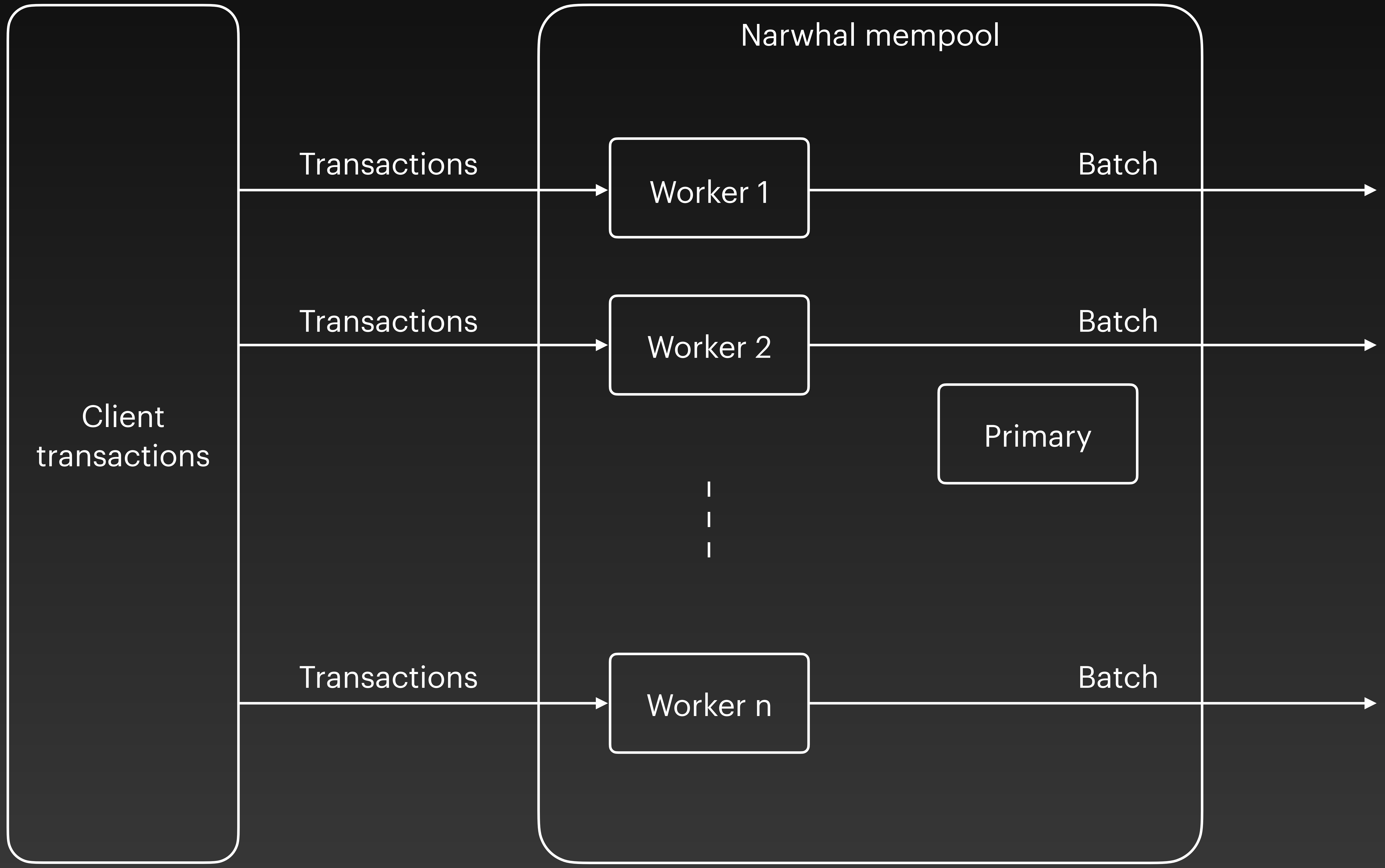

Narwhal

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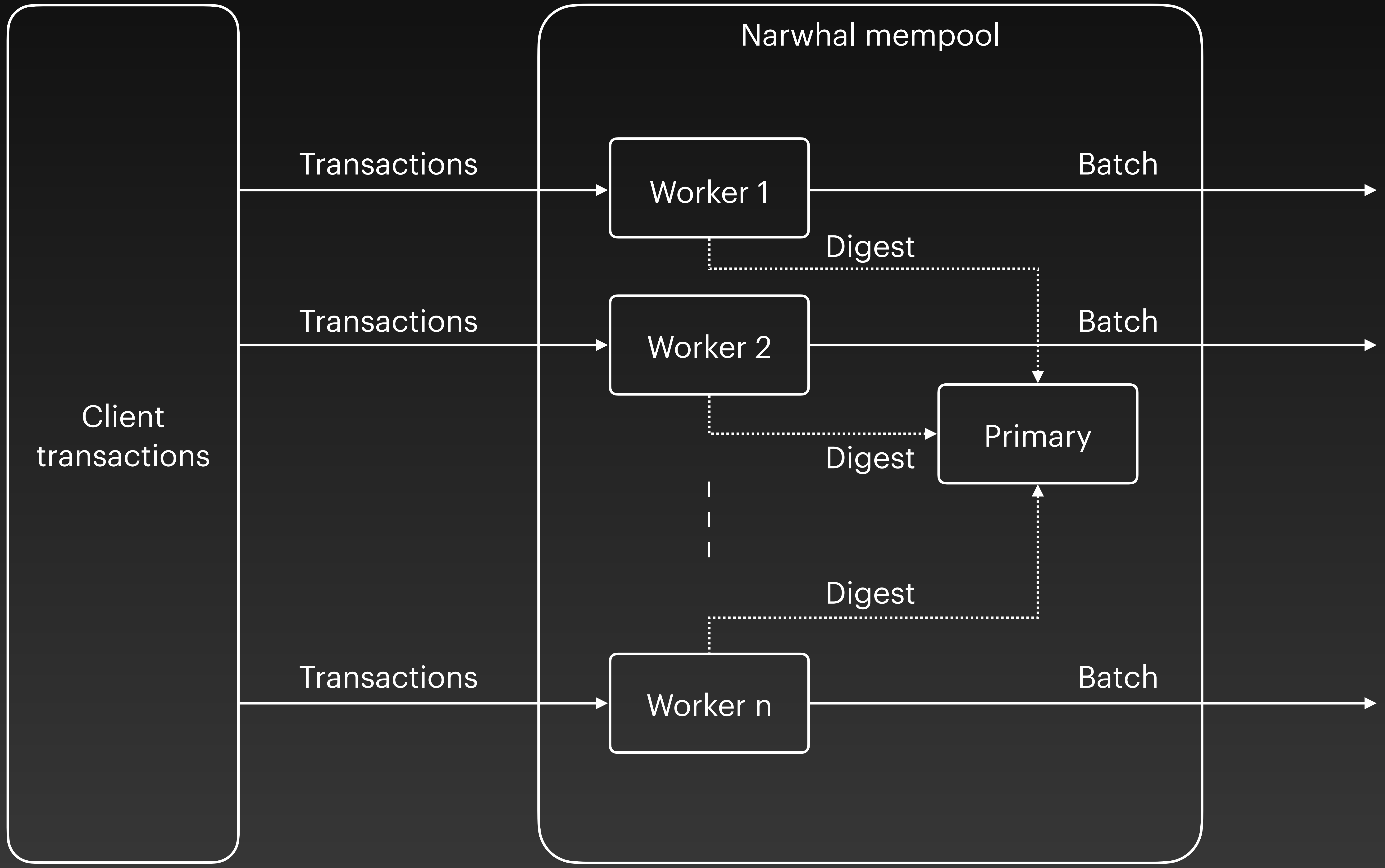

Narwhal

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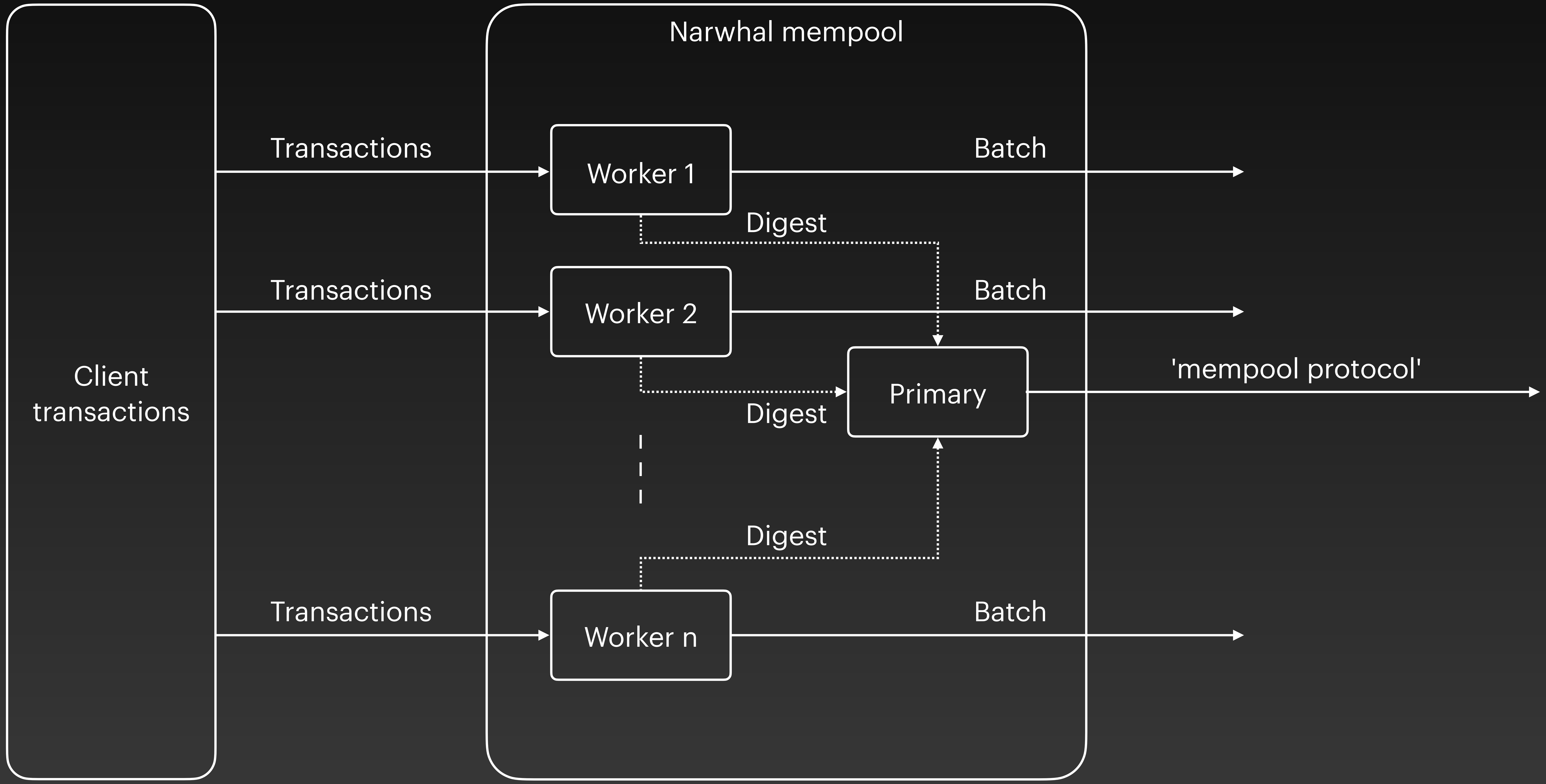
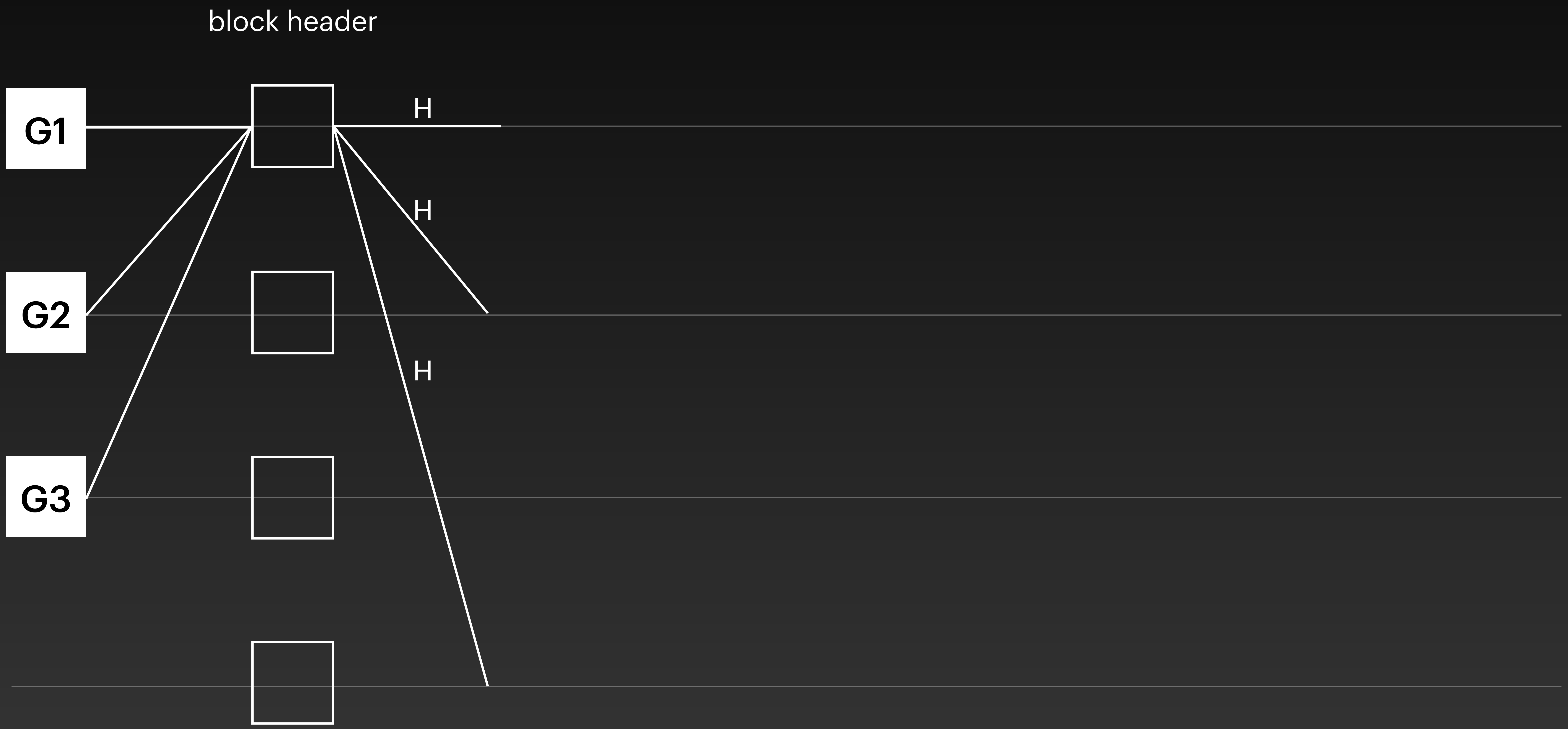


Narwhal

The primary machine



Narwhal

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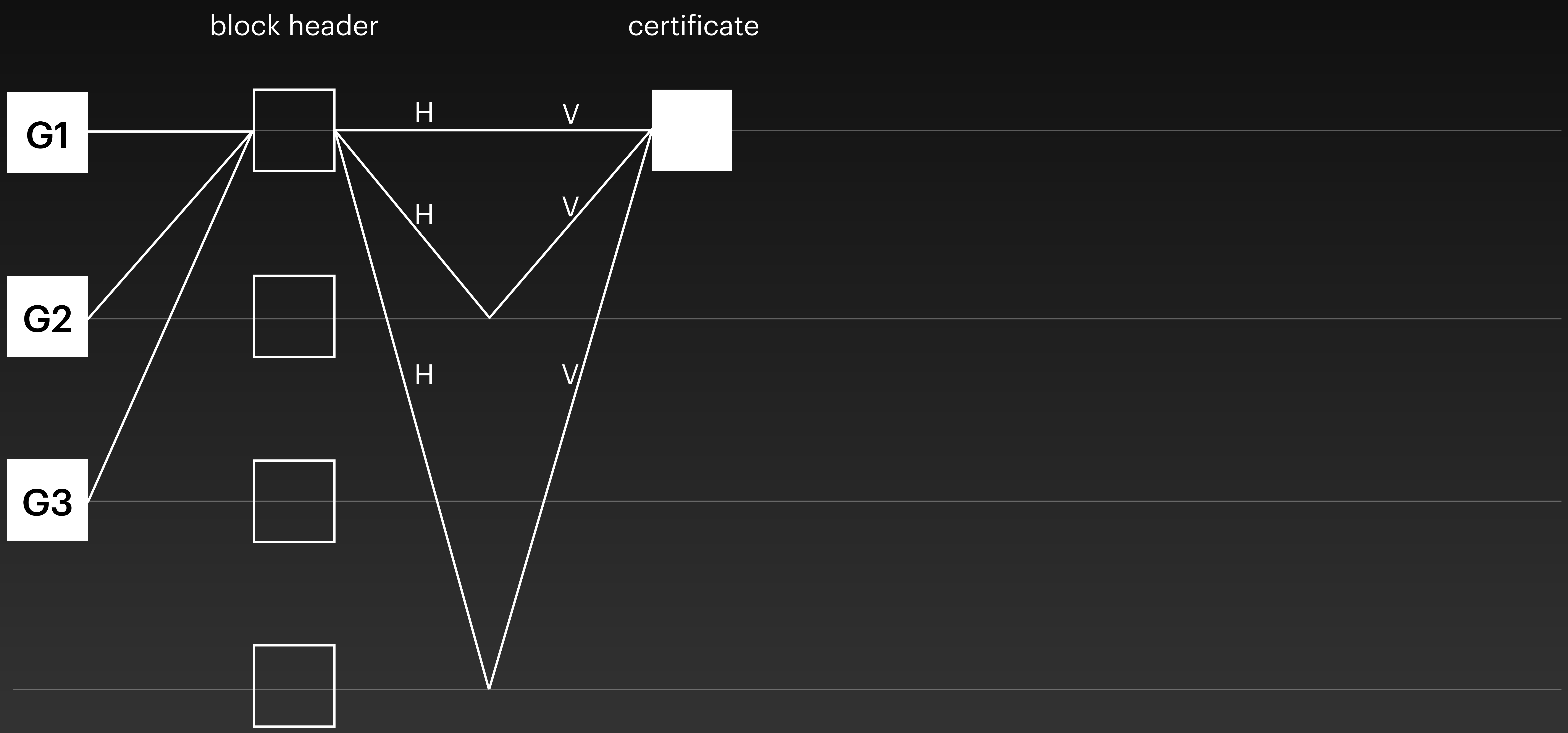

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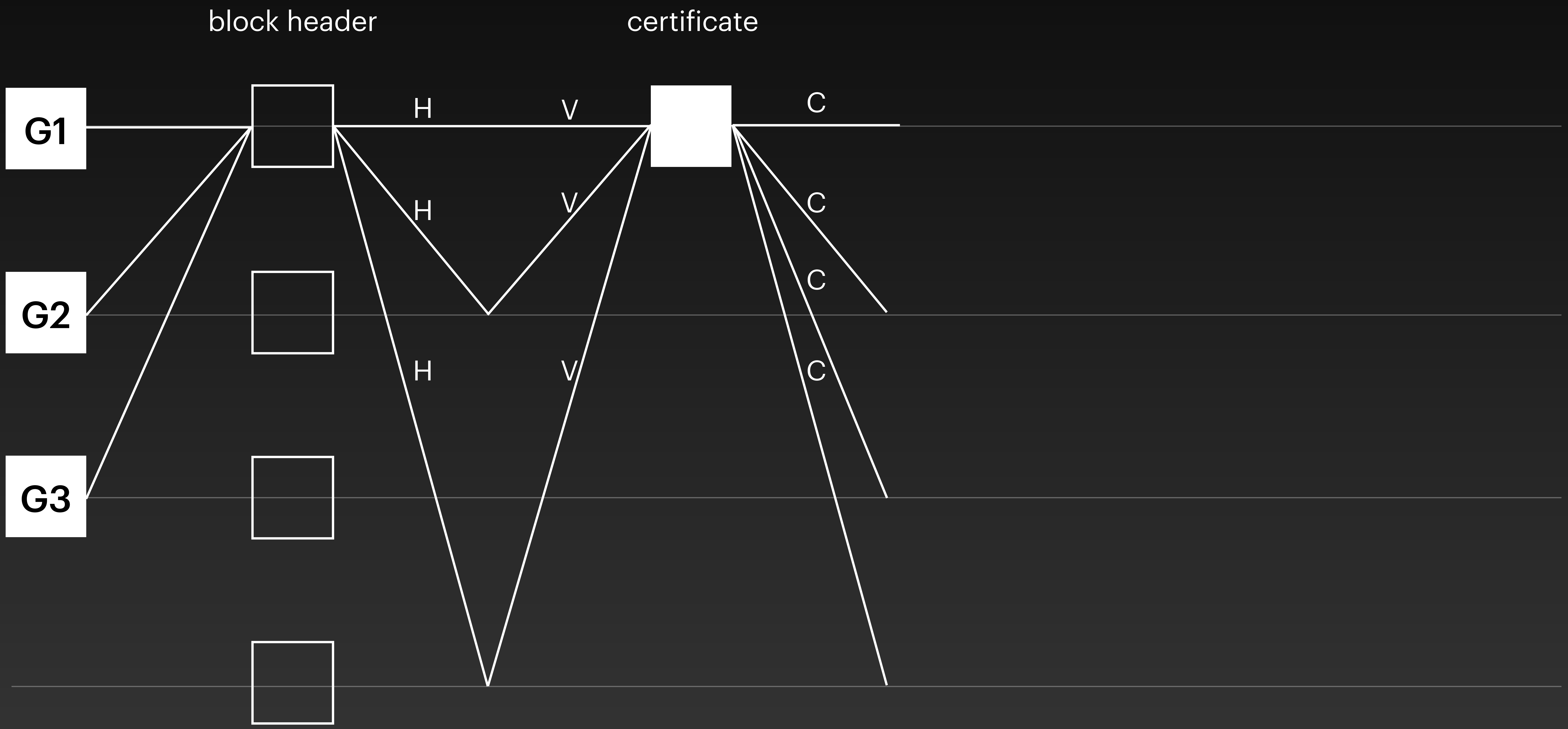

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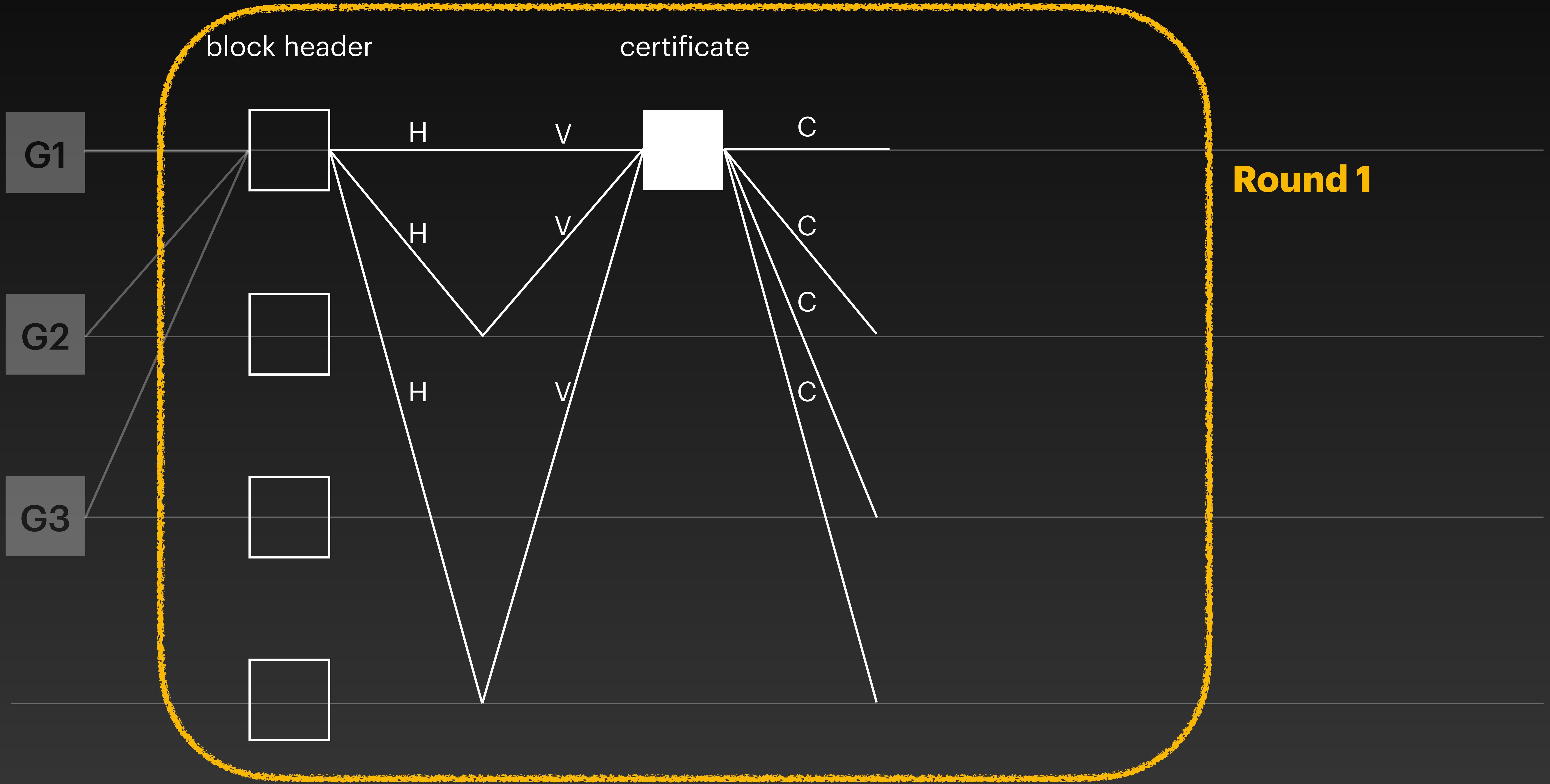
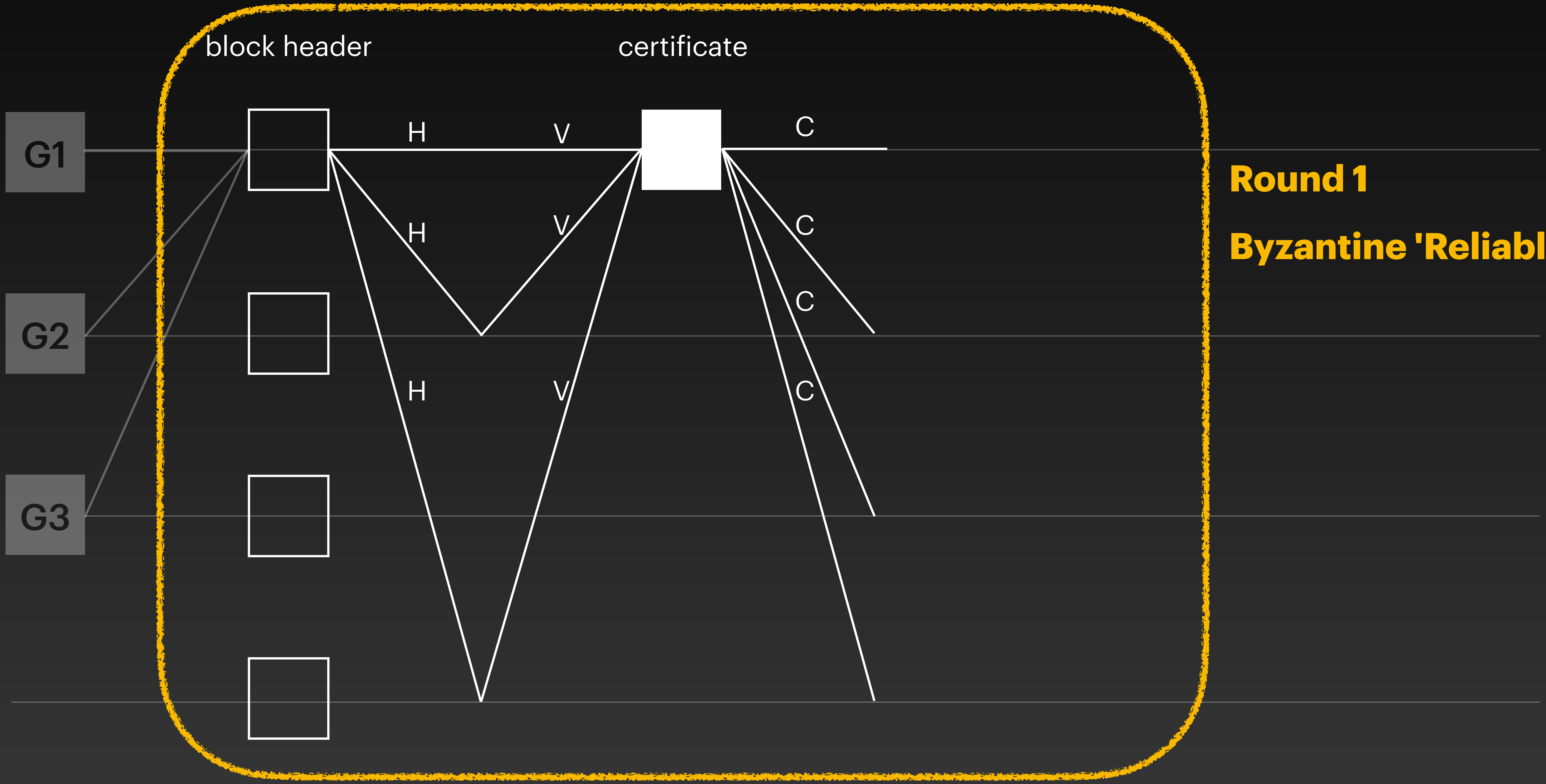


Narwhal

The primary machine

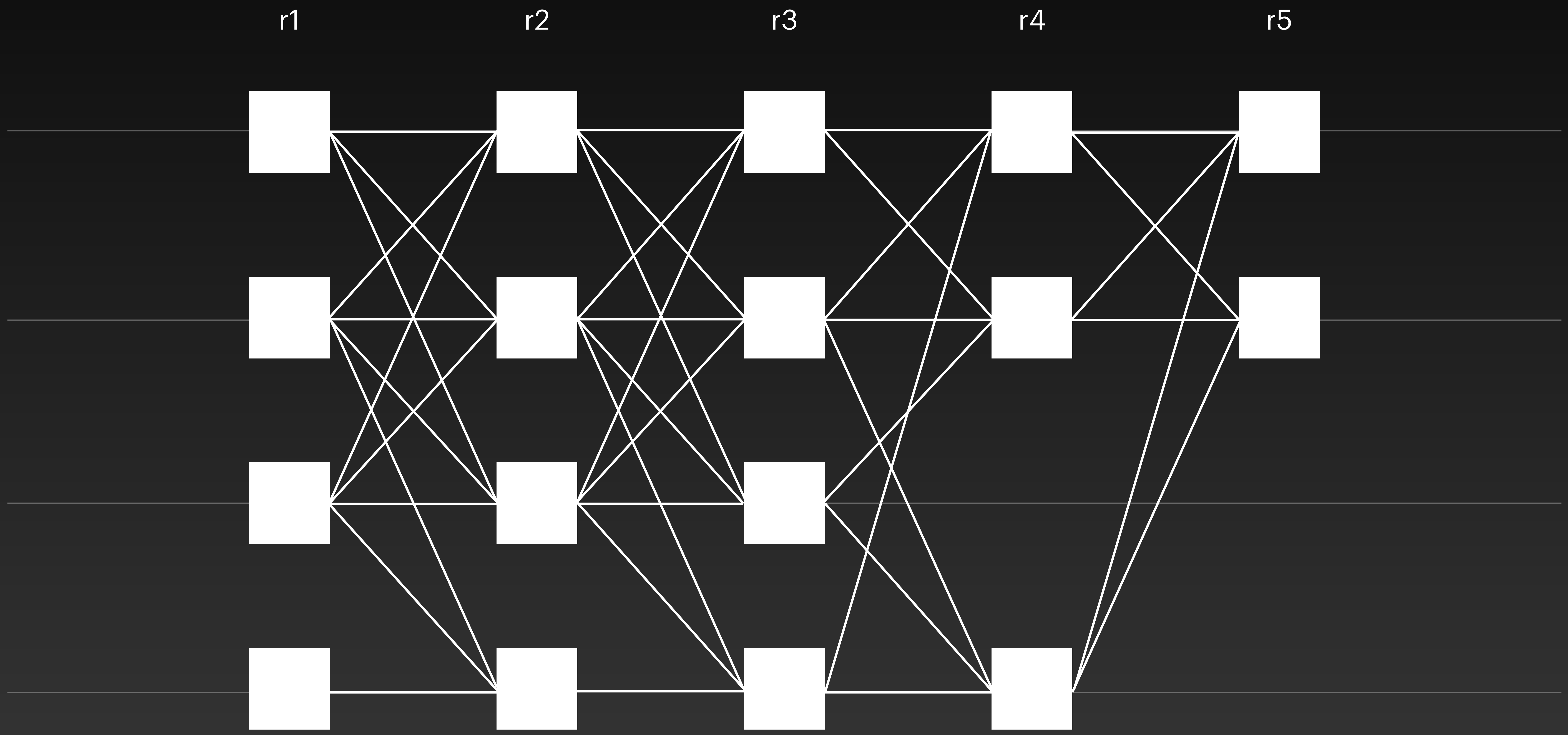


Round 1

Byzantine 'Reliable' Broadcast

Narwhal

The primary machine

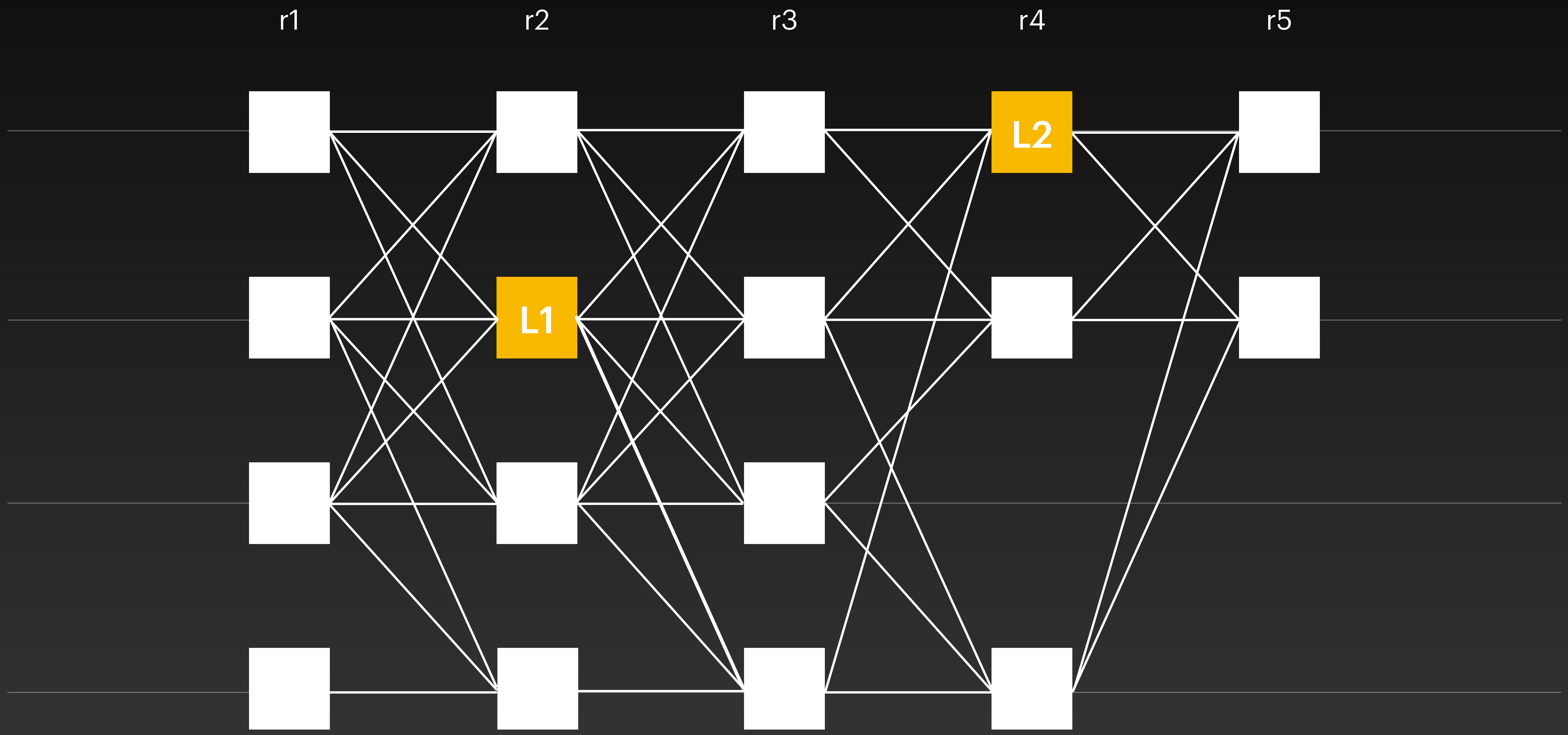


Modified Narwhal

Adapt Narwhal for partial-synchronous networks

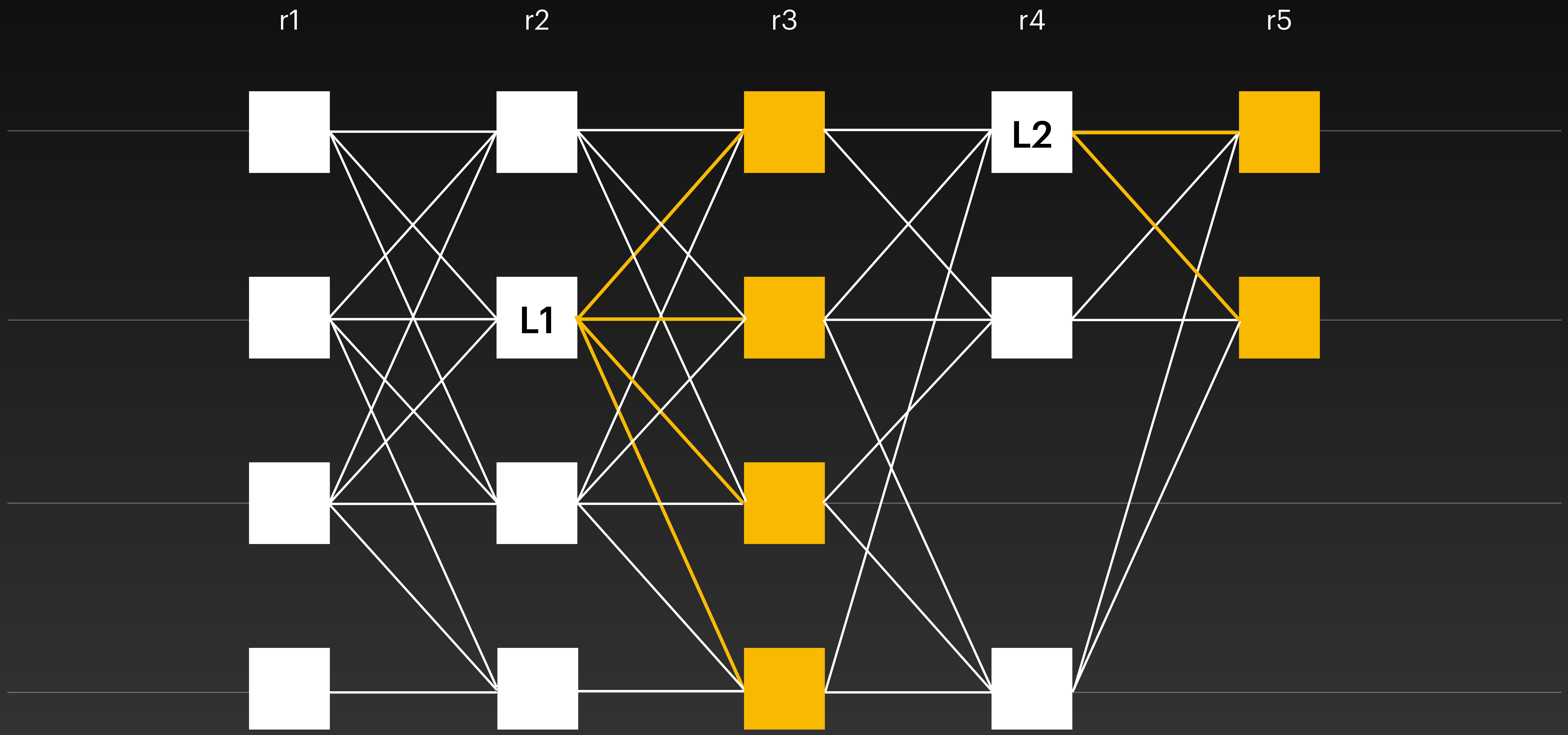
Modified Narwhal

Even rounds: wait for the leader (or to timeout)



Modified Narwhal

Odd rounds: wait for enough votes (or to timeout)



Bullshark

Zero-message partially-synchronous consensus

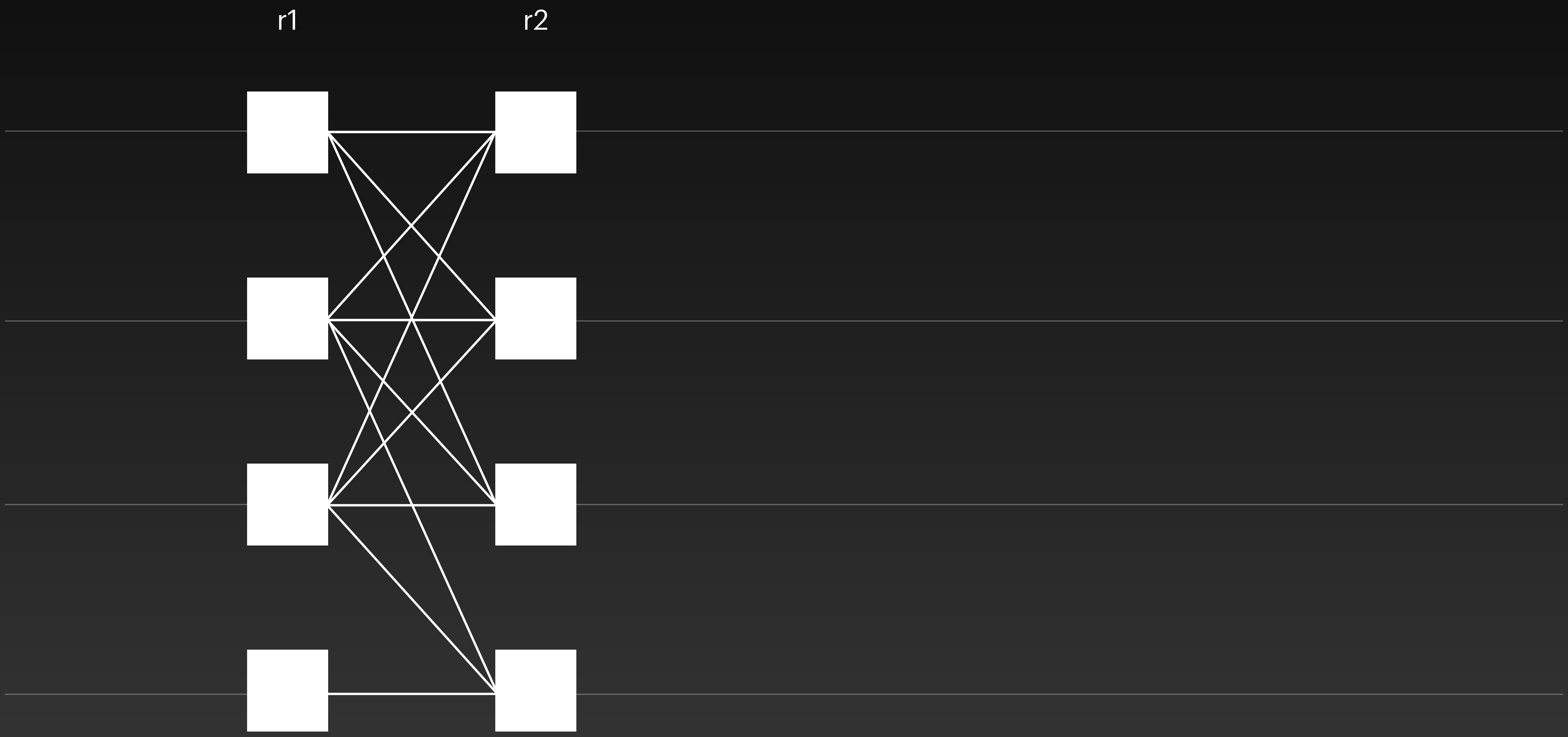
Bullshark

Zero-message partially-synchronous consensus

* without asynchronous fallback

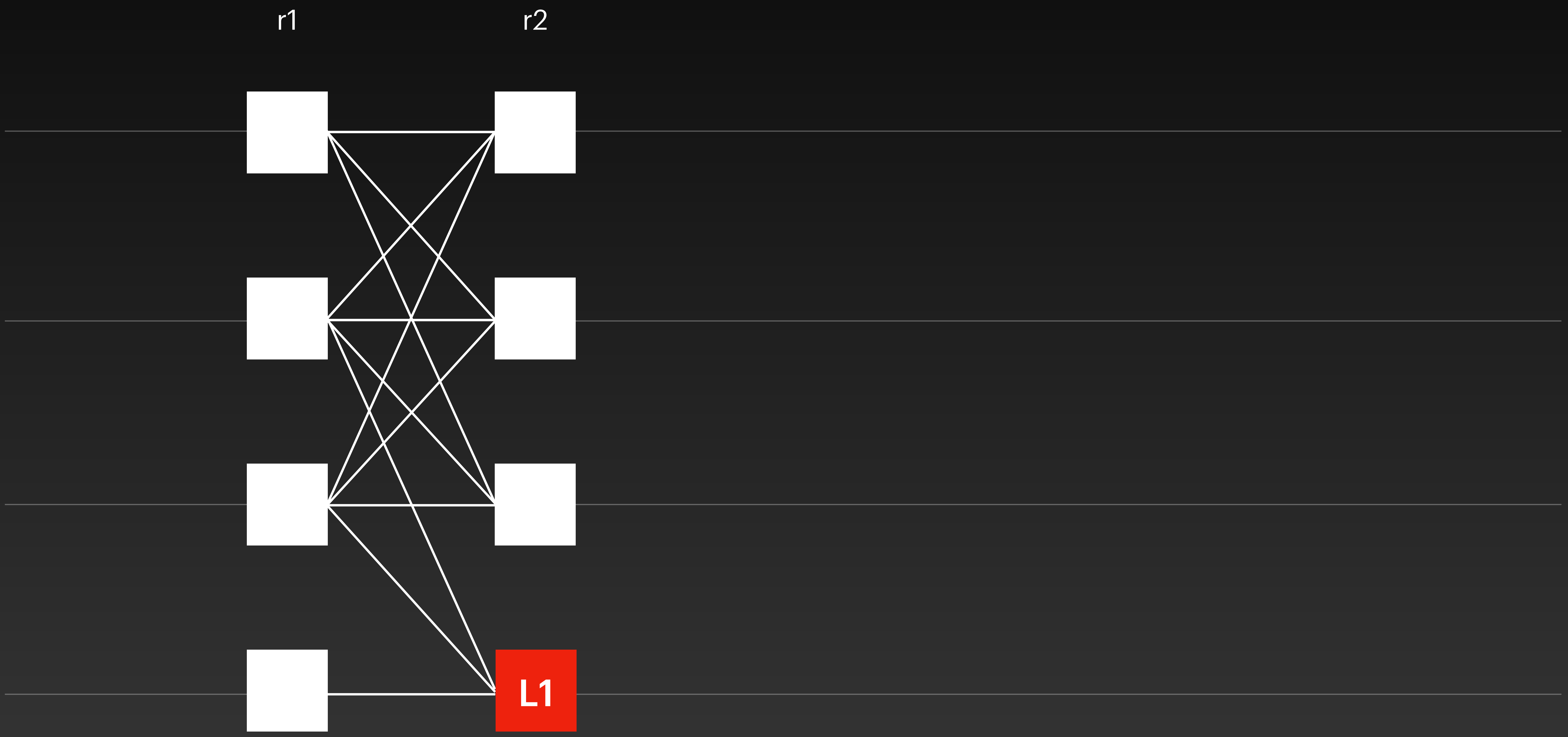
Bullshark

Just interpret the DAG



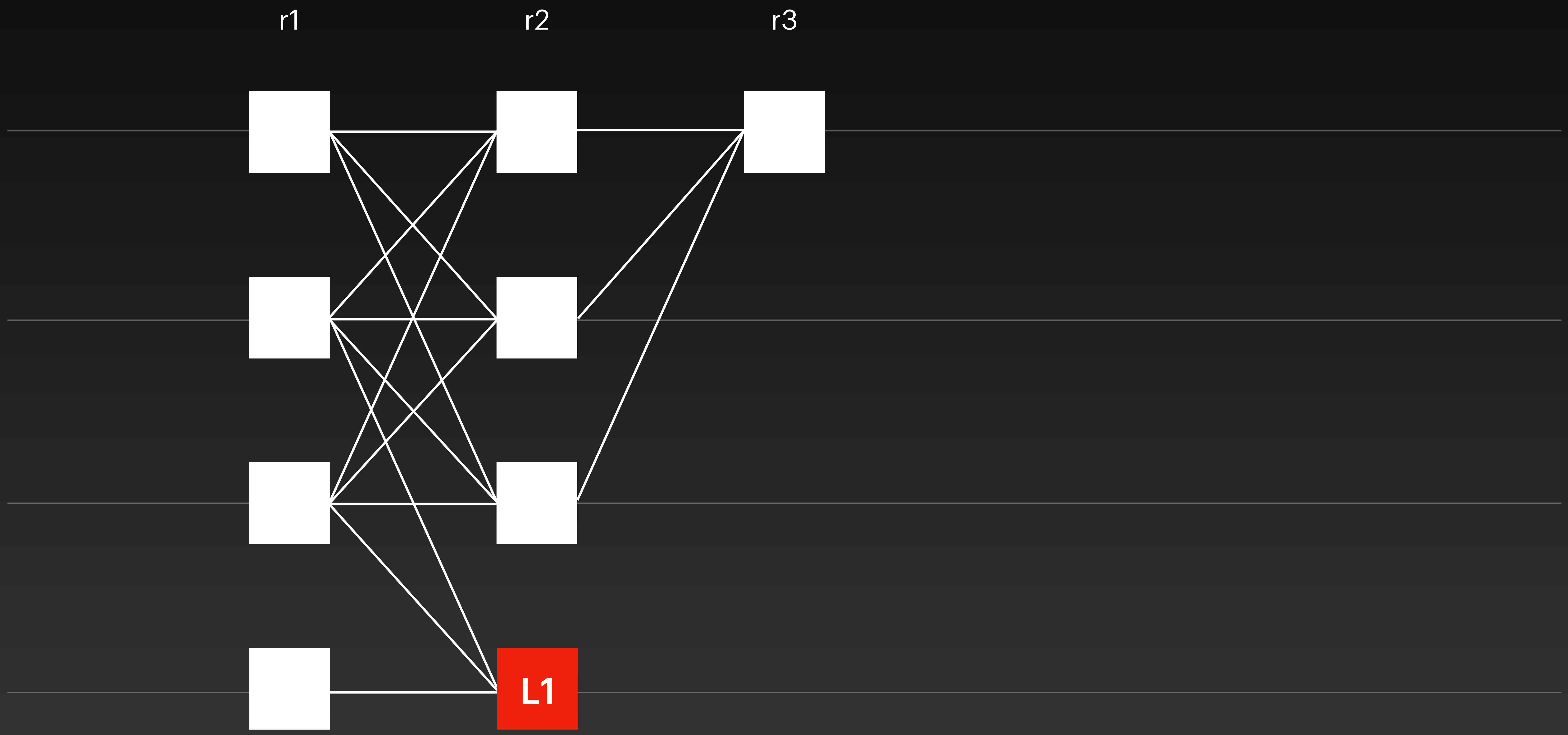
Bullshark

Deterministic leader every 2 rounds



Bullshark

The leader needs f+1 links from round r



Bullshark

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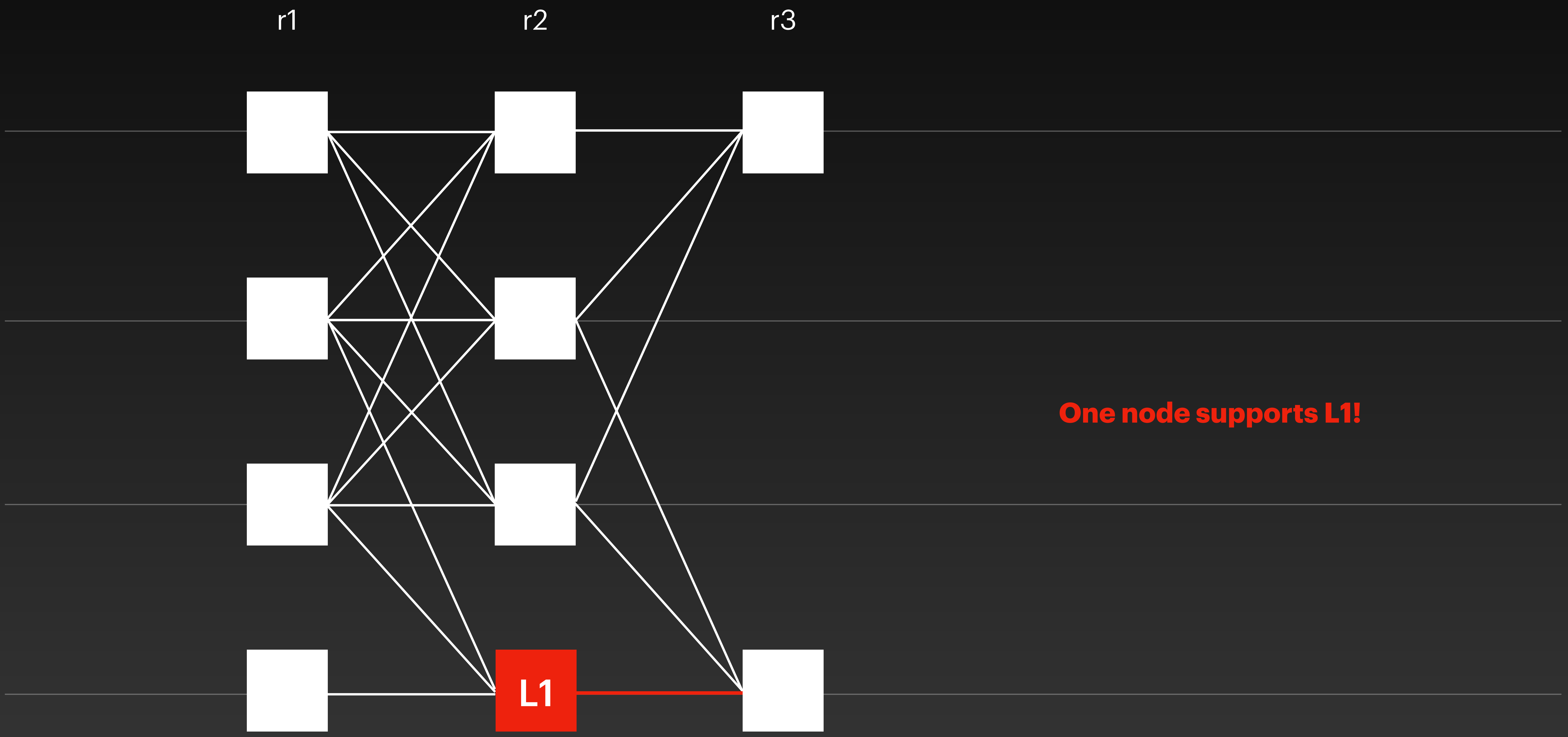
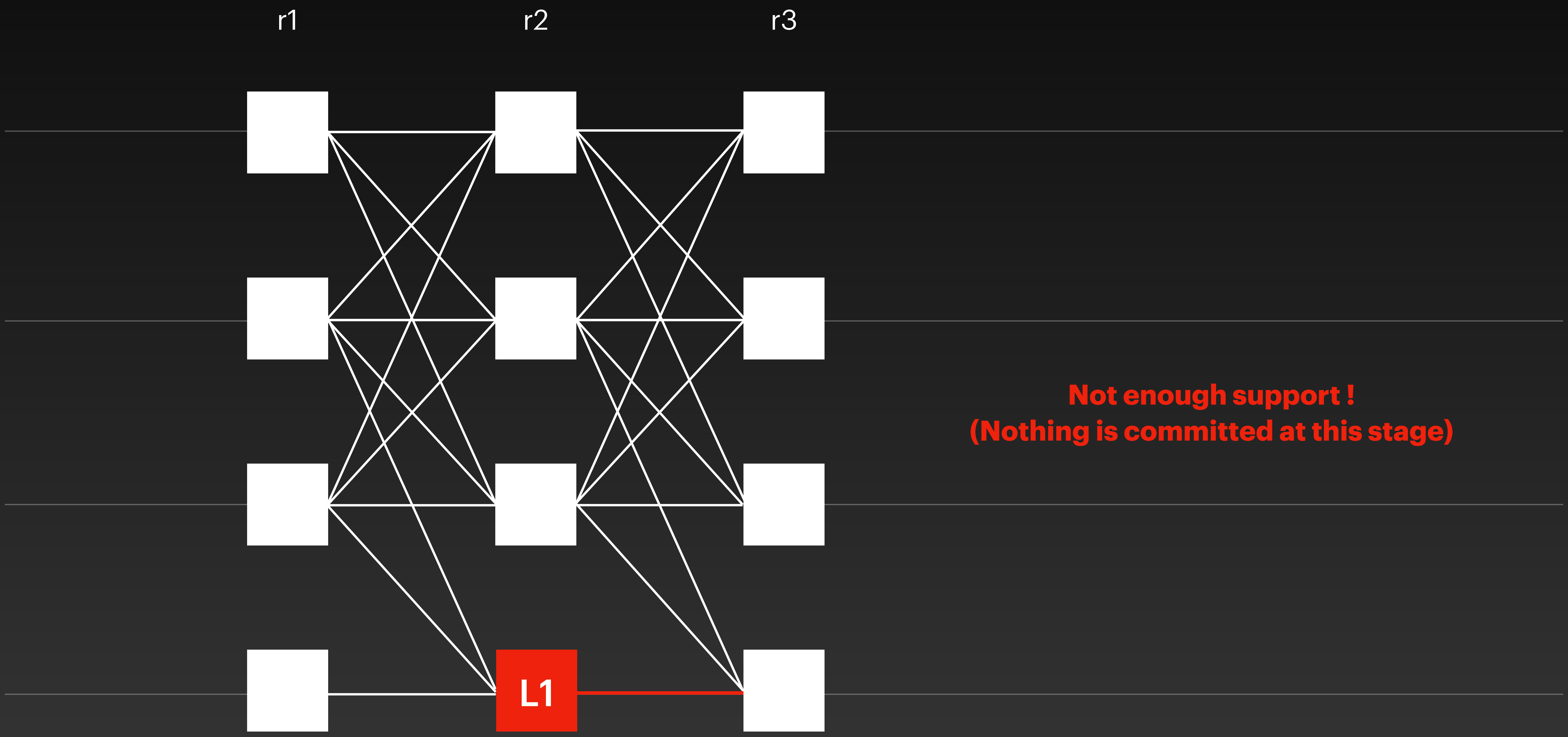


One node supports L1!

Bullshark

The leader needs f+1 links from round r



Not enough support !
(Nothing is committed at this stage)

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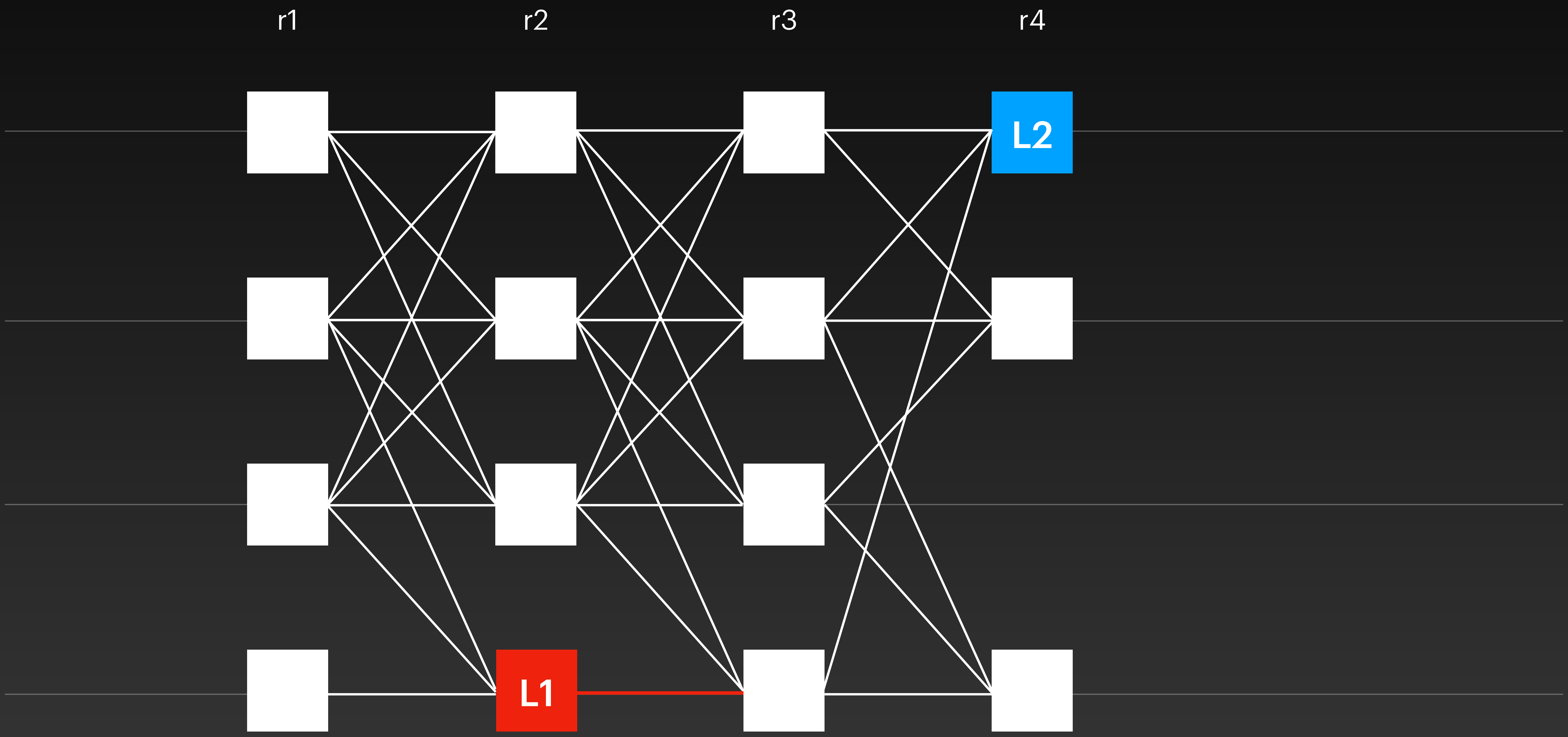
Elect the leader of r4



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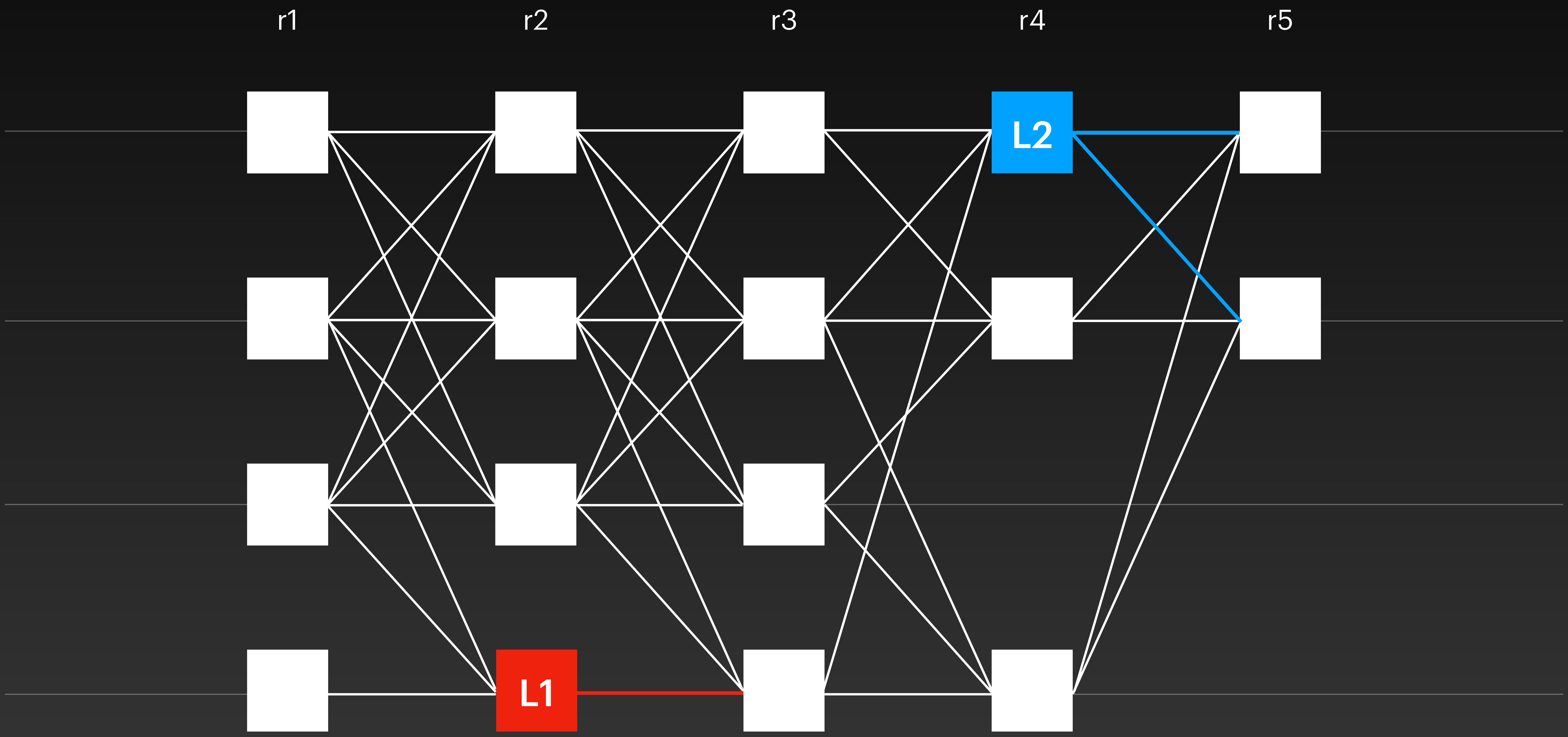
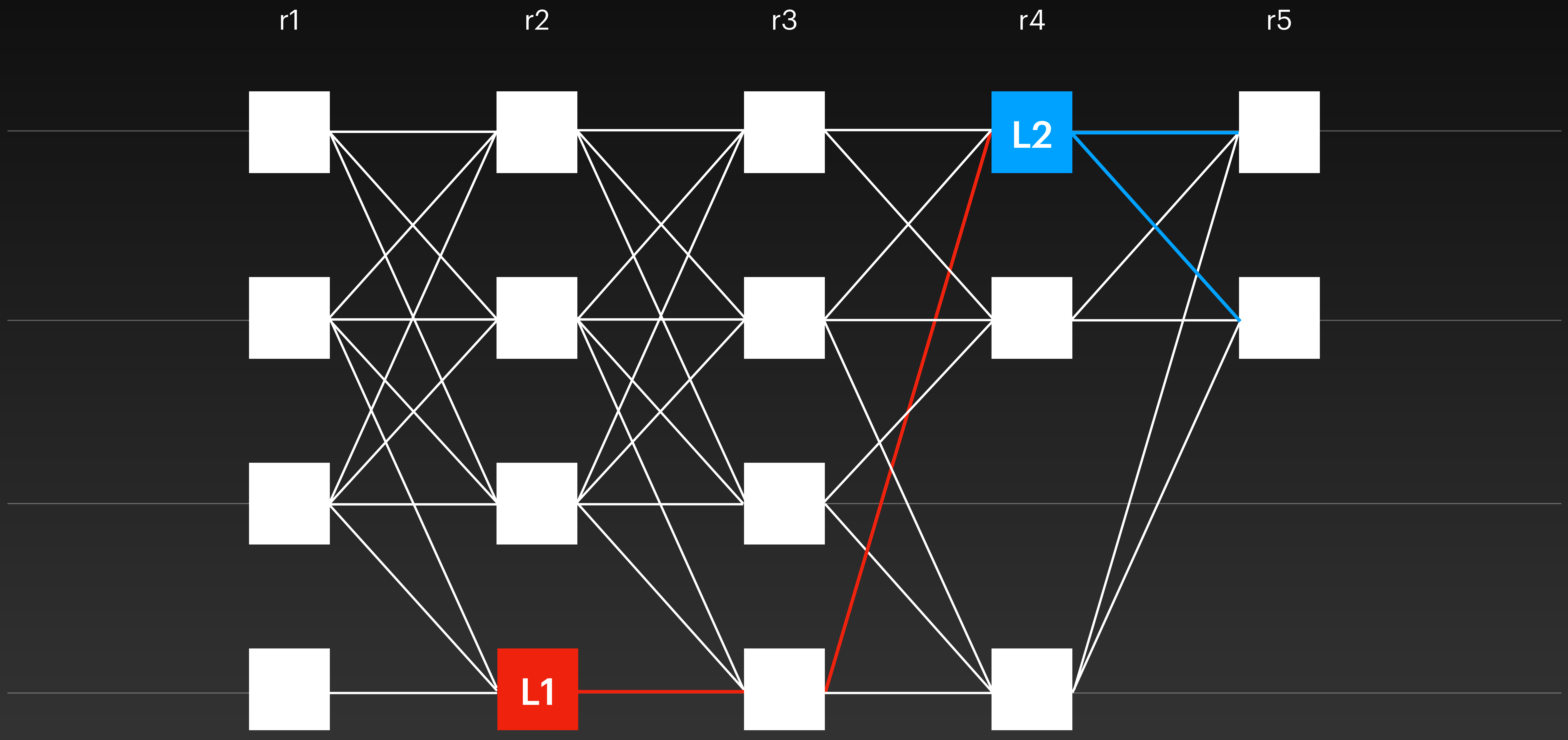
Leader L2 has enough support



Bullshark

Leader L2 has links to leader L1

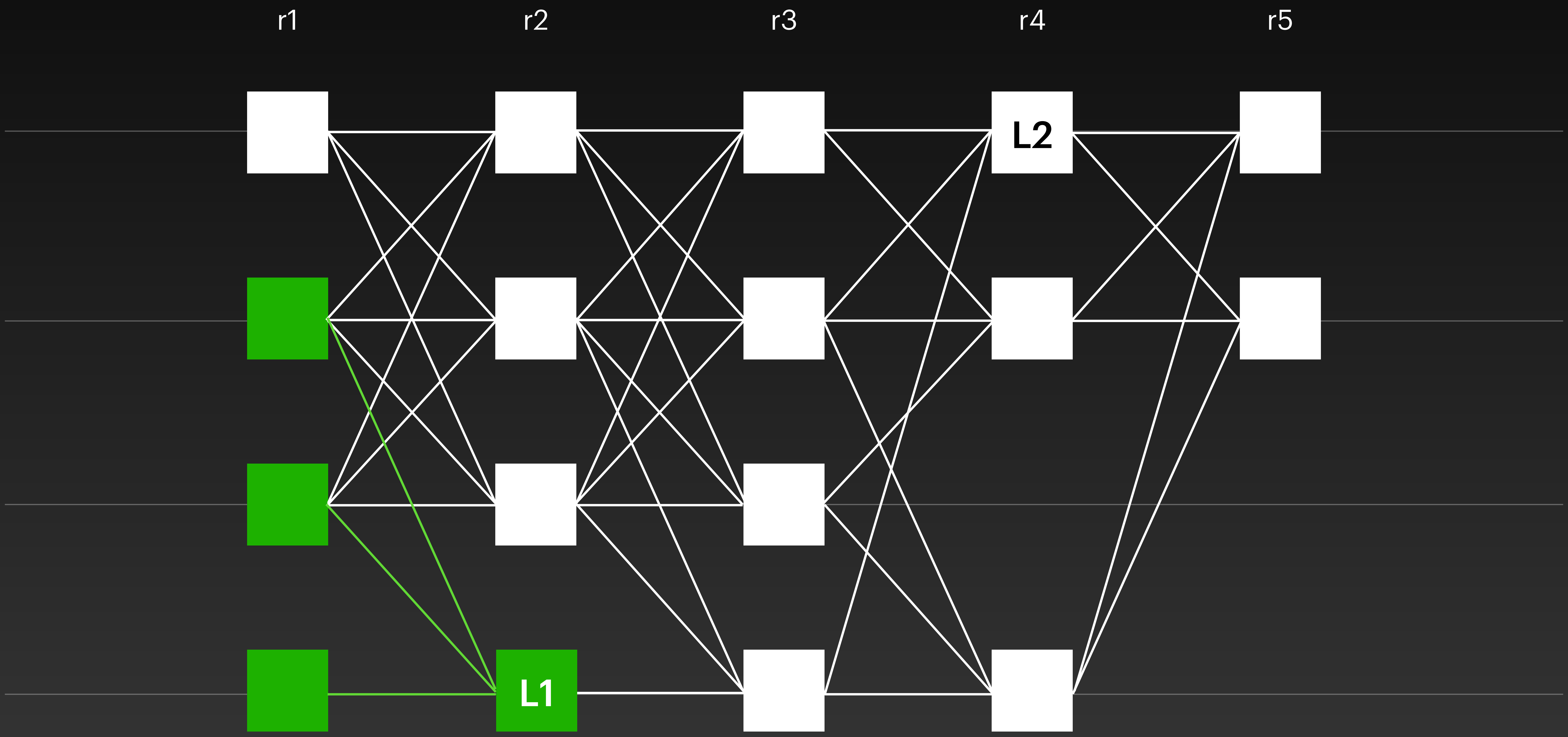


First commit L1

Then commit L2

Bullshark

Commit all the sub-DAG of the leader



Bullshark

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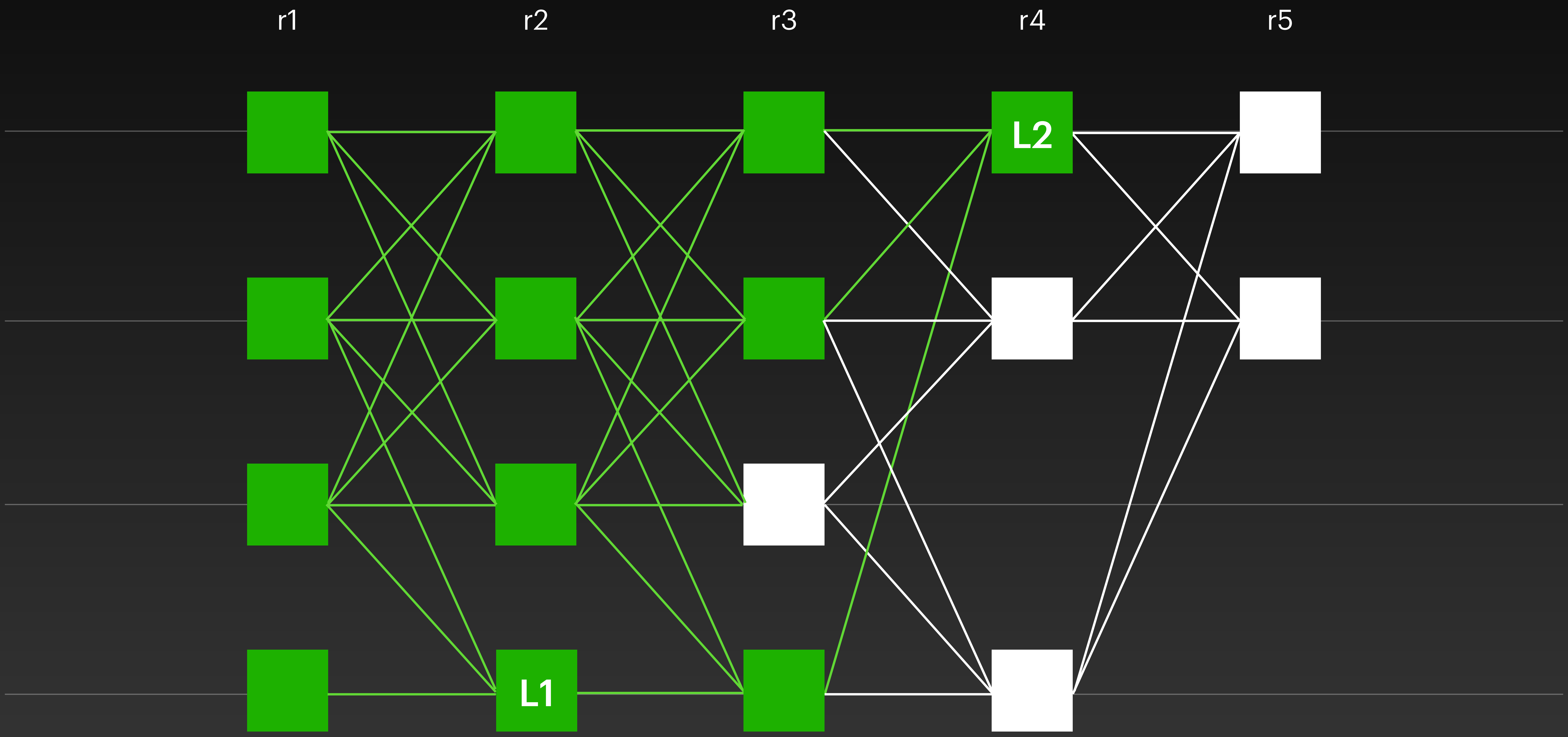


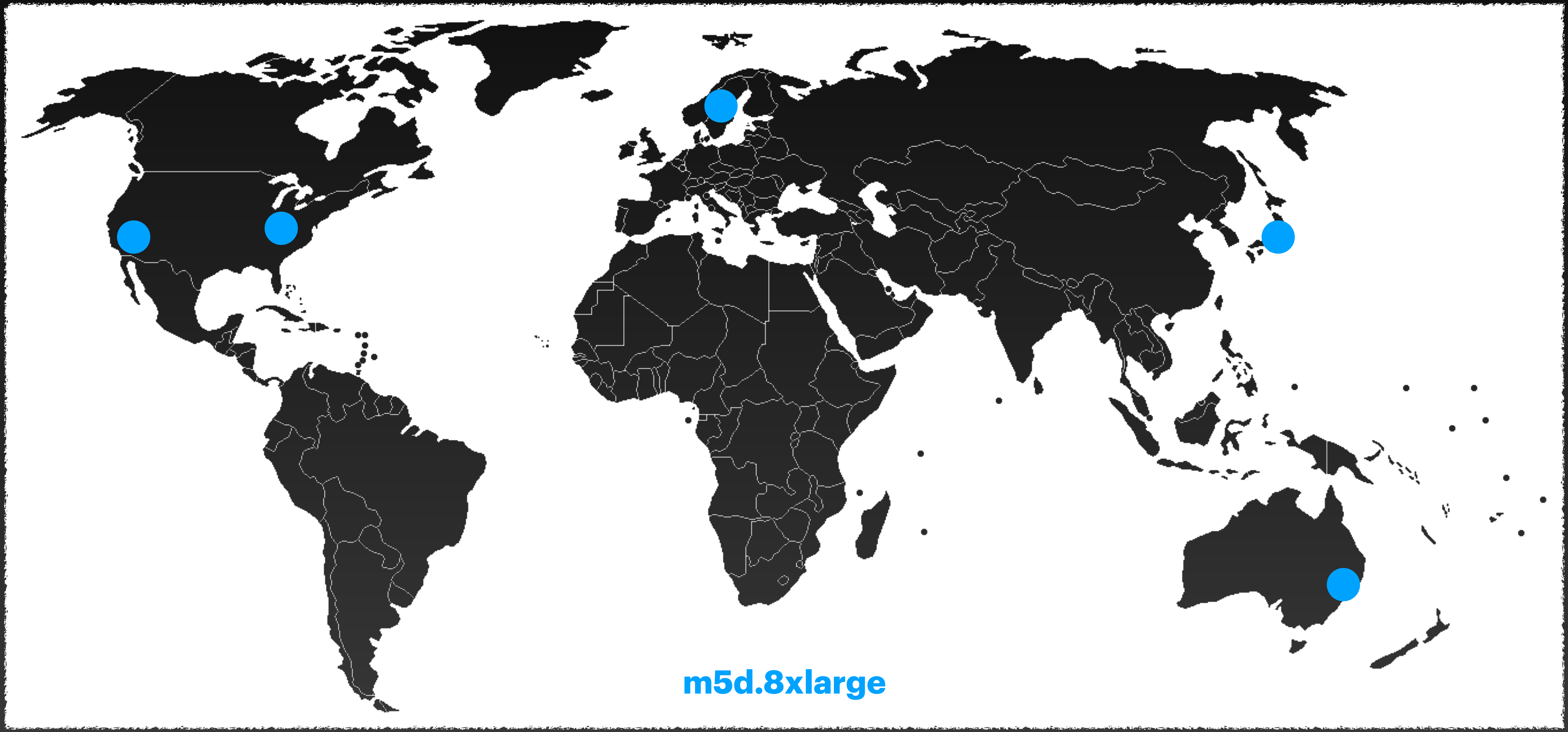
Implementation

- Written in Rust
- Networking: Tokio (TCP)
- Storage: RocksDB
- Cryptography: ed25519-dalek

https://github.com/asonnino/narwhal

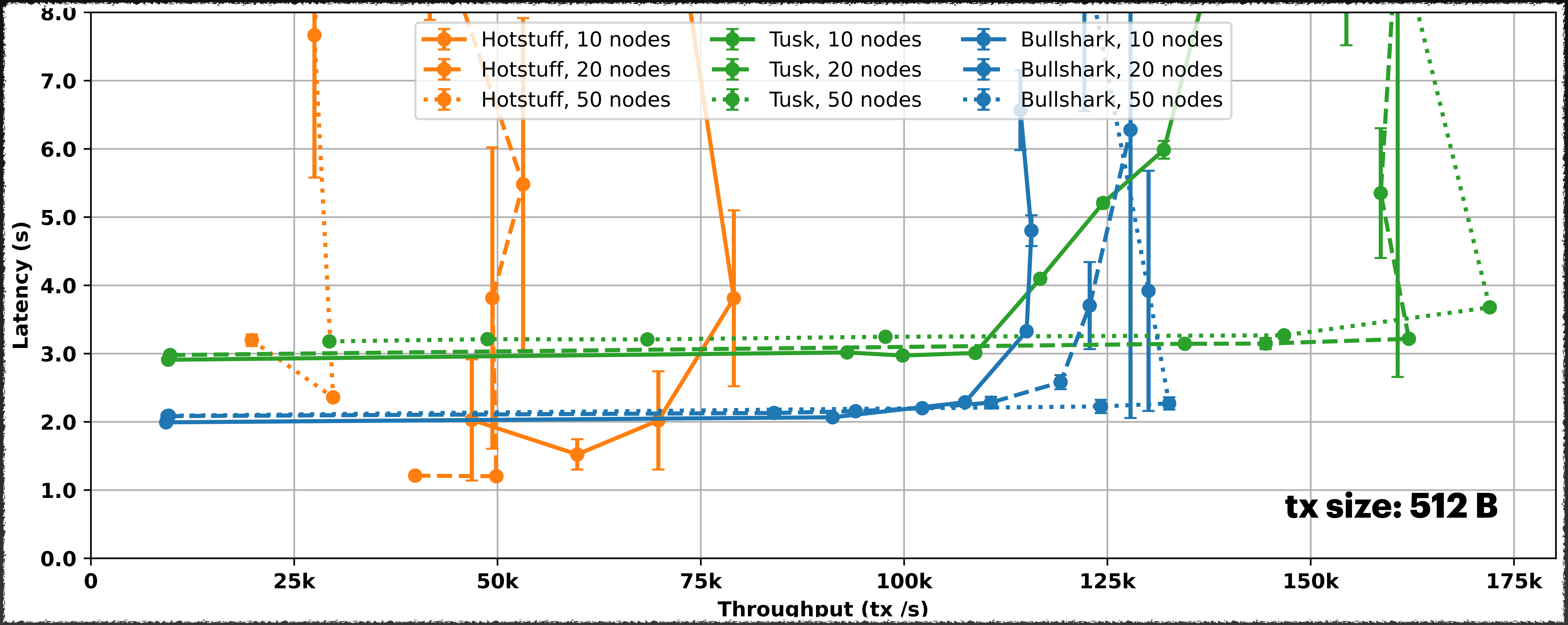
Evaluation

Experimental setup on AWS



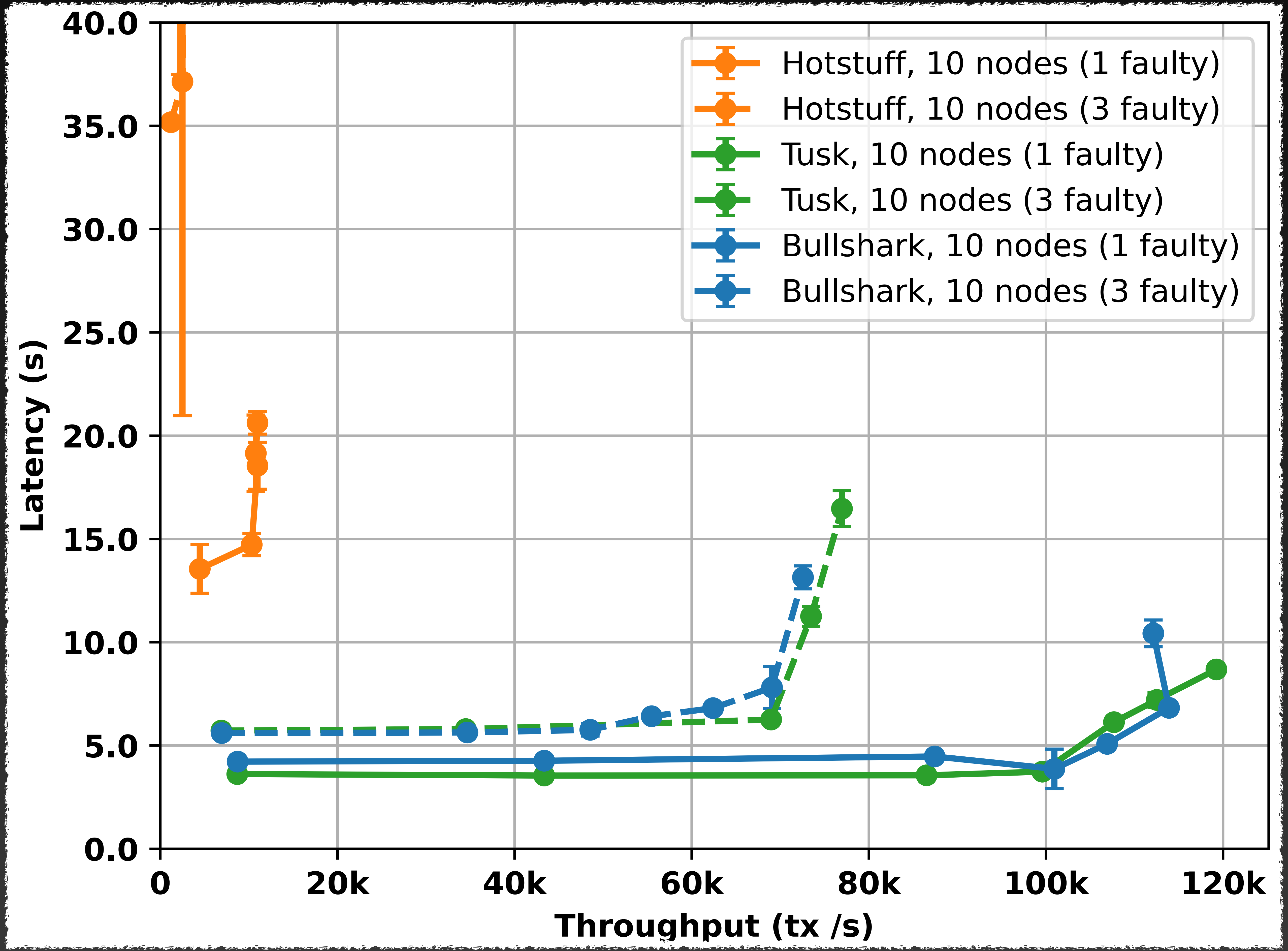
Evaluation

Throughput latency graph



Evaluation

Performance under faults



Conclusion

Bullshark

- Zero-message overhead, no view-change, no common-coin
- Disseminate data with Narwhal, exploits periods of synchrony

- **Paper:** https://sonnino.com/papers/bullshark.pdf
- **Code:** https://github.com/asonnino/narwhal

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