Student Presentation

Just say NO to Paxos Overhead: Replacing Consensus with Network Ordering

Benjamin Kuykendall

COS 518: Advanced Computer Systems

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Problem statement

Consensus is slow.

Paxos achieves consensus with a 2-message delay.

This is optimal when the network is asynchronous [Lam06b].

Previous solutions

Asynchronous unordered:

- Paxos [Lam98]
- Raft [OO14]

Usually reliable & ordered network:

- Fast Paxos [Lam06a]
- Speculative Paxos [PLL+15]

Totally ordered atomic broadcast:

- Trivial [BJ87]

Key idea

Separate concerns of ordering and reliable delivery.

Ordered unreliable multicast:

- Network-Ordered Paxos

To get OUM: add sequence numbers using new hardware.

To get NOPaxos: execute non-dropped operations in order.

Key challenges

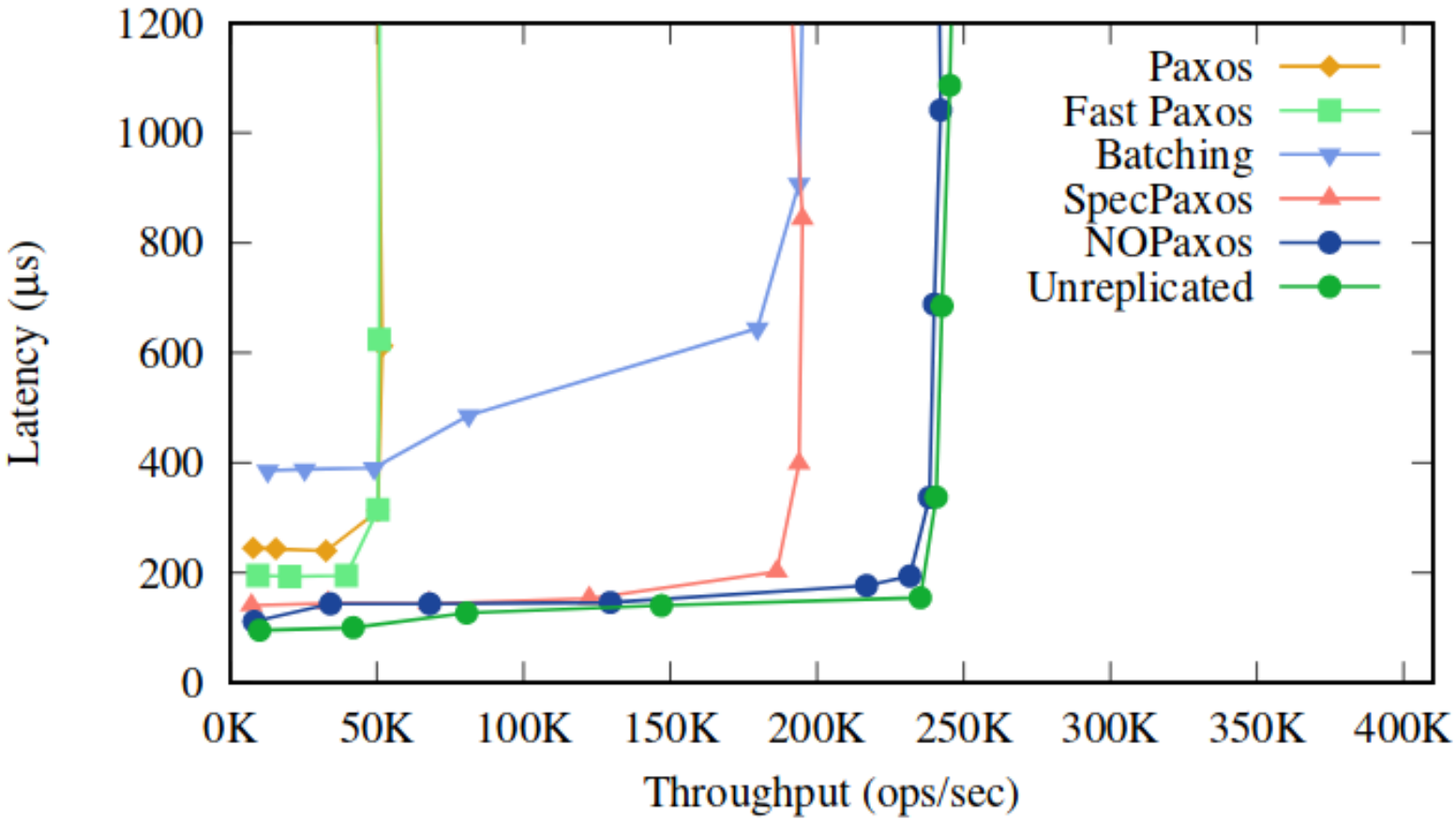
Build a fast sequencer.

Detect dropped messages and agree not to execute.

Deal with failures.

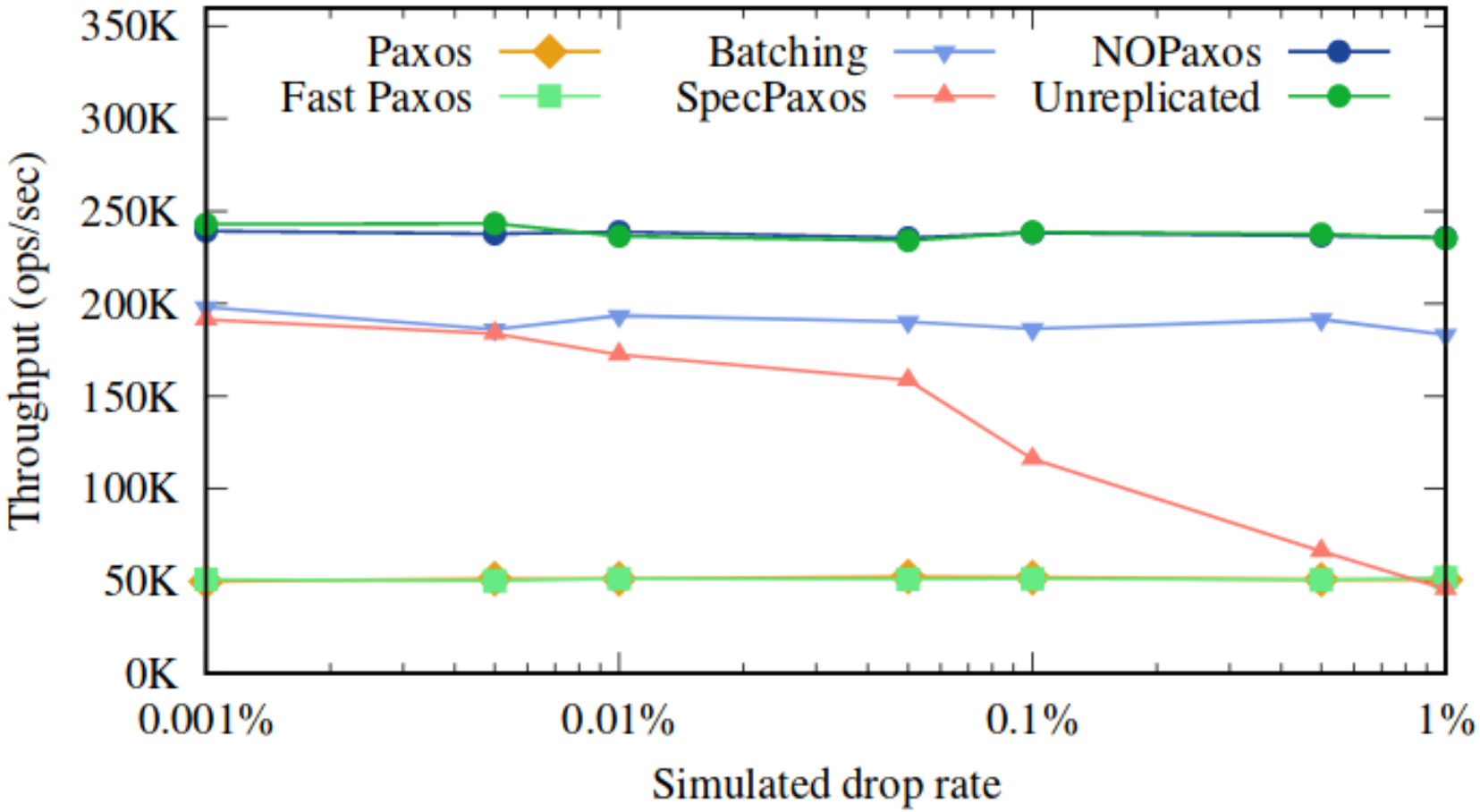
Key result

Fast sequencing $\Longrightarrow$ consensus in one round trip.



Key result

Dropped packets resolved quickly.



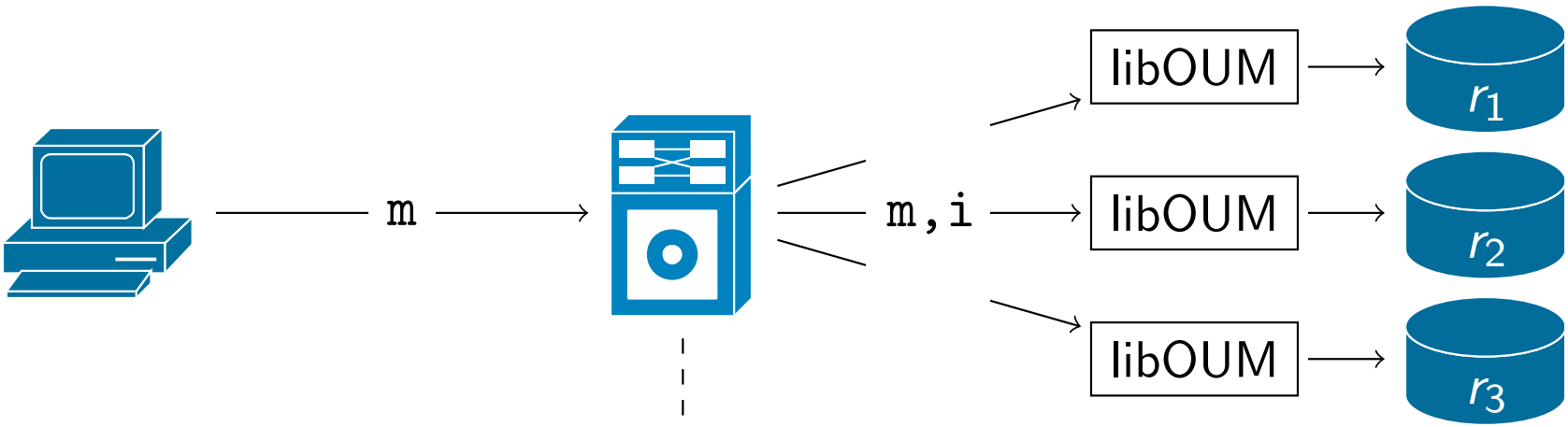
Impact

Useful functionality for programmable network switches.

Idea of accomplishing functionality “in-network”.

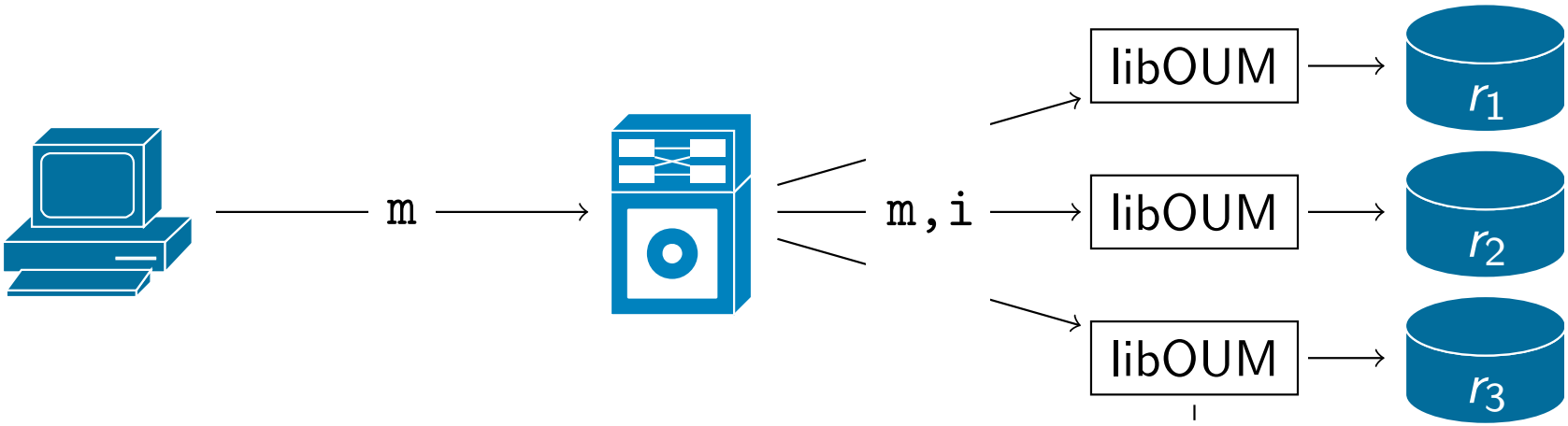
Technical details

OUM Implementation



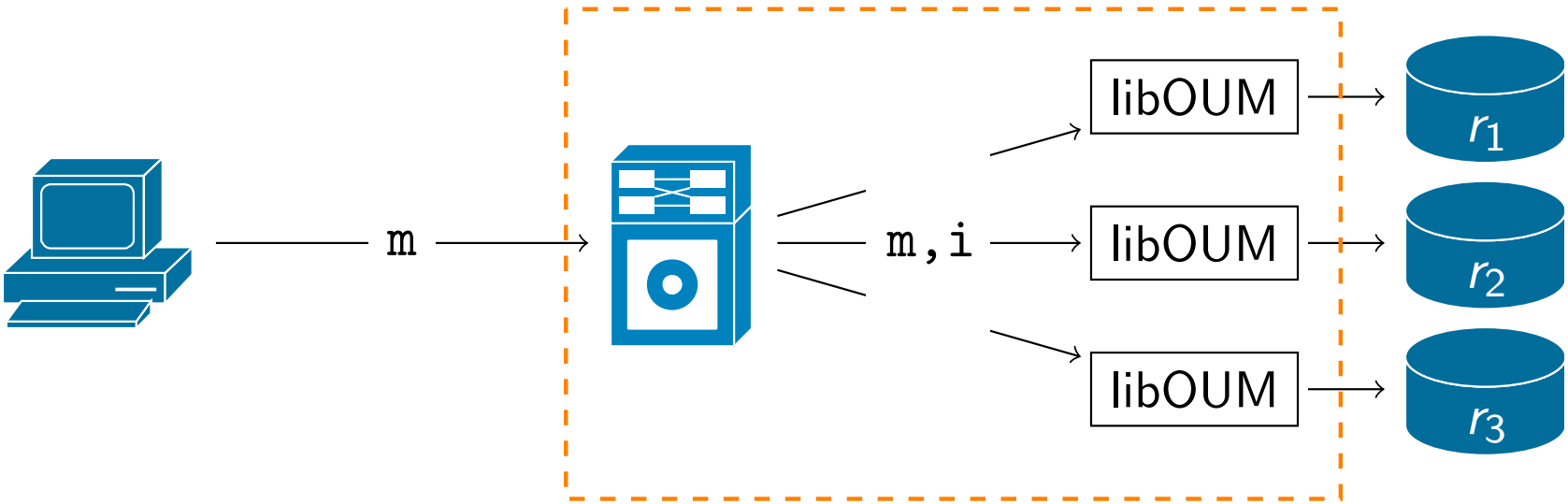

```
counter <- 0
on input m:
    i <- counter++
    send (m,i) to each replica
```

OUM Implementation




```
counter <- 0
on input (m,i):
    for j from counter to i-1:
        send ⊥ to app
    if i == counter:
        send m to app
    counter <- max(i+1, counter)
```

OUM Implementation



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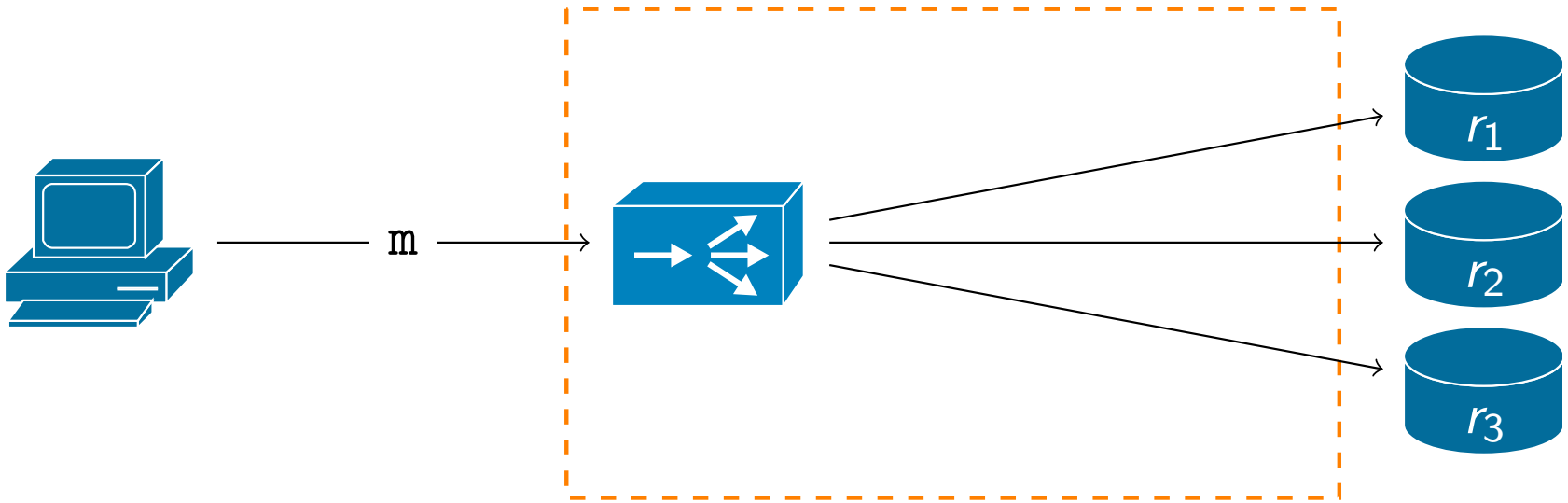
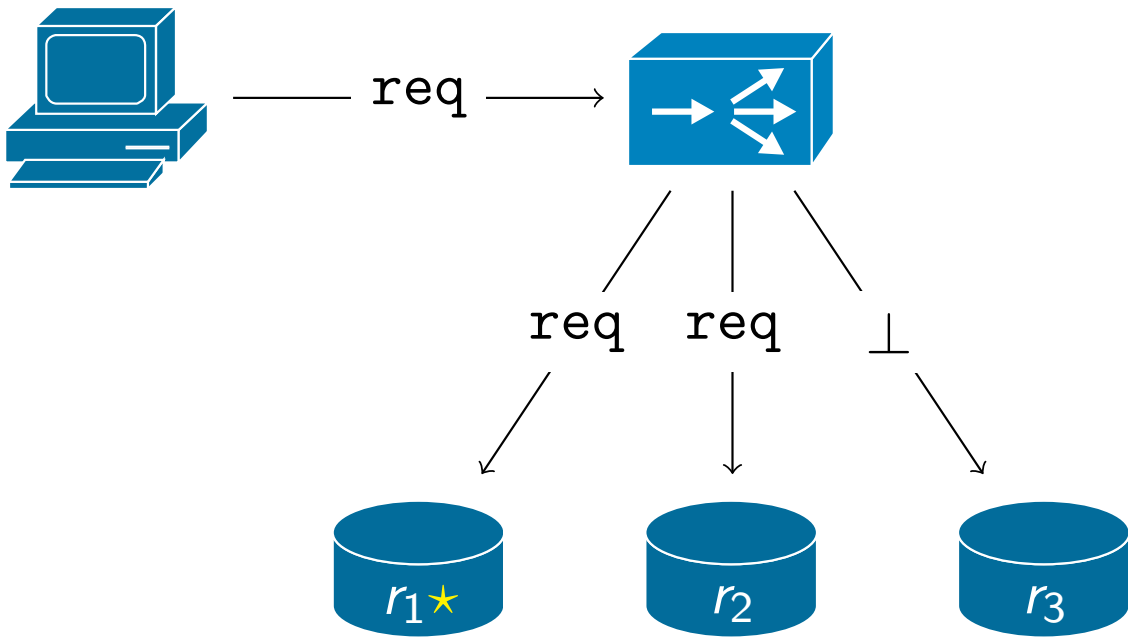
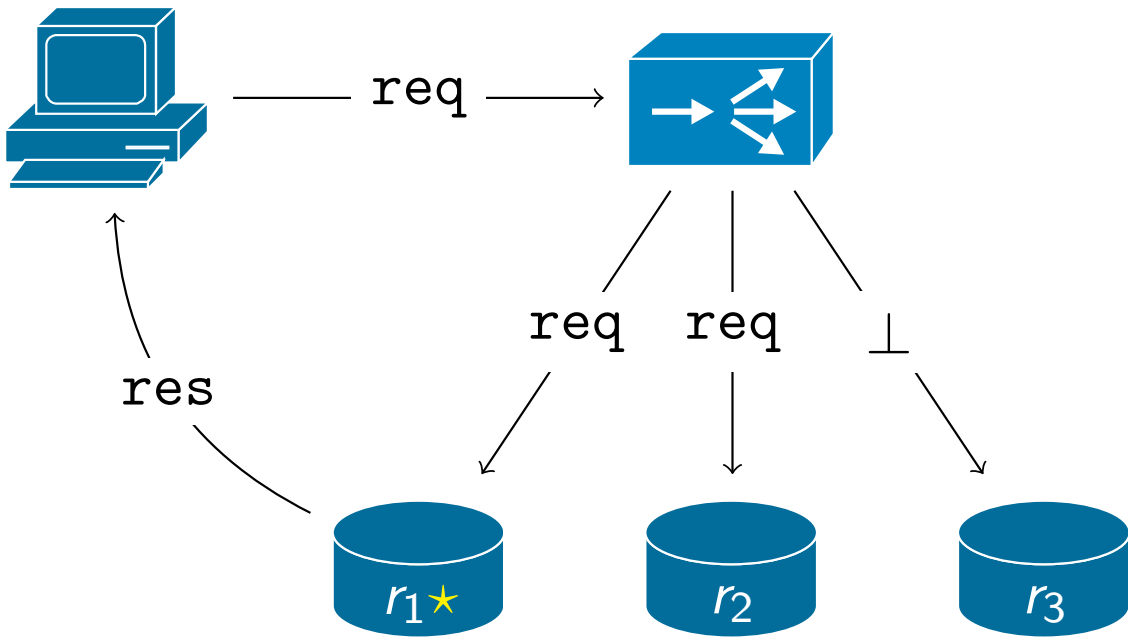


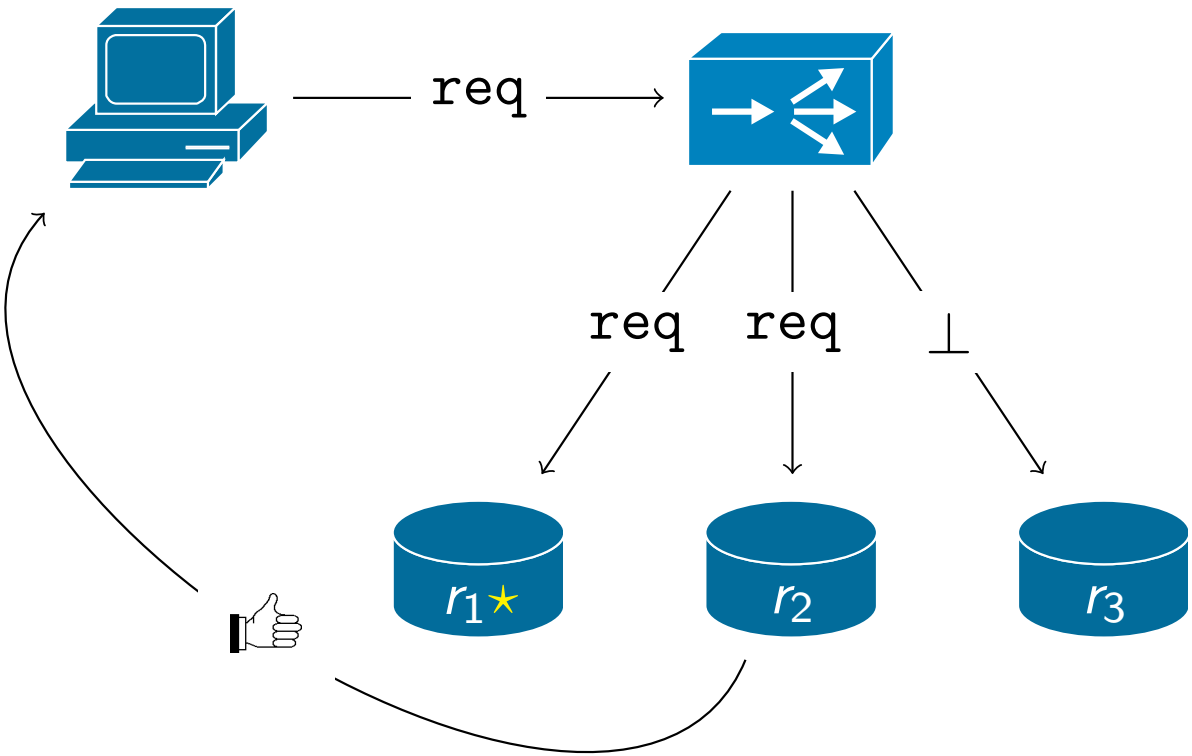
NOPaxos Implementation



NOPaxos Implementation



NOPaxos Implementation



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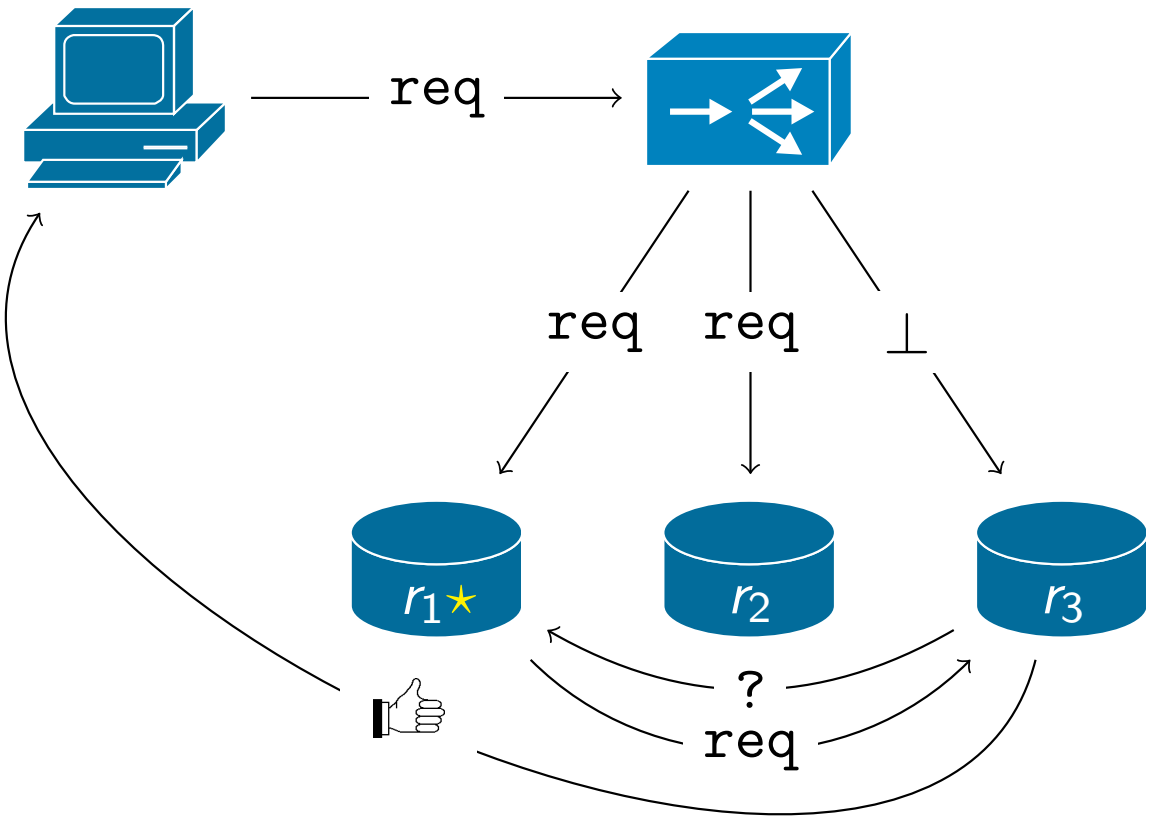
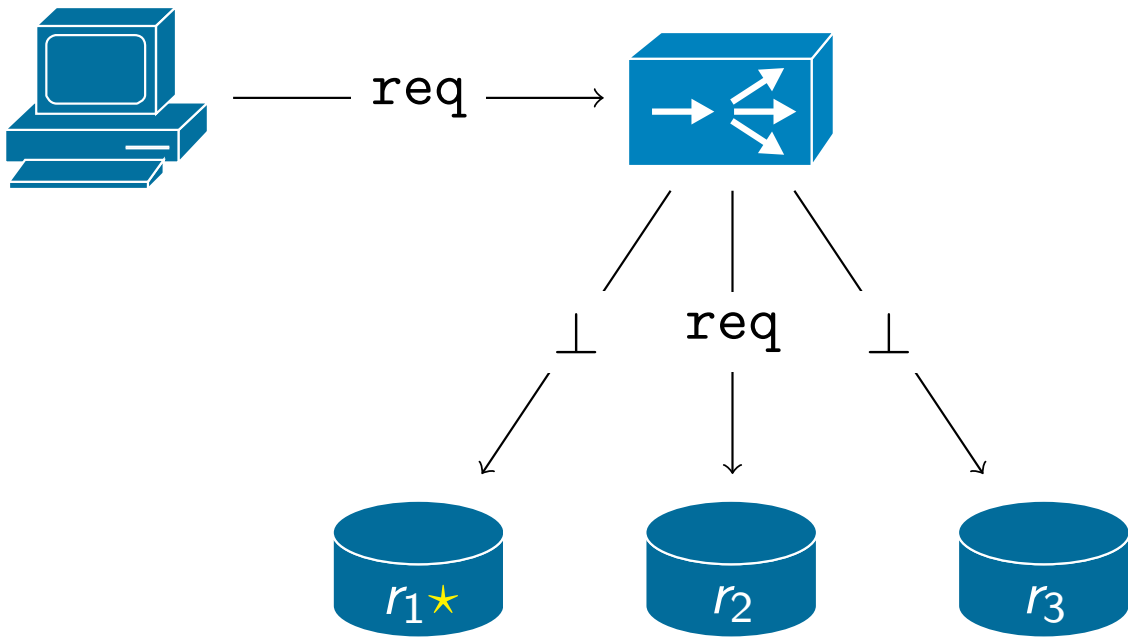


NOPaxos Implementation



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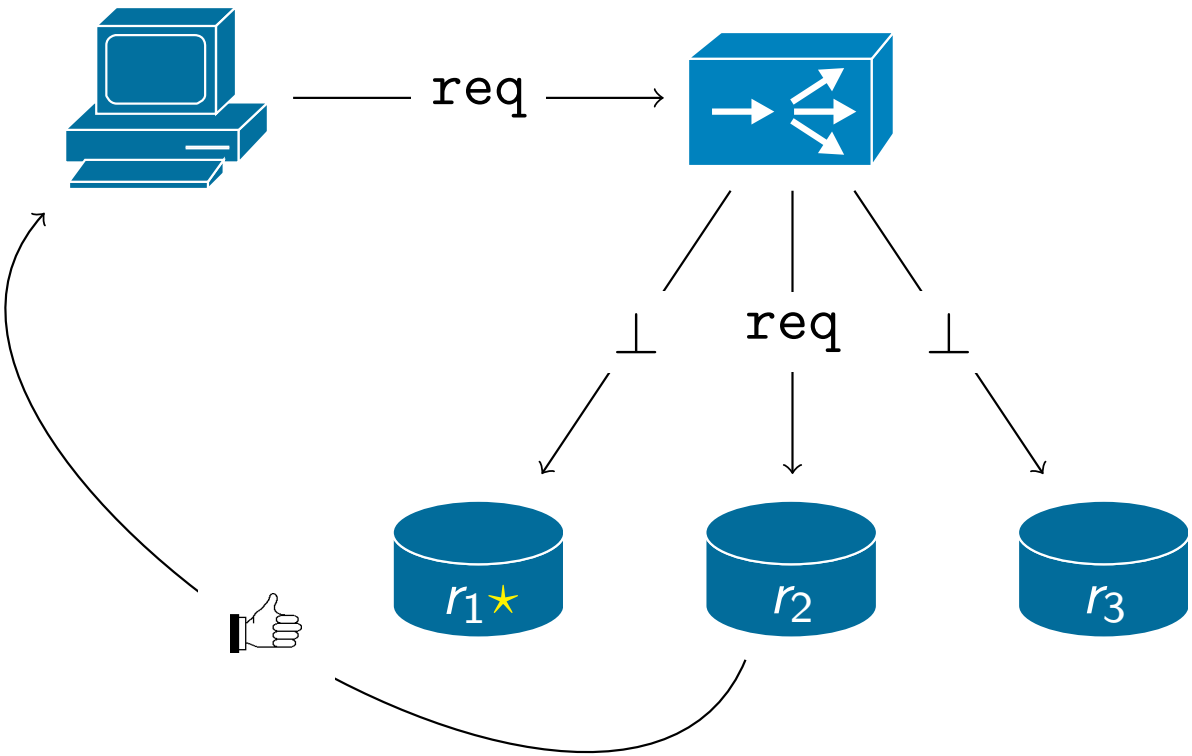
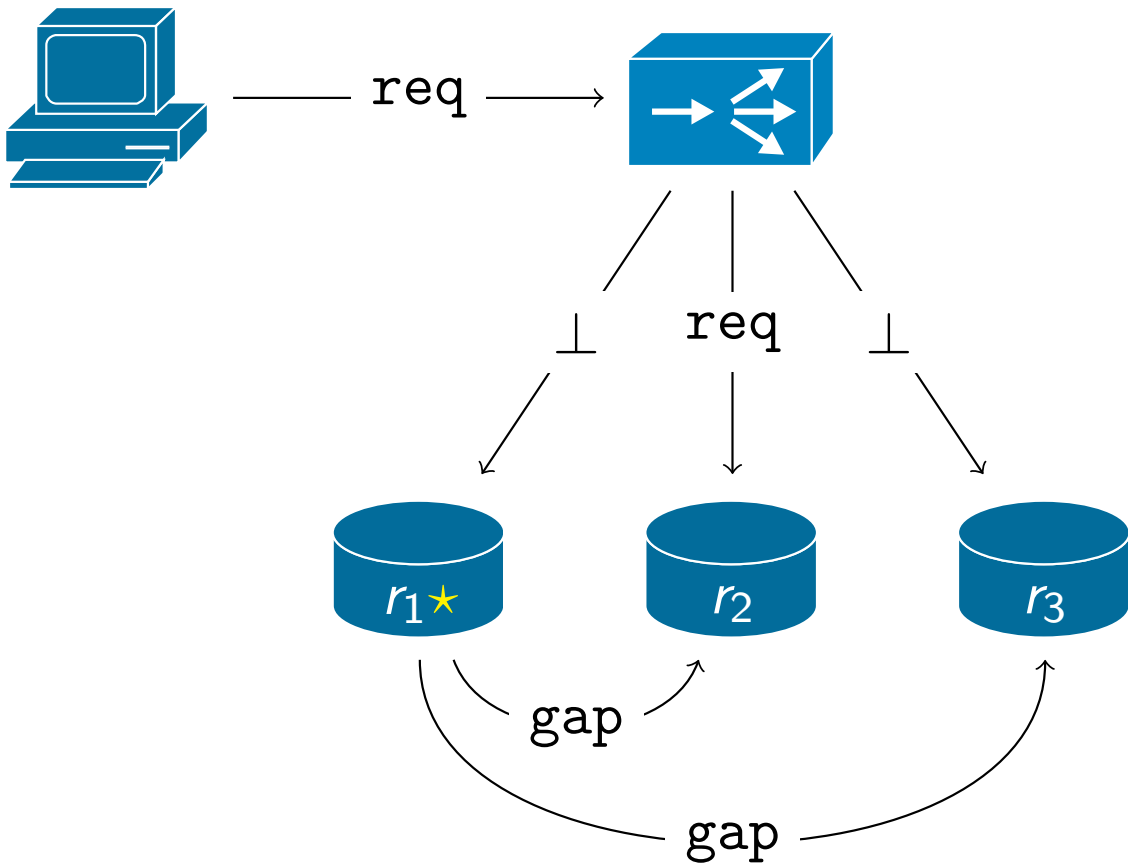
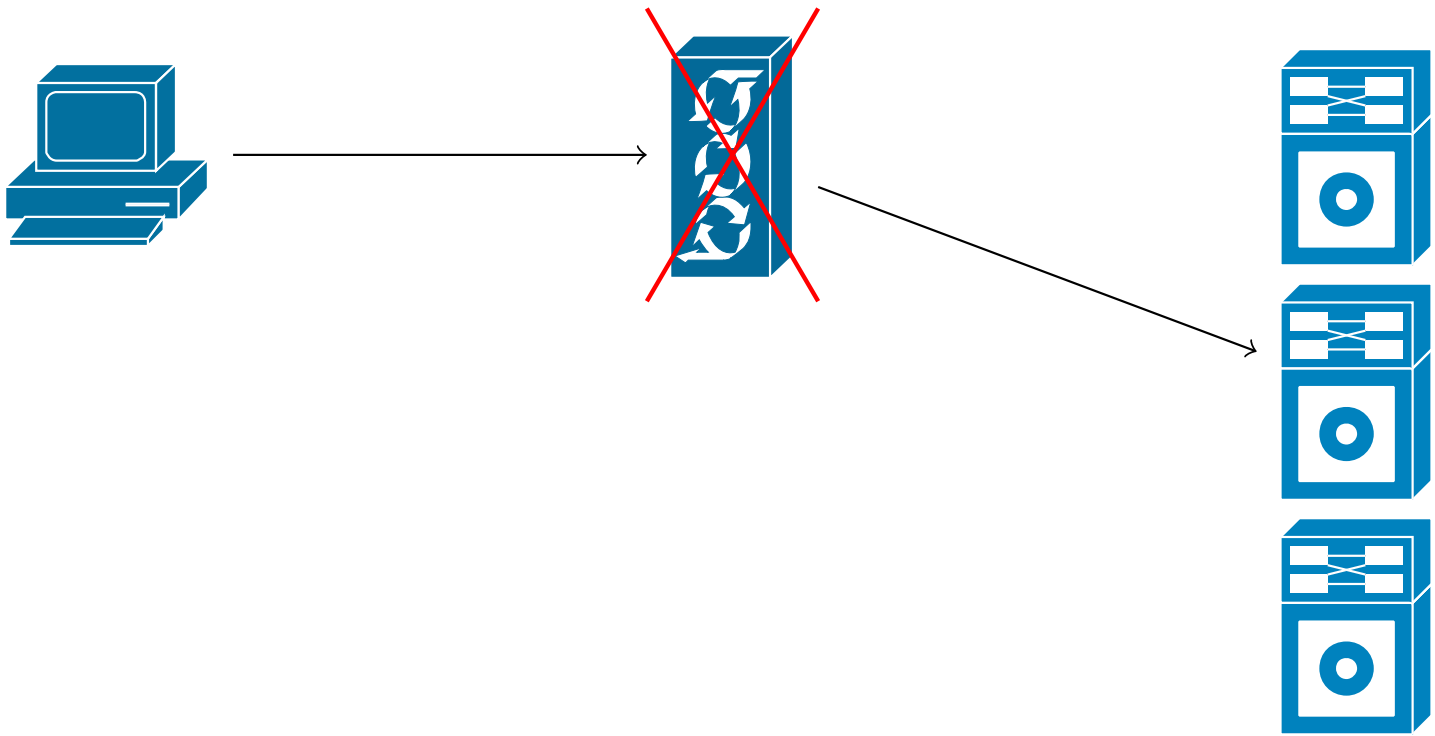


NOPaxos Implementation

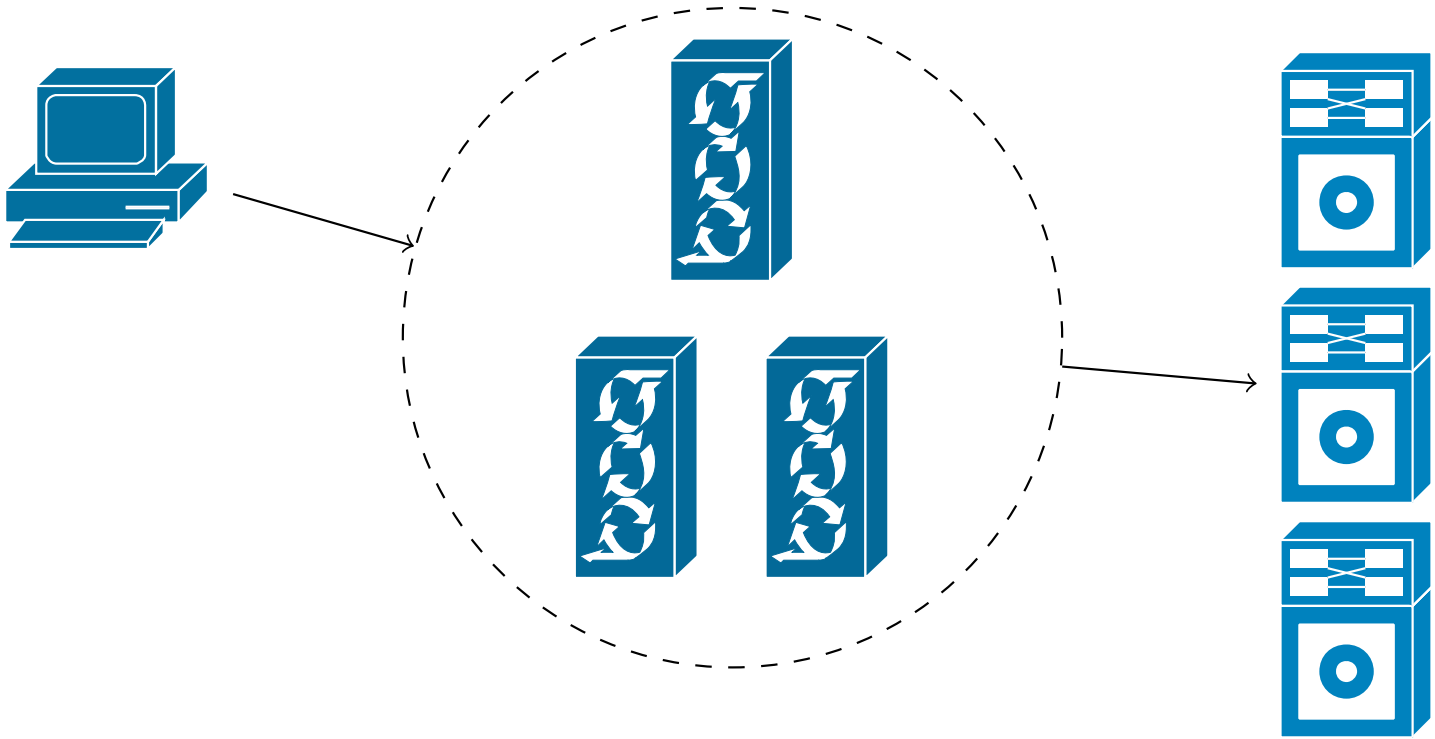


Sequencer failure

Sequencer failure



Sequencer failure



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