The End of a Myth: Distributed Transactions Can Scale

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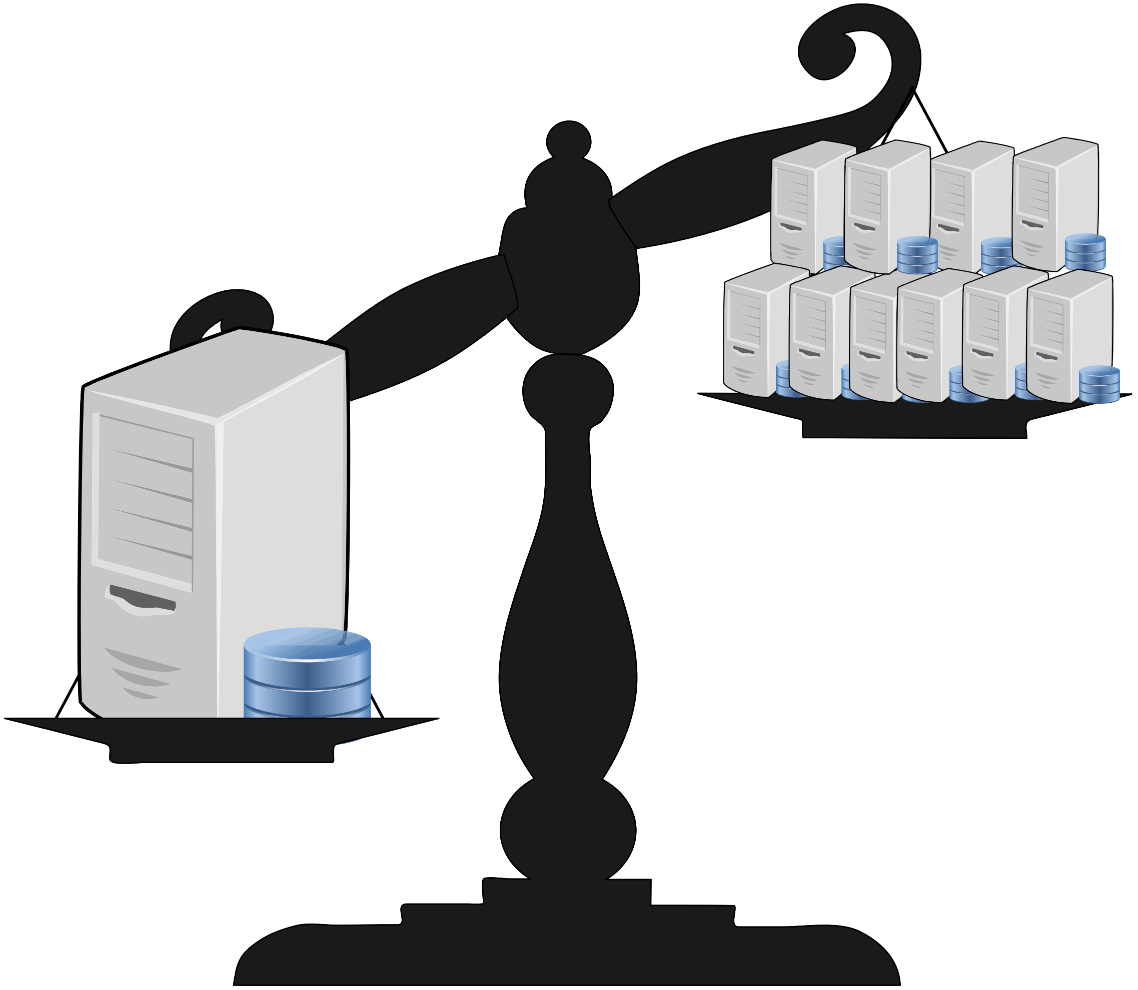
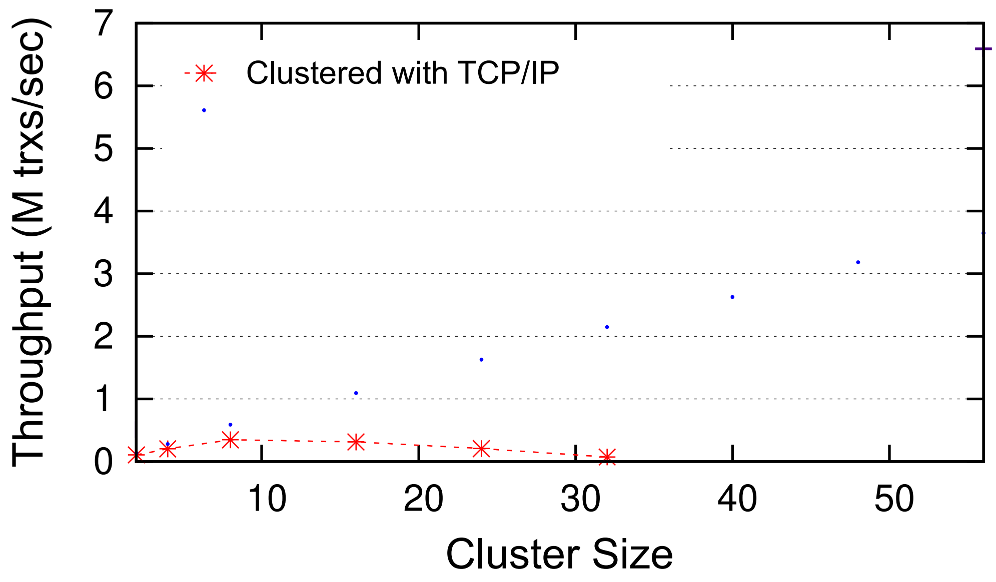
Why distributed transactions?

Cheaper for the same processing power



The problem with distributed transactions

Adding more machines doesn't increase performance



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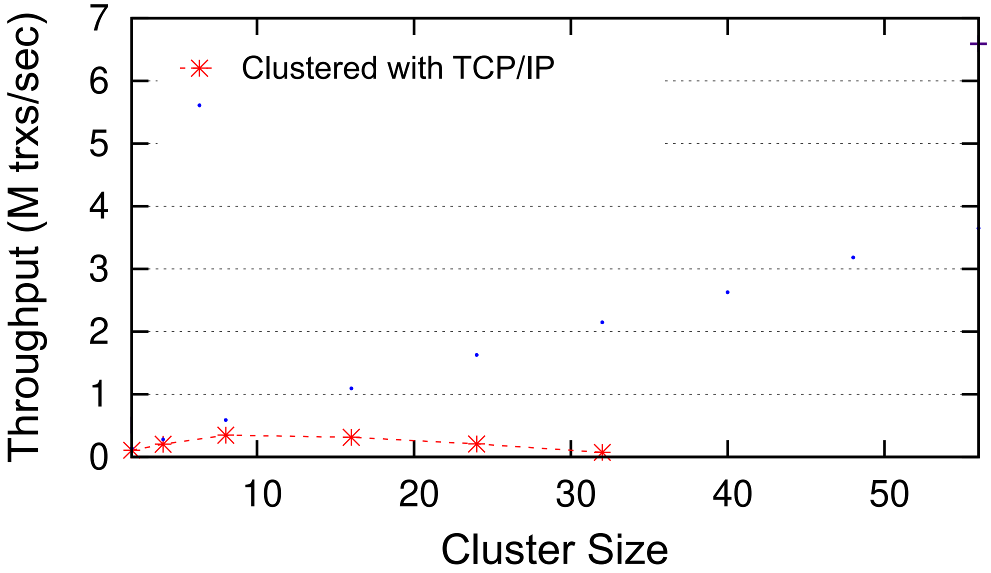


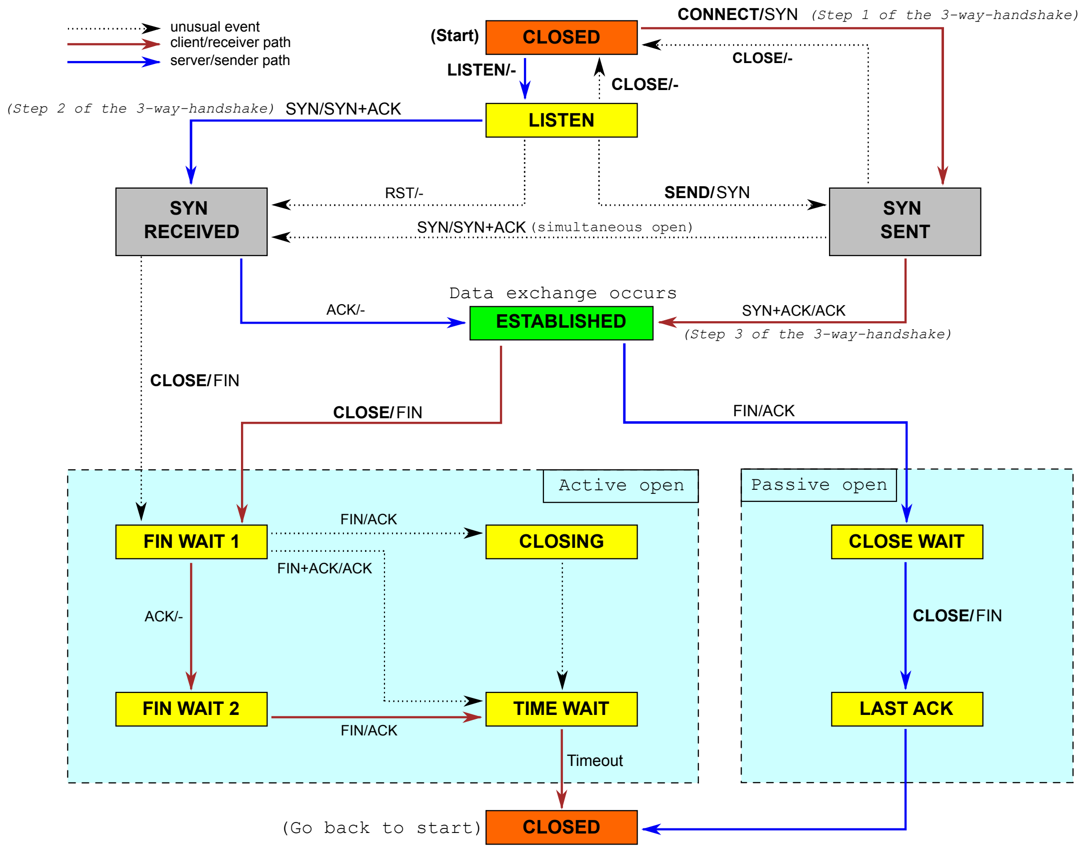
Accurate representation of a DB administrator

Why can’t they scale?

Background: TCP/IP

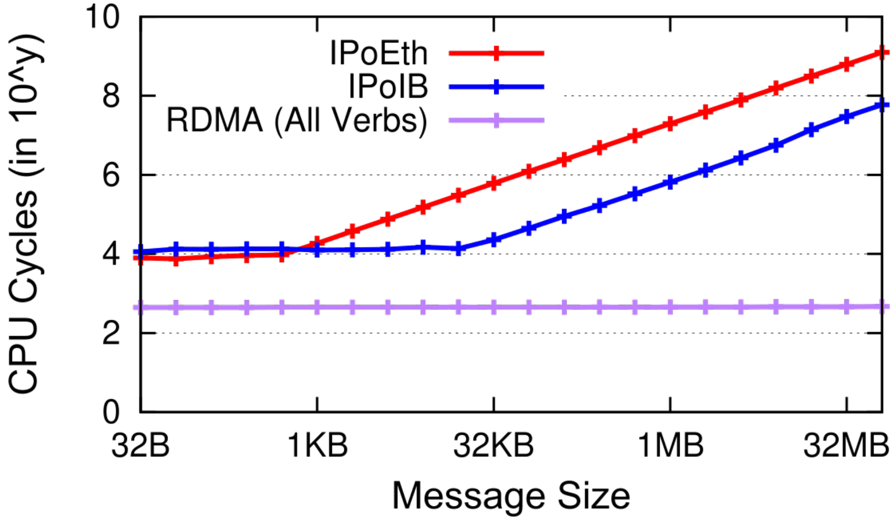
TCP/IP is computationally expensive

Complex design

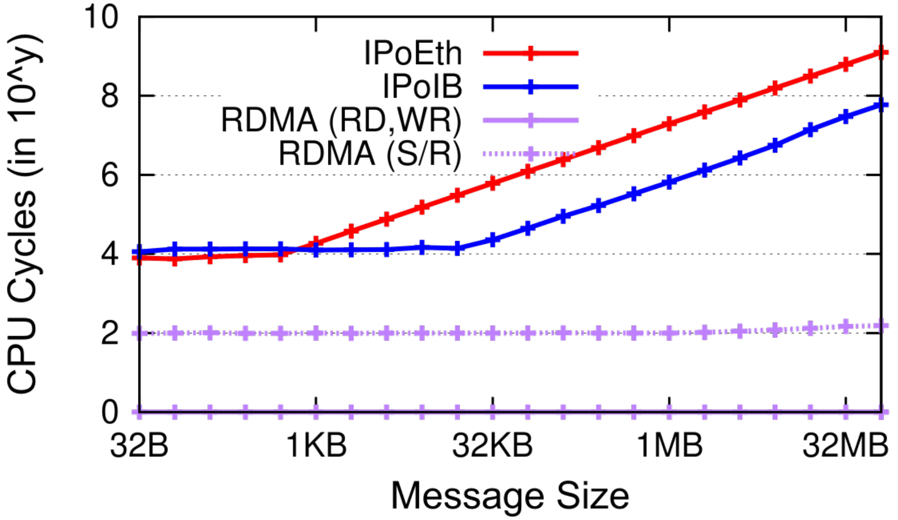


TCP/IP is computationally expensive

Fixed window size causes linear overhead



Client

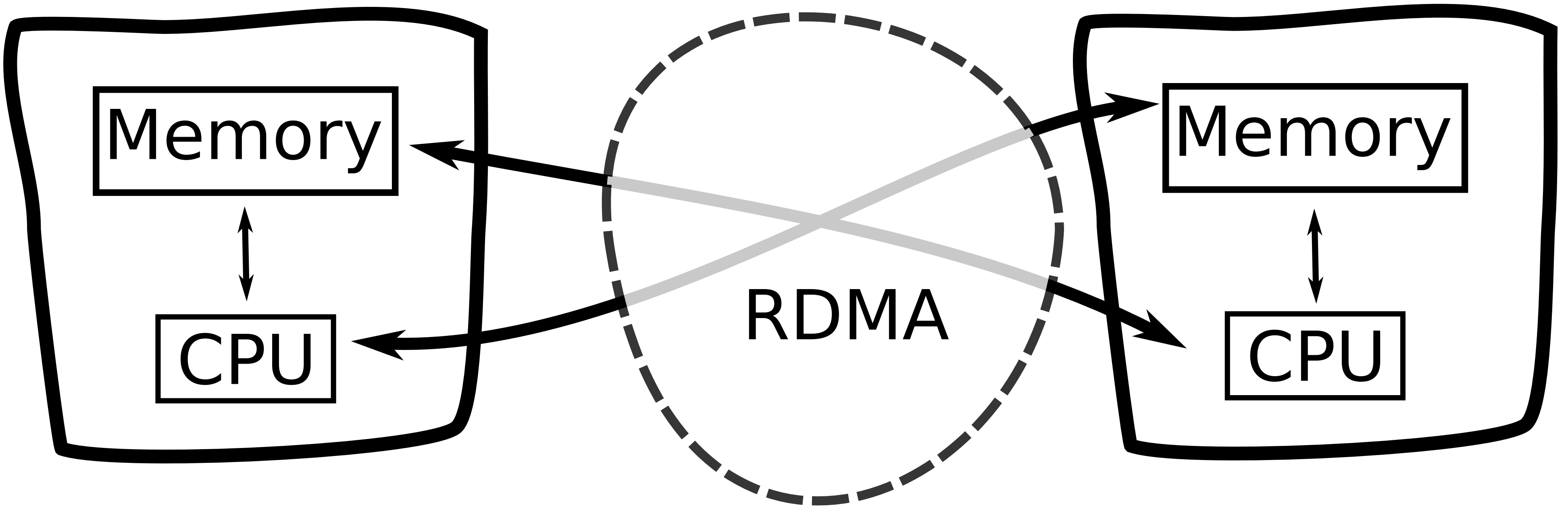


Server

How do we replace TCP/IP?

Background: RDMA

Remote Direct Memory Access (RDMA)



RDMA is great!

- Low latency
- High throughput
- Supported by InfiniBand

RDMA is hard to use

One-sided communication:

Receiver is not notified of connection

RDMA is hard to use

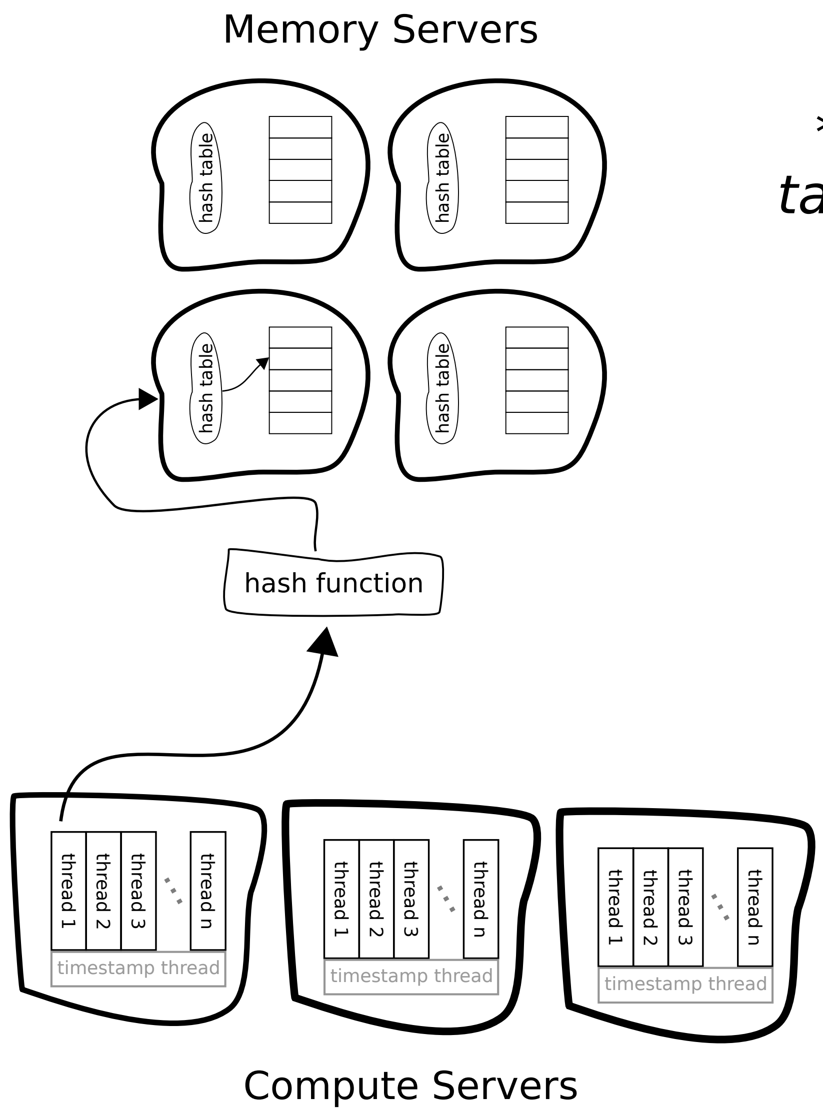
One-sided communication:

Receiver is not notified of connection

So far, most solutions that use RDMA, only do so for part of the design

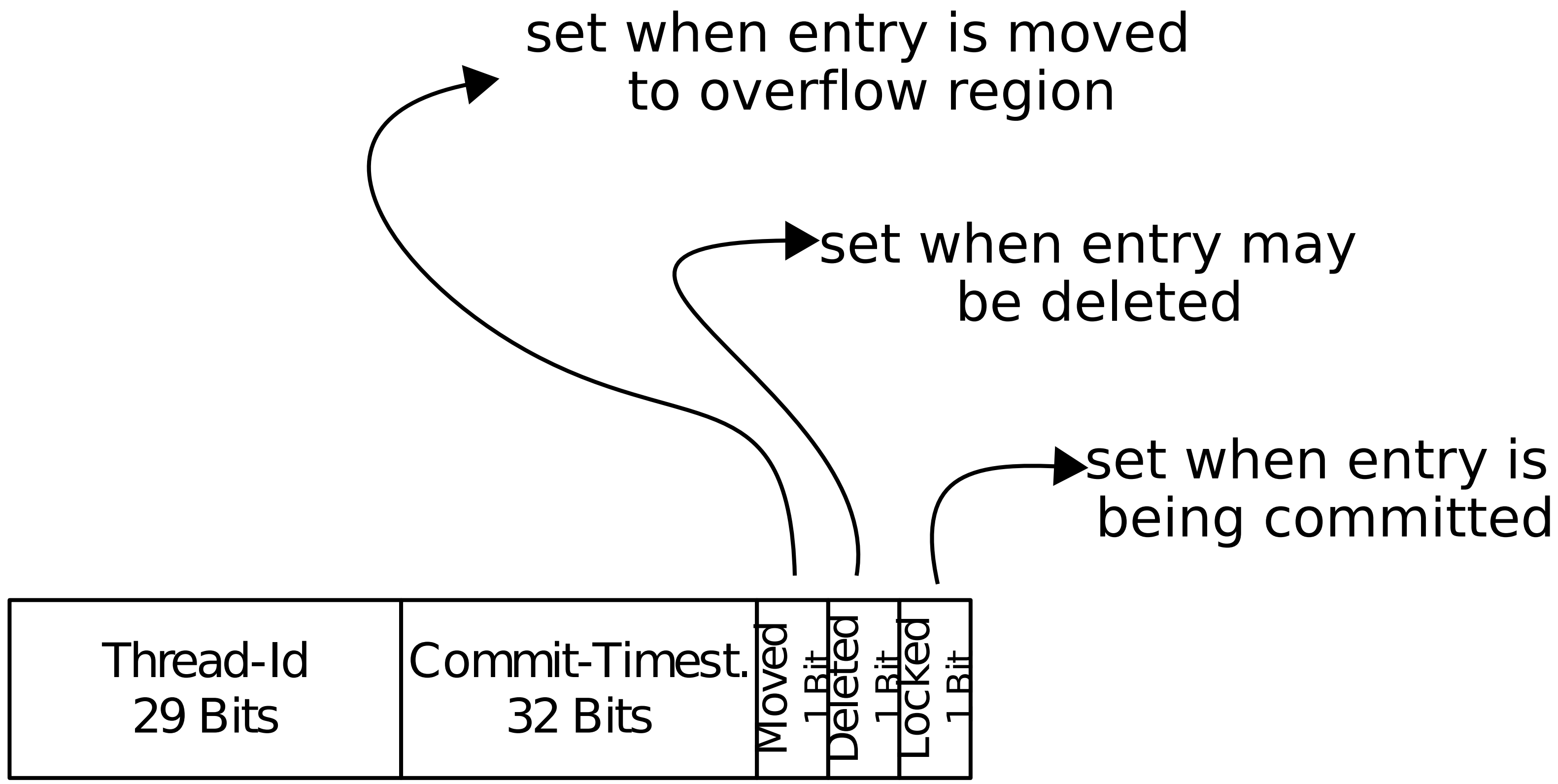
We need a system redesign

Main design

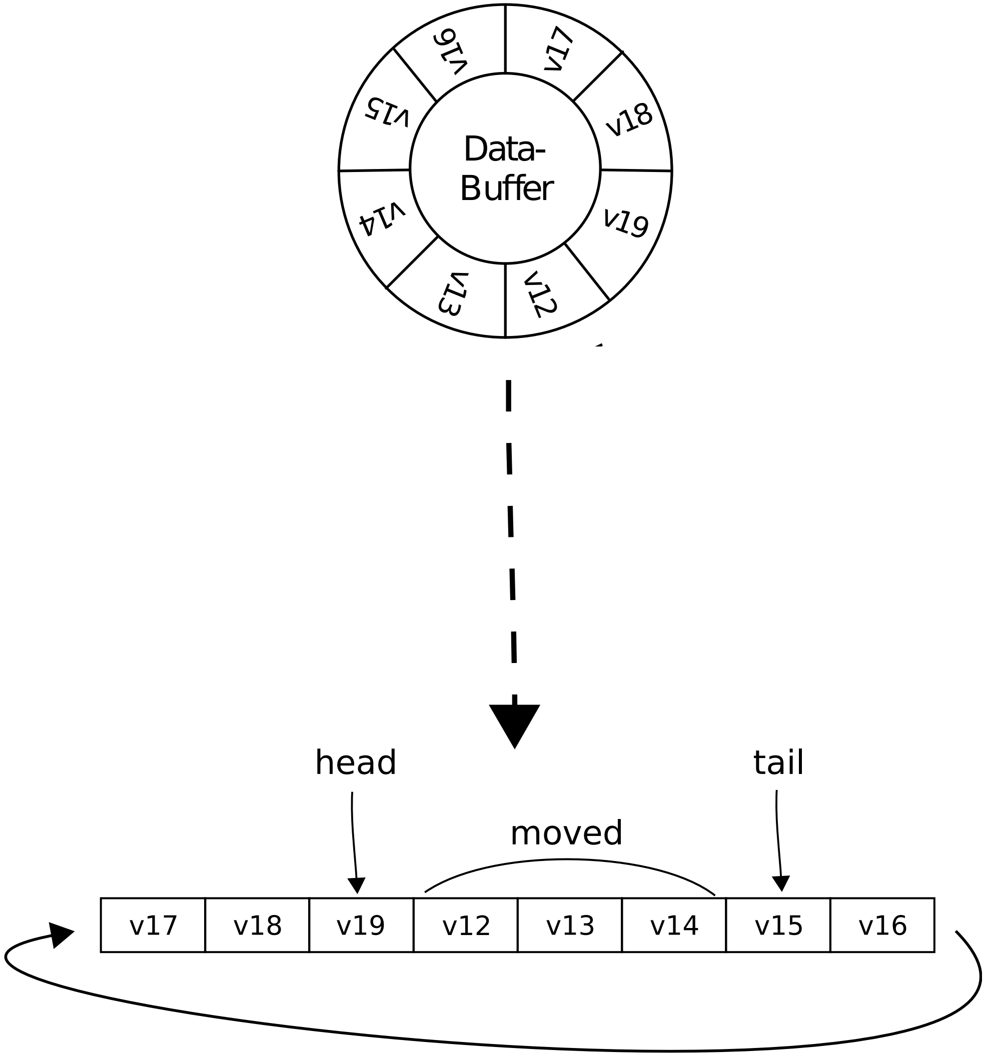


**Actually, the hash table might point to a different memory server*

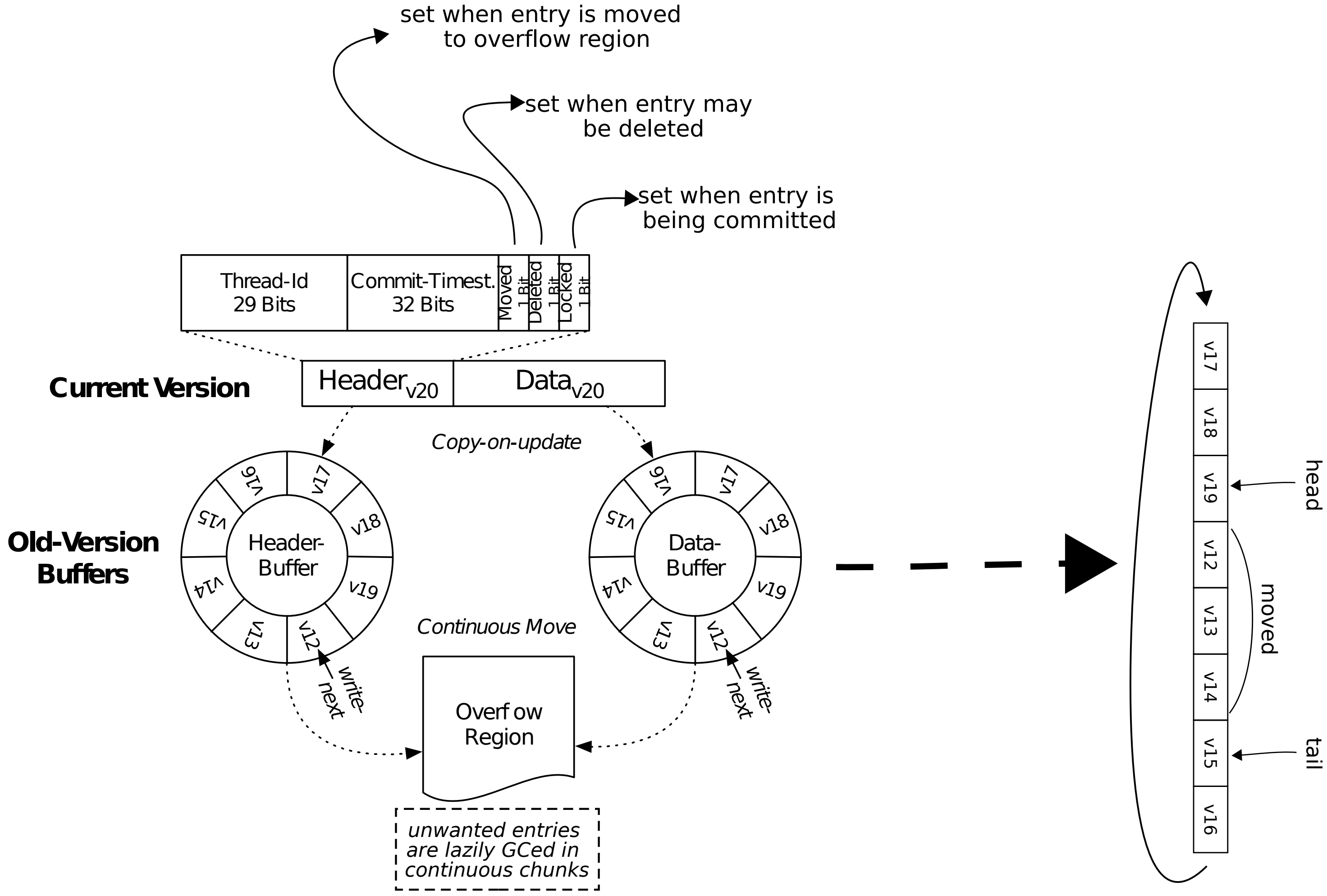
Data entries



Old-version Buffers



Data entries



Timestamp vector (Read timestamp)

Main design

- Read before fetching data
- Each cell is the commit timestamp of a thread
- Stored in a single Memory server

Optimizations

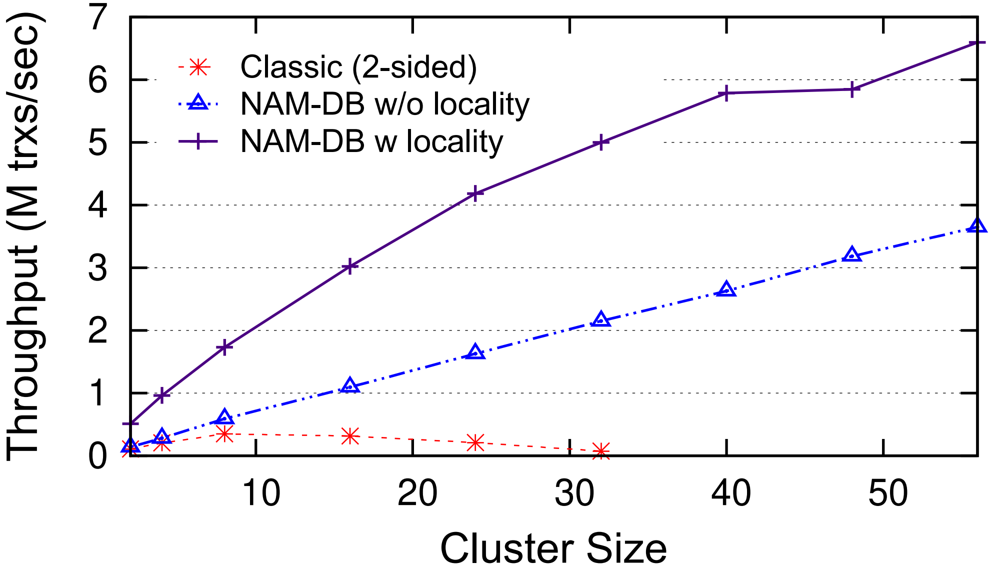
- Fetched by a dedicated thread in each Compute server (big ts reader)
- Threads in a Compute server might share commit timestamp (compression)

Further notes

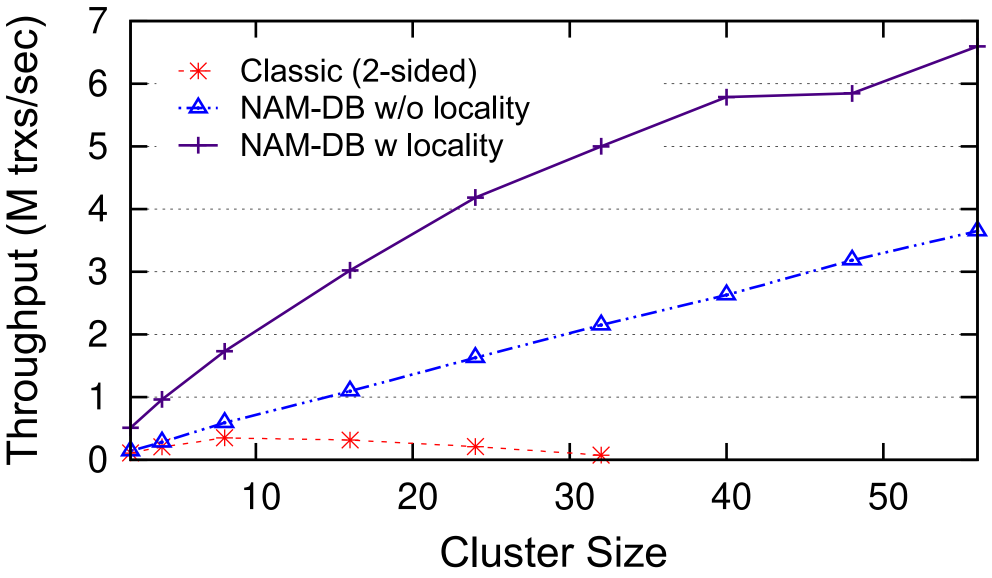
- Compute and Memory servers might coexist, taking advantage of locality
- Timestamp vectors may be partitioned
- Secondary indexes (B+-trees, hash tables)

Is it good enough?

Linear scalability



Linear scalability

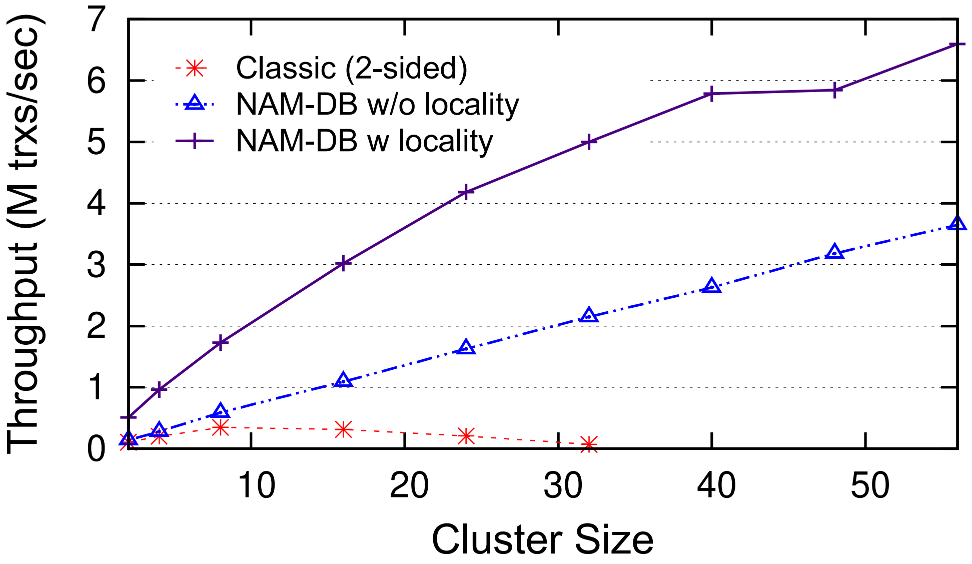


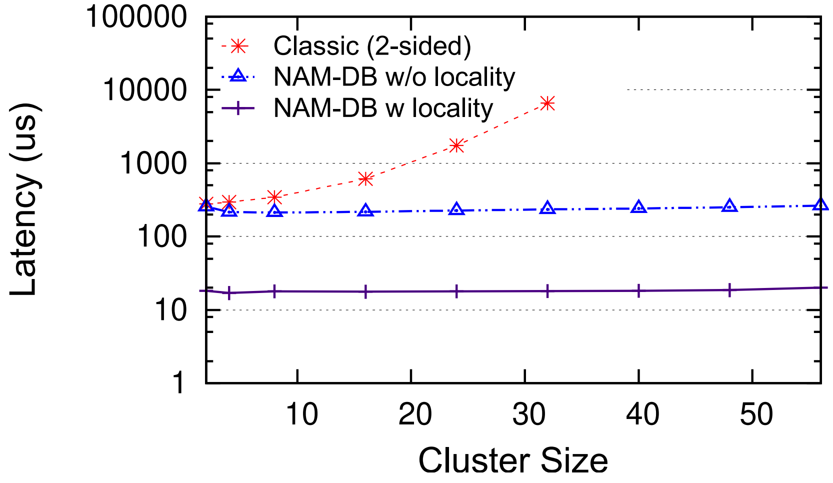
Experiments

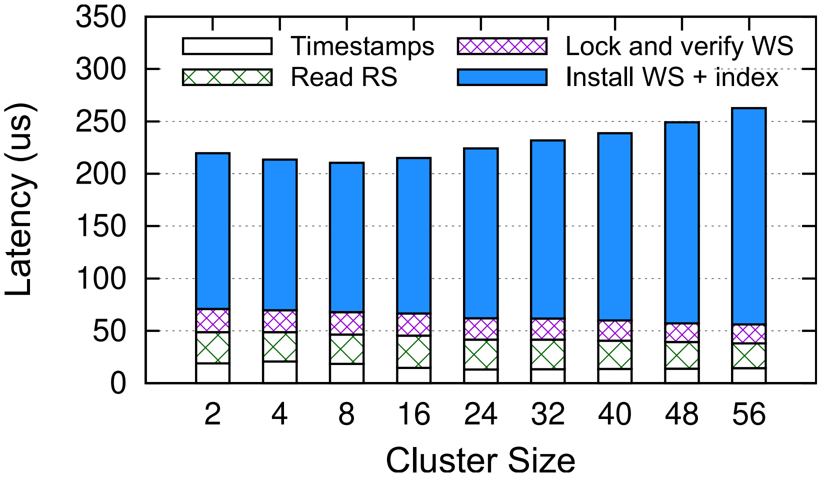
Setup

- **TPC-C benchmark**
- **2011-released InfiniBand (FDR)**
- **Two clusters, with 8 and 57 machines**

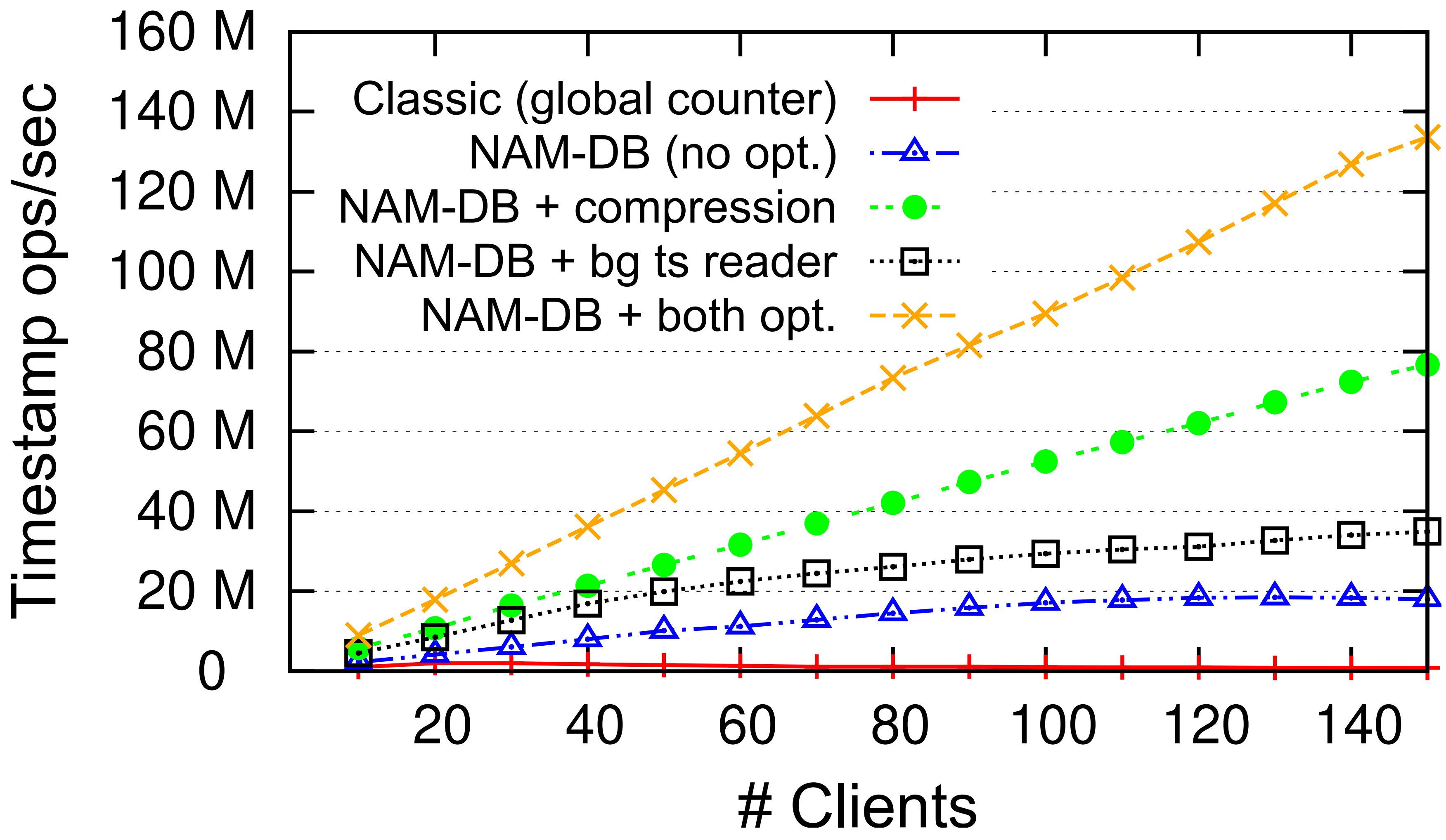
Experiment 1: System scalability



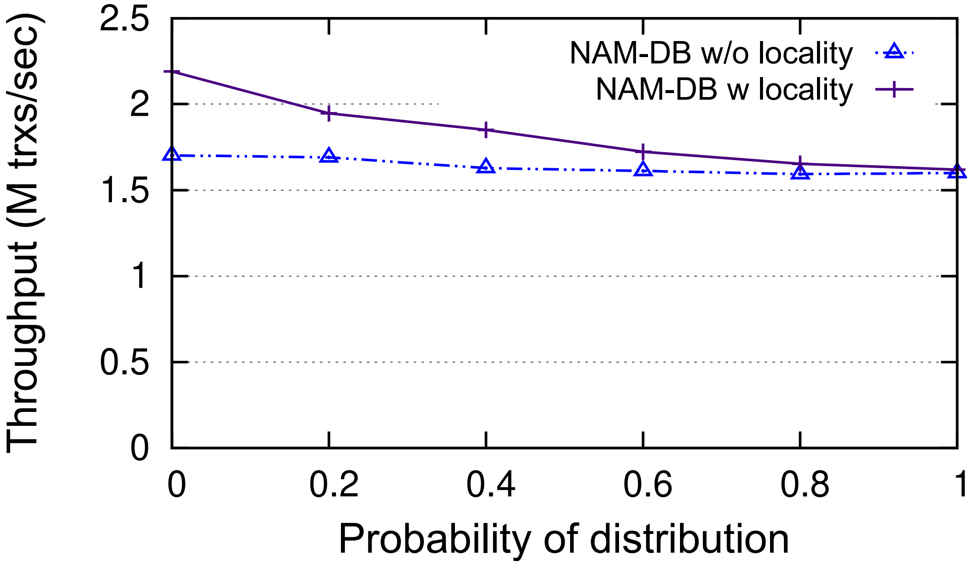


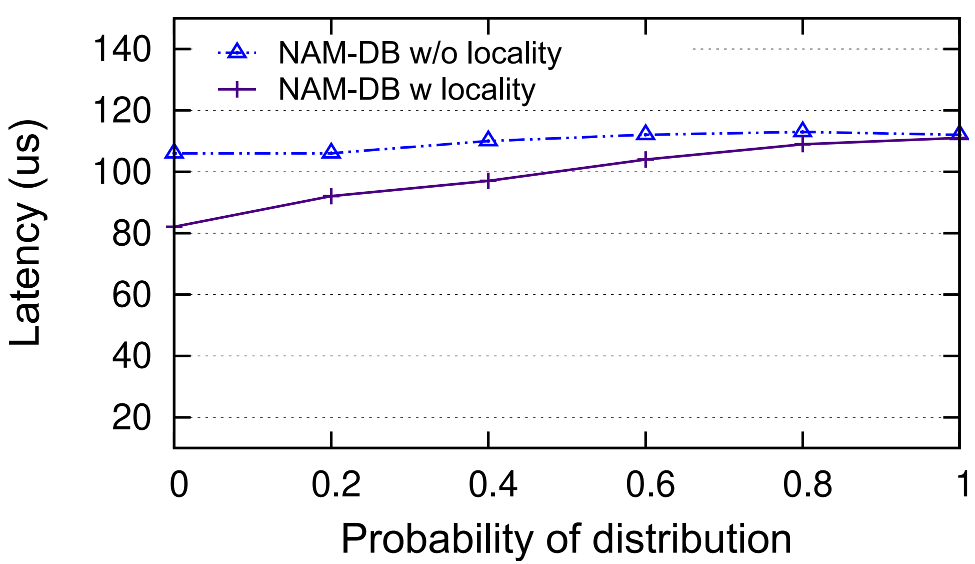


Experiment 2: Scalability of the Oracle

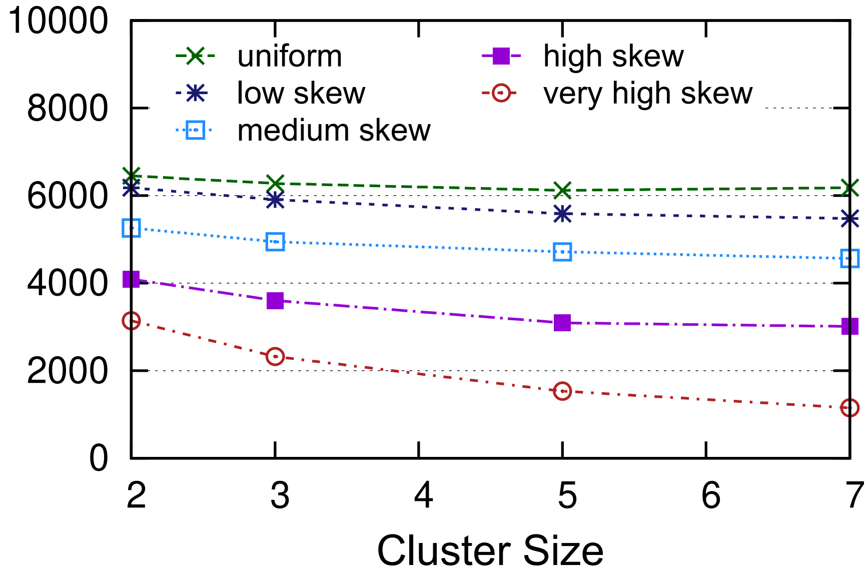


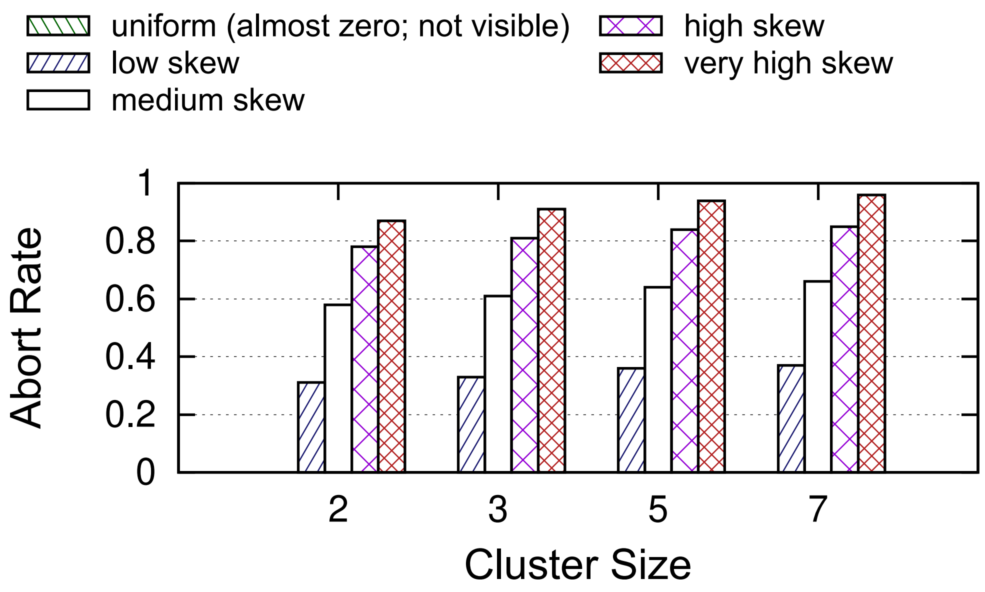
Experiment 3: Effect of Locality



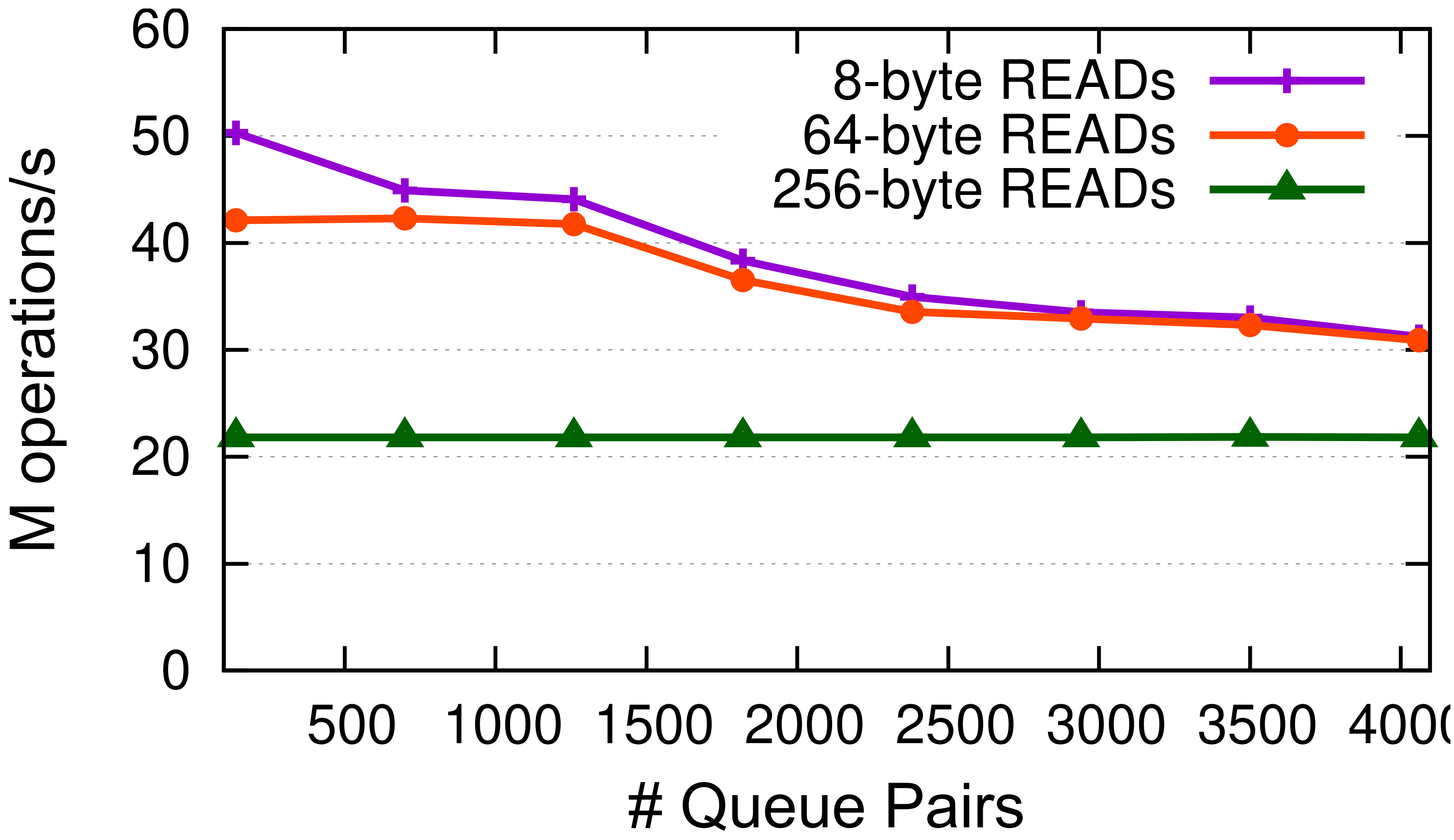


Experiment 4: Effect of Contention





Experiment 5: Scalability of RDMA Queue Pairs



Gaps in the logic

Future work

Future work

- Optimize for OLAP
- Reliably emulate large clusters and perform experiments
- Analyze performance, and optimize constants
- Explore collocation methods
- Explore secondary indexes

Thank you!

Media sources

E. Zamanian et al. The end of a myth: Distributed transactions can scale

C. Binnig et al. The end of slow networks: It’s time for a redesign