ETH
Eidgenössische Technische Hochschule Zürich
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The Multimed System

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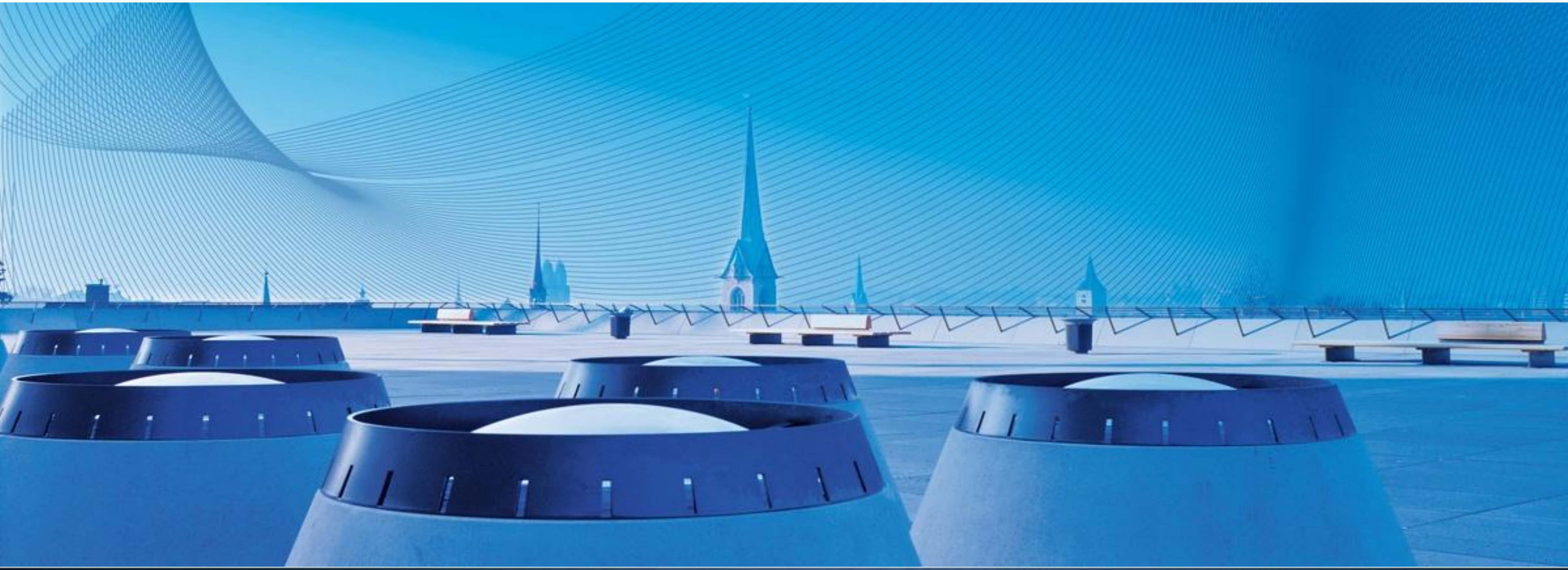

A story about "Data, Data, Data!"

… and multicores

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Multicores – a challenge for system software

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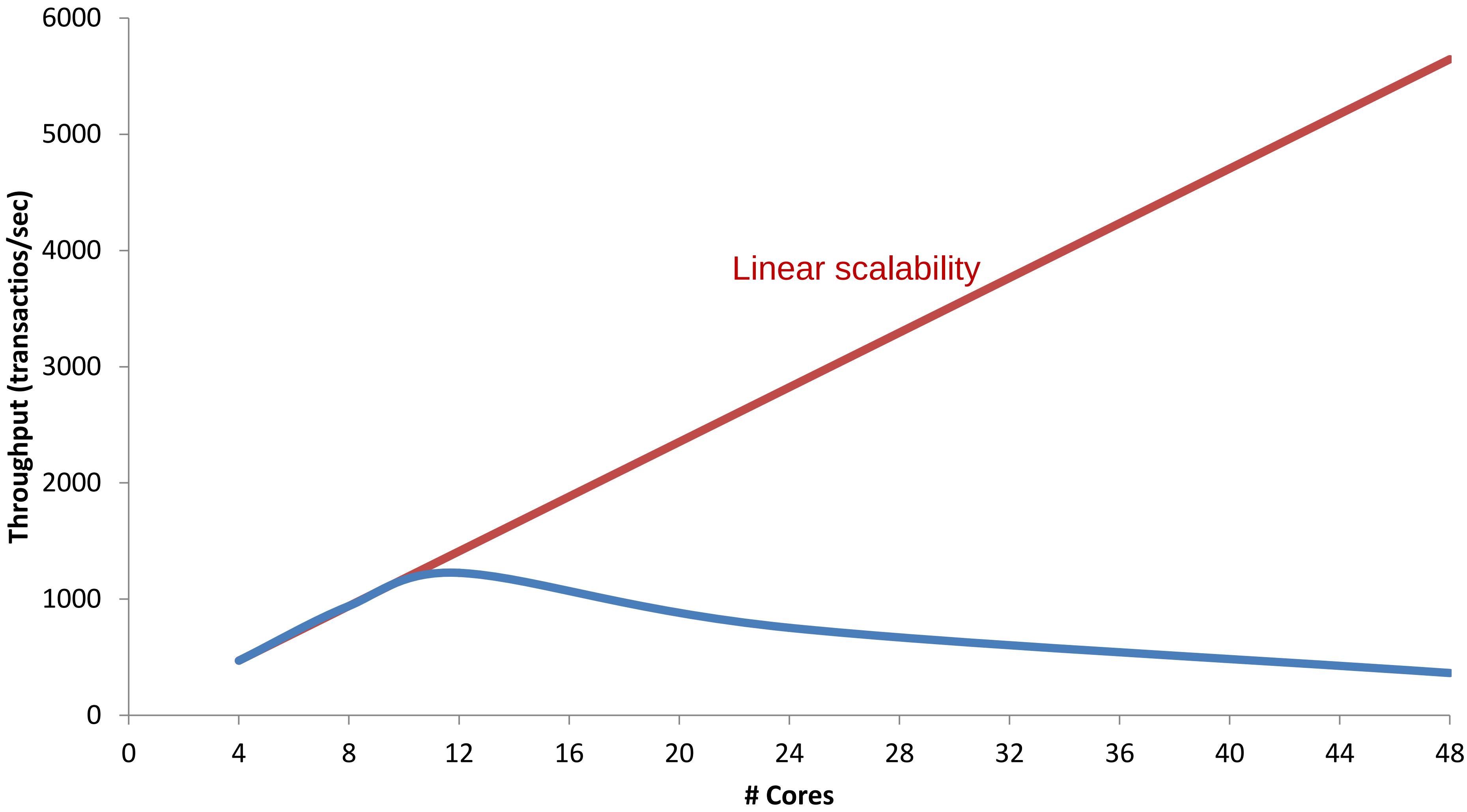
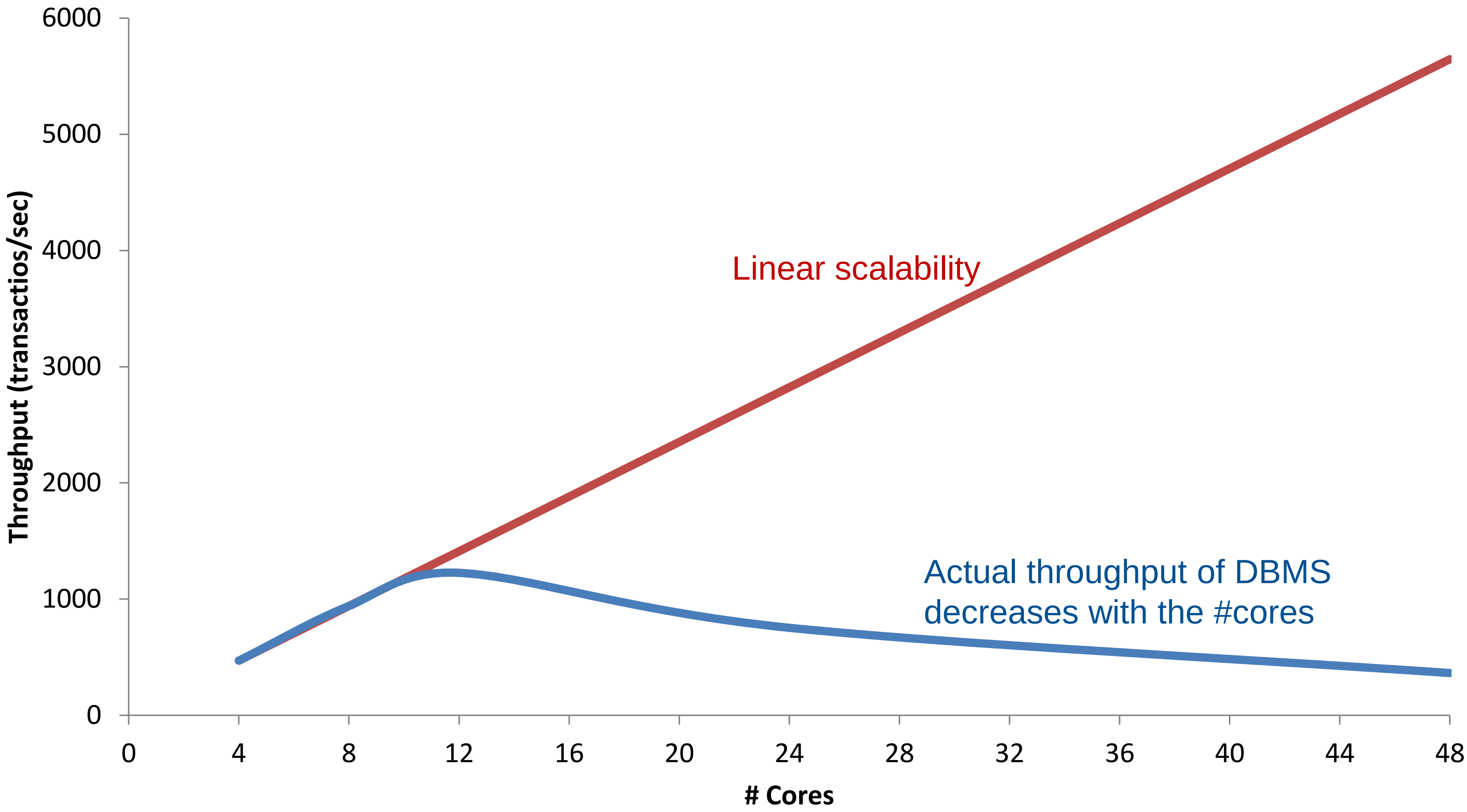


Multicores – a challenge for system software



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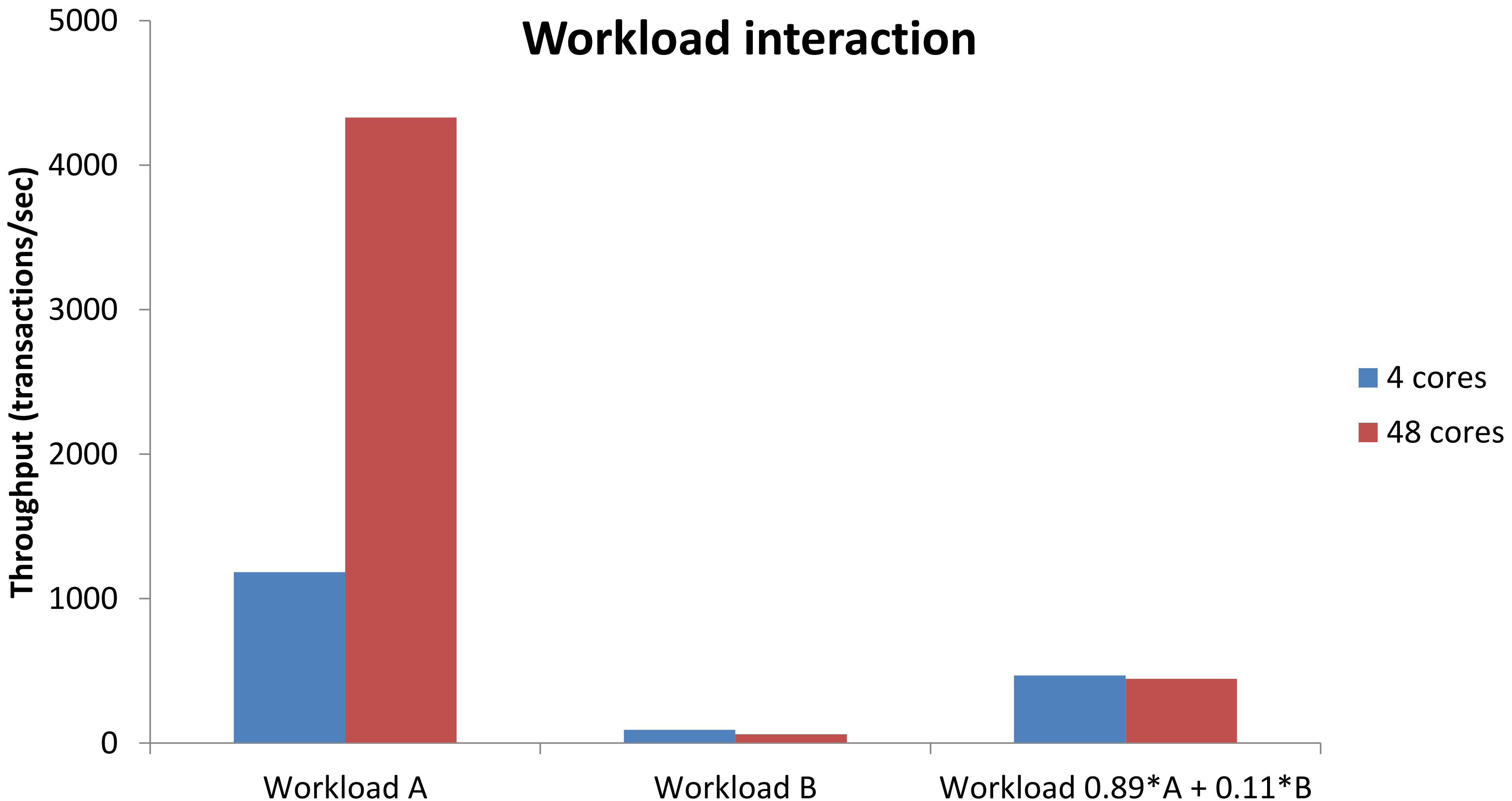

Multicores – a challenge for system software

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Increasing number of hardware contexts

→ Higher contention on shared data structures
- Spinning and blocking locks (Johnson, DaMoN'09)
- MCC-DB (Rubao, VLDB'09)

→ Impact of updates and large scans
- Crescando (Unterbrunner, VLDB'09)

→ Design for concurrent operations, yet not for parallelism
- Shore-MT (Johnson, EDBT'09)

→ Increasing load interaction
- Multimed (Eurosys'11)

Database trends for multicores

Database trends for multicores

- **Fix & pray!**

```
while (!scales) {
        find_bottleneck();
        fix_it();
}
```

  - Shore-MT, MCC-DB, Most of commercial DBMS, …

- **Throw out the old things!**
  - Research: column stores, main memory, shared scans, FPGA/GPU
  - Appliances: Teradata, Netezza/IBM

- **Be smart! ☺**

Multimed's approach

Multimed’s approach

- Based on **single-master data replication**
  - Ganymed (Plattner, Middleware'04), Byzantium (Garcia, Eurosys'11)
  - Proven approach for clusters
  - Not a universal solution for all workloads

… within the same machine

- View the multicore as a **distributed system**
  - Barrelfish (Baumann, SOSP'09), fos (Wentzlaff, ACM OSR'09)

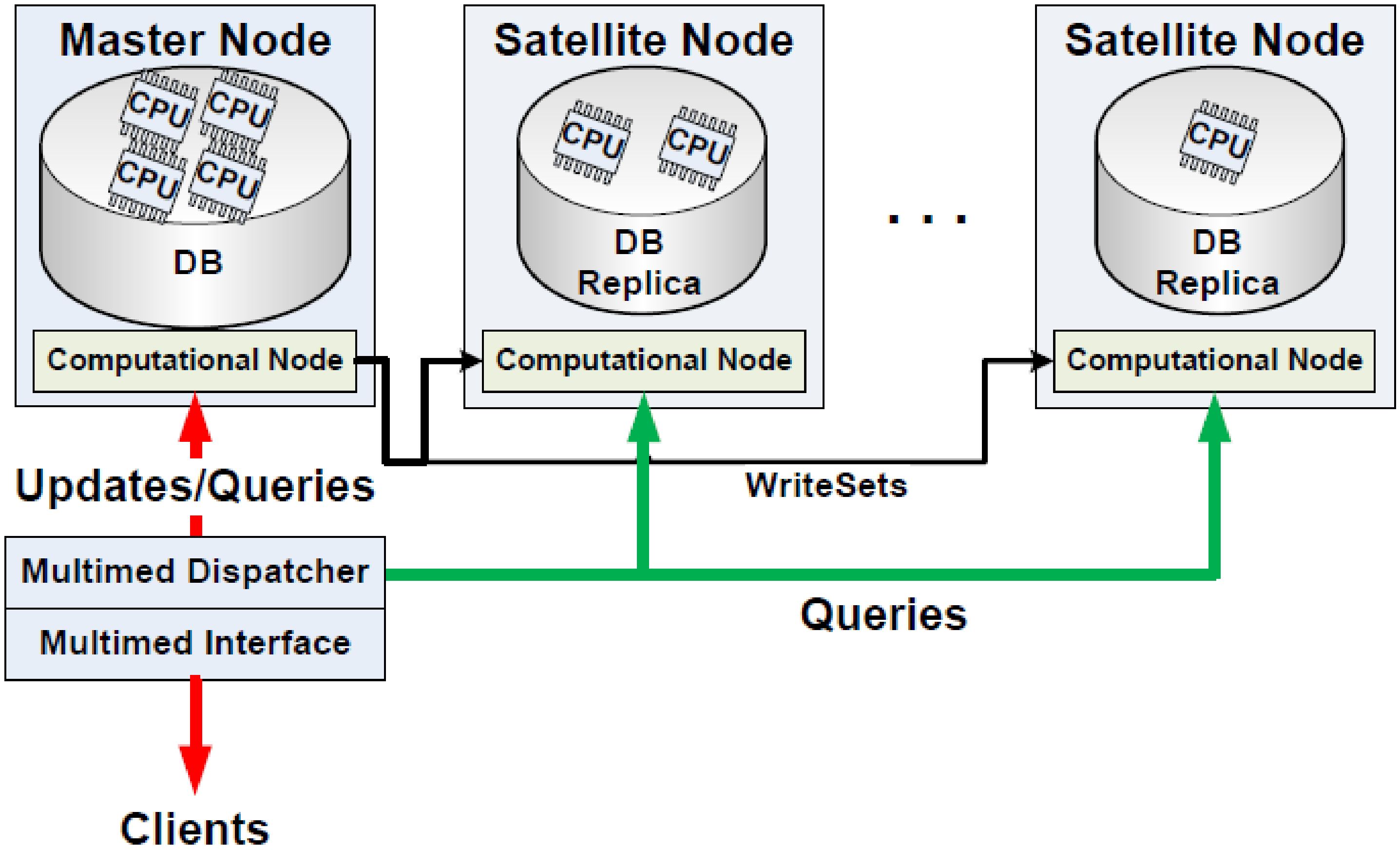
… **partition resources** into clusters

  - Cerberus (Song, Eurosys'11)

… and run a database on each partition

➔**Non-intrusive** approach for scaling DBMSs to multicores

Multimed architecture



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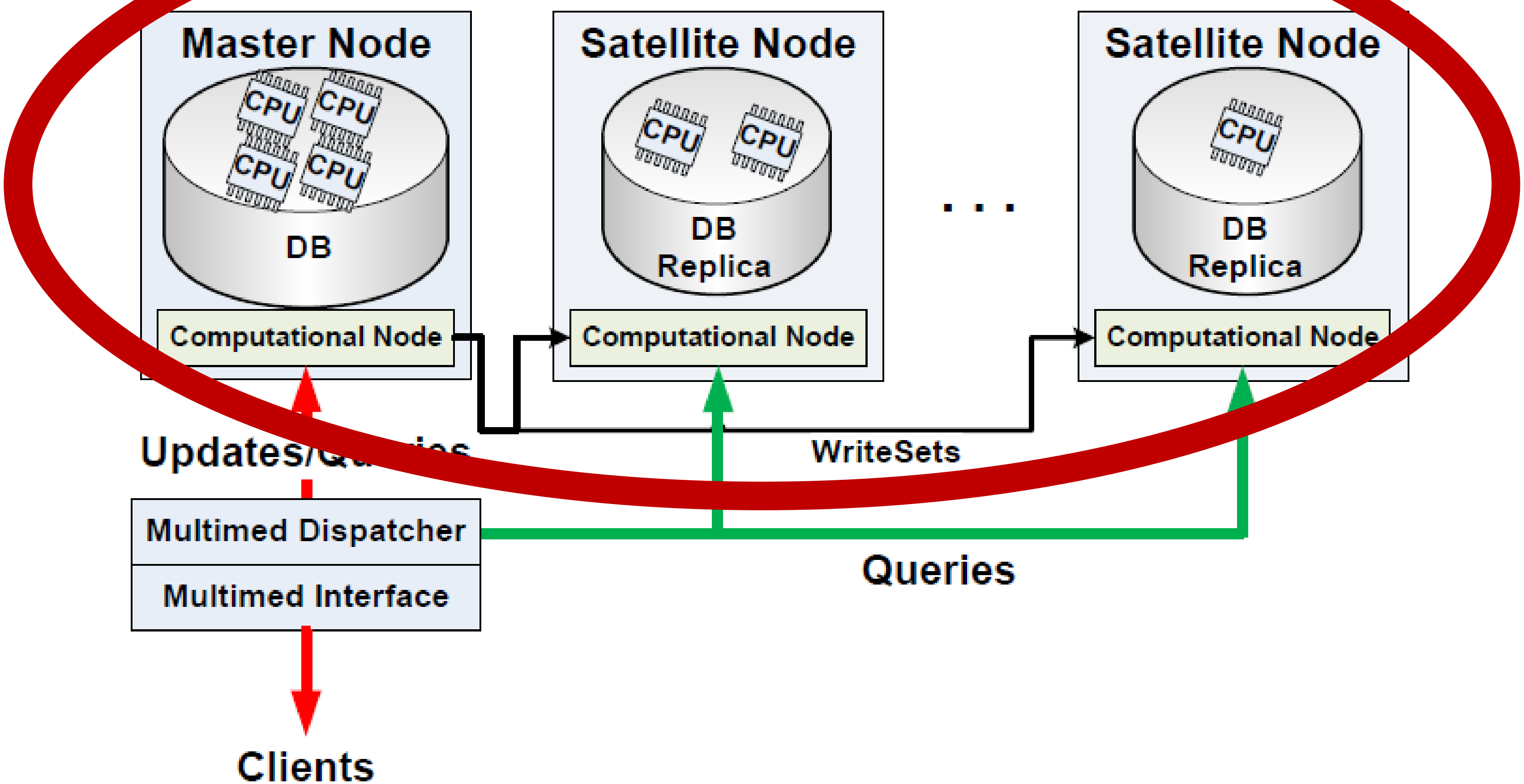

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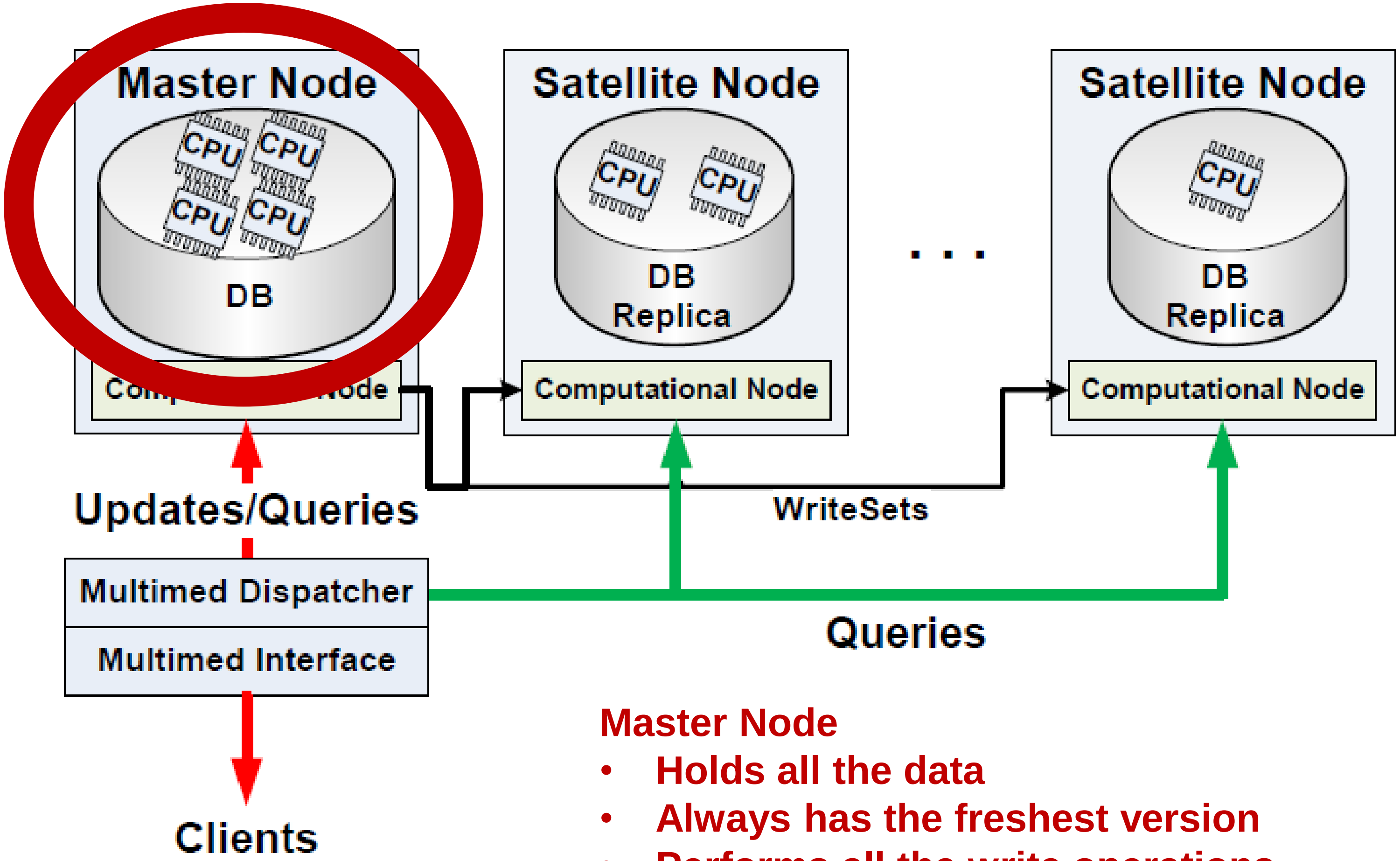
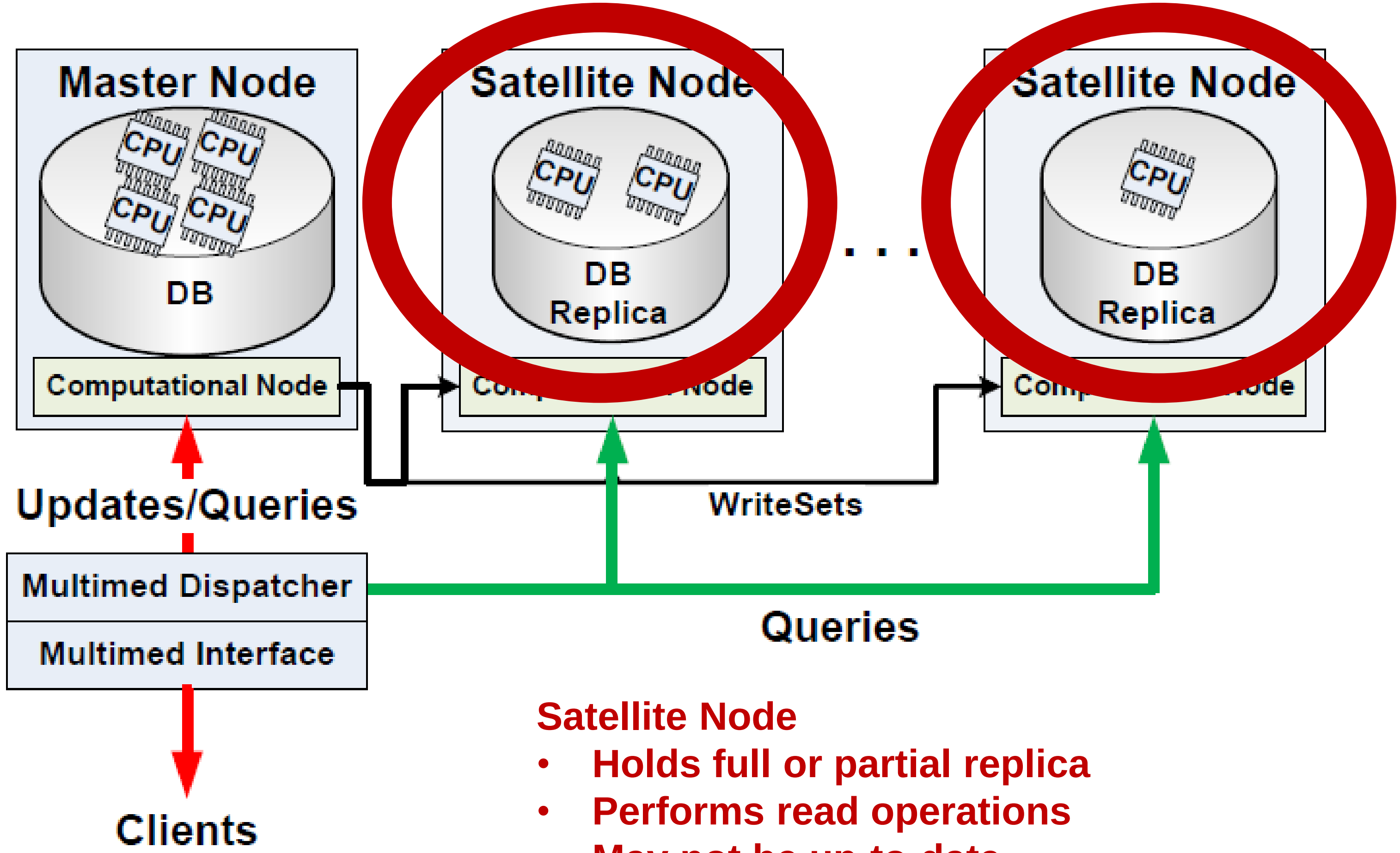


Master Node

- **Holds all the data**
- **Always has the freshest version**
- **Performs all the write operations**

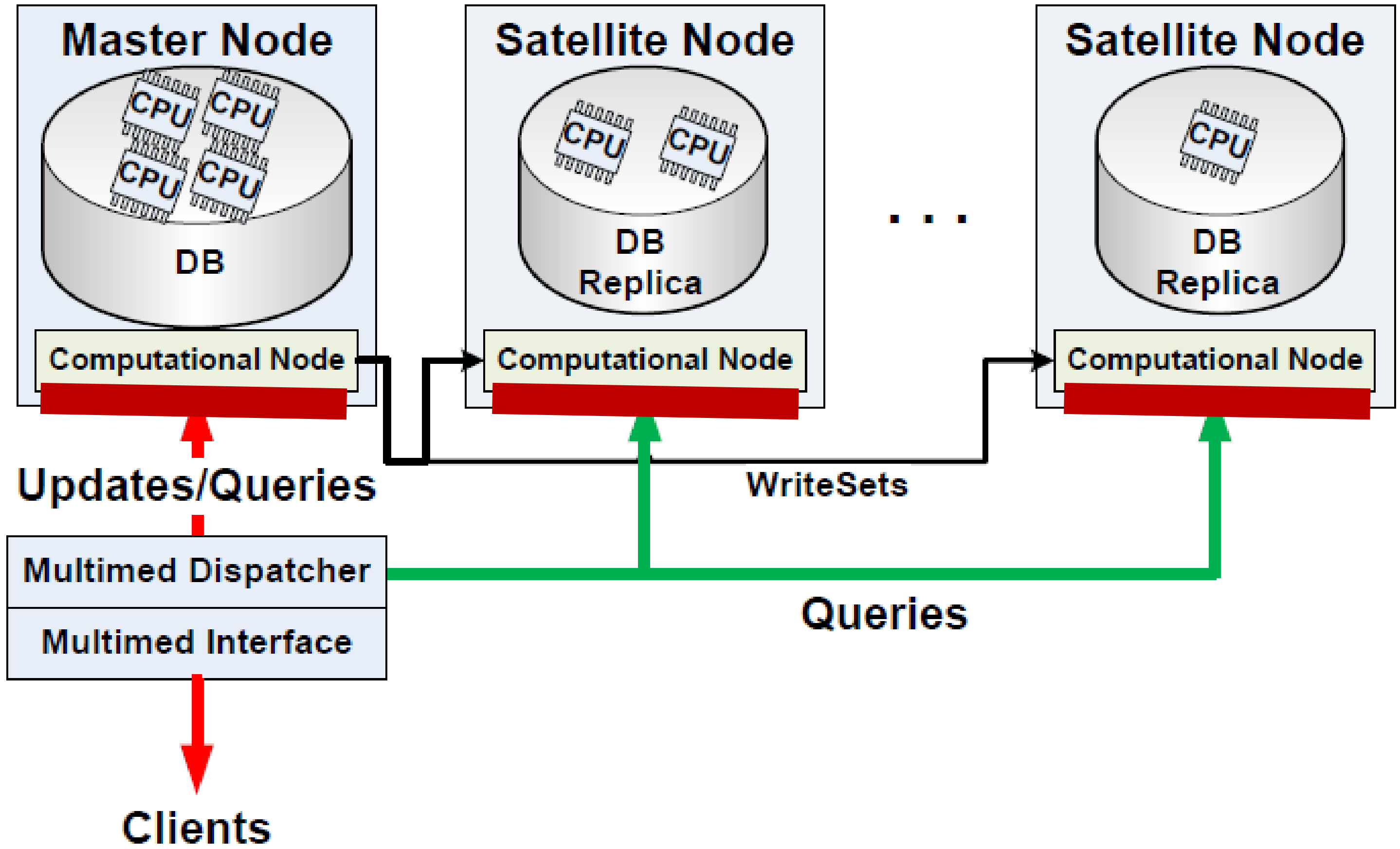
Multimed architecture



Satellite Node

- **Holds full or partial replica**
- **Performs read operations**
- **May not be up-to-date**
- **Many possible optimizations**

Multimed architecture



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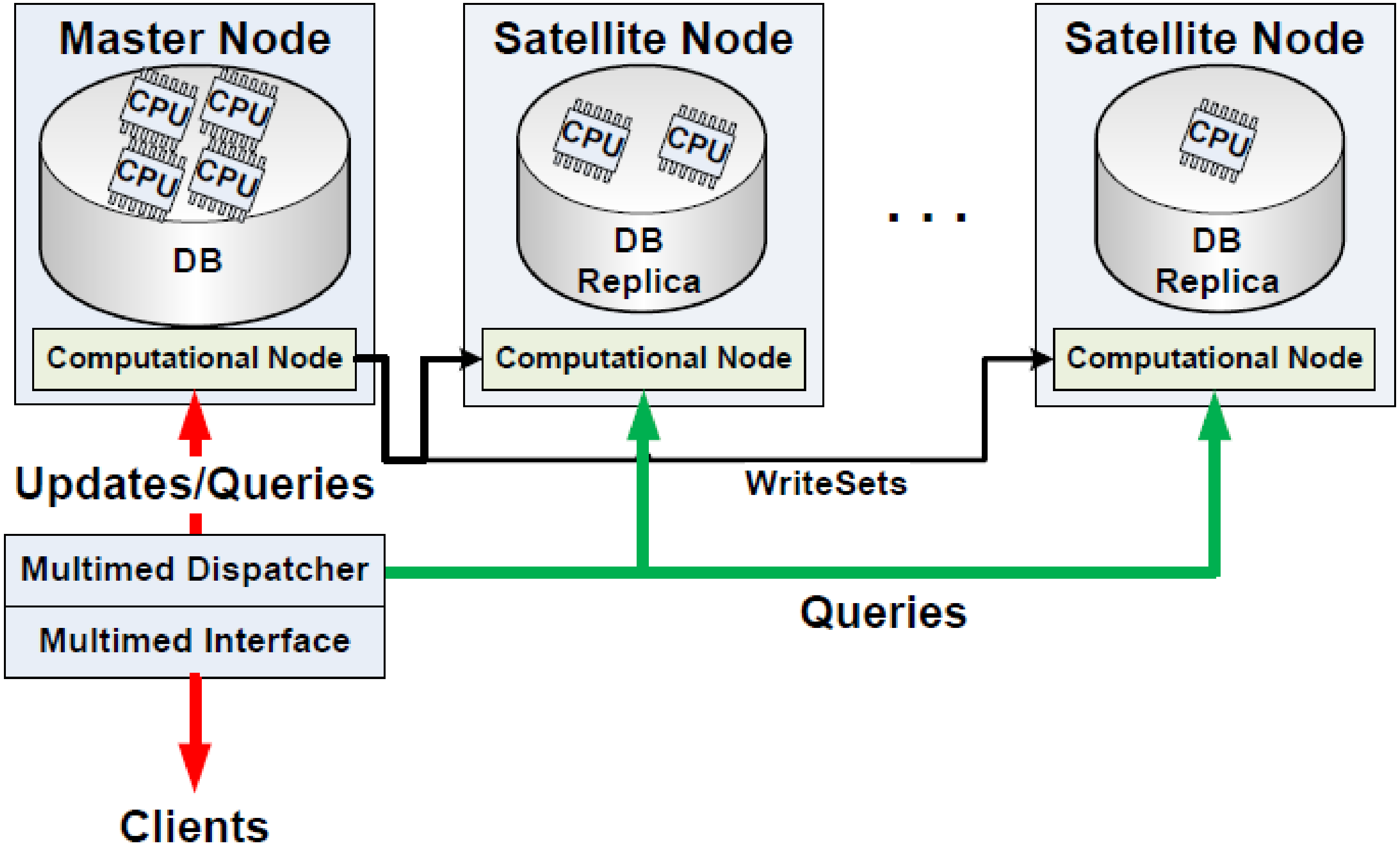

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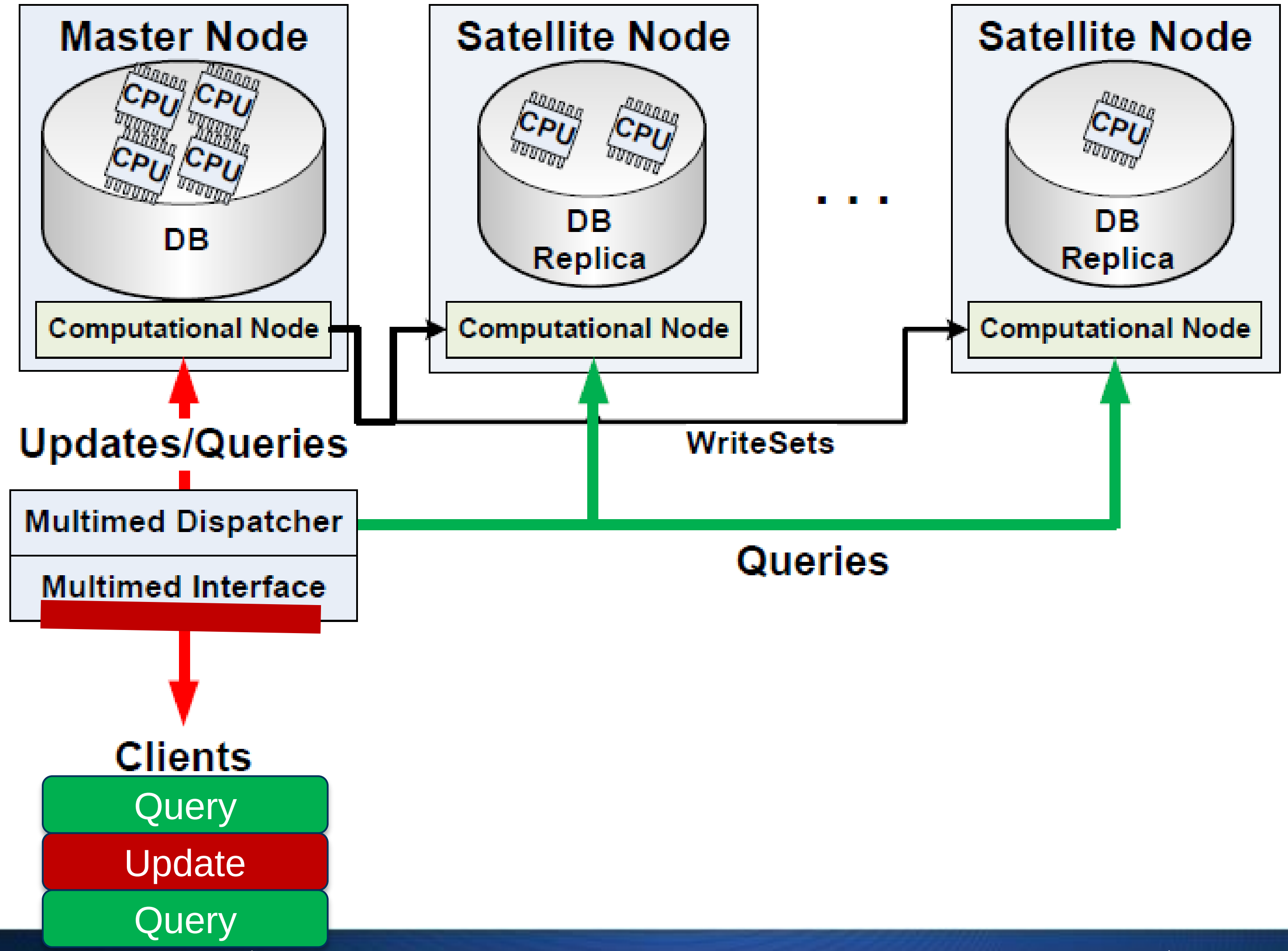

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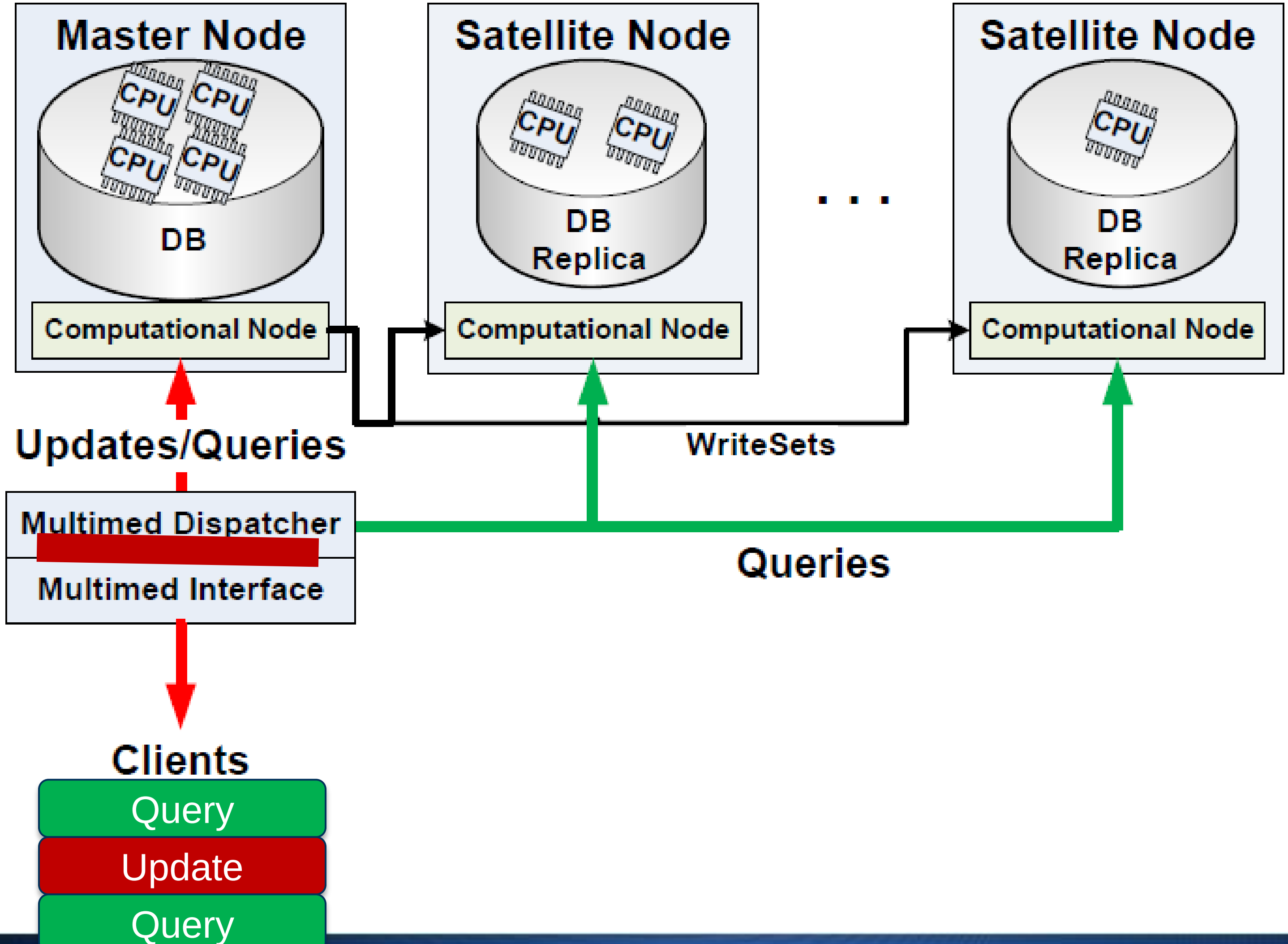
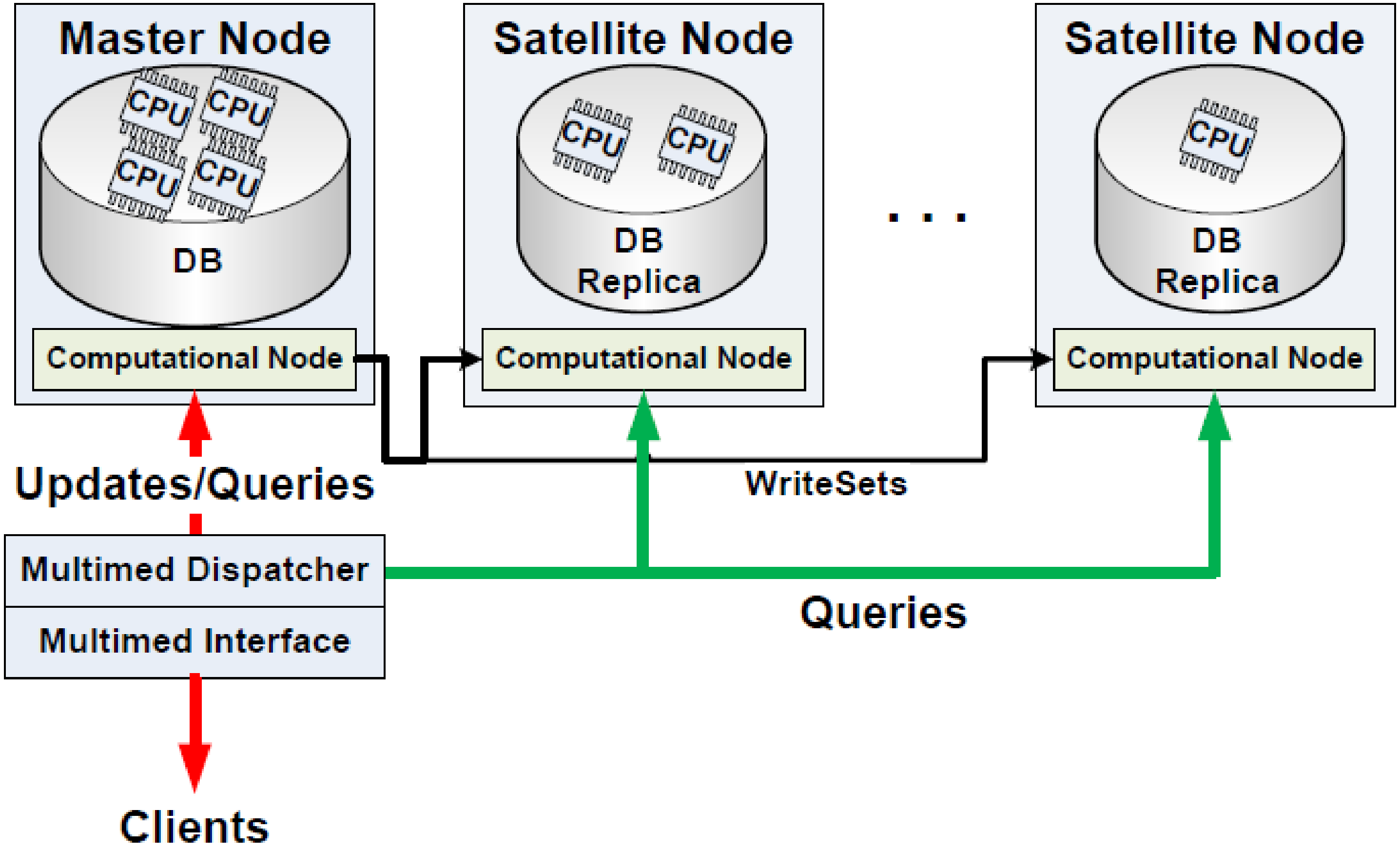


Multimed execution



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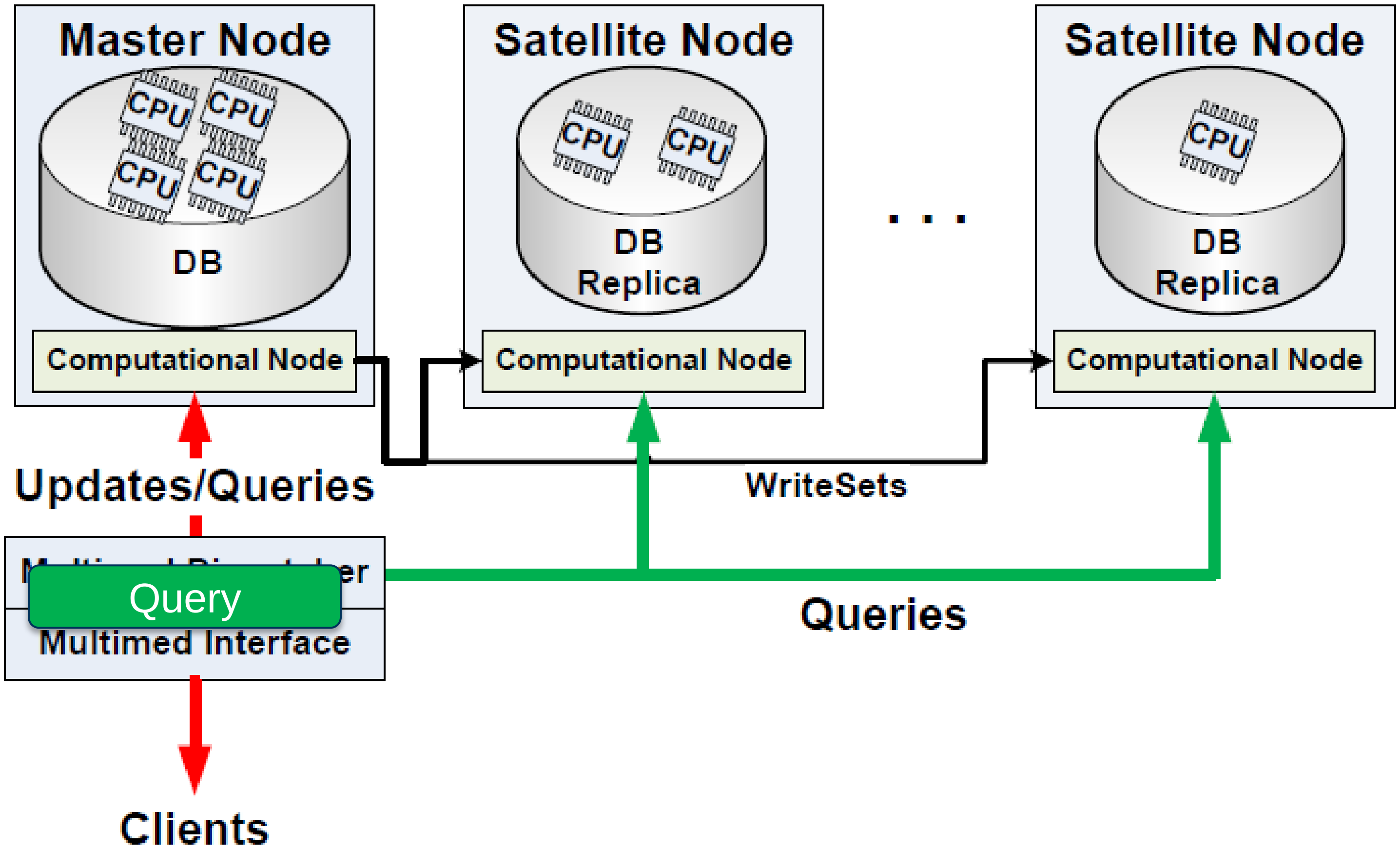

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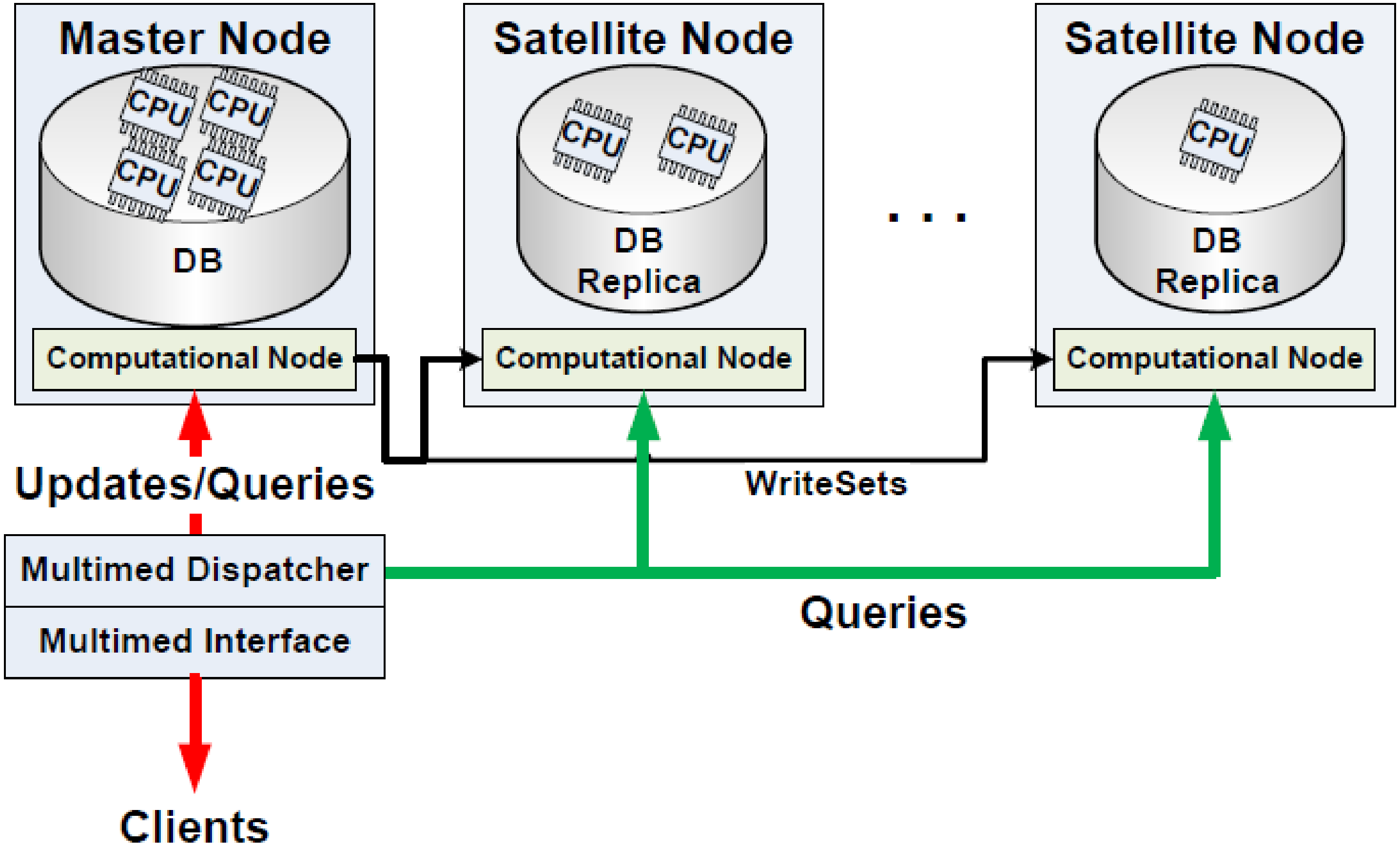

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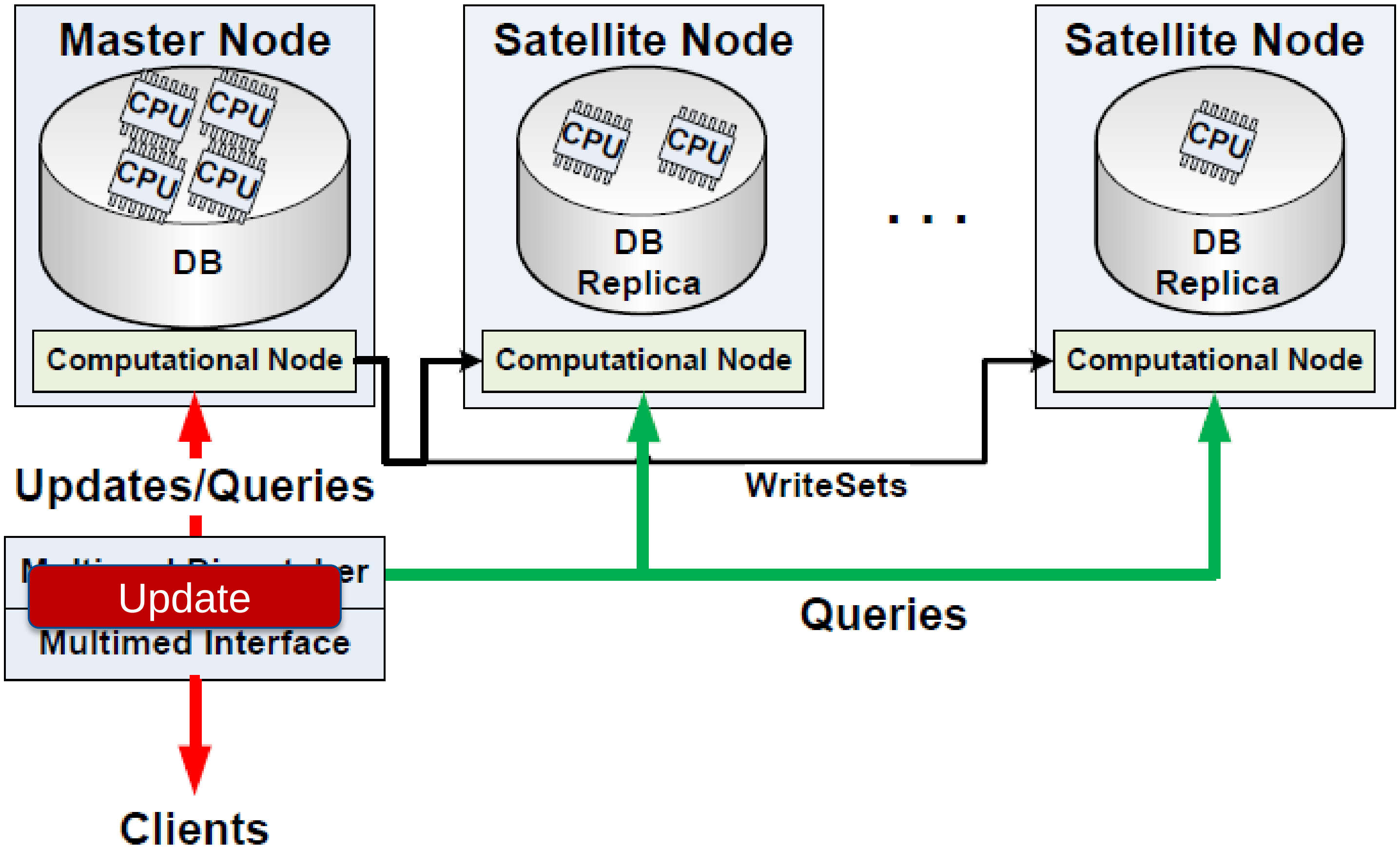

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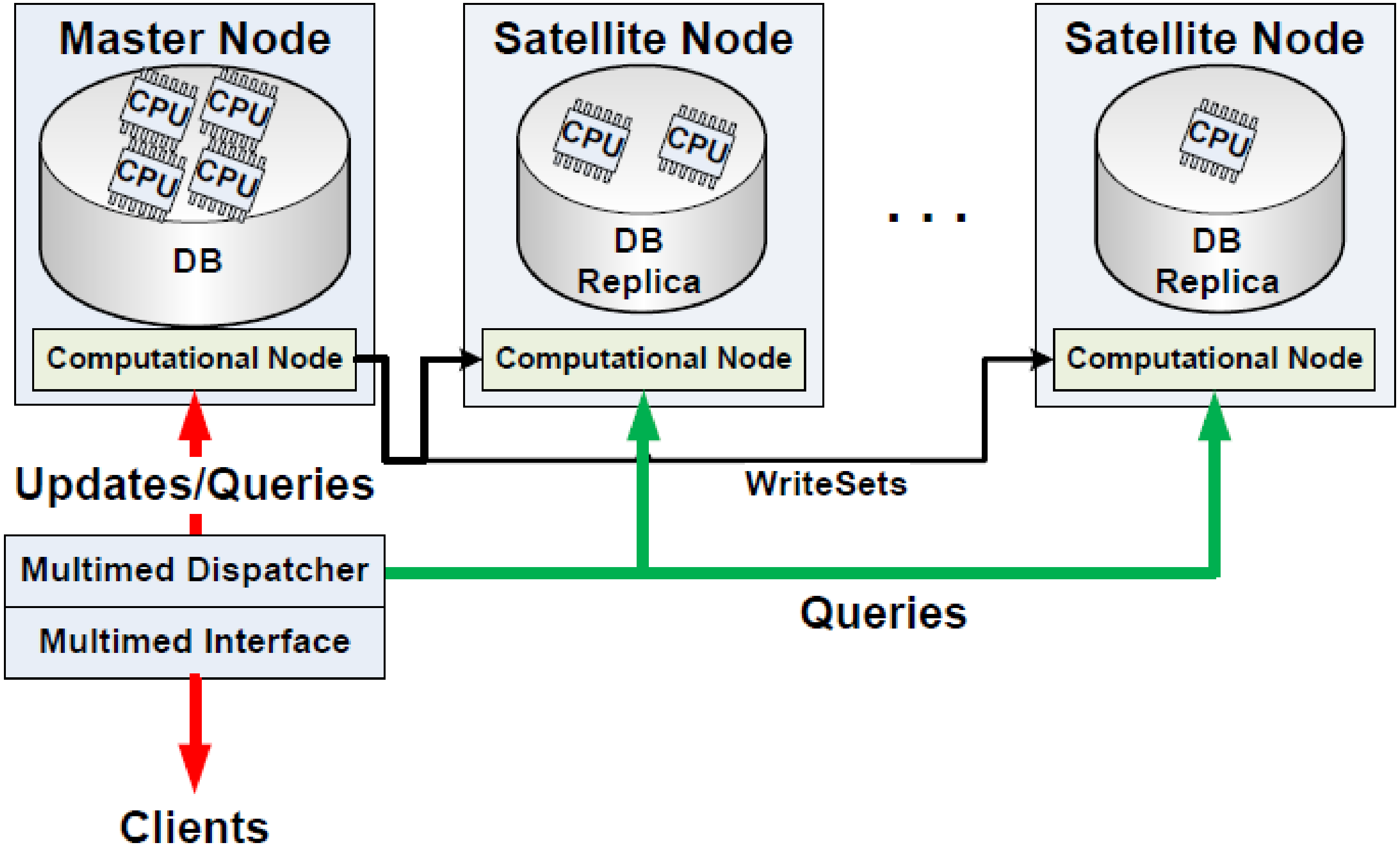

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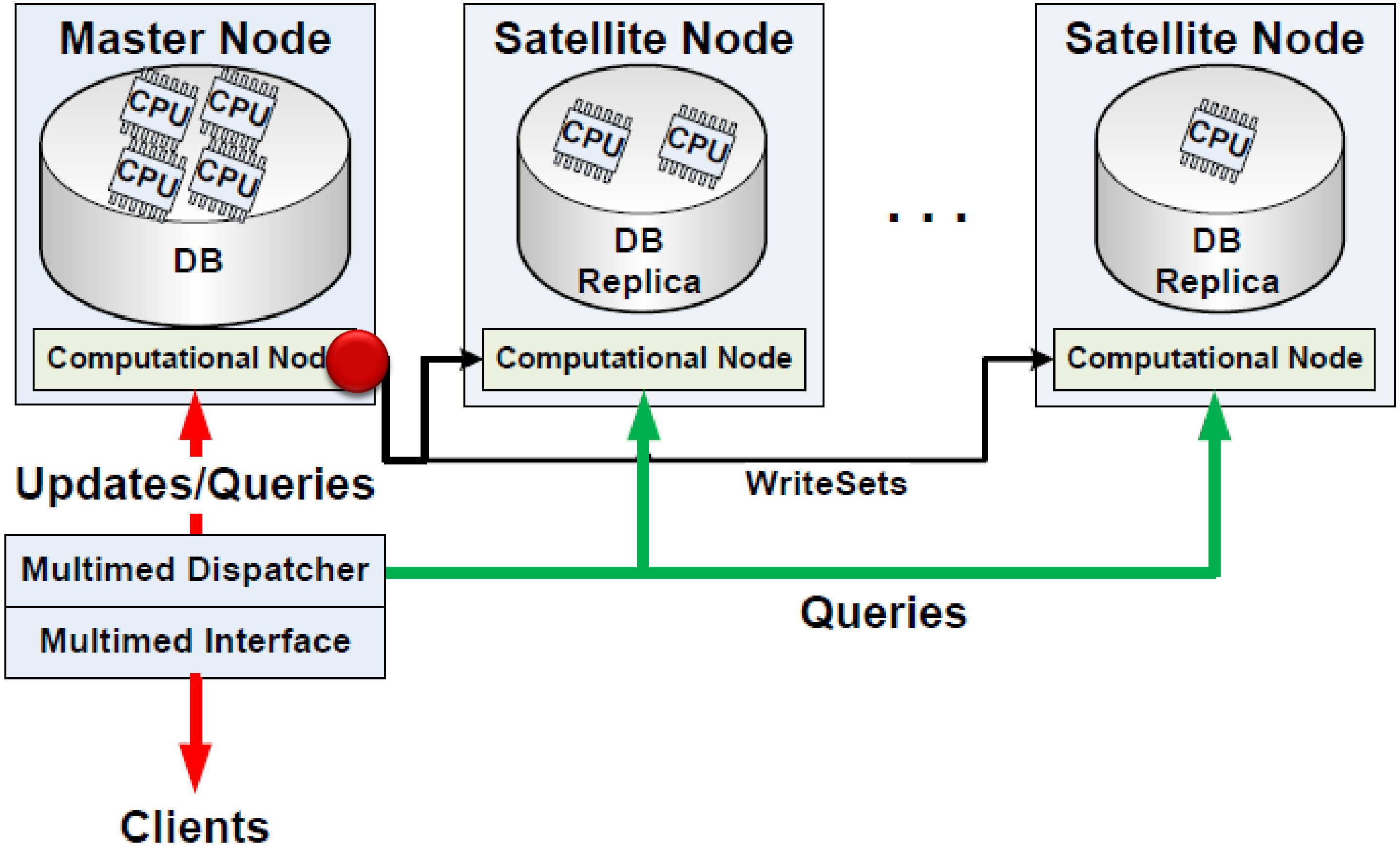

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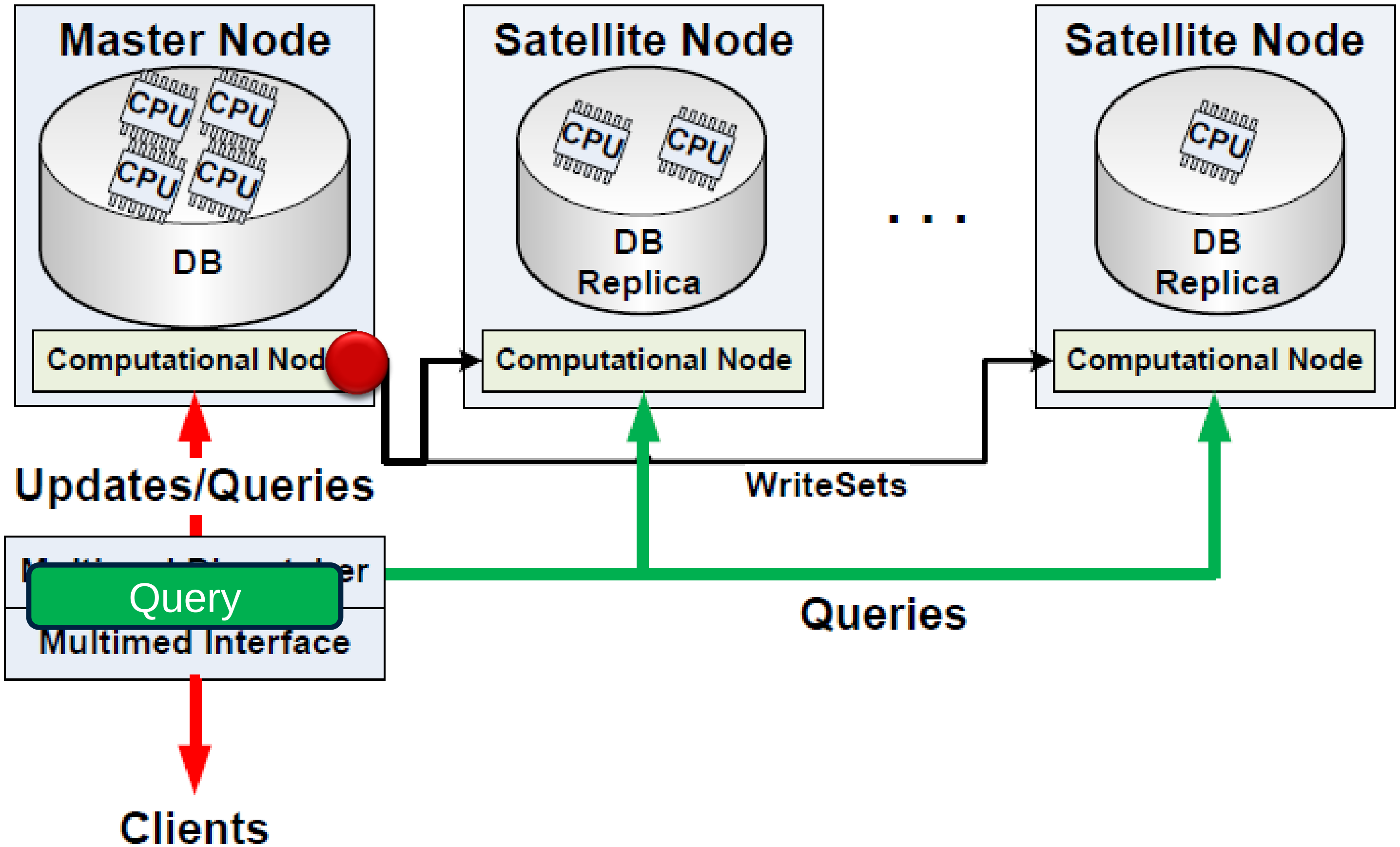

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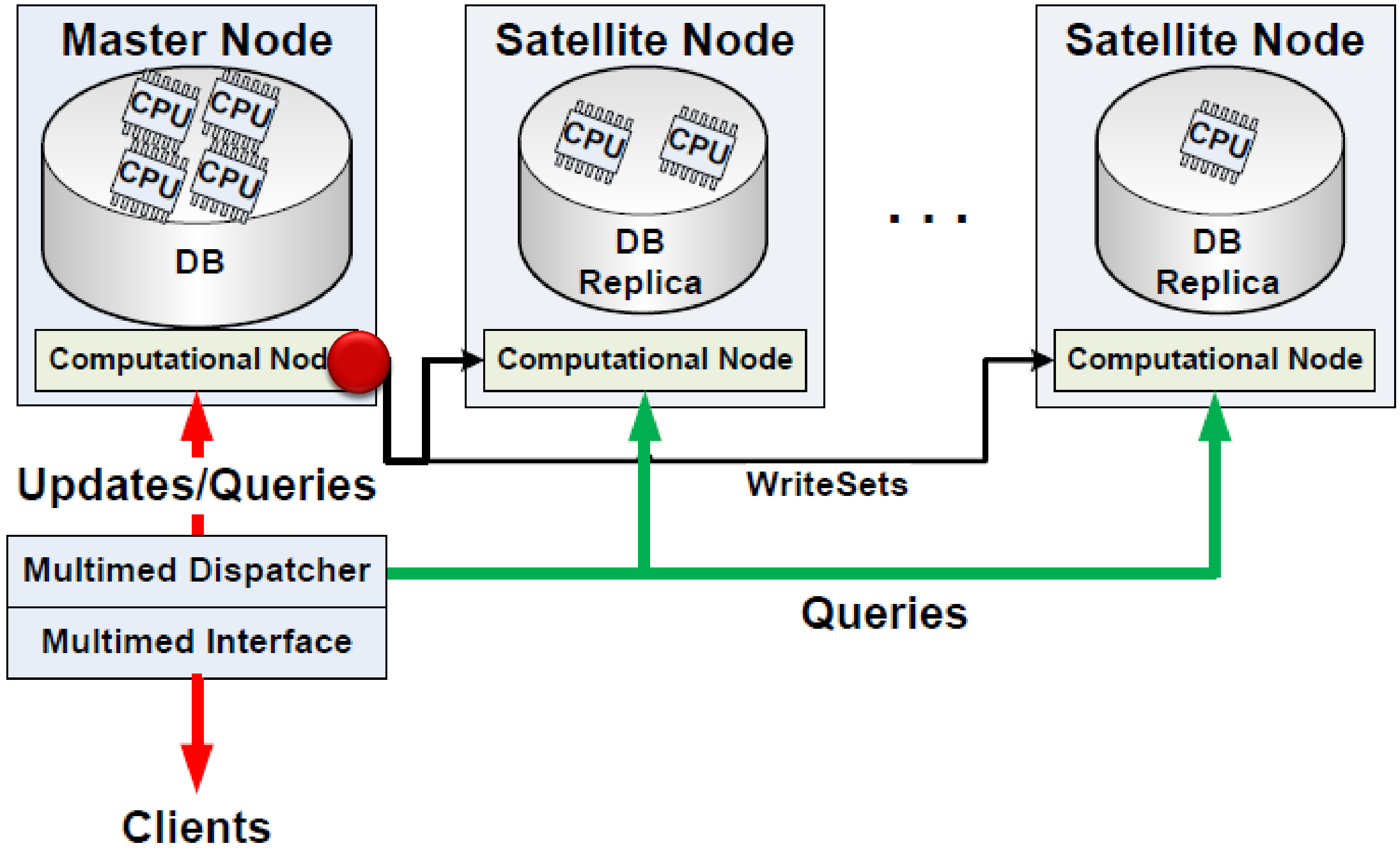
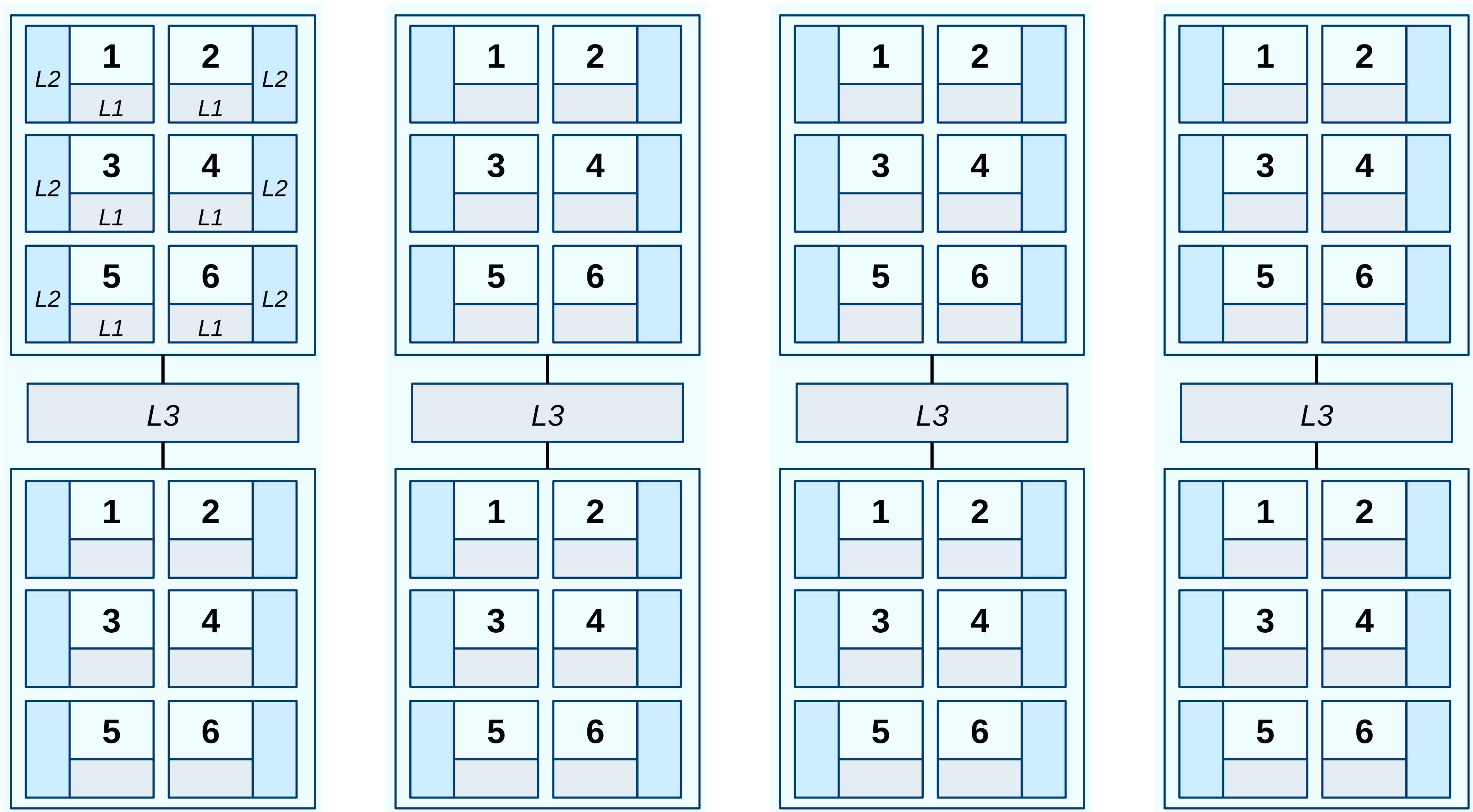


System deployment,
48 core, 4 socket AMD Magny-Cours



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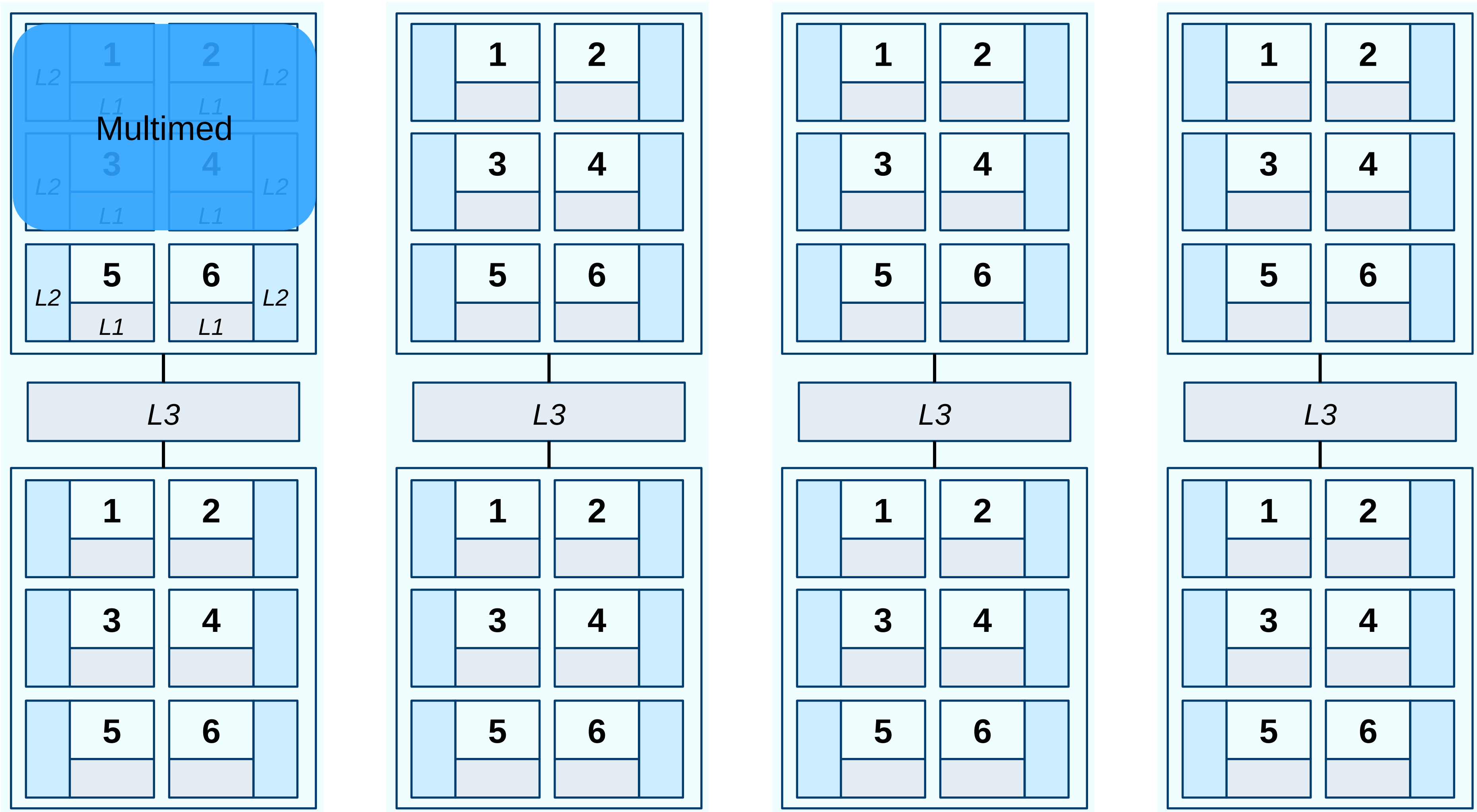

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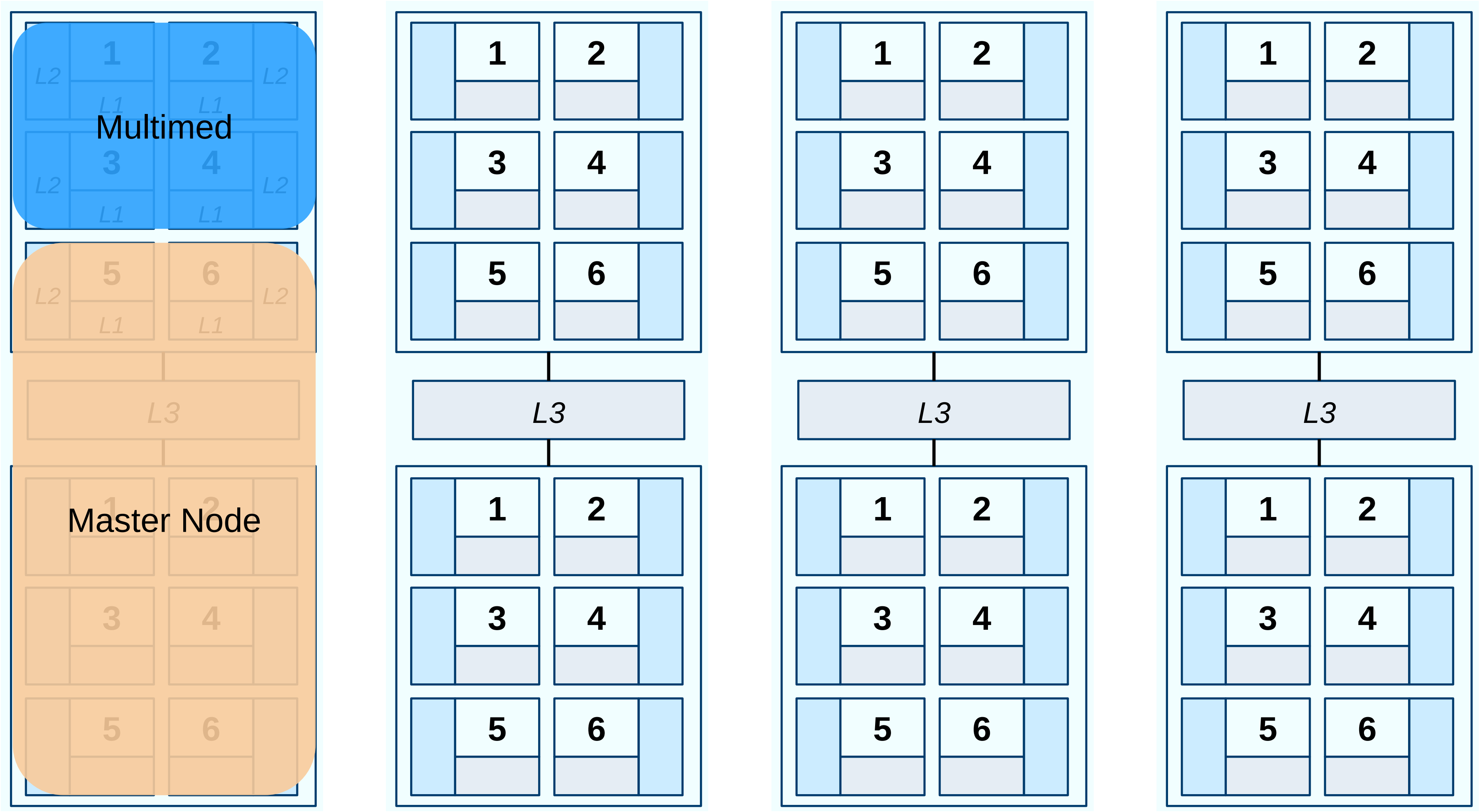

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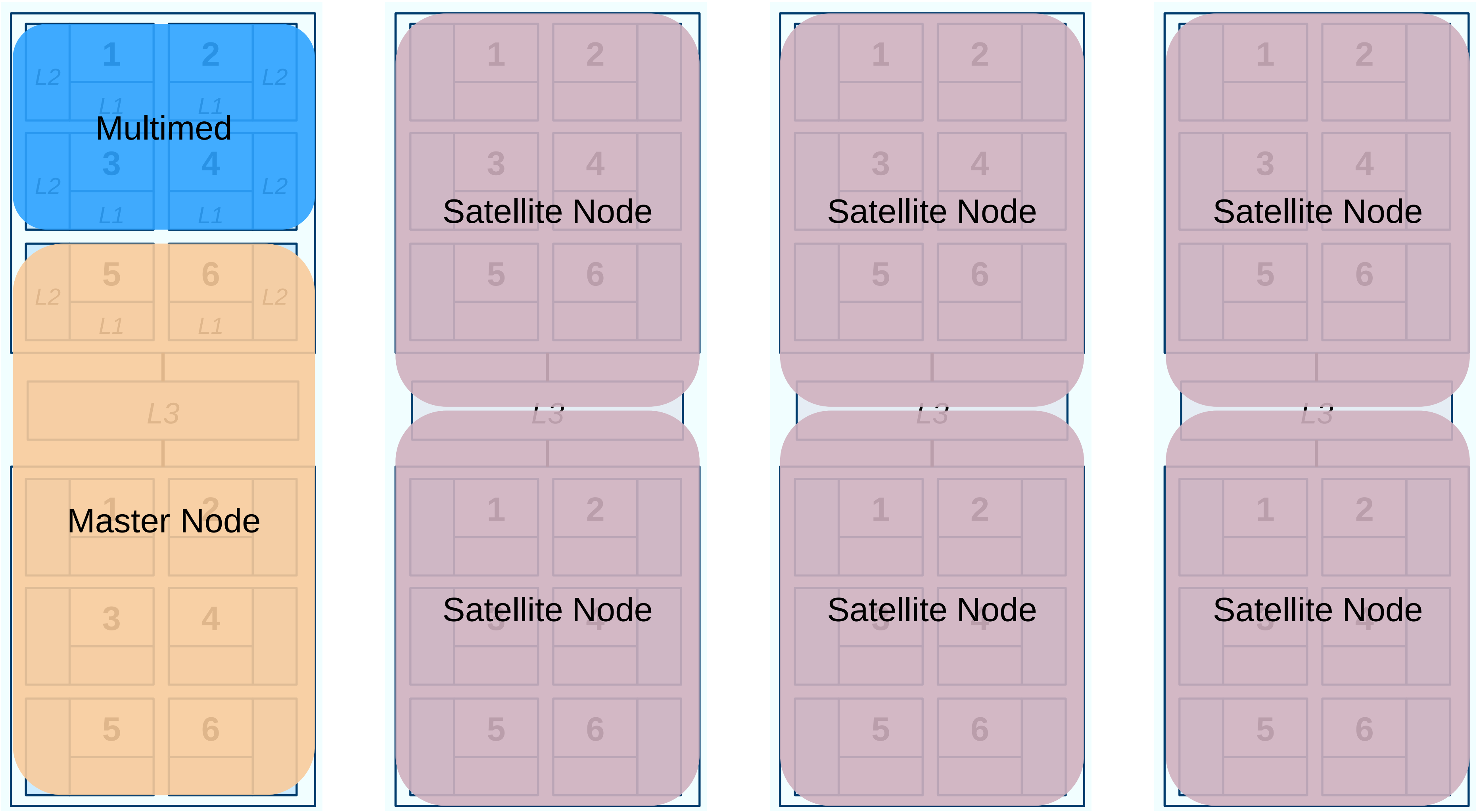

Multimed's scalability

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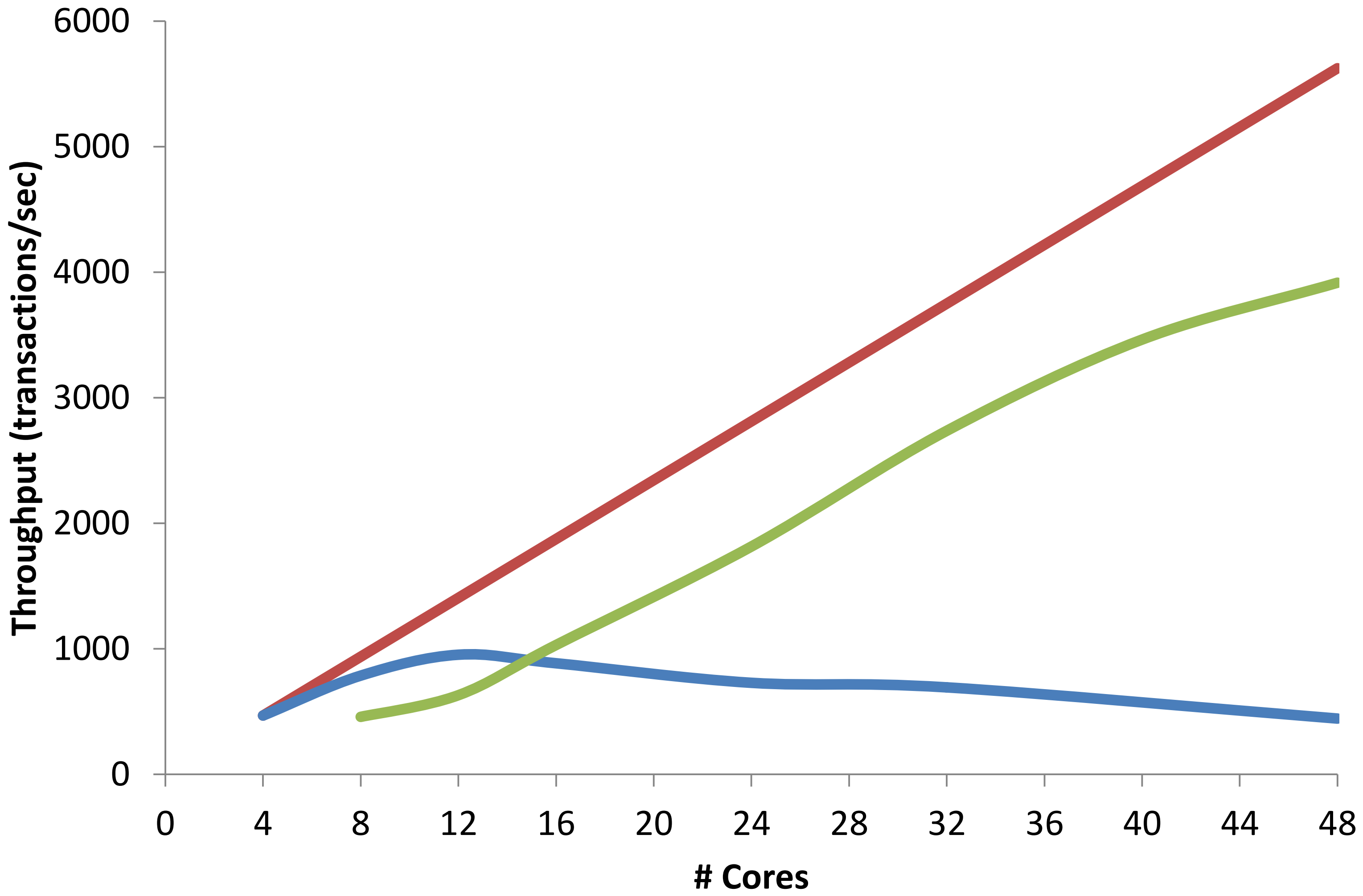

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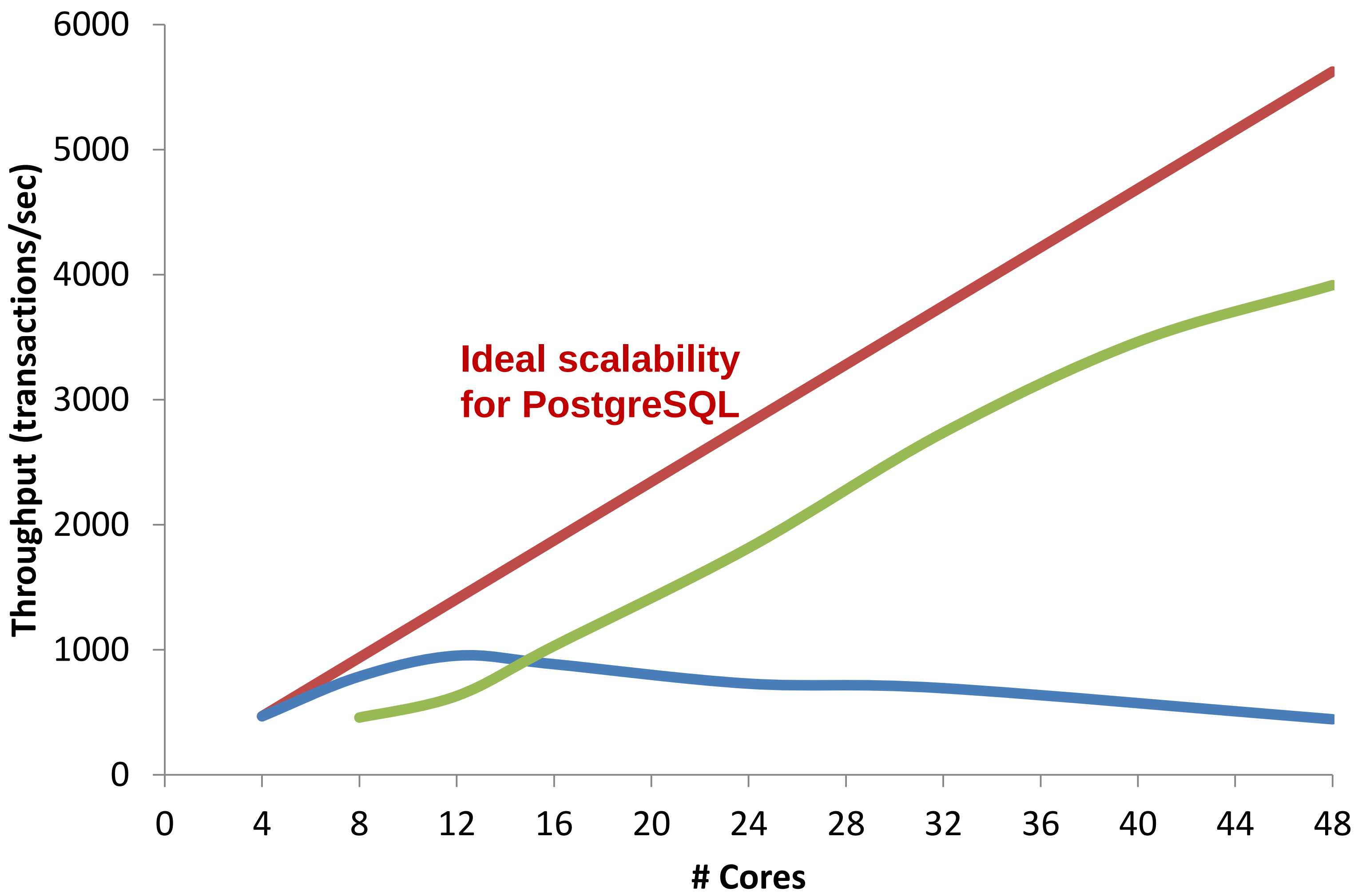

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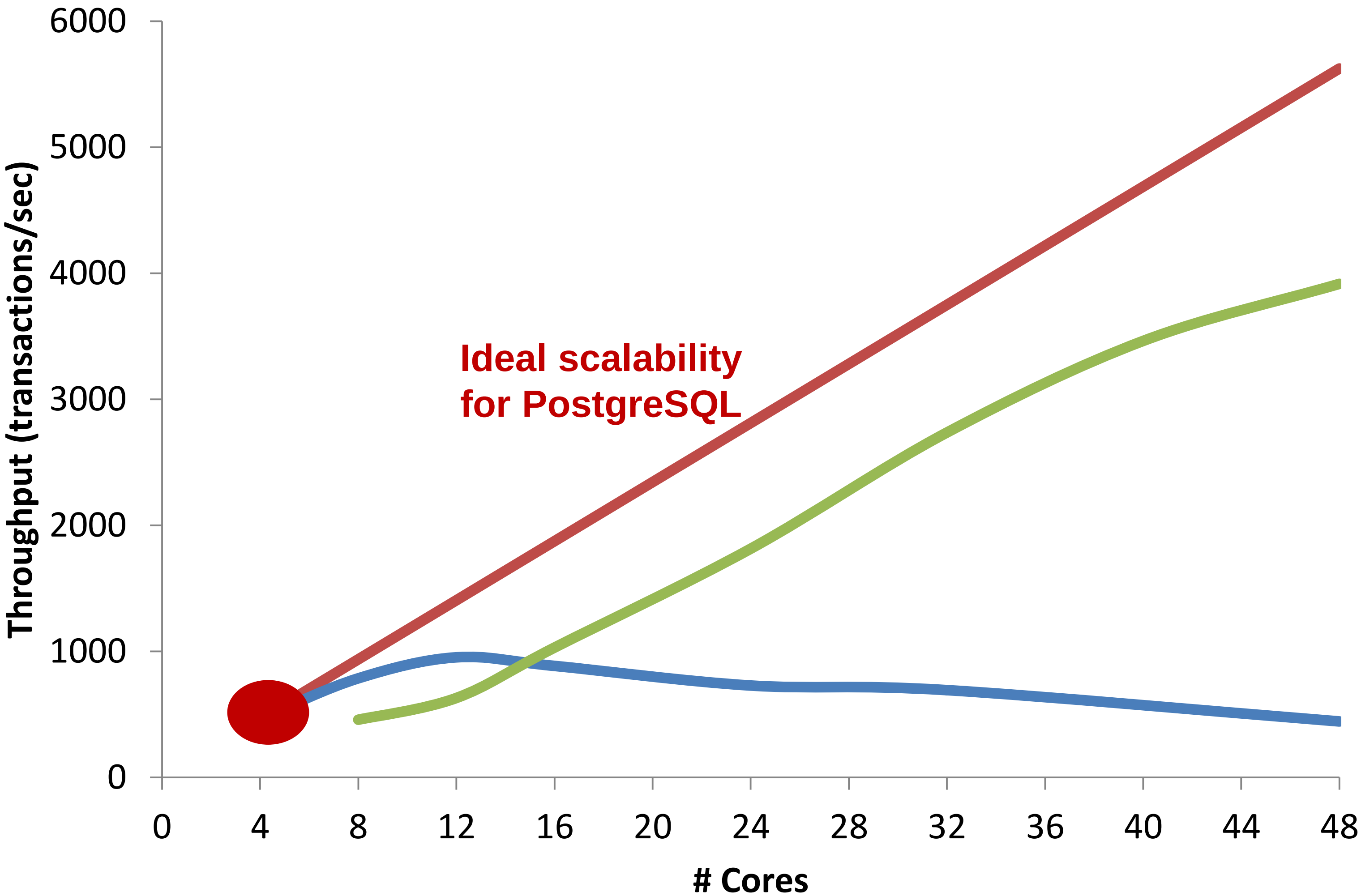

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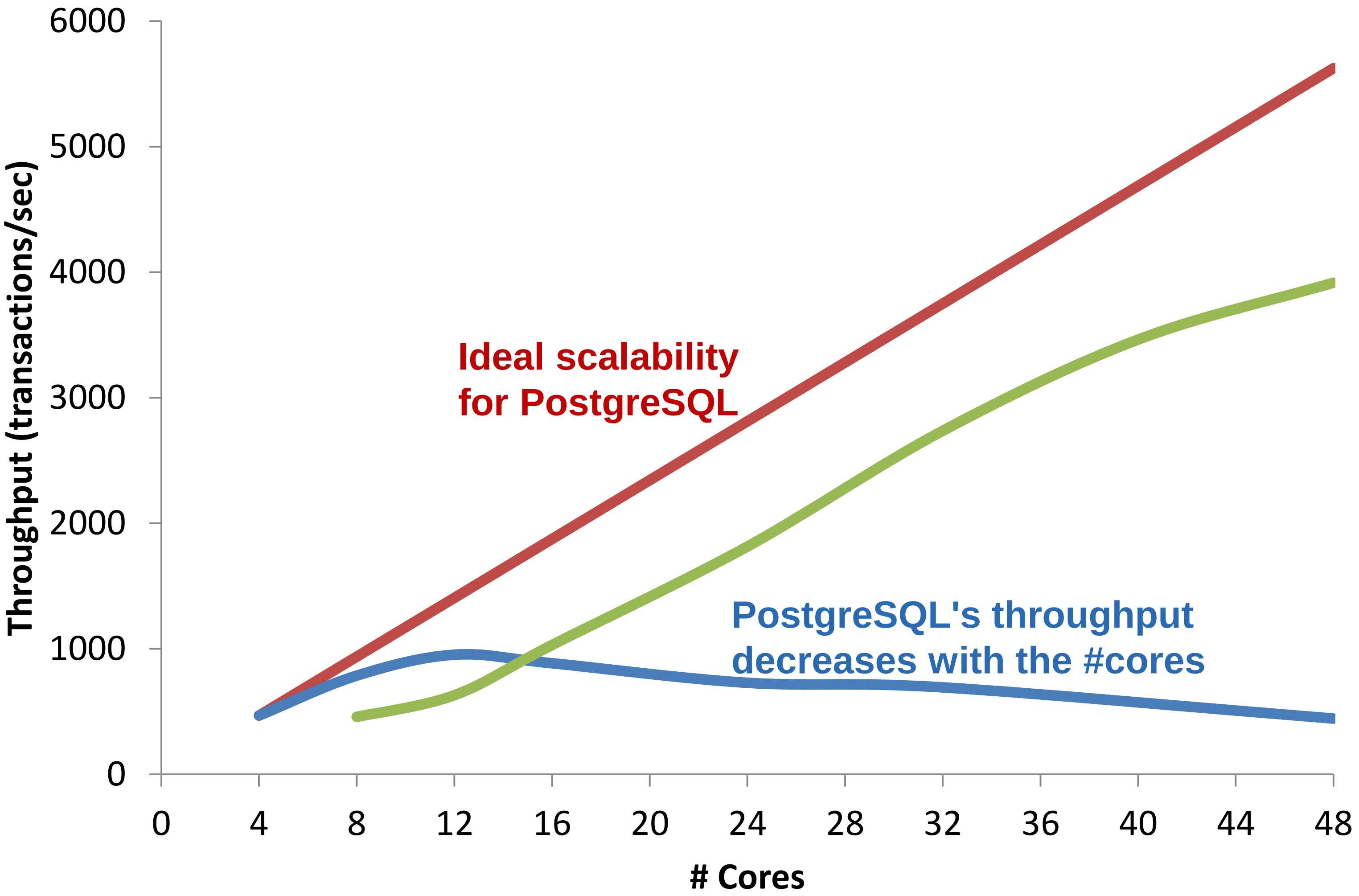

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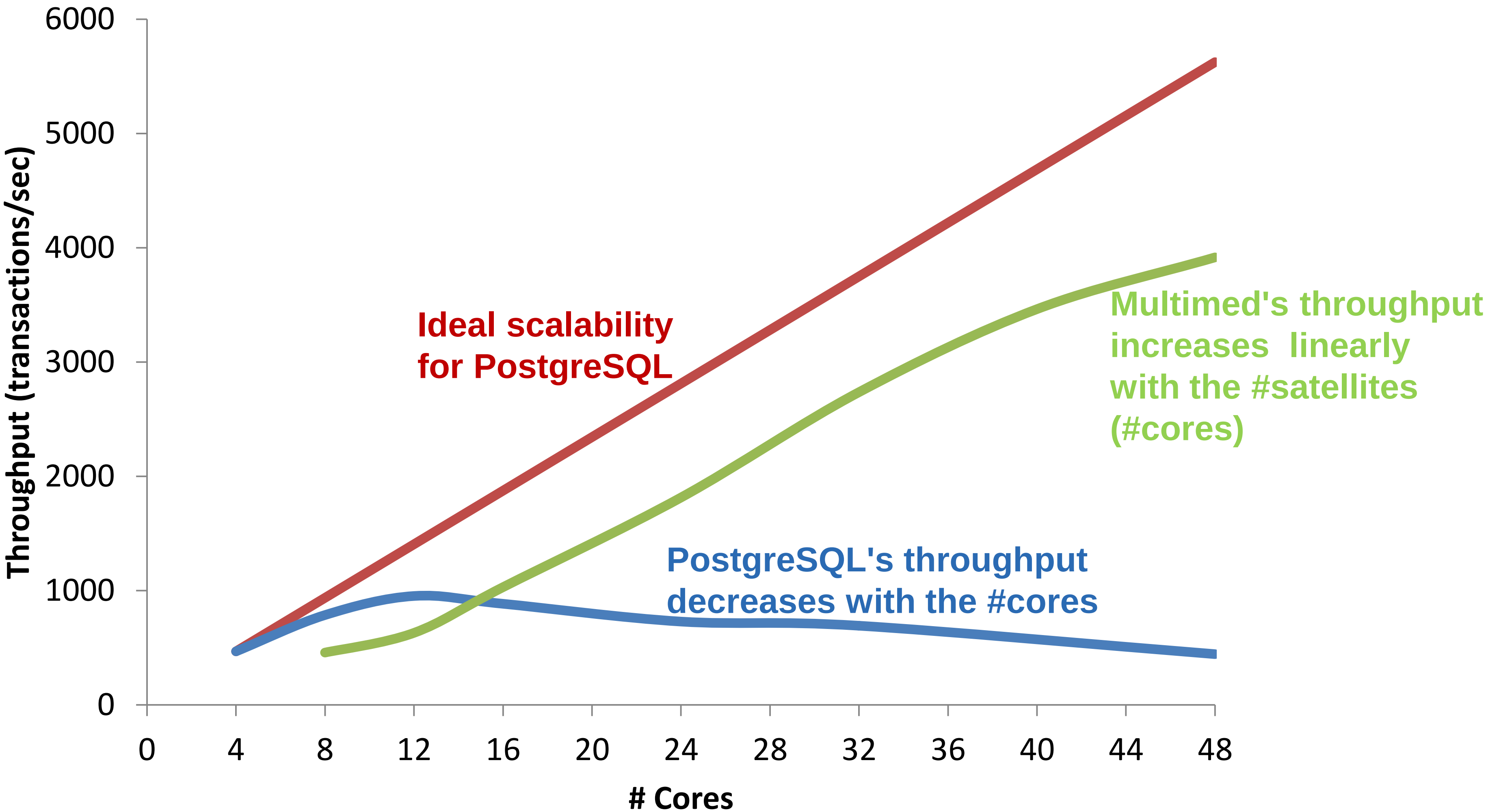

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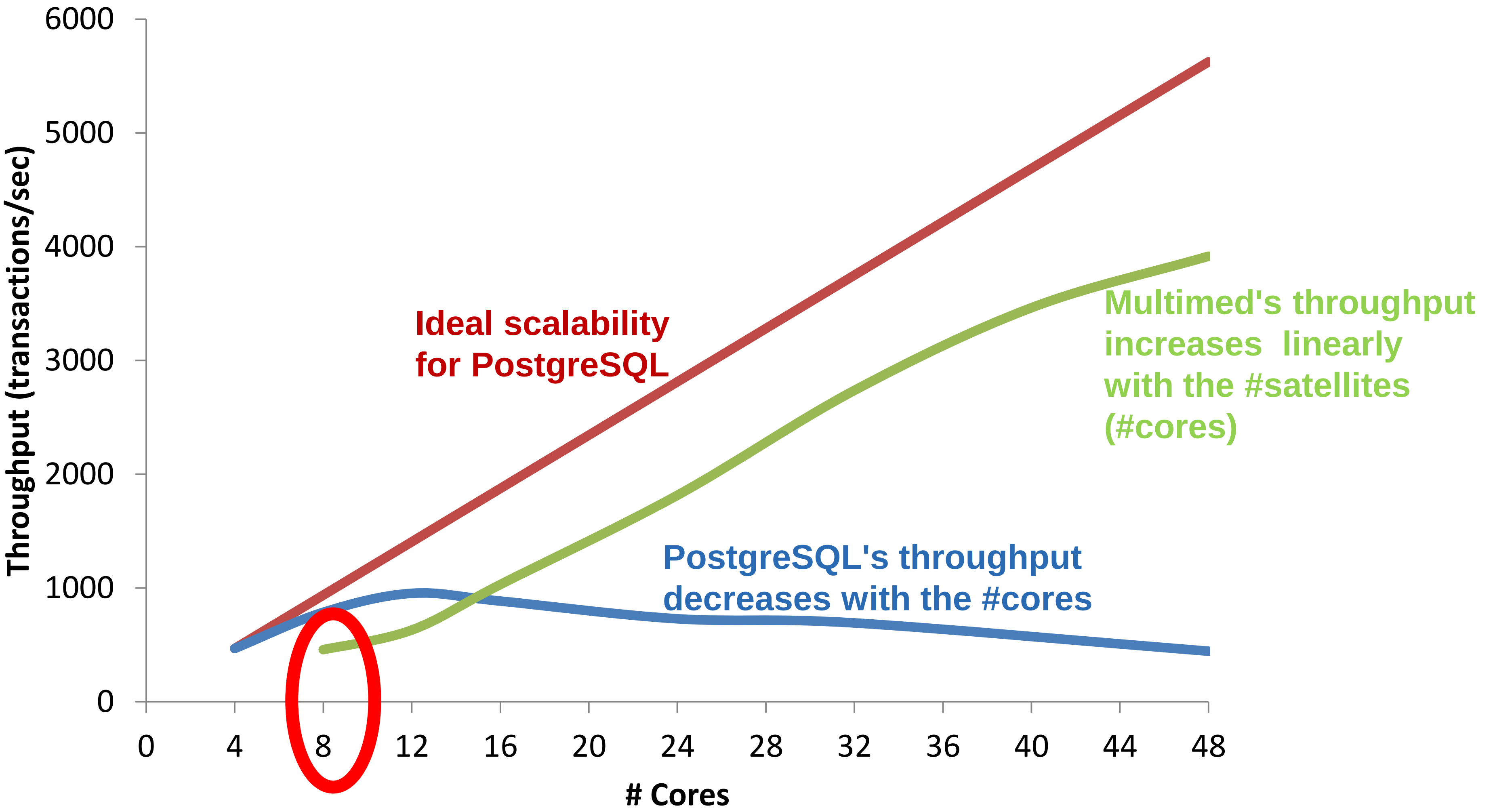

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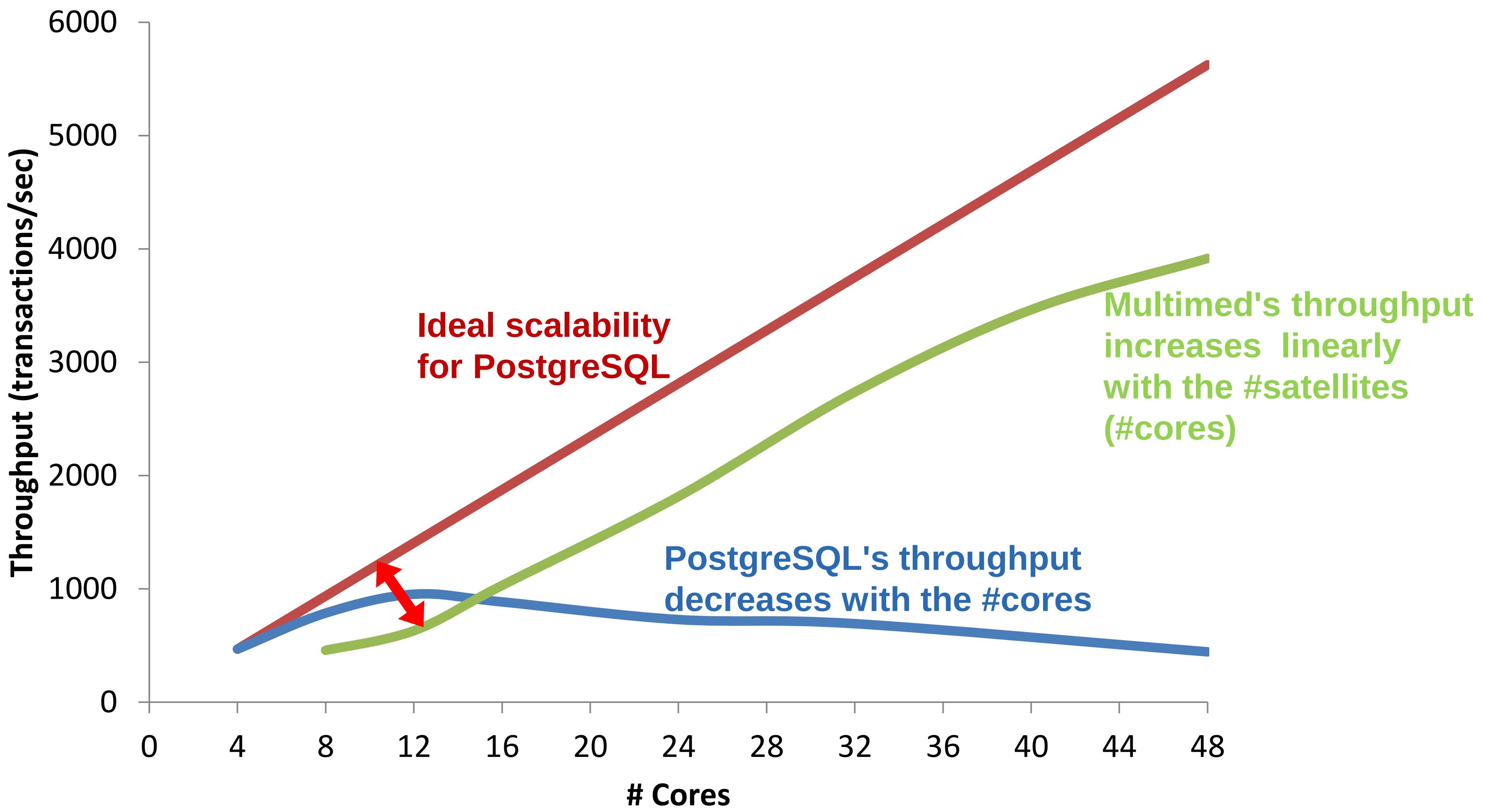

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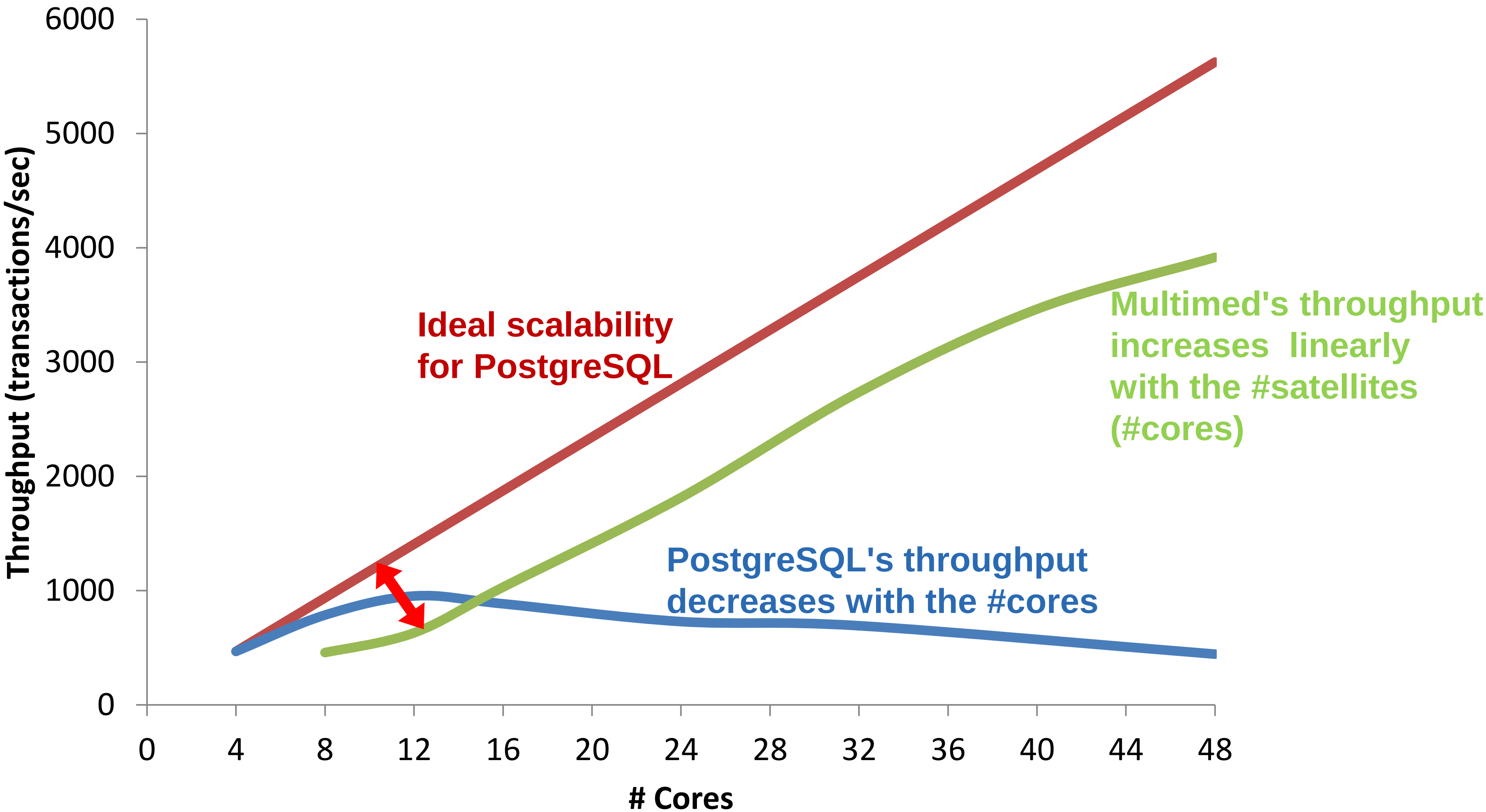

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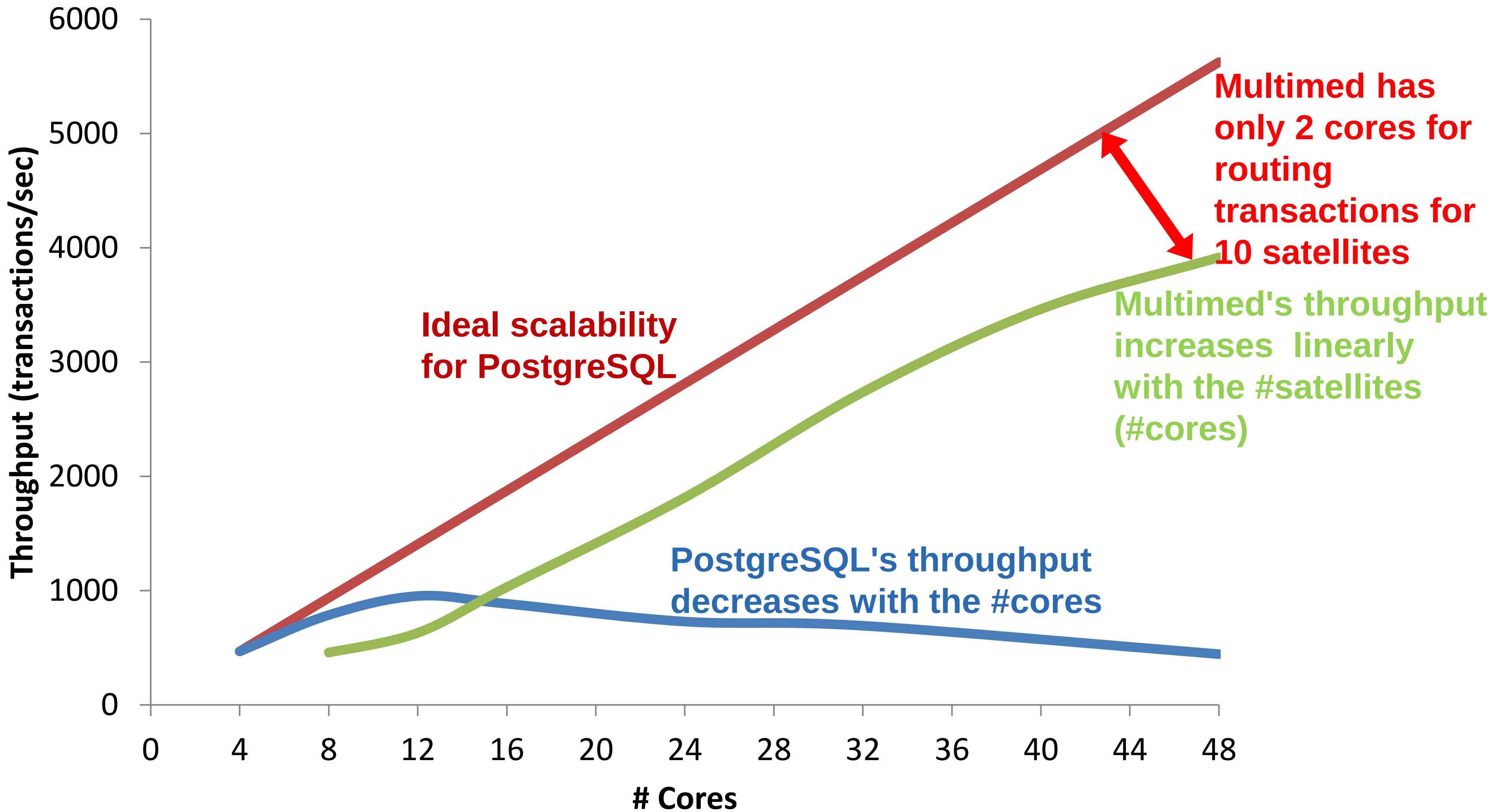


Why does Multimed work?

Why does Multimed work?

- *Intuitively*:
  - Reduces contention by replication
  - Solves the problems of load interaction by running "heavy" transactions on specific satellite nodes
  - Each engine runs on a small #cores

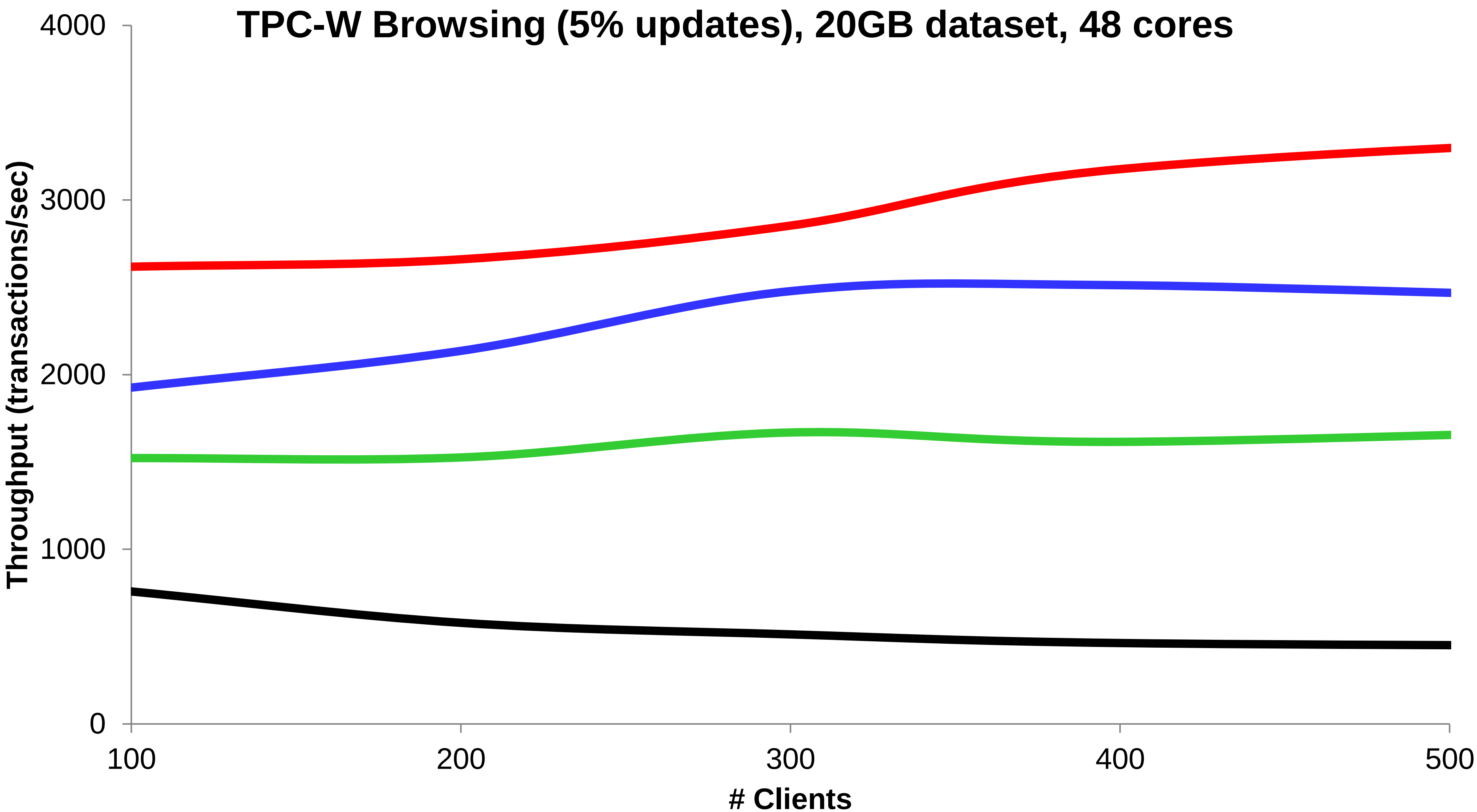
- *Counter intuitively*:
  - Routing layer adds latency,
  - Replication adds latency, **but**
  - Requests are answered faster by each satellite due to less load interaction and contention, compensating for these latencies
  - Shared caches

Databases and workloads

Databases and workloads

- Target workloads
  - Read-heavy workloads with updates (TPC-W)
    - TPC-W Browsing (5% Updates)
    - TPC-W Shopping (20% Updates)
  - Mainly main memory resident datasets

Experimental results, PostgreSQL



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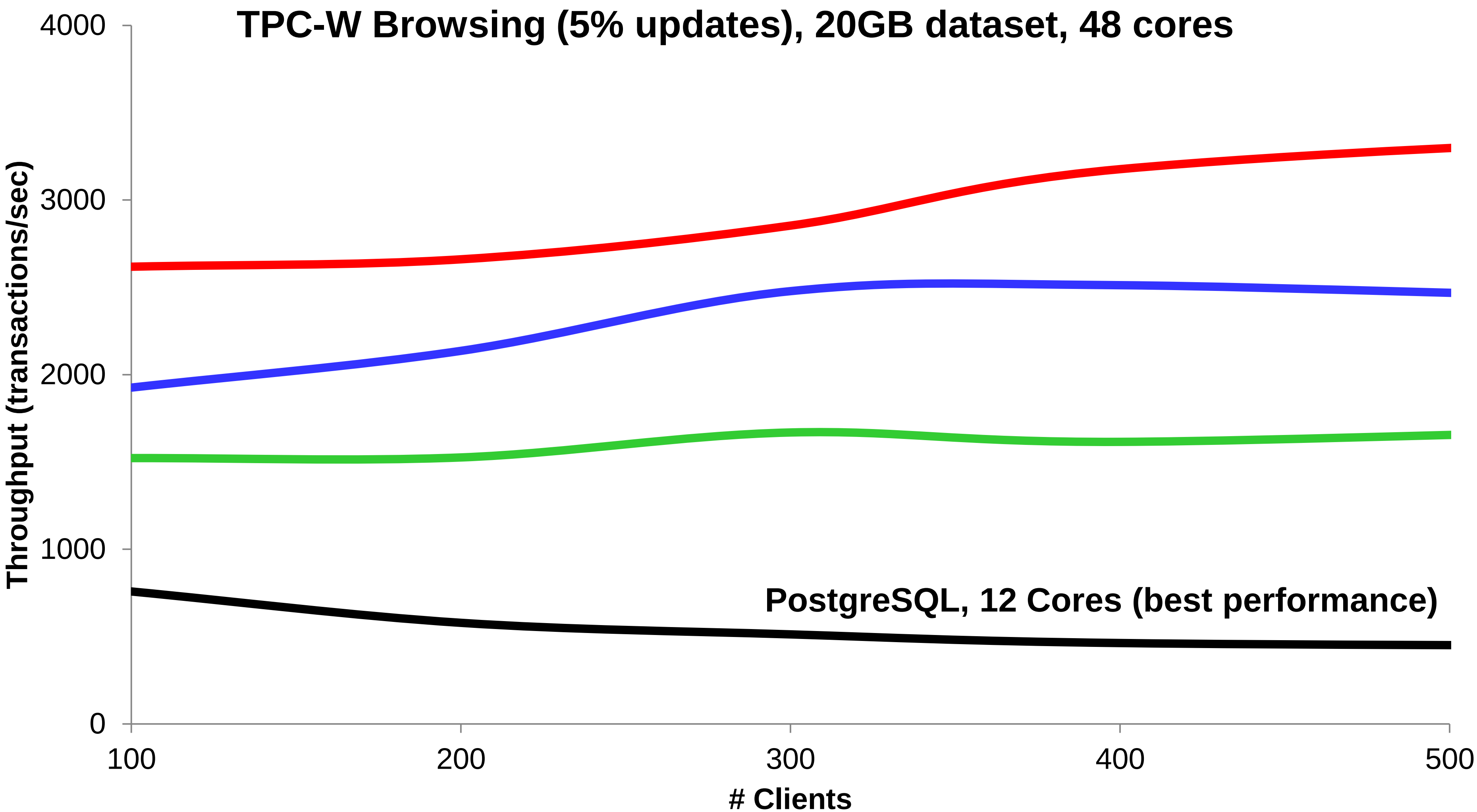

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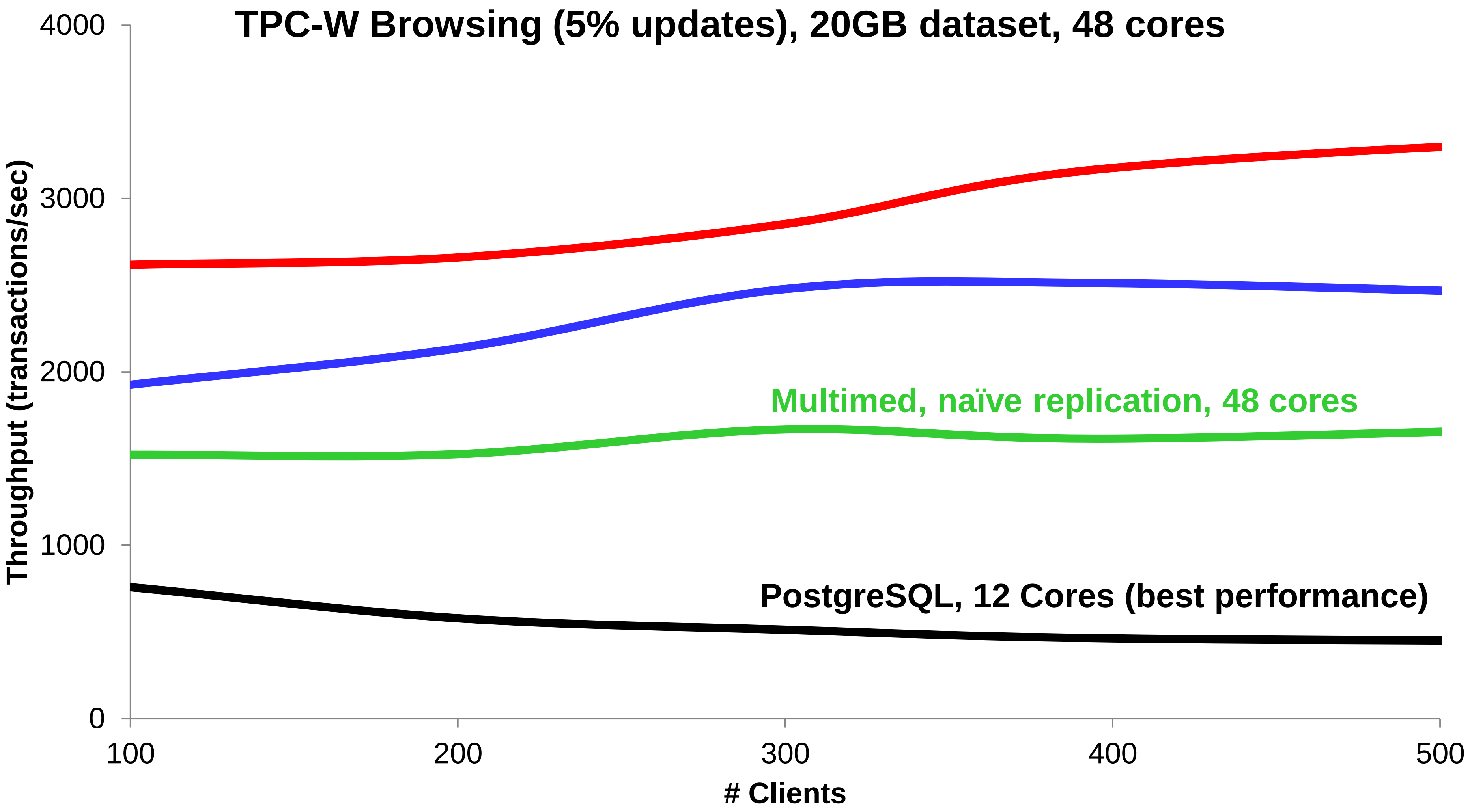

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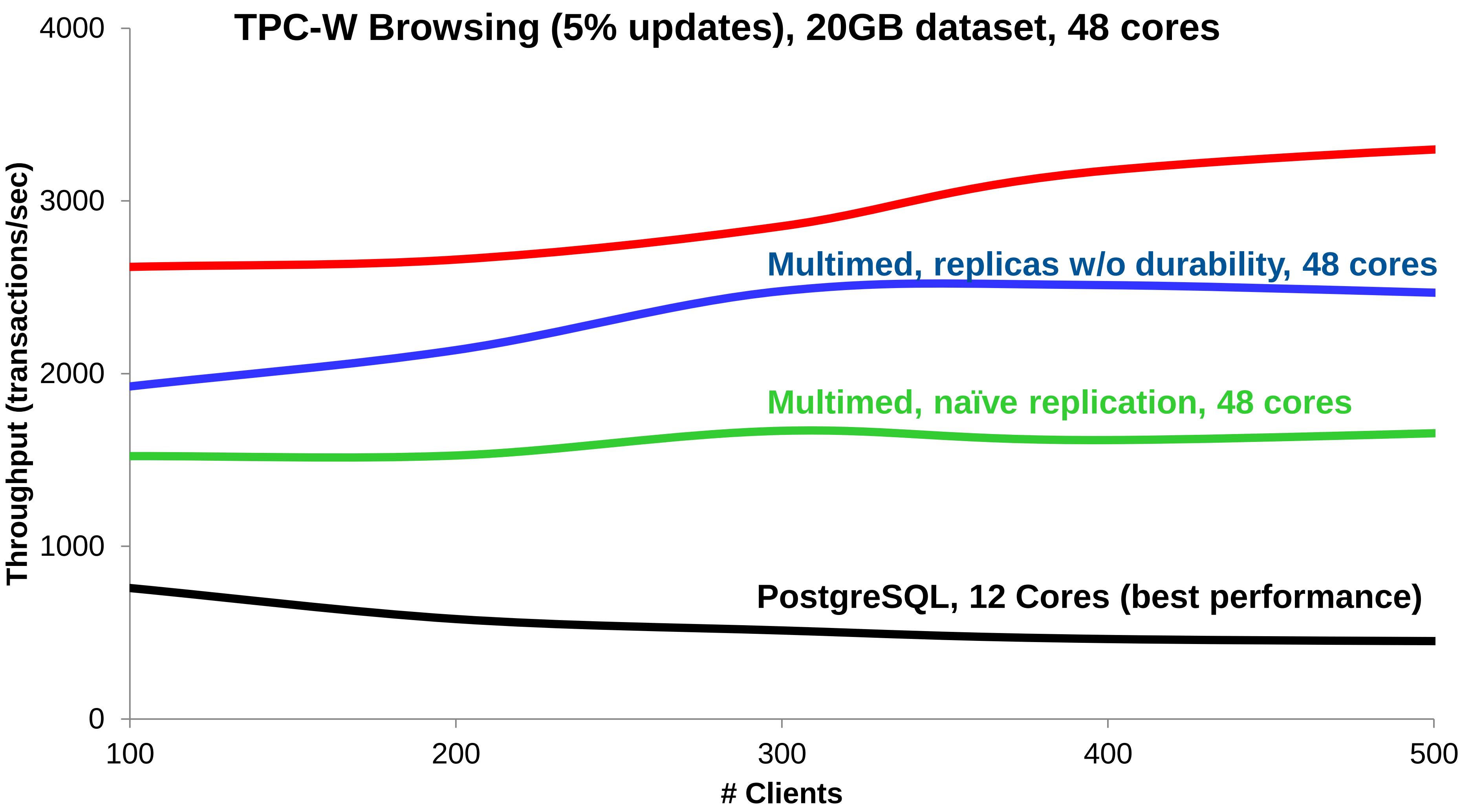

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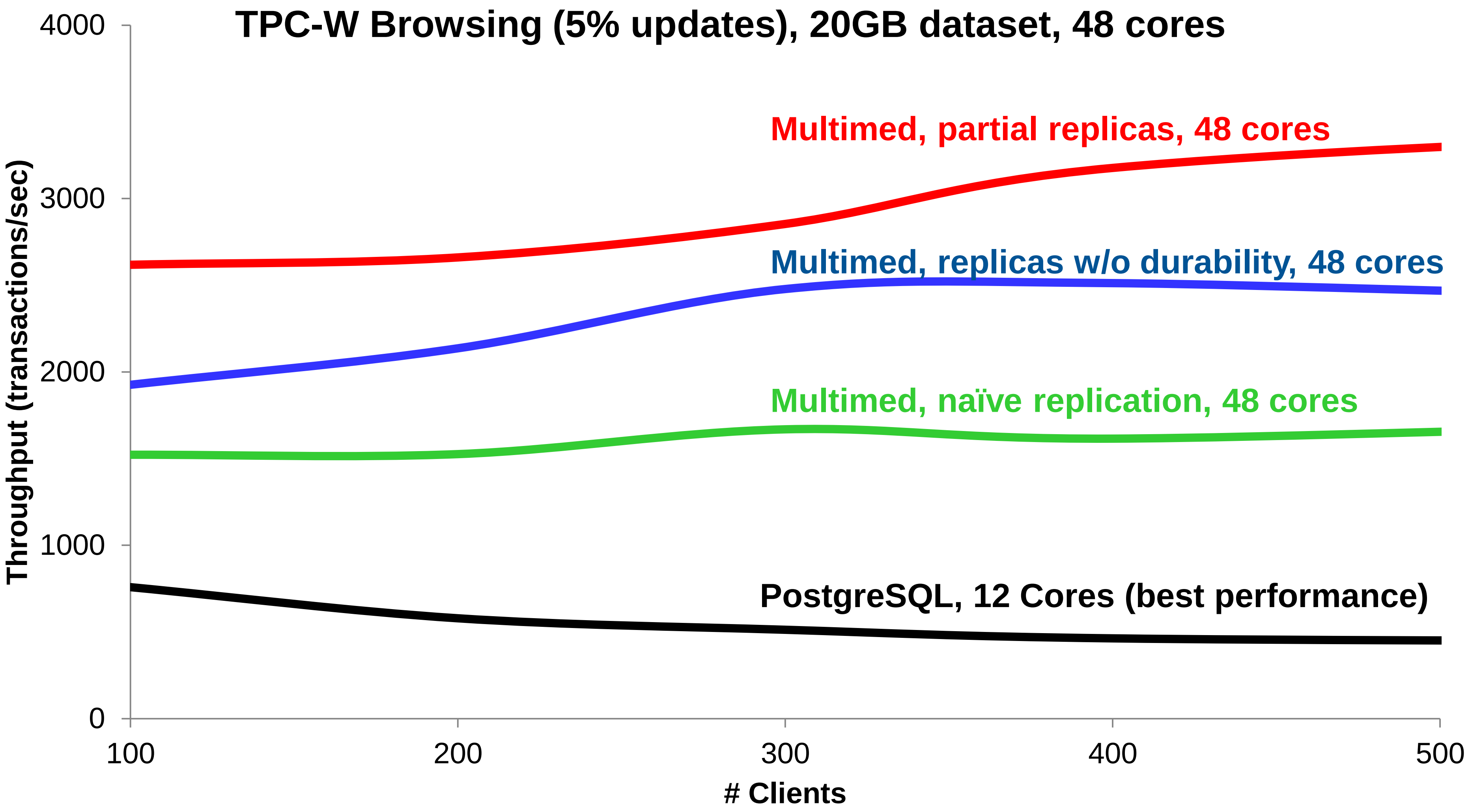

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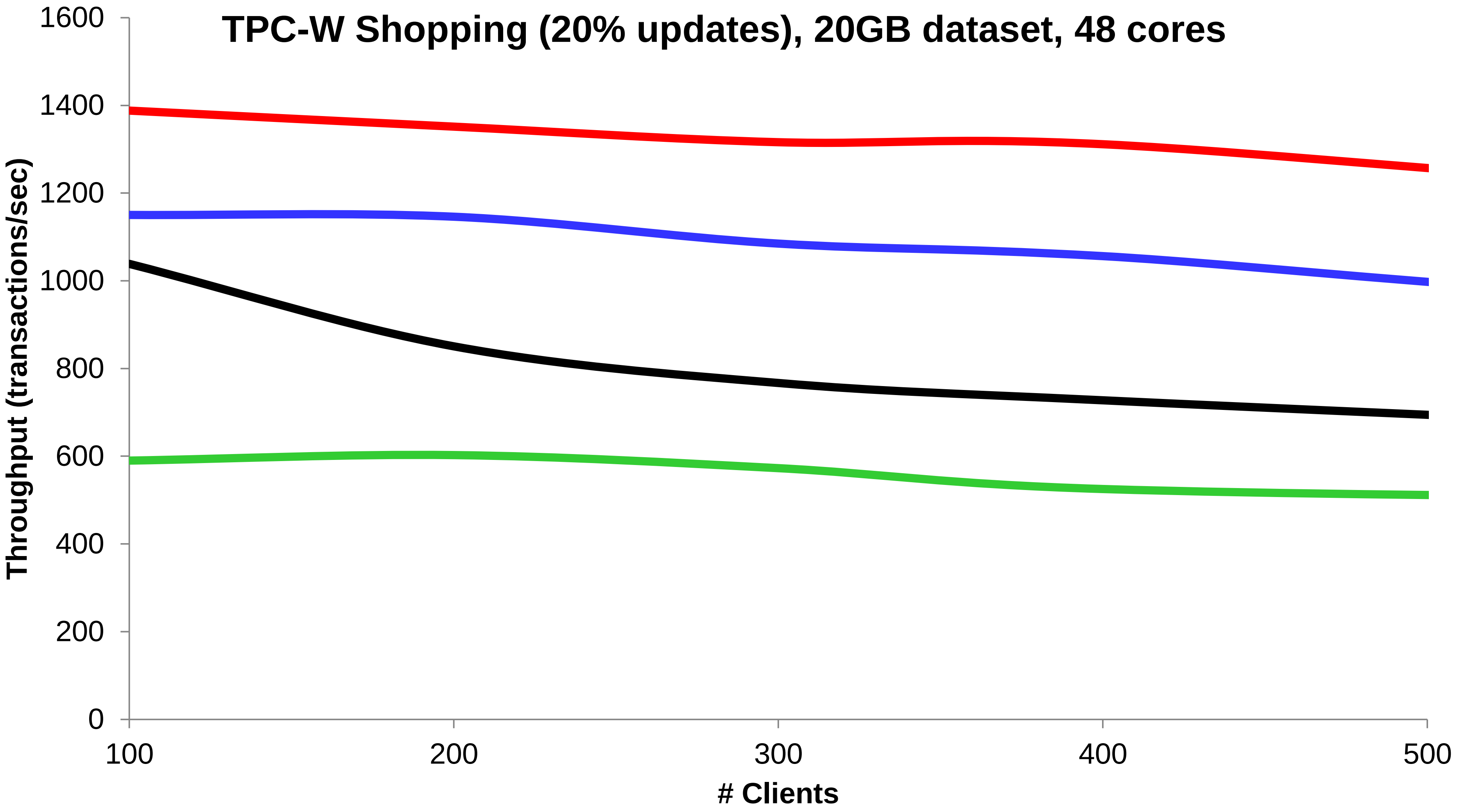

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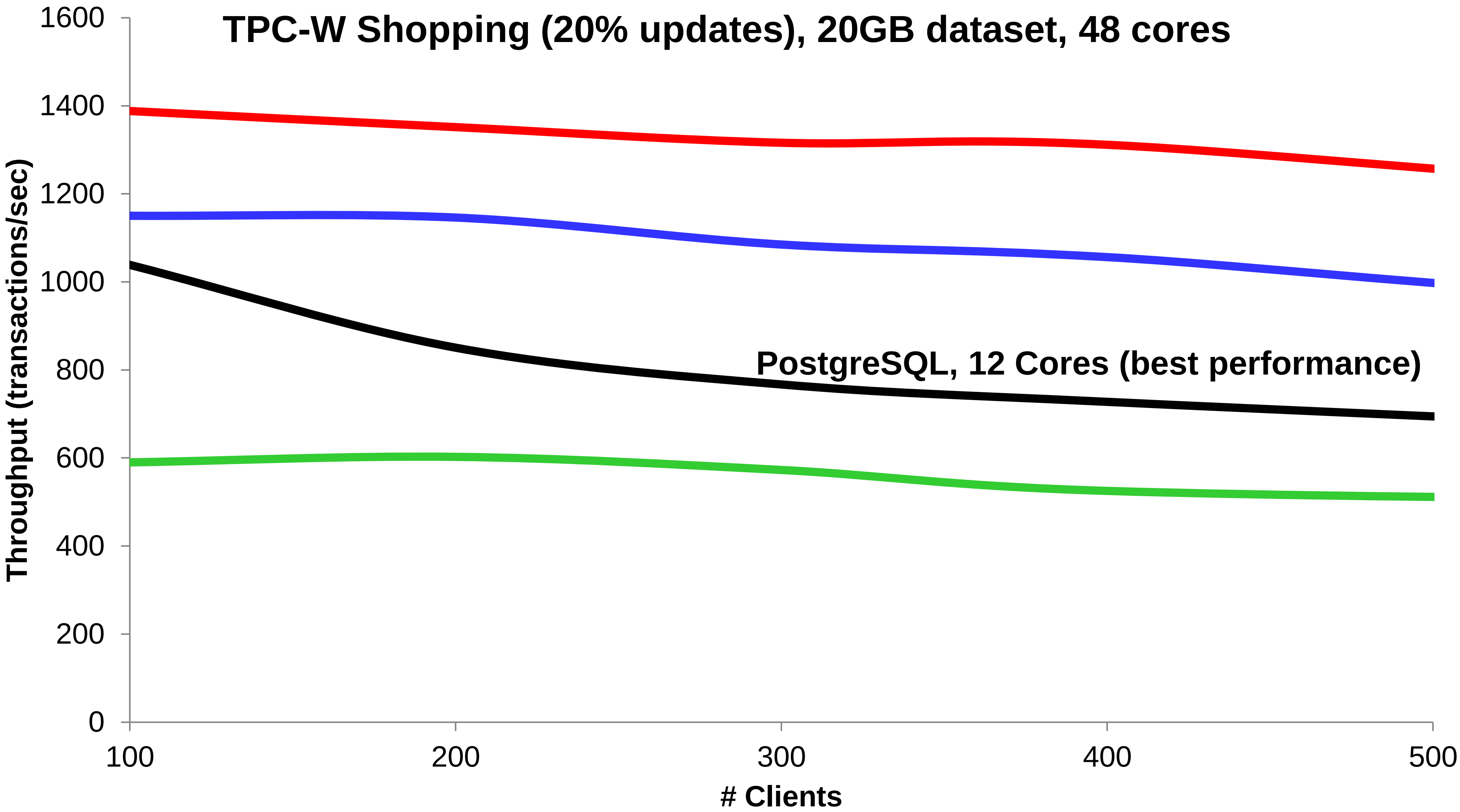

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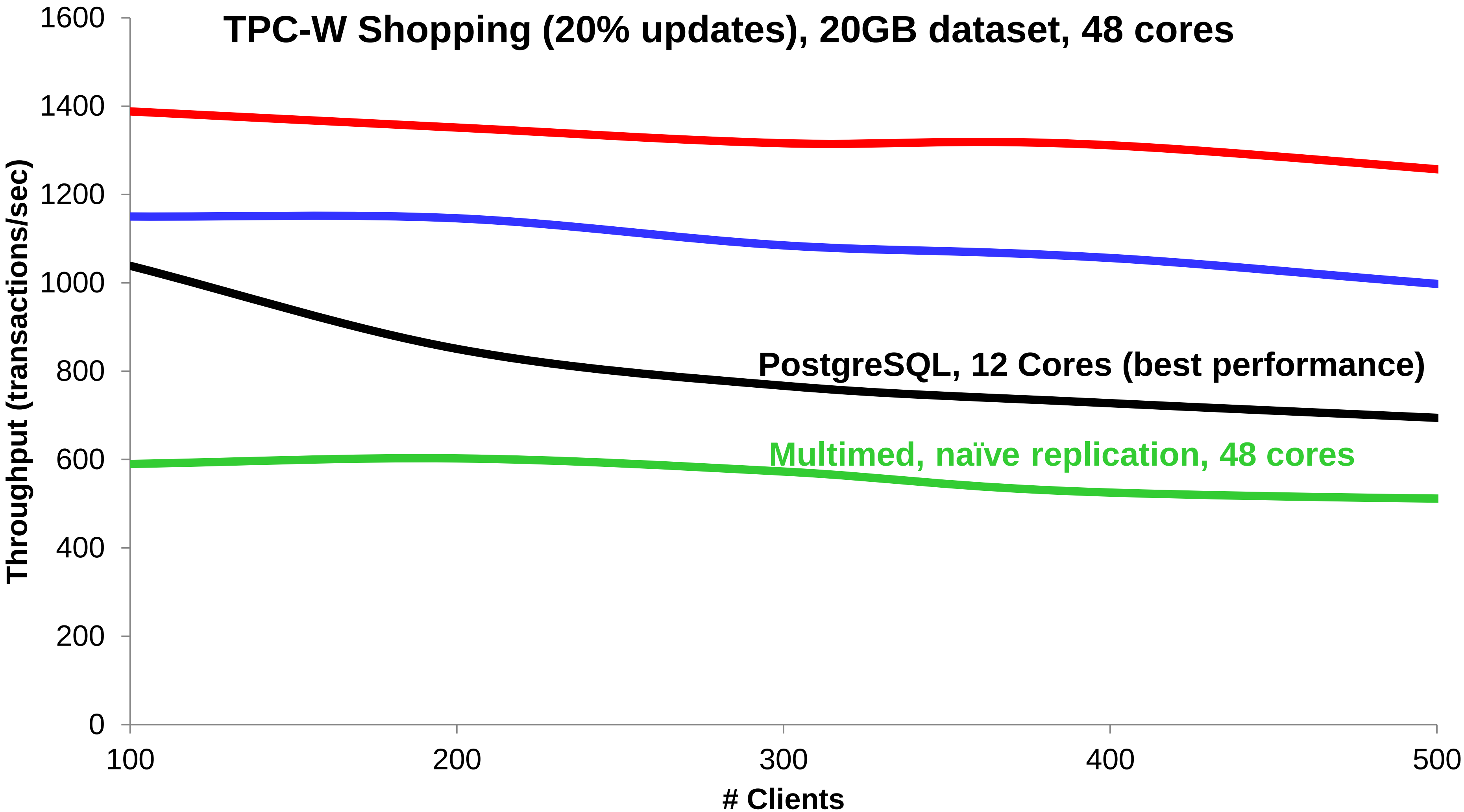

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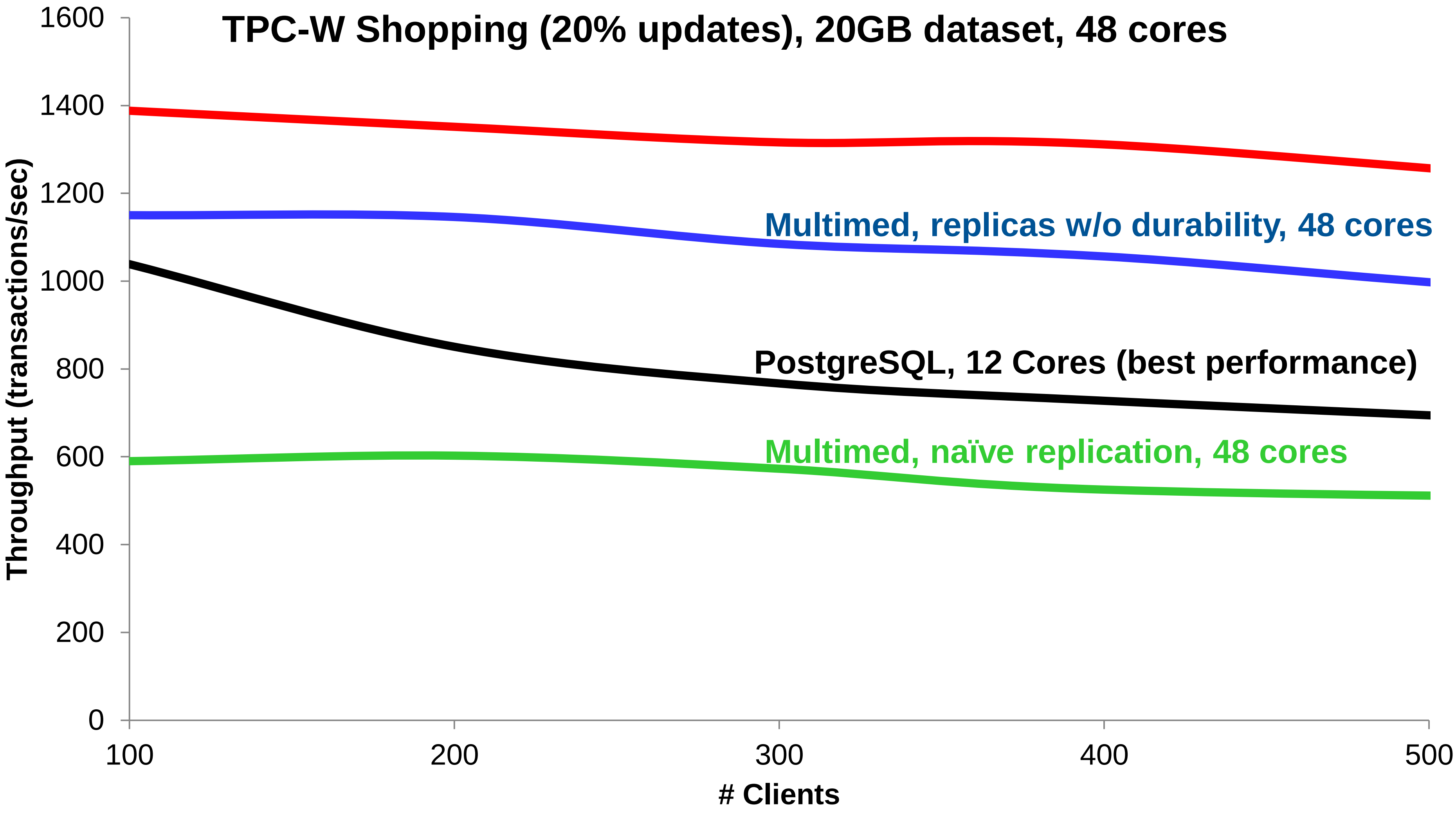

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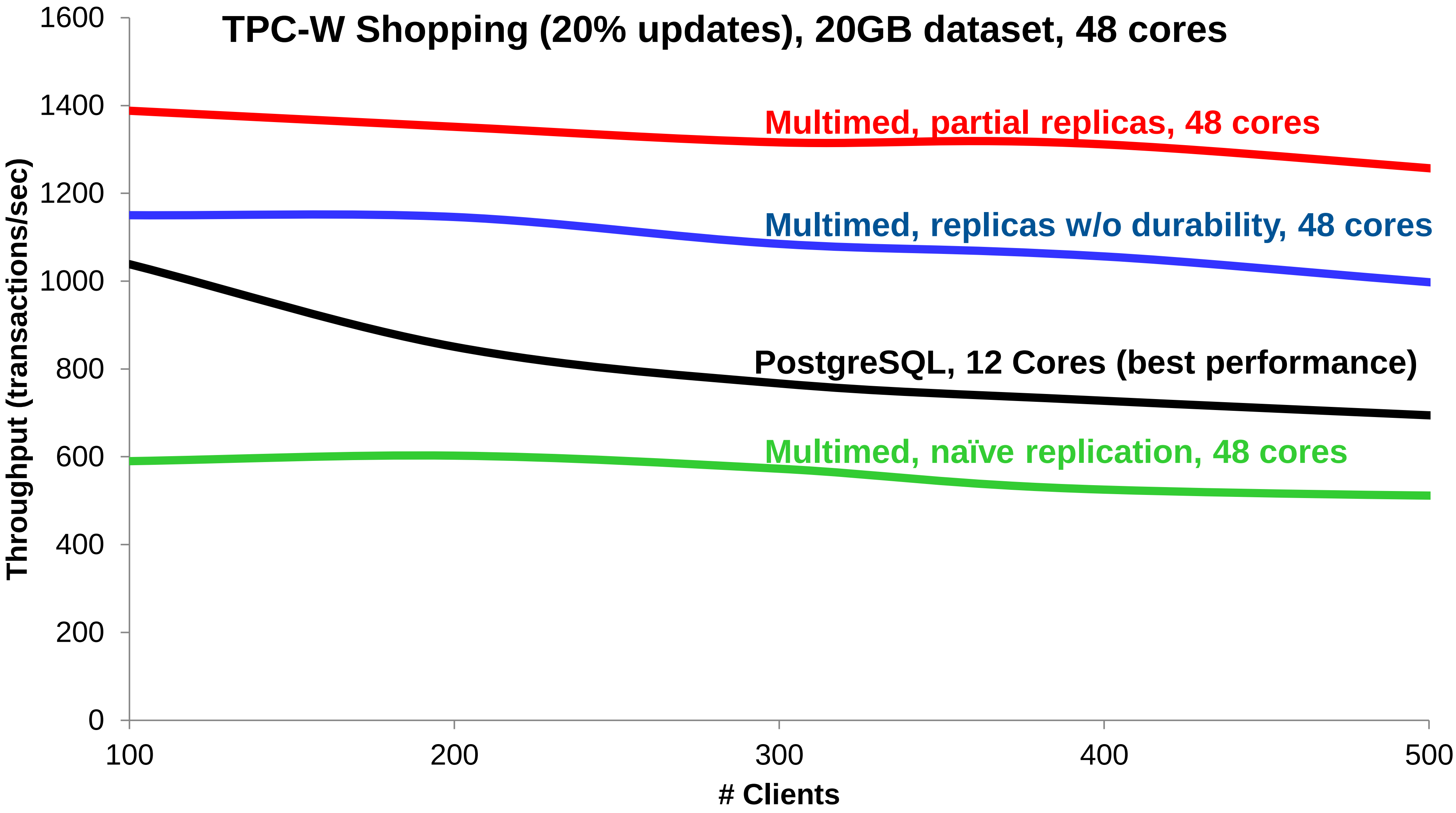

The morale of the story

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Why parallelize when you can distribute?

*** for the PowerPoint version that was presented at EuroSys 2011, please send an email to tsalomie at inf.ethz.ch**