Postgres-XC
PG session #3

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Agenda

- Self-introduction
- Highlights of Postgres-XC
- Core architecture overview
- Performance
- High-availability
- Release status

Self-introduction

- Michael Paquier, 27 years old.
- Based in Tokyo since 2009
- Working for NTT Data Intellilink
  - 500 employees
  - Website http://www.intellilink.co.jp
  - Company of NTT Data Group: 55,000 employees
- Working on DB system support mainly PostgreSQL
- PostgreSQL community member
  - pgbench shell-related features of 9.0
  - 2PC studies
- Core developer of Postgres-XC
- Other information:
  - Email: michael.paquier@gmail.com
  - Twitter: @michaelpq
  - Blog: http://michael.otacoo.com

Highlights

Highlights - Postgres-XC

- Cluster software focused on write-scalability
- Based on PostgreSQL
  - world's most advanced open source database
  - PostgreSQL license
- Same client APIs as PostgreSQL
  - Ease of application migration from existing PostgreSQL deployment
  - Same drivers, same front end, same SQL queries
- Licensing
  - PostgreSQL license (more or less BSD)
  - Free to use, modify and redistribute for commercial purposes

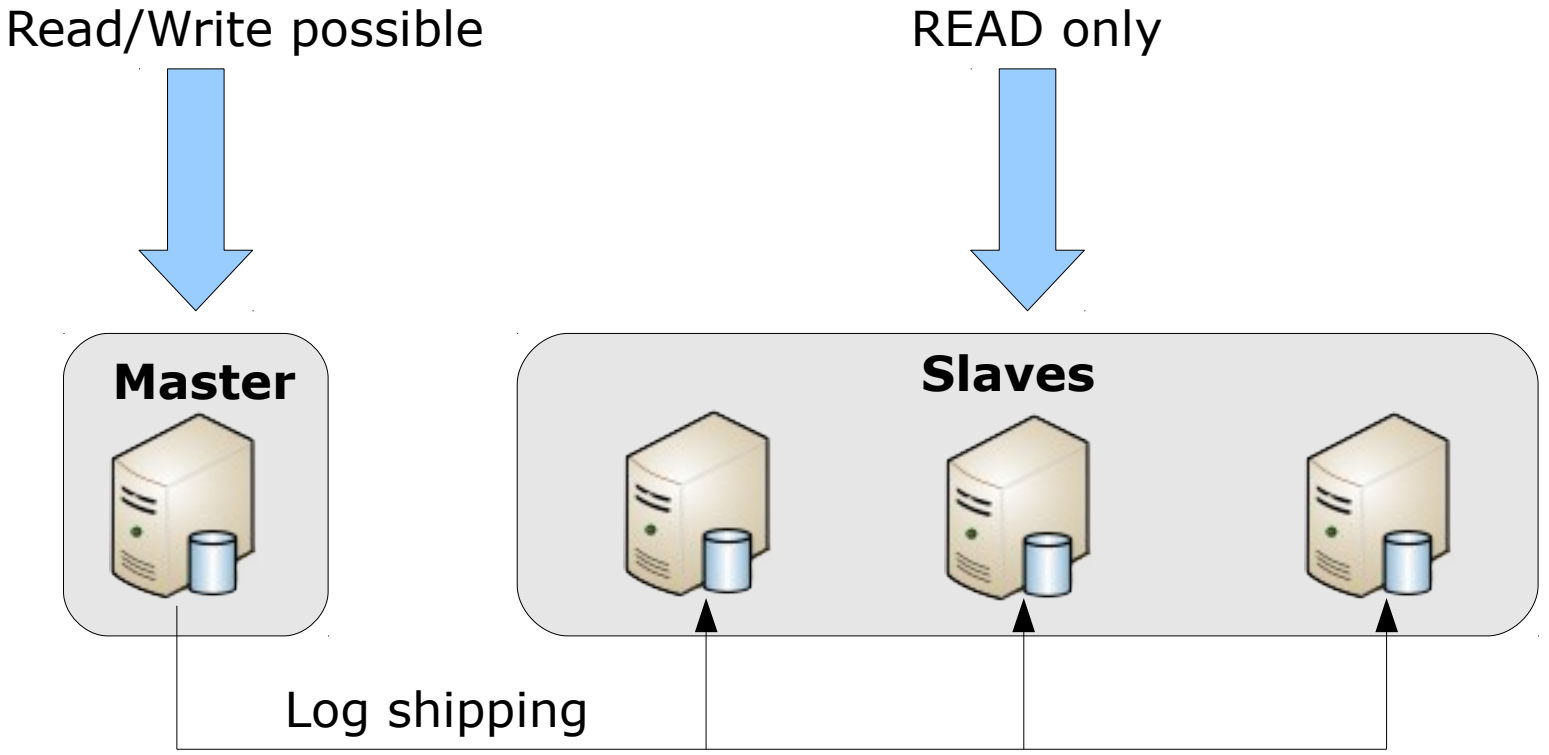
History

- Started through a collaboration between EnterpriseDB and NTT Open Source Software Center in January 2009
- Goal to build a PostgreSQL based clustering solution which can serve as an alternative to Oracle RAC
- Development is community-based, with resources gathered from NTT and EnterpriseDB
- Licensing terms changed from GPL to PostgreSQL license (same as Postgres) in 2011

Core architecture

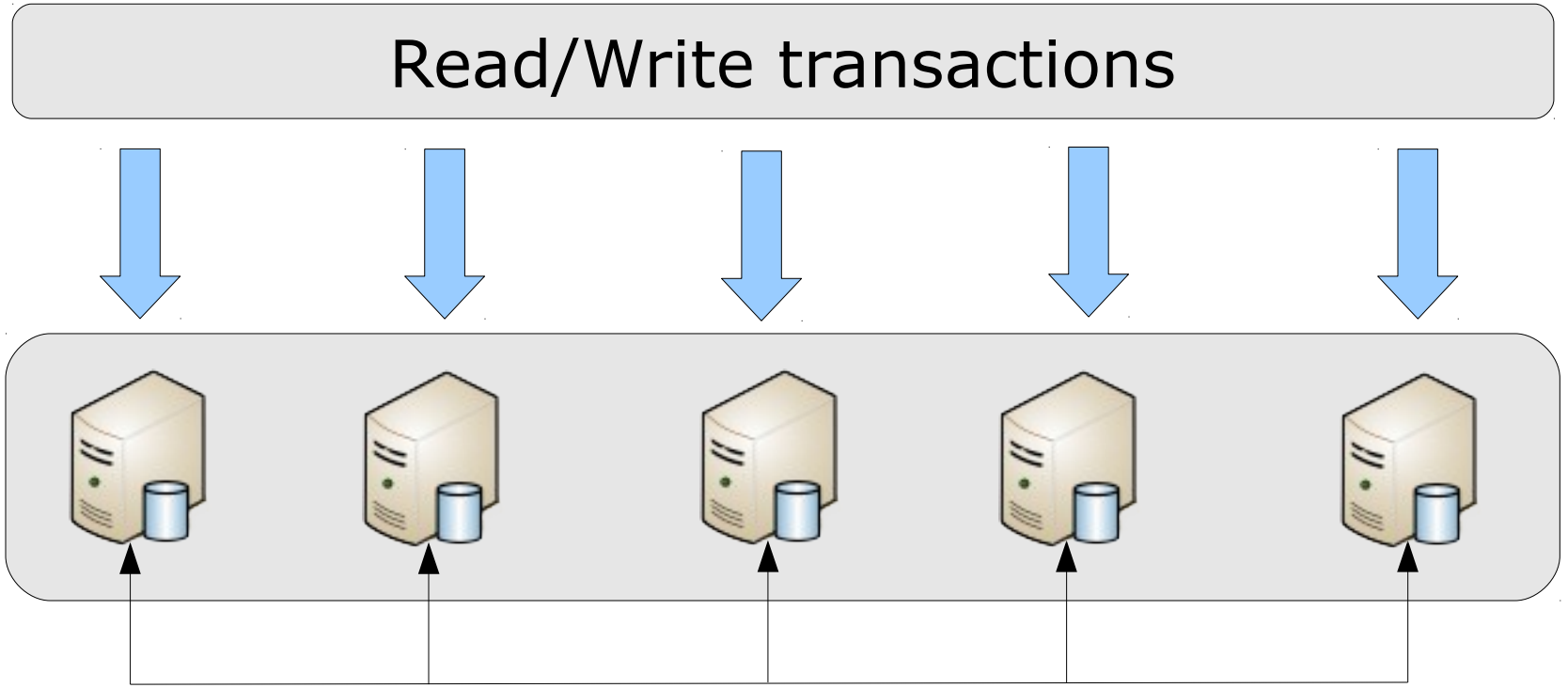
About PostgreSQL 9.1

- Streaming replication and HOT-Standby



- Asynchronous mode => timestamp view not consistent
- Synchronous mode => timestamp view consistent

And Postgres-XC itself?



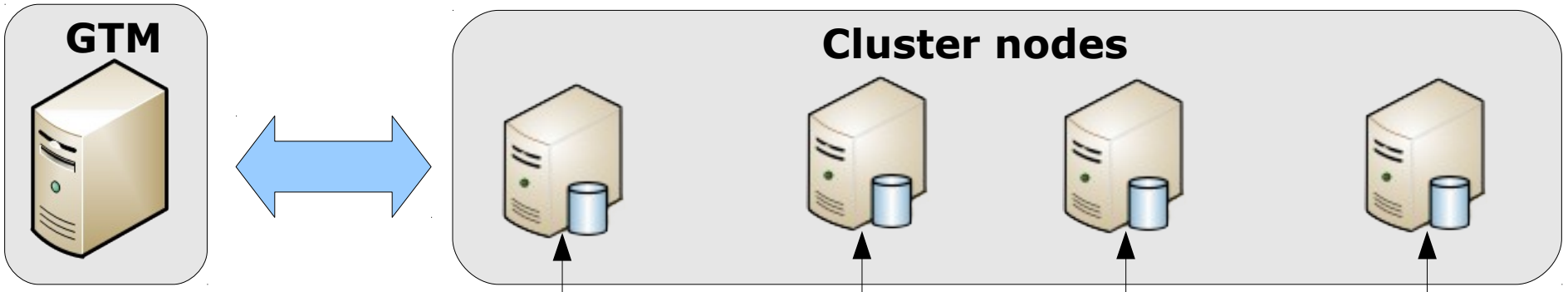
Distributed/replicated tables
Same data consistency/transparency
Same timestamp view

In short

- Symetric cluster of PostgreSQL
  - No Slave and no Master
  - Read and write scalability
  - Transparent Transaction Management
  - Shared-nothing structure
  - 3 types of nodes: GTM, Coordinator, Datanode

Node types – GTM (1)

- Designed for transparency
- Feeding of MVCC-related data: transaction ID, snapshot
- Cluster follows GTM timeline: timestamp, sequence



Snapshot
GXID
Timestamp
Sequence values

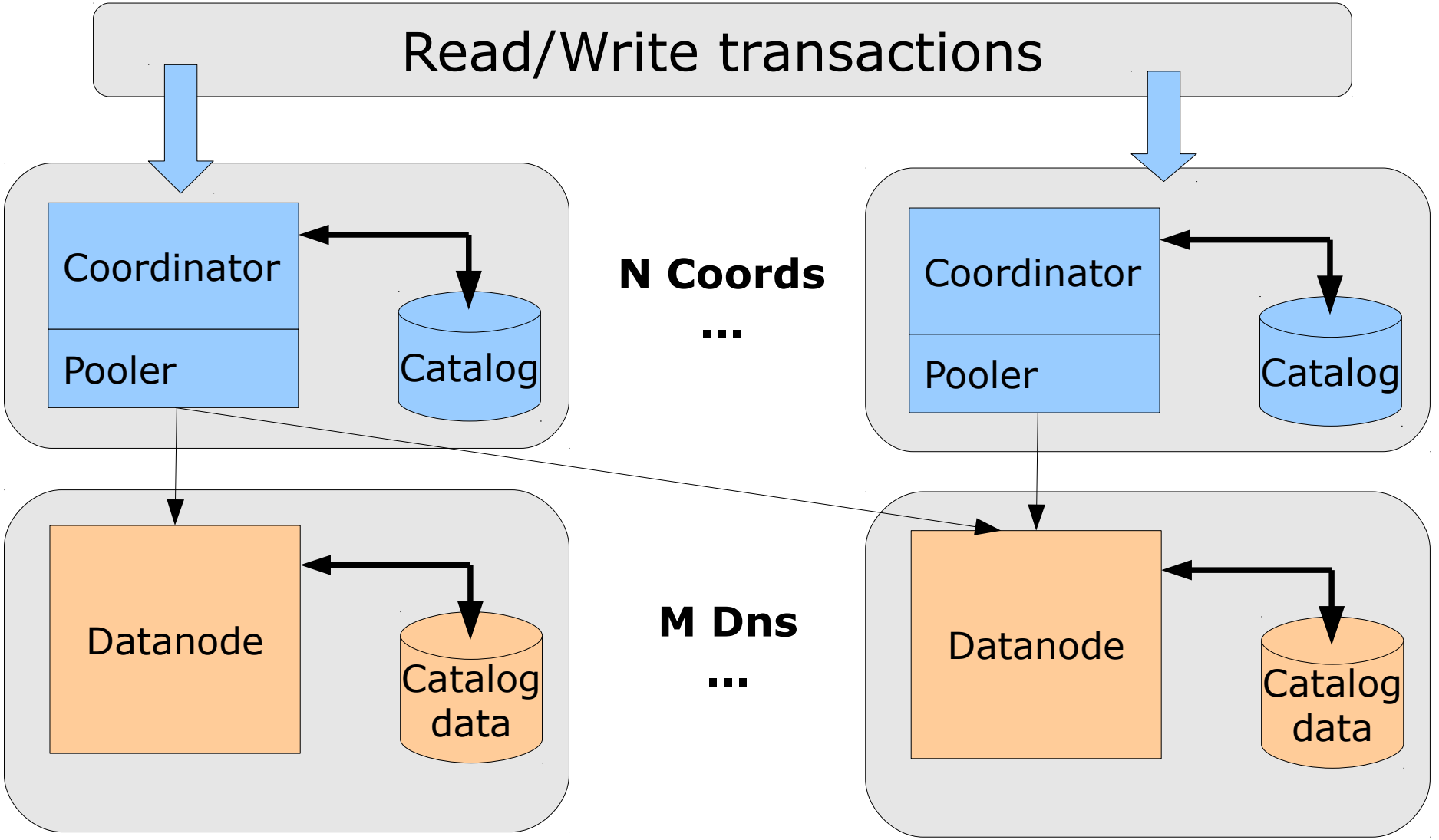
Node types - Coordinator (2)

- Point of contact for the application/client
- Management of remote node data
  - Parse and partially plan the statements
  - Determine the data to be fetched from remote nodes at planning or execution
  - Fetch the required data by issuing queries to dedicated Datanodes
  - Combine and process the data to evaluate the results of the query (if needed)
  - Pass the results to the applications
- Manages two-phase commit
- Stores catalog data: cluster-related information
- Needs and manages space for materializing results from remote nodes
- Binary based on the latest PostgreSQL release

Node types - Datanode (3)

- More or less a PostgreSQL instance (remote node)
- Stores tables and catalogs
- Executes the queries from client Coordinator and returns results to it
- Data nodes can be made fault tolerant by Hot-Standby and Synchronous Replication technologies available of standard PostgreSQL
- Binary same as Coordinator, based on latest PostgreSQL release

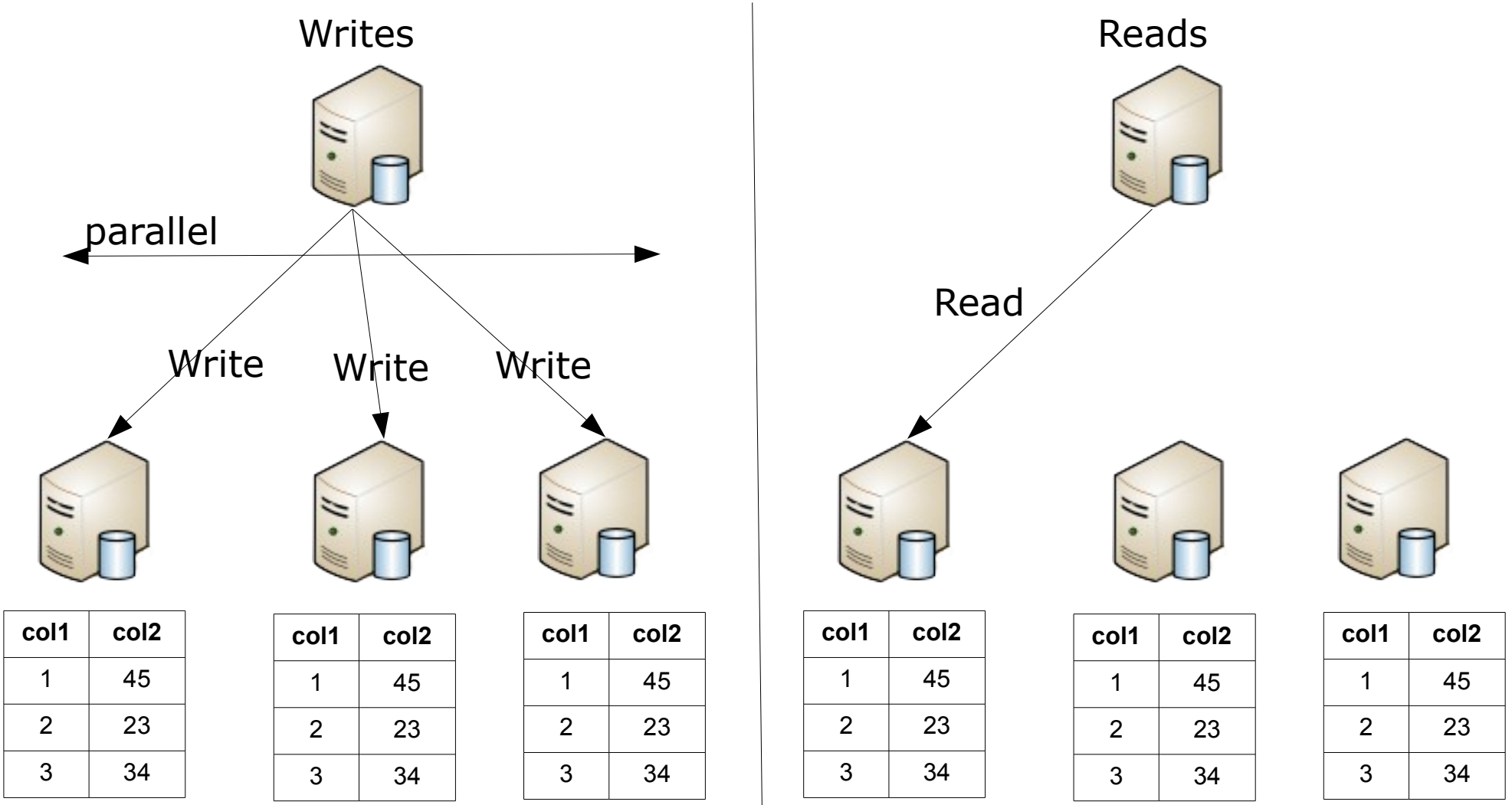
Node types - Global (4)



Data management

- Table types
  - Replicated table
    - Each row replicated to Datanodes
    - Statement based replication
  - Distributed table
    - Each row of the table is stored on one datanode, decided by one of following strategies
      - Hash
      - Round Robin
      - Modulo
- Managed by SQL extensions (CREATE TABLE)
- Possible to define subset of nodes

Replicated tables



col1	col2
1	45
2	23
3	34

col1	col2
1	45
2	23
3	34

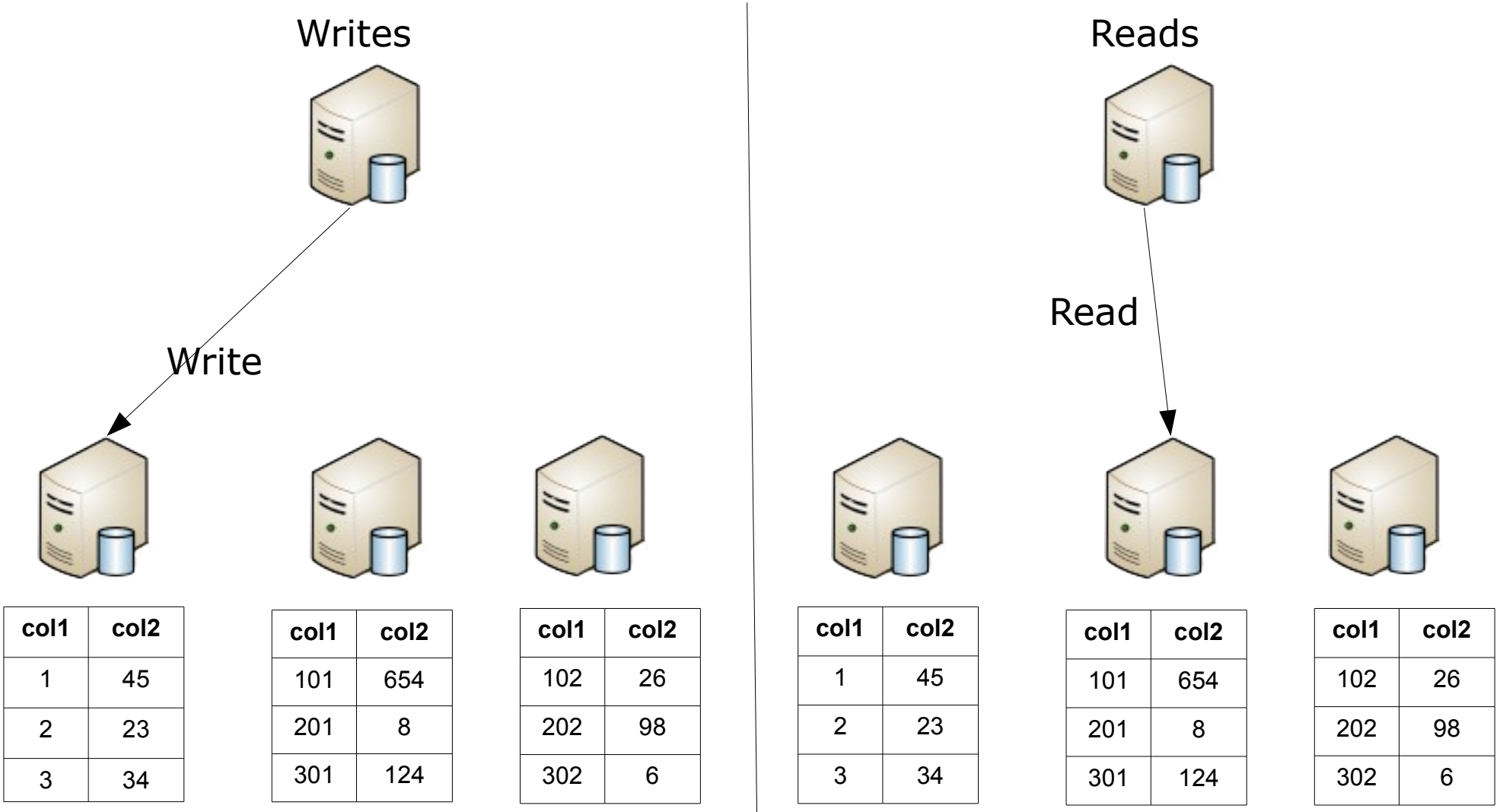
col1	col2
1	45
2	23
3	34

col1	col2
1	45
2	23
3	34

col1	col2
1	45
2	23
3	34

col1	col2
1	45
2	23
3	34

Distributed tables



col1	col2
1	45
2	23
3	34

col1	col2
101	654
201	8
301	124

col1	col2
102	26
202	98
302	6

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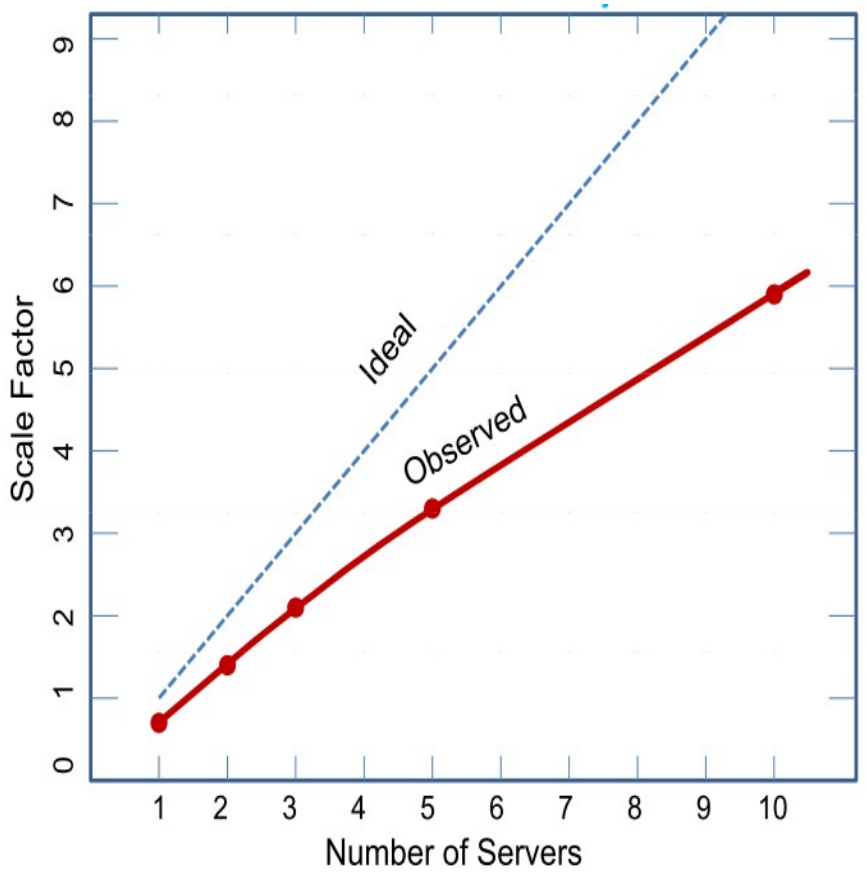
Performance

Scalability measurements

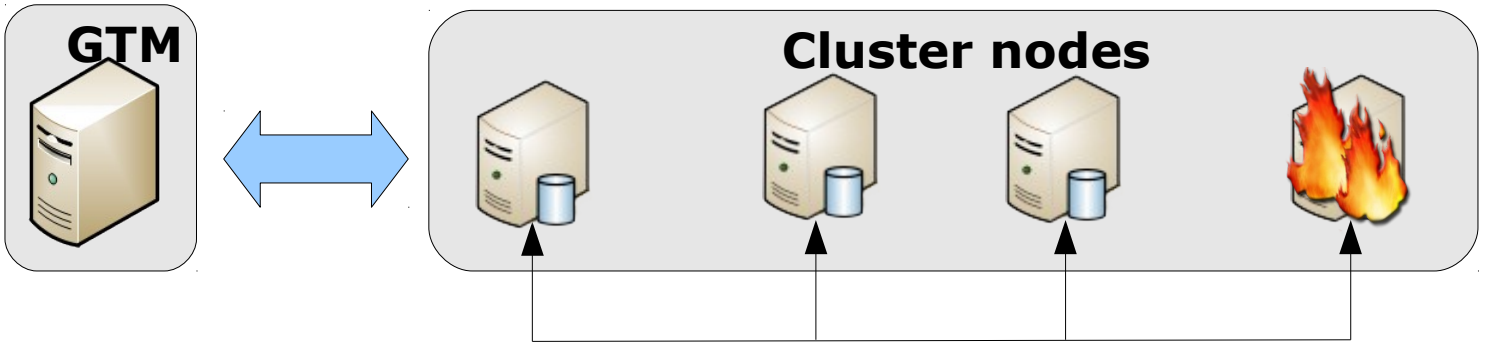


- Tests done with DBT-1 (TPC-W) benchmark with some minor modification to the schema
- 1 server = 1 coordinator + 1 datanode
- Coordinator is CPU bound
- Datanode is I/O bound
- CPU usage
  - Coordinator 30%
  - Datanode 70%

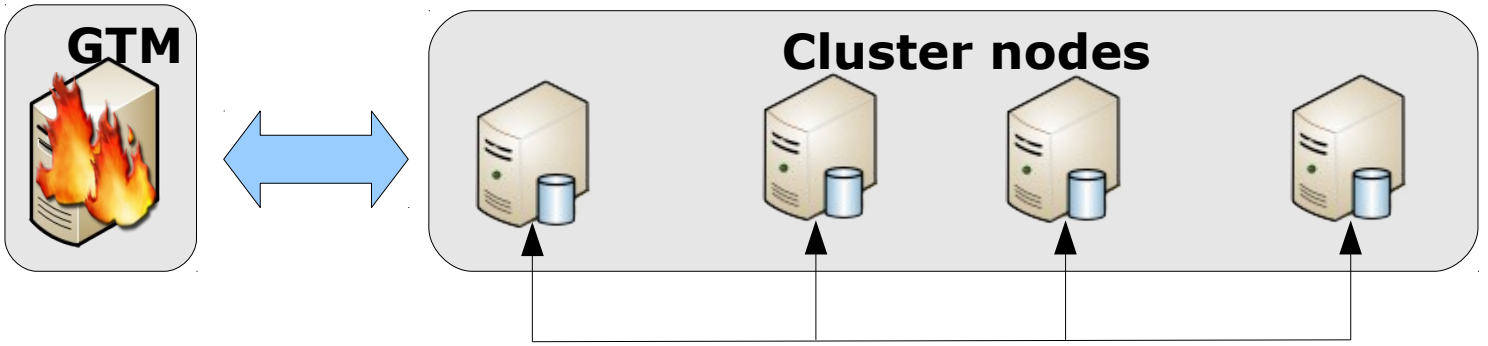
About high-availability

Cluster SPOF problem

- Datanode is a SPOF if it has a portion of distributed table.

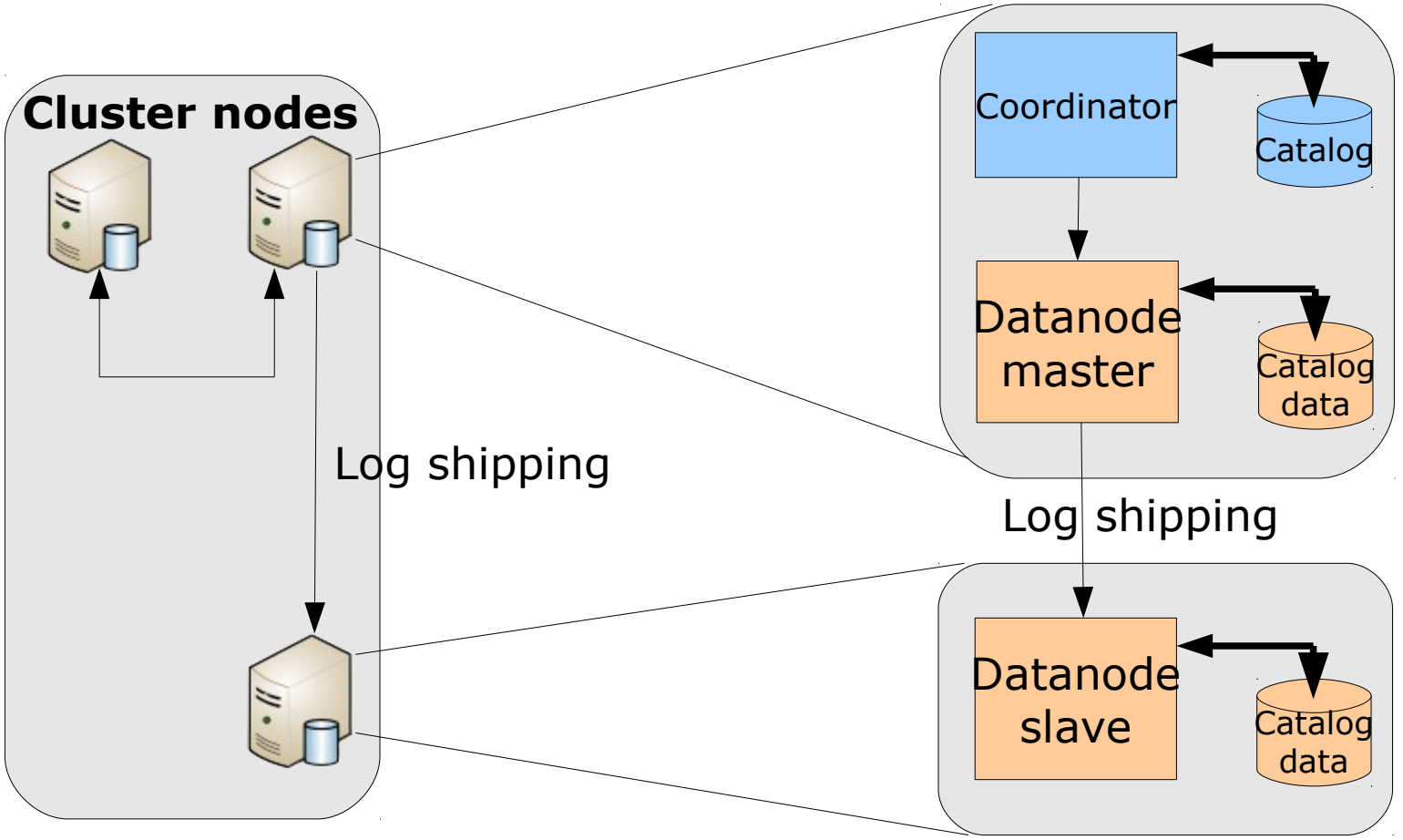


- GTM case



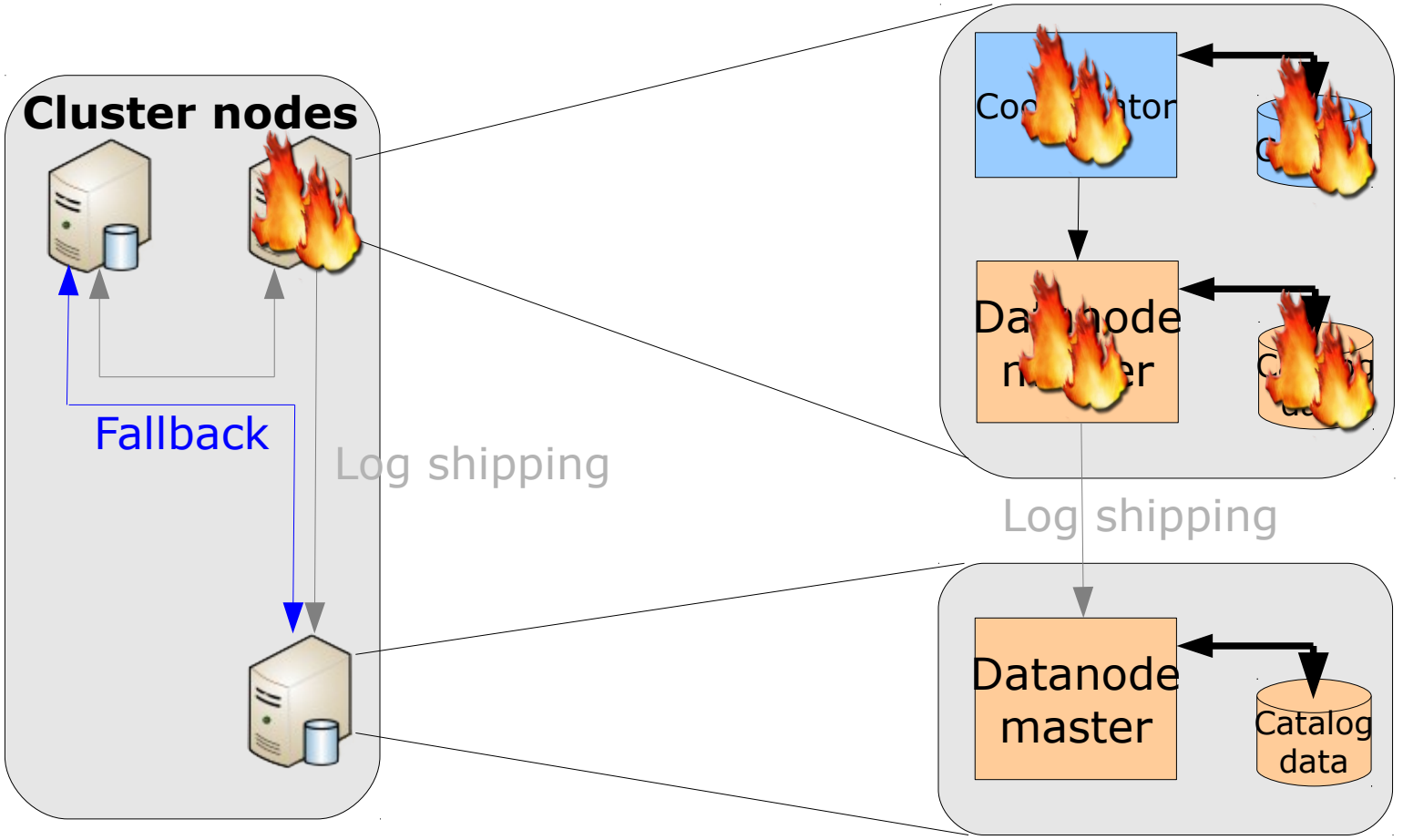
Datanode SPOF resolution (1)

- PostgreSQL 9.1 synchronous stream-rep



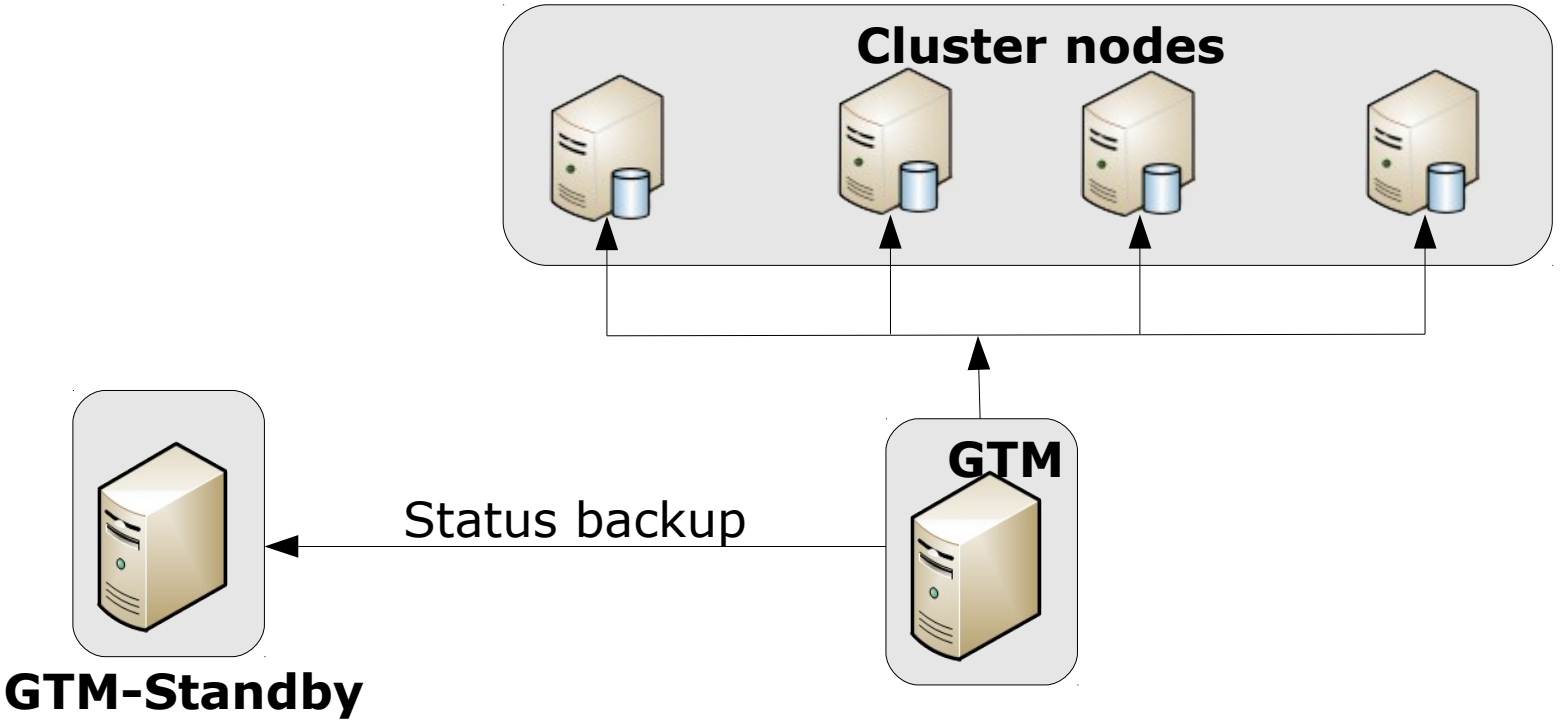
Datanode SPOF resolution (2)

- Fallback slave node



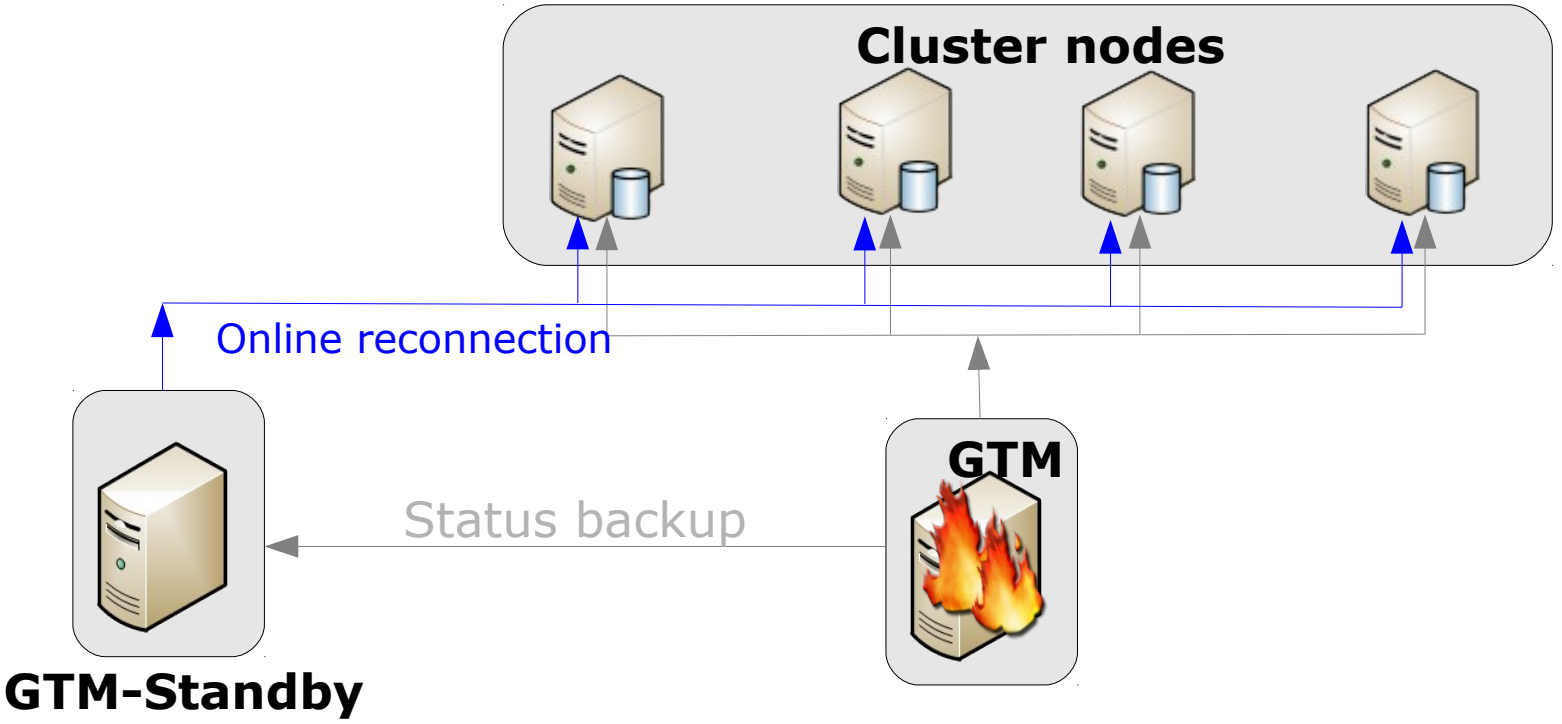
GTM SPOF resolution (1)

- Use of a standby for GTM



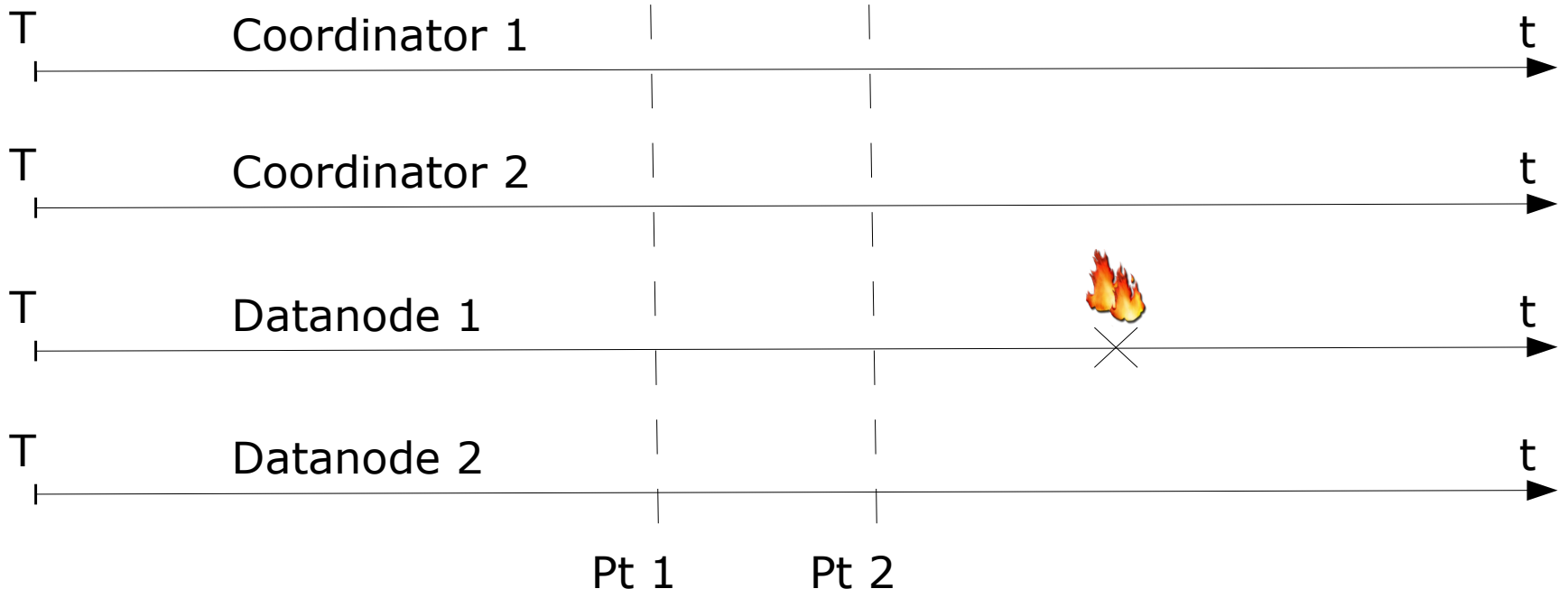
GTM SPOF resolution (2)

- Fallback to standby and reconnect nodes



PITR – requirements (1)

- PITR, Point in-time recovery
  - Rollback the database to a given past state
  - Need consistent points to restore shared-nothing nodes



PITR – requirements (2)

- Transaction status has to be consistent in the cluster
- Each transaction must be either:
  - Committed/Prepared/Aborted/Running on all the involved nodes
  - We must avoid cases where transaction is prepared and committed partially, or prepared and rollbacked partially
- Write record in WALs of all the coordinators and datanodes at a moment when all the transaction statuses are consistents.
- External Application can provide such timing as with BARRIER
  - *CREATE BARRIER barrier_id*
- BARRIER:
  - Waits that partially committed or aborted transactions commit (2PC)
  - Blocks all transaction commit when running a barrier
  - Still needs a timeout functionality
- When running PITR, specify recovery_target_barrier in recovery.conf

Release status
What now and next?

Current functionalities

- Up to 0.9.7 (current release of January 2012)
  - Based on PostgreSQL 9.1
  - 90%-92% of SQL
  - Major DDL/DML (TABLE, ROLE, VIEW, SELECT INTO, DEFAULT values)
  - General select support: support extension
    - HAVING, GROUP BY, ORDER BY, LIMIT, OFFSET, aggregate, window function, etc.
  - SQL-based cluster setting
  - Relation-size functions

About Postgres-XC 1.0

- Release on April 2012 (plan)
- Tablespace
- Triggers
- SERIAL
- Cluster bootstrap
- SELECT FOR UPDATE

After 1.0

- Node addition/removal
  - Move tuples from a node to another node
    - Ex: update of a distribution column
- Online server removal/addition
- Connection balancing between master and slave Datanodes for read transactions.
- SQL/MED, Foreign data wrapper (FDW) integration
- Installation, configuration, operation
- Global deadlock detection (global wait-for-graph)

Project ressources and contacts

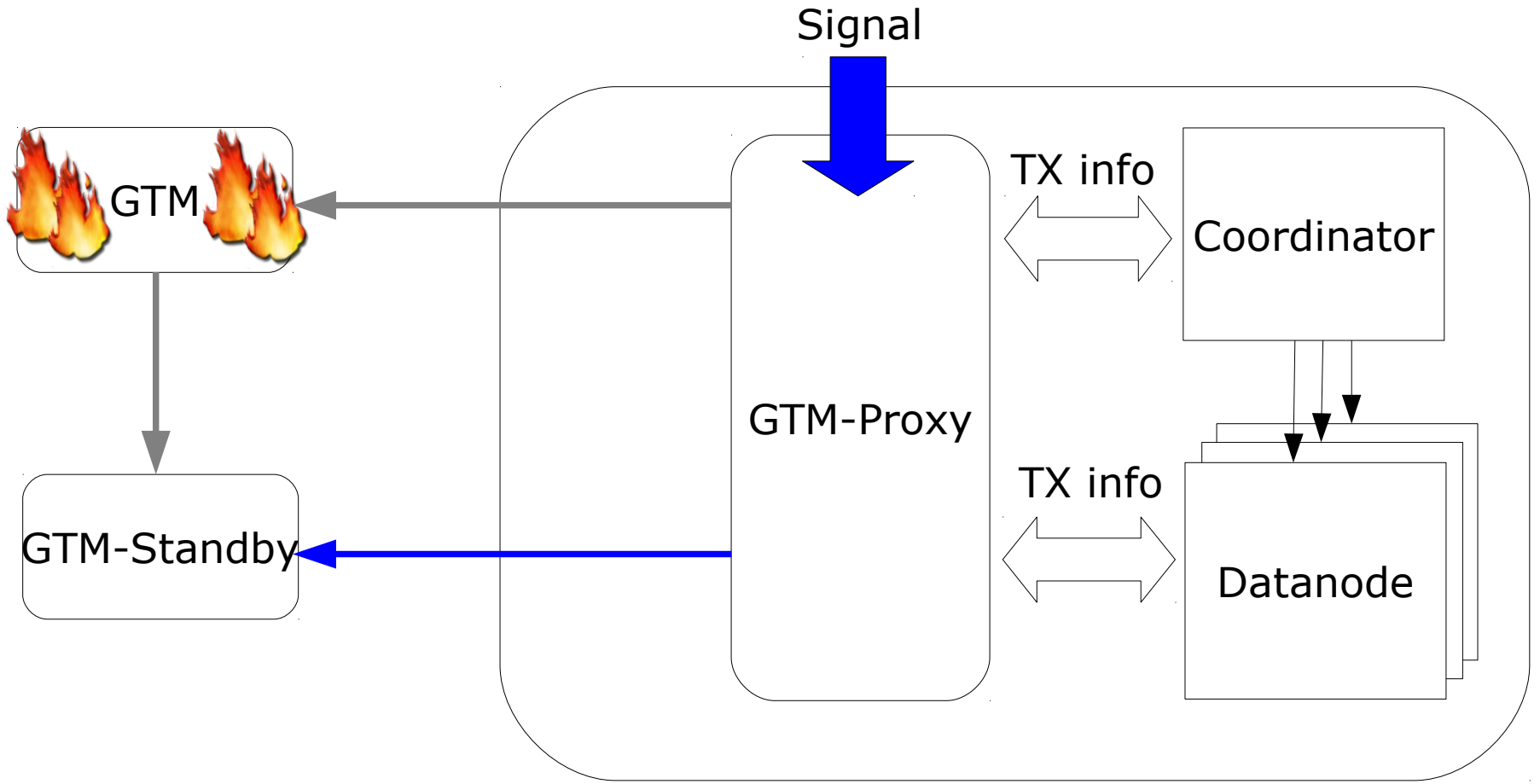
- Project home
  - http://postgres-xc.sourceforge.net
- Developer mailing list
  - postgres-xc-developers@lists.sourceforge.net
  - postgres-xc-general@lists.sourceforge.net
- Contacts
  - michael.paquier@gmail.com
  - koichi.szk@gmail.com
- Twitter: @michaelpq
- Blog: http://michael.otacoo.com

Sponsored and supported by:

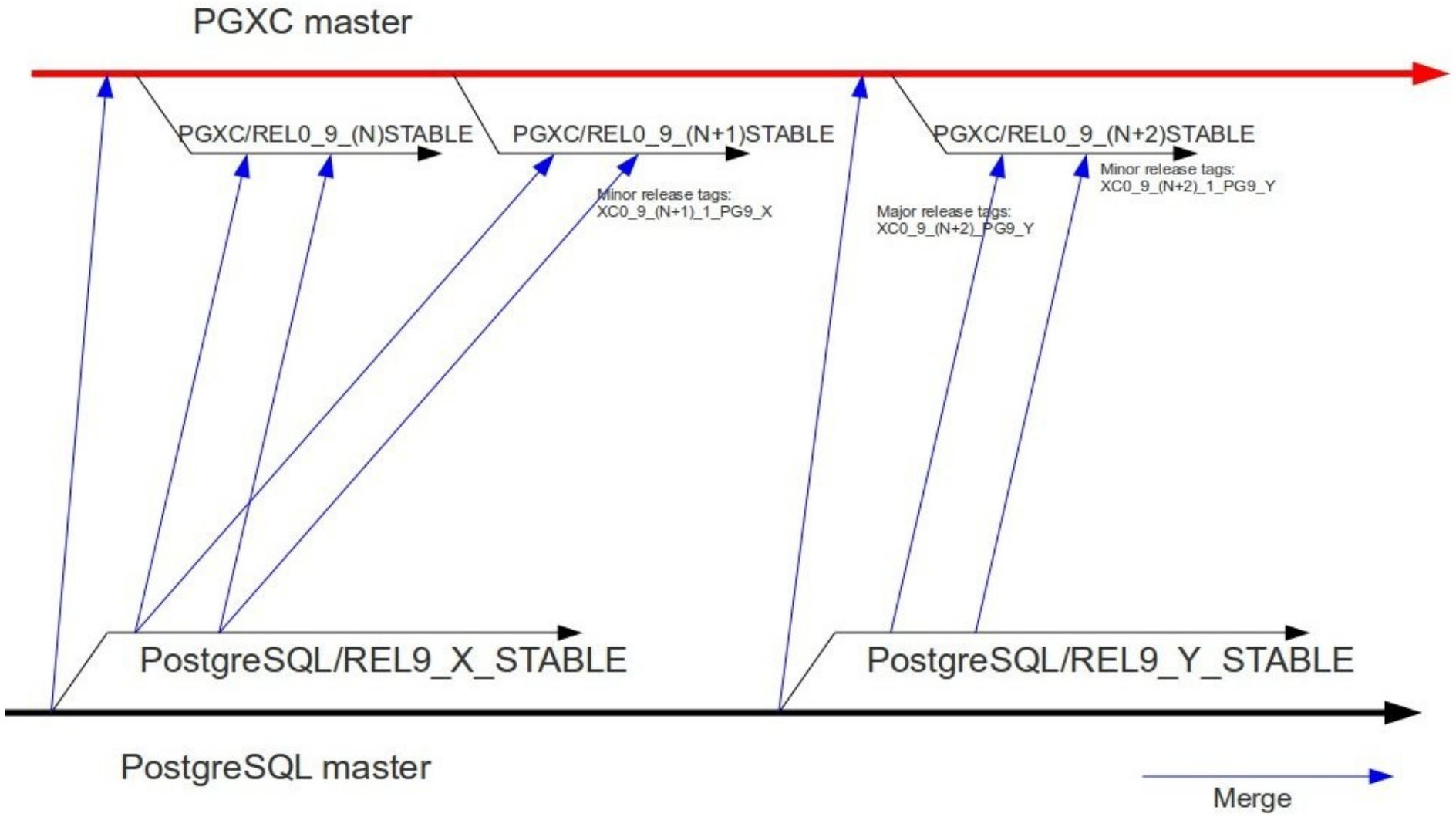
Thanks for your attention.
Questions?

GTM Proxy reconnection

- Signal GTM Proxy and reconnect nodes



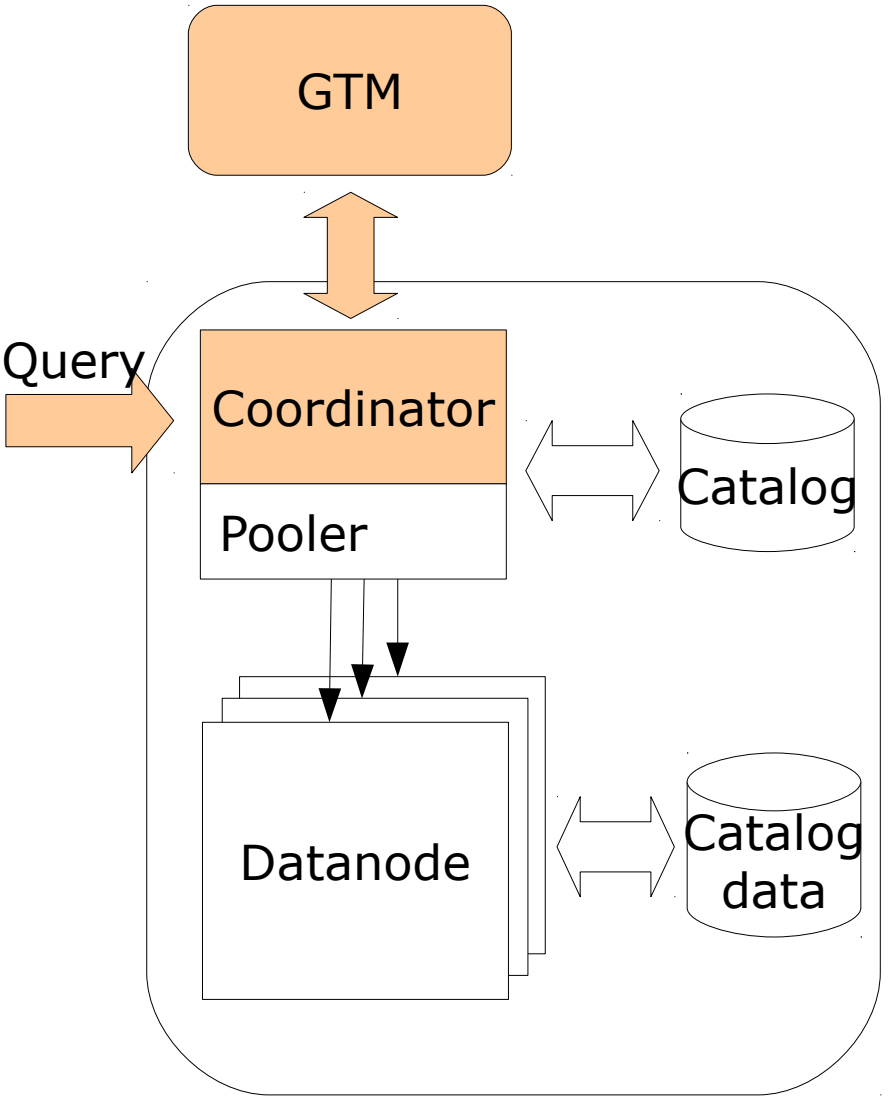
Release policy



Key algorithm

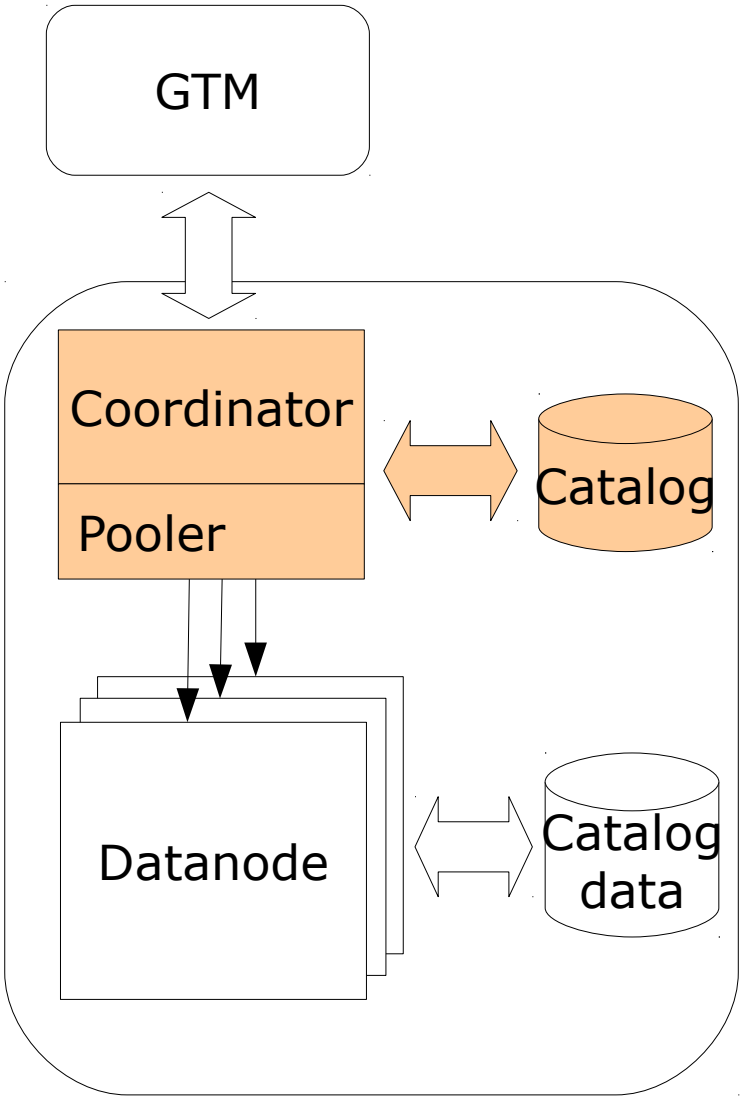
Query algorithm (1)

- Receive query from application
- Get snapshot, GXID and timestamp from GTM



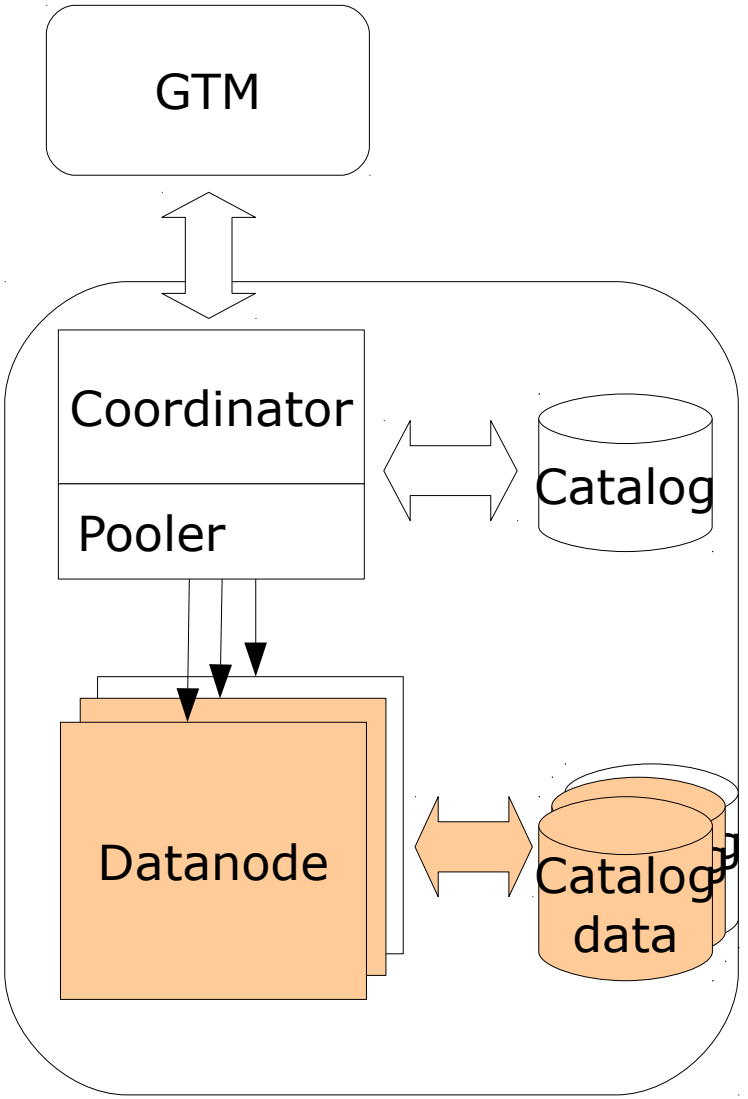
Query algorithm (2)

- Incoming statements: analyzer and rewriter
- Planning: analyze nodes to be involved. Build queries for local nodes (push down if necessary)



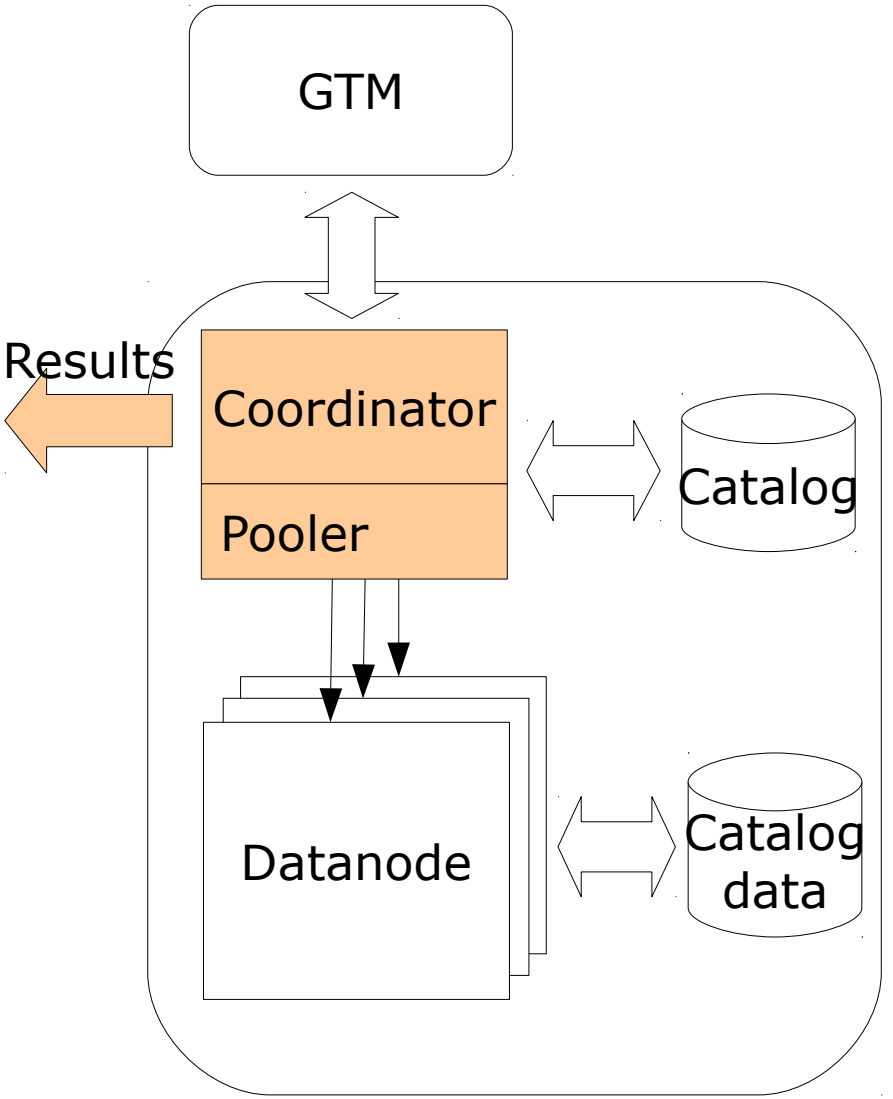
Query algorithm (3)

- Run queries on remote Datanodes and send back results to Coordinator

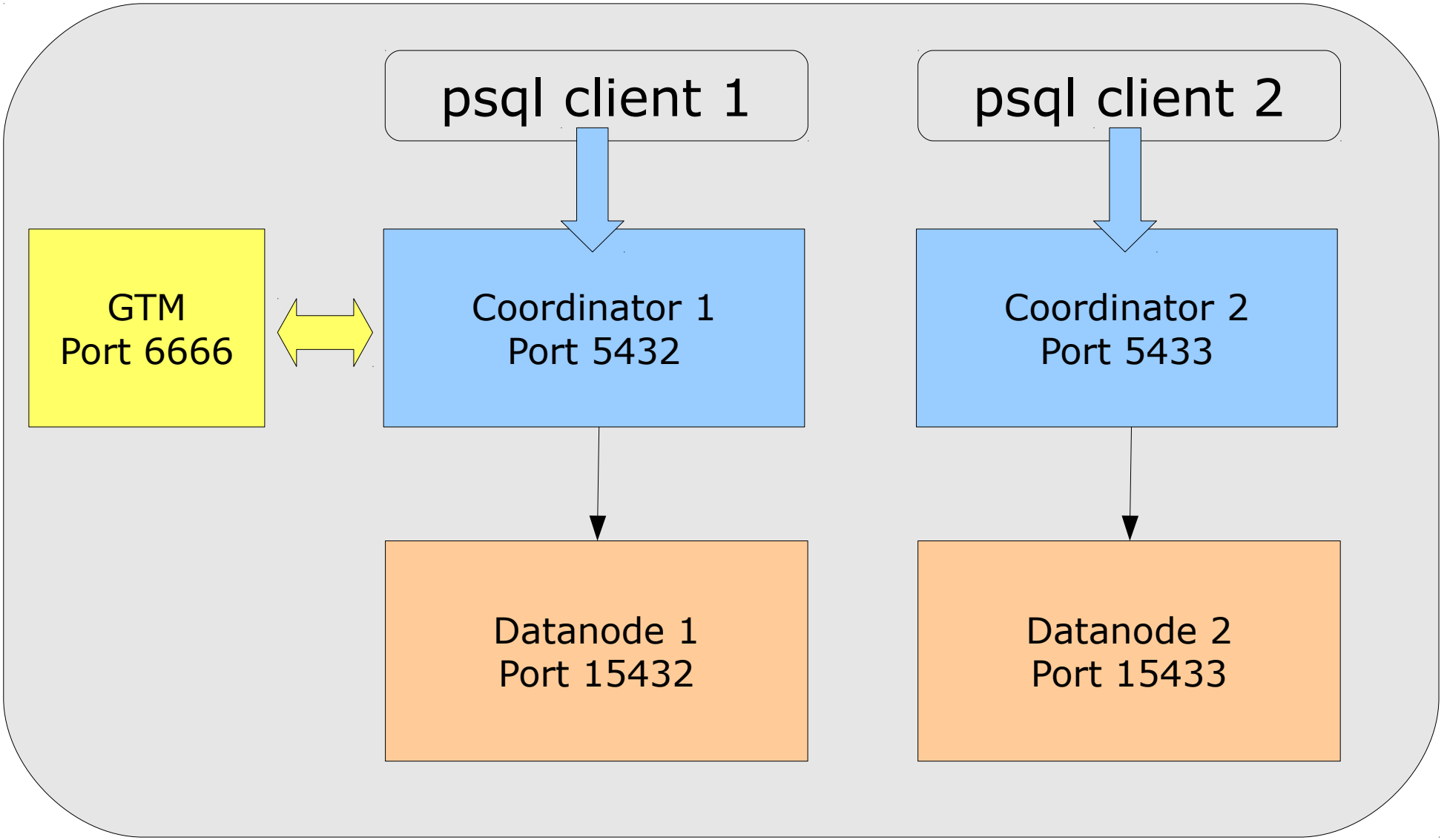


Query algorithm (4)

- Materialize results if necessary and send back to client



Demonstration



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