Logical Replication in PostgreSQL

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PostgreSQL

Whoami

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  - PostgreSQL developer and consultant
- PostgreSQL contributor for over a decade
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Logical Replication

- Target node is writeable
  - Allows temp tables
  - Allows different indexes
  - Allows different security
  - Allows data transformation
- Selective Replication
  - Can replicate subset of database
- Cross-version

History

Logical Replication History

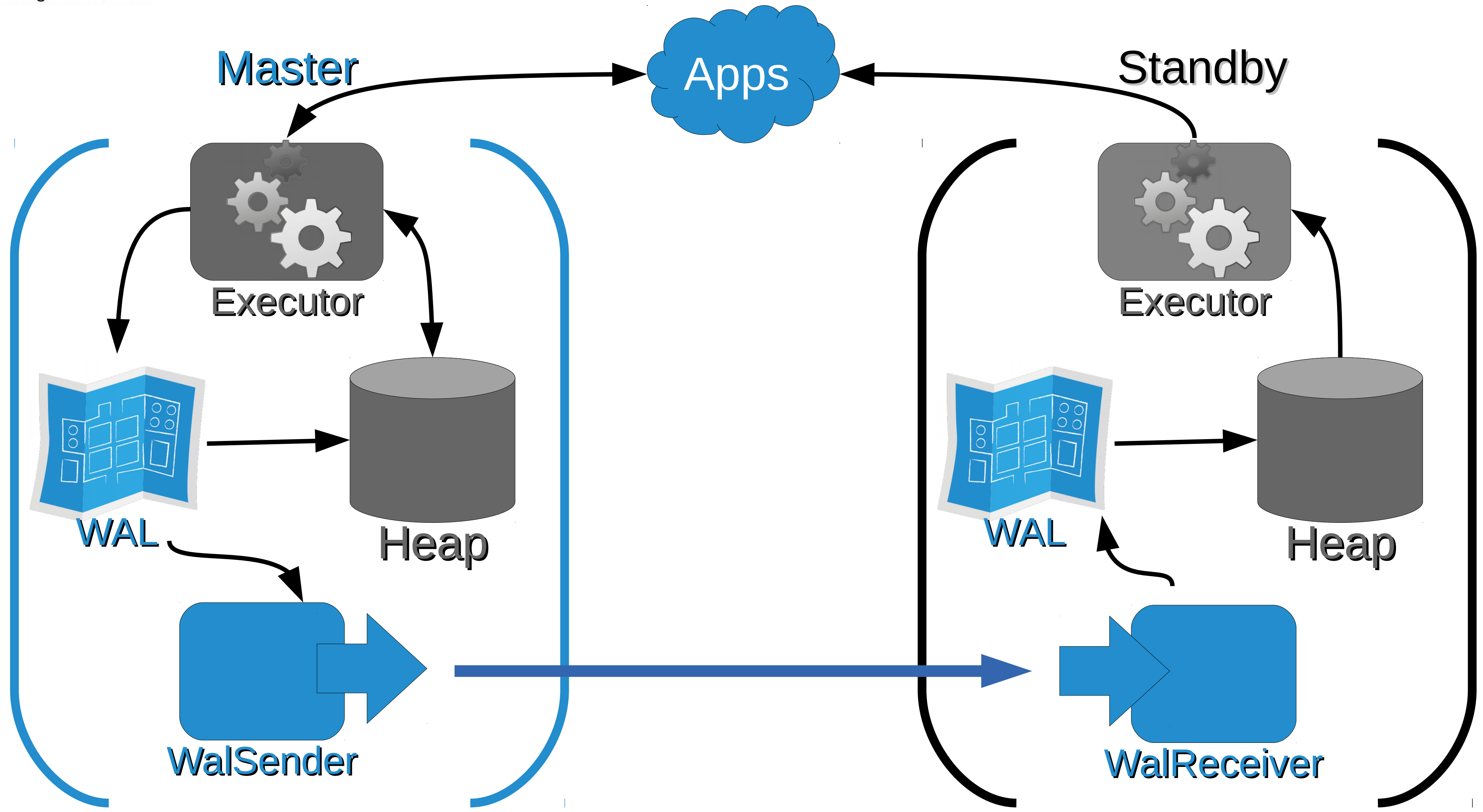
- Trigger based solutions
  - Slony (~2004)
  - Londiste (~2007)
- Run outside of the PostgreSQL
- Use table(s) as queue
  - Amplify load on the upstream
  - No sync replication
- Complex code to ensure commit order

Current Development

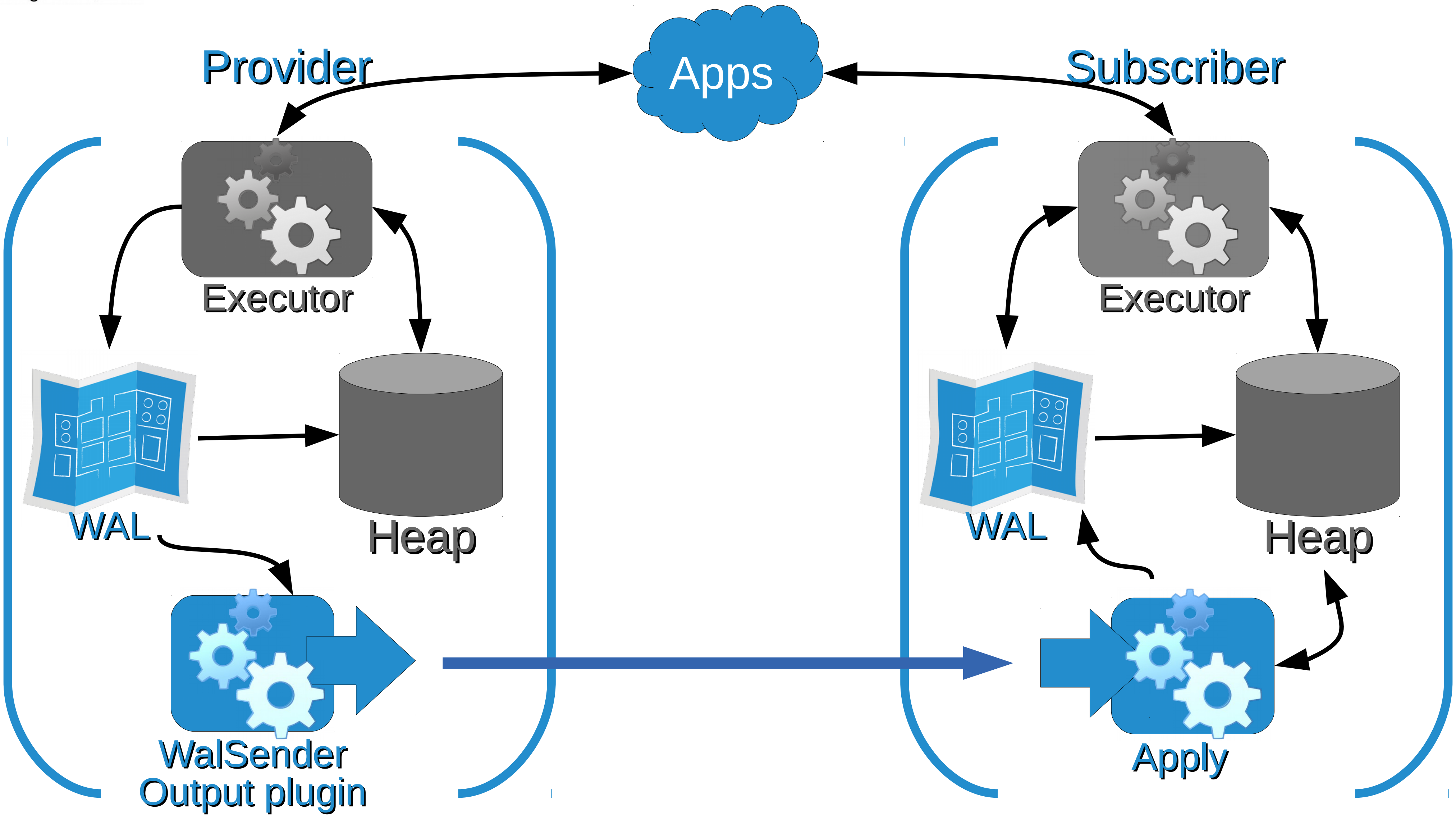
- BDR
  - Modified PostgreSQL 9.4 + extension
  - 9.6 coming soon (extension only)
  - Multi-master
  - Transparent DDL
- pglogical
  - Extension for 9.4+
  - Mostly for one way replication
  - Replacement for trigger-based solutions

Streaming Replication

Physical Streaming Replication

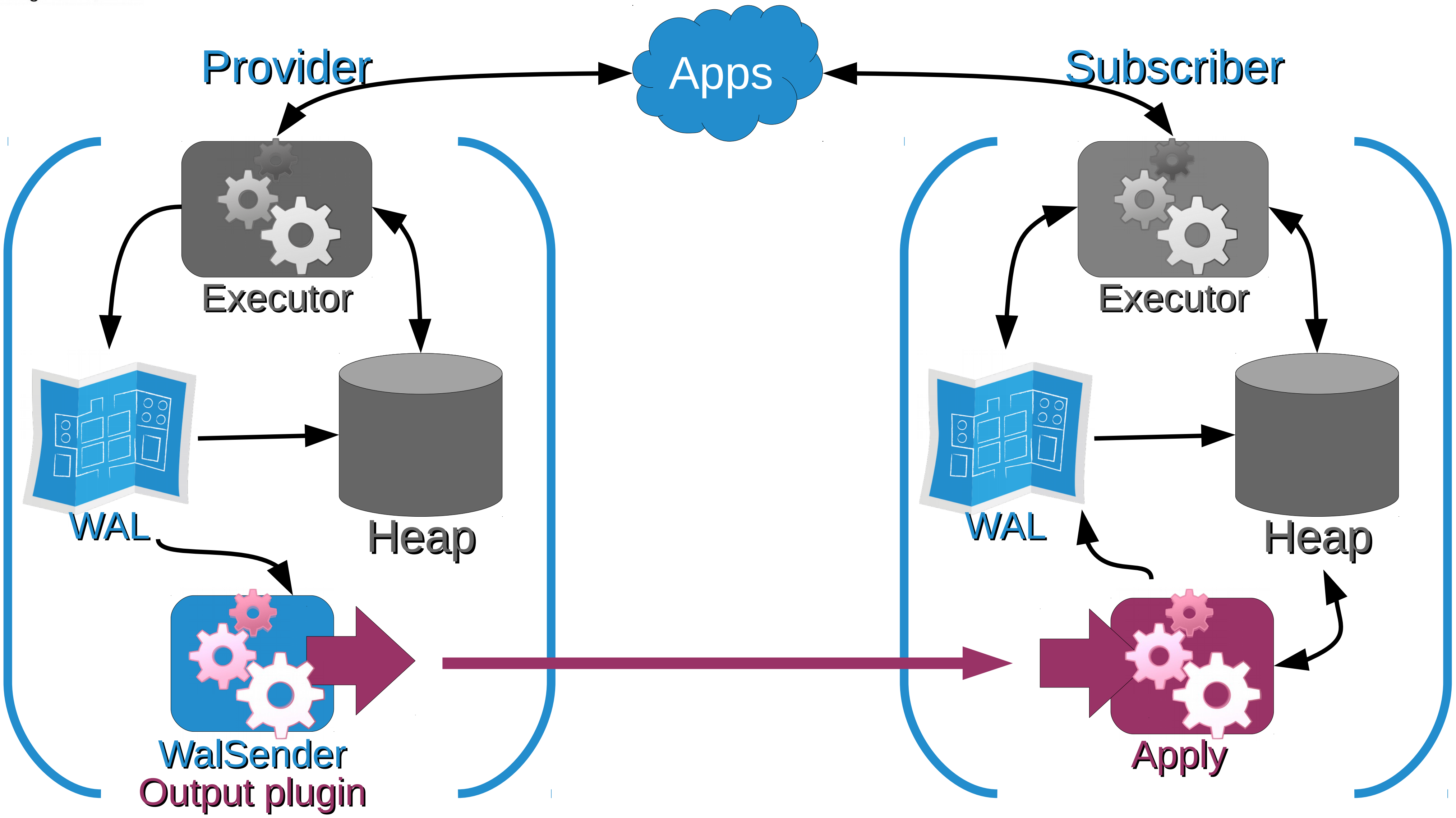


Logical Streaming Replication



pglogical

PGLogical


Provider
Apps
Subscriber
Executor
Executor
WAL
Heap
WAL
Heap
WalSender
Output plugin
Apply

pglogical

- Selective Replication
- Online Upgrade
- Data Transport
  - Data integration
  - Streaming changes to analytical database
  - Master configuration data management
  - ...
- Optionally synchronous apply

pglogical

- Installs as extension
  - Runs as part of PostgreSQL instance
  - All configuration is inside the database
- Uses logical decoding to read WAL
  - Minimal overhead on provider
  - Transactions are sent in commit order
- Executes triggers marked as ENABLE REPLICA on subscriber

Installation

- Extension
  - CREATE EXTENSION pglogical;
- Provider
  - create_node(‘myprovider’, ‘dbname=foo host=10.10.1.1’)
- Subscriber
  - create_node(‘mysubscriber’, ‘dbname=foo host=10.10.1.2’)
  - create_subscription(‘mysubscription’, ‘dbname=foo host=10.10.1.1’)

Replication Sets

- Replication is defined in terms of groups (sets) of tables, rather than individual tables
  - Need to be defined on each provider node
- Table is not replicated until added to a set
- Tables may be defined in more than one set, but changes for the table will only be sent **once** to each subscription

Replication Sets

- By default new replication sets replicate all actions
  - INSERT, UPDATE, DELETE, TRUNCATE
- It's possible to filter actions for given replication set
- Useful for data aggregation, data warehousing etc.
- Predefined sets, “default”, “default_insert_only”, “ddl_sql”

Table replication

- Add table to replication set
  - pglogical.replication_set_add_table(
    set_name := ‘default’,
    relation := ‘public.users’,
    synchronize_data := true);
- Full data resynchronization possible at later time
  - pglogical.alter_subscription_resynchronize_table
- Structure cannot be synchronized automatically yet

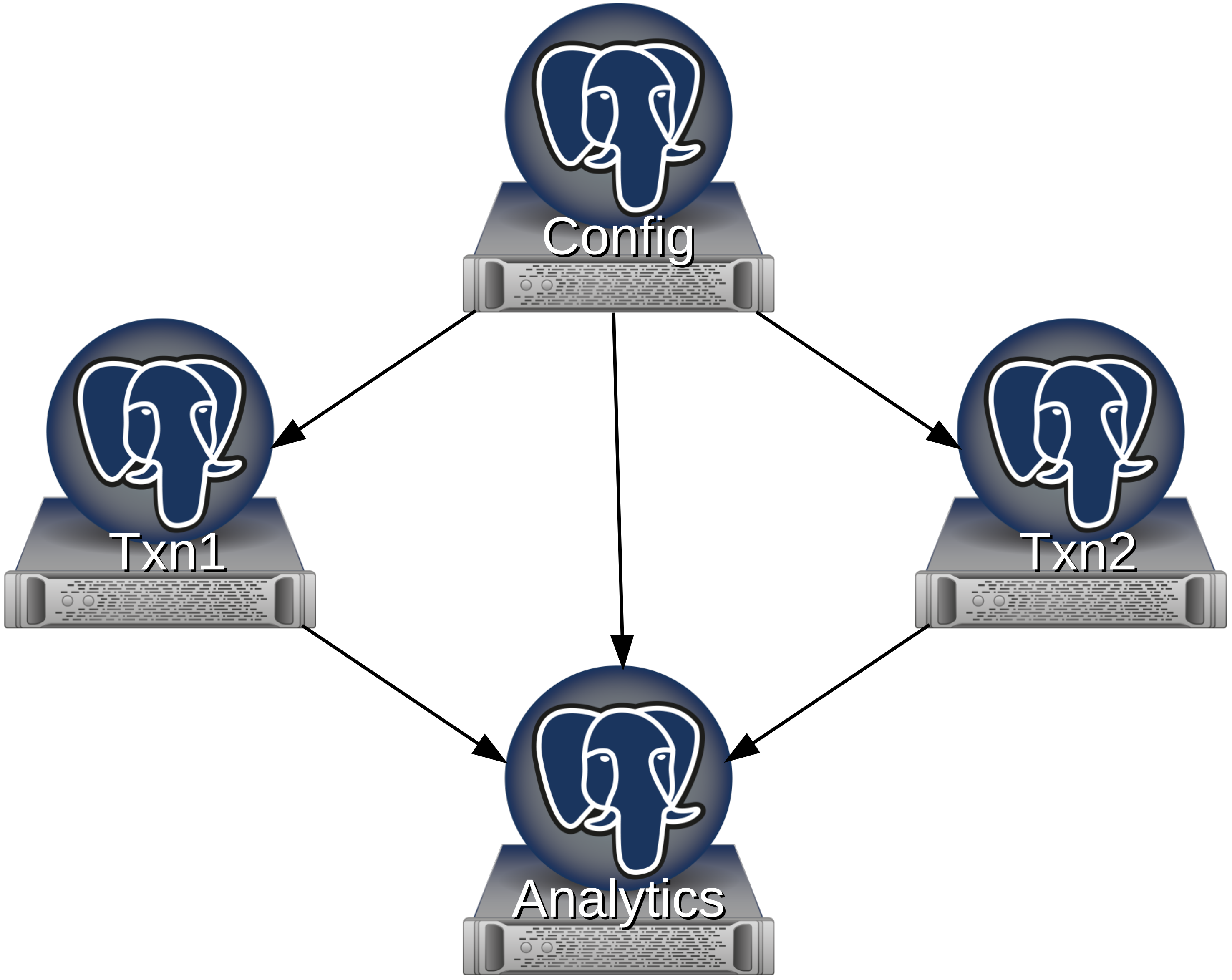
Sequences

- Replicated using replication sets just like tables
  - pglogical.replication_set_add_sequence
- Replicated periodically in bulk
- Dynamic buffering of last value
  - Subscriber is in front of the provider
  - This is similar to how Londiste replicates sequences

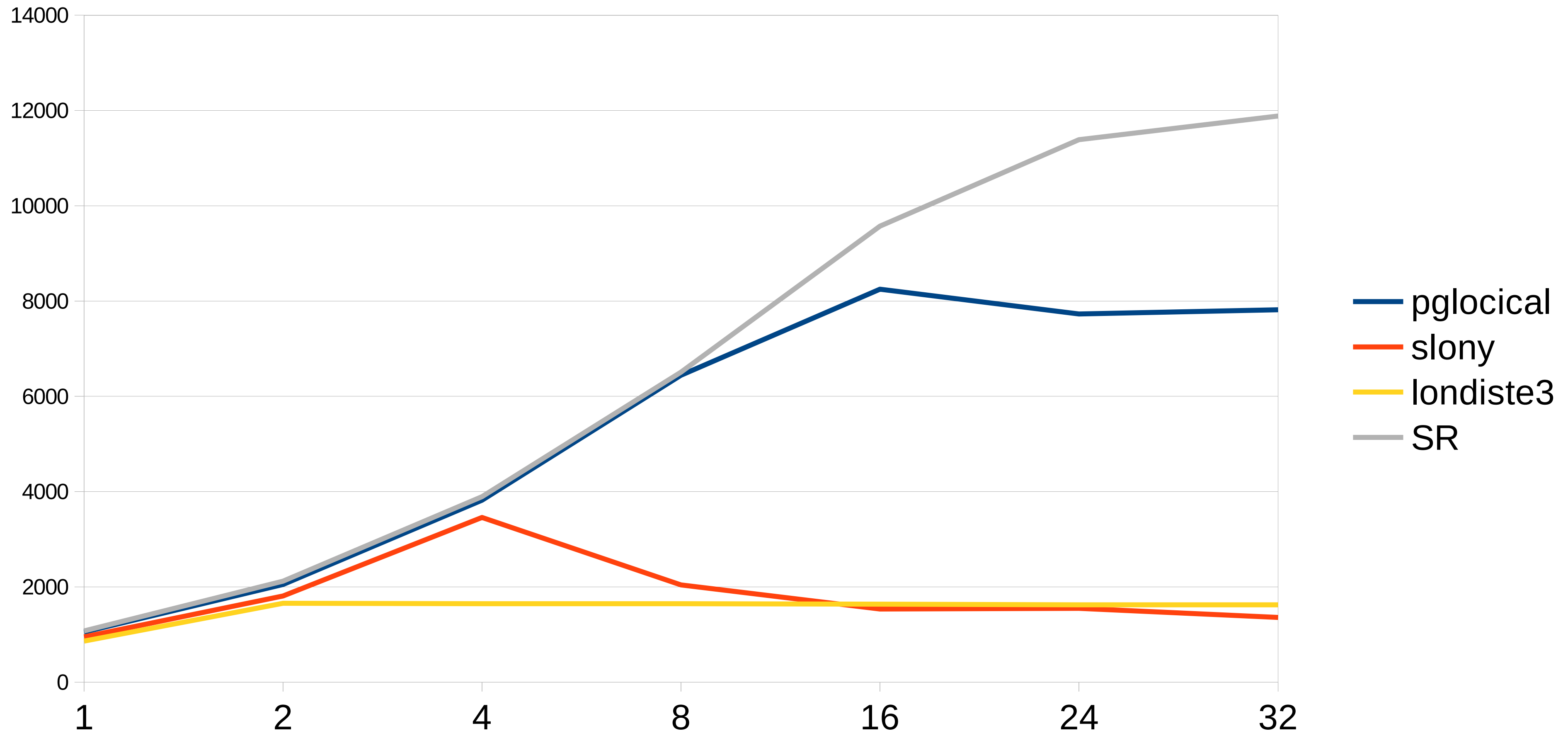
DDL Replication

- Initial schema either fully synchronized or not at all
- The DDL commands are not automatically replicated yet
- pglogical.**replicate_ddl_command**(
    command [, replication_sets])
  - replication_sets defaults to “ddl_sql”

Example setup



Performance (pgbench)



Caveats

- Big transactions may cause replication to lag
  - This is common problem for transactional replication systems
- Does not play well with physical replication yet
  - Failover
- Currently requires superuser

Future

pglogical 2.0

Column Filtering

- Add table to replication set
  - pglogical.replication_set_add_table(
    set_name := ‘default’,
    relation := ‘public.users’,
    columns := ‘{id,name,...}’);
- Array of replicated columns
- REPLICA IDENTITY columns required
- The table on subscriber does not need the extra columns

Row based Filtering

- Add table to replication set
  - pglogical.replication_set_add_table(
    set_name := ‘default’,
    relation := ‘public.users’,
    row_filter := ‘expression’);
- Standard SQL expression
- Same limitations as CHECK CONSTRAINT
- Executed during replication
  - Session variables of the replication connection

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Thanks!

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- https://2ndquadrant.com/en/pglogical/
- https://github.com/2ndQuadrant/pglogical