BDR and UDR

Andres Freund
PostgreSQL Contributor & Committer
Working at Citus Data

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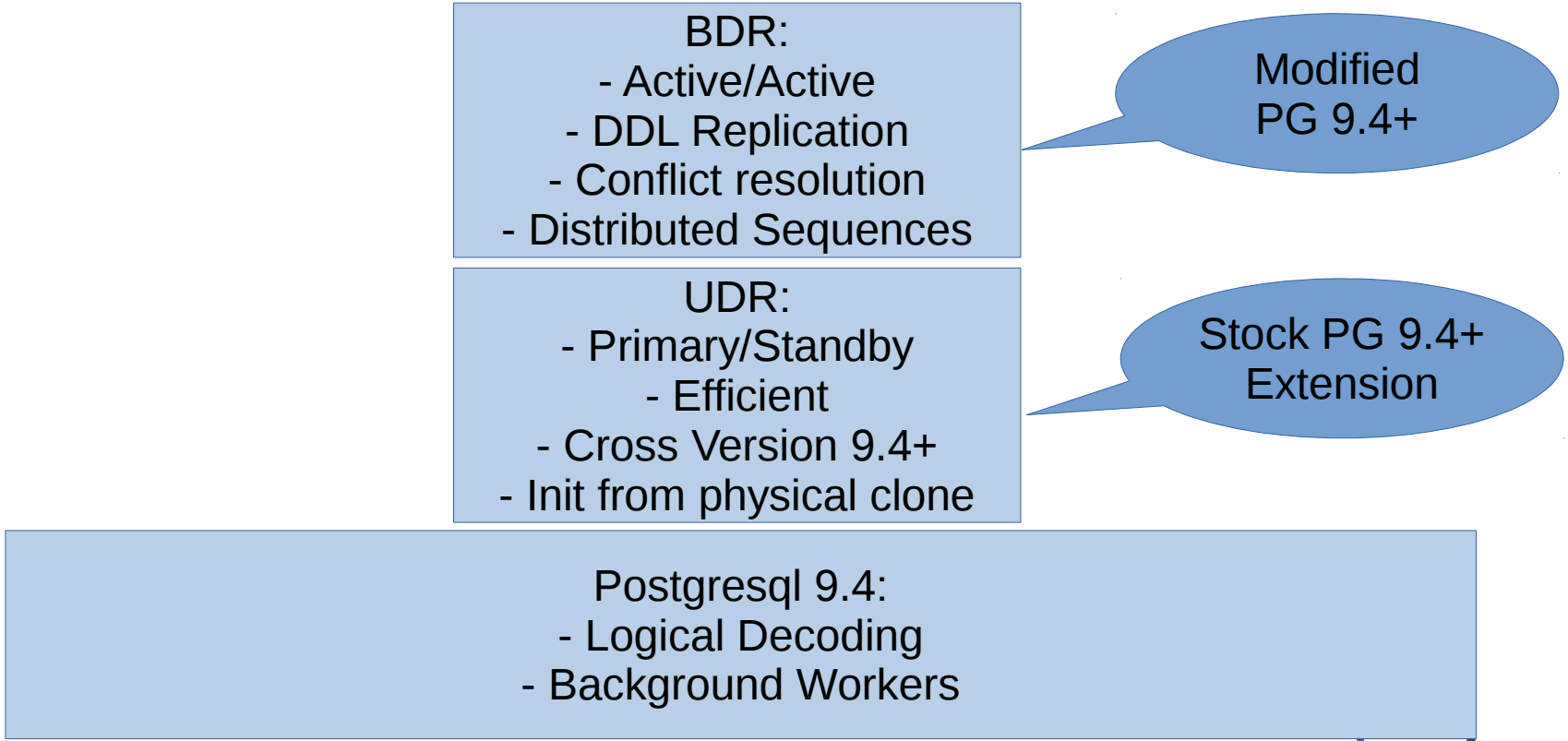
Logical Decoding

- AKA changeset extraction; change data capture
- All changes to a database in commit order
- Configurable output format
- Low level API
- Efficient
- More features than possible with pqg etc.

What are UDR/BDR

- Logical replication solutions
- Built on top of logical decoding
- We move as much as possible into core PG
- Database, or smaller, scope
- Created by 2ndQuadrant; with some external contributions
- Funding, amongst others, from Intel Security, Adyen

How do things fit together



Using UDR

1) Basic configuration on all nodes
2) Subscribe standby to primary
3) Subscribing clones all data, while writes are continuing to go on on the master
4) Cloning can be logical or physical

Prerequisite Configuration

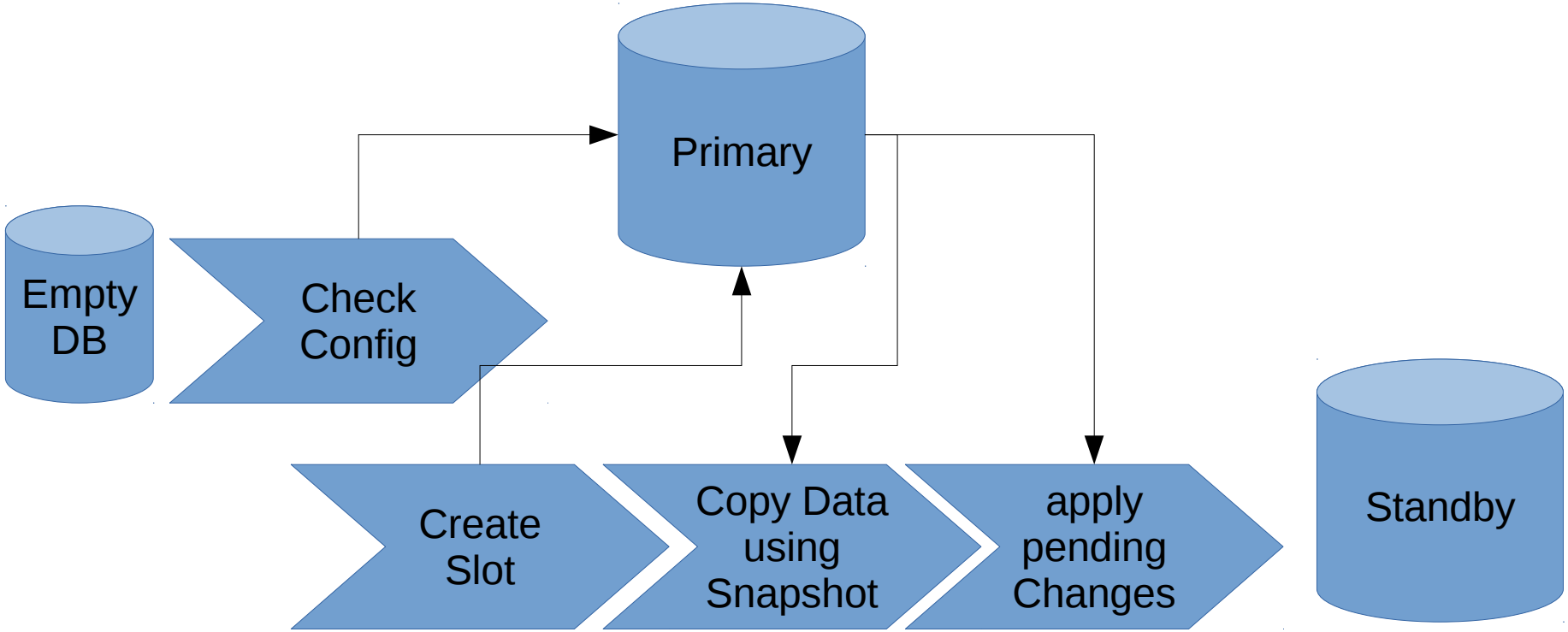
- `max_wal_senders = 10`
- `max_replication_slots = 10`
- `shared_preload_libraries = 'bdr'`
- `wal_level = 'logical'`
- Replication access in pg_hba.conf

Preparing the Primary

```
Postgres=# SHOW wal_level;
postgres=# SHOW max_replication_slots;
postgres=# CREATE EXTENSION btree_gist;
postgres=# CREATE EXTENSION bdr;
postgres=# CREATE TABLE testtable(key text primary key);
postgres=# INSERT INTO testtable(key) VALUES ('a');
```

Creating the Standby

```
postgres=# CREATE EXTENSION btree_gist;
postgres=# CREATE EXTENSION bdr;
postgres=# SELECT bdr.bdr_subscribe(
    local_node_name := 'node-standby-01',
    subscribe_to_dsn := 'host=primary',
    node_local_dsn := 'host=standby-01'
);
postgres=# bdr.bdr_node_join_wait_for_ready();
Postgres=# \d testtable
```


Primary
Empty DB
Check Config
Create Slot
Copy Data using Snapshot
apply pending Changes
Standby

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Executing DDL

```
postgres=# CREATE TABLE fail();
postgres=# SELECT bdr.bdr_replicate_ddl_command($DDL$
    CREATE TABLE public.nofail();
$DDL$);
```

Uncouple Standby

```
postgres=# SELECT bdr.bdr_part_by_node_names(
    ARRAY['node-standby-01']
);
```

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Replication Sets – The Why

- Often only part of the data is import
  - Session tables, long lived temp tables, log data
- Different destinations want different data
  - Local Availability: everything
  - Failover to other DC: important data

Replication Sets – What & How

- Every table can be in multiple sets
- Every subscriber can subscribe to one or more sets
- The '`default`' set contains all tables without explicit configuration
- The '`all`' set …

Replicating Sets

```
postgres=# SELECT bdr.bdr_subscribe(
    local_node_name := 'node-standby-01',
    subscribe_to_dsn := 'host=primary',
    node_local_dsn := 'host=standby-01',
    replication_sets := ARRAY['default', 'important']
);
```

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Configuring Tables

```
postgres=# CREATE TABLE users(...);
postgres=# CREATE TABLE logins(...);
postgres=# CREATE TABLE sessiondata(... );
/* cloned here */
postgres=# bdr.table_set_replication_sets('
 'sessiondata', ARRAY['volatile']);
postgres=# bdr.table_set_replication_sets('
 'users', ARRAY['important']);
postgres=# bdr.table_set_replication_sets('
 'logins', ARRAY['logdata', 'volatile']);
```

Replication Sets – Caveat!

- All tables are cloned initially
- Only subscribed to tables are updated
- Changing set subscription requires a restart
- No builtin re-synchronization after set changes

BDR

- Very similar!
- No master, no subscription to a single node
- First node: create group
- Further nodes: join group

Prerequisite Configuration

- `max_wal_senders = 10`
- `max_replication_slots = 10`
- `shared_preload_libraries = 'bdr'`
- `wal_level = 'logical'`
- Replication access in pg_hba.conf
- `track_commit_timestamps = on`
- `bdr.log_conflicts_to_table = on`

Create BDR Group:

```
postgres=# CREATE EXTENSION btree_gist;
postgres=# CREATE EXTENSION bdr;
postgres=# SELECT bdr.bdr_group_create(
    local_node_name := 'node-01',
    node_external_dsn := 'host=node-01');
```

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Join BDR Group:

```
postgres=# CREATE EXTENSION btree_gist;
postgres=# CREATE EXTENSION bdr;
postgres=# SELECT bdr.bdr_group_join(
    local_node_name := 'node-02',
    node_external_dsn := 'host=node-02',
    join_using_dsn := 'host=node-01',
);
\c another host
postgres=# SELECT bdr.bdr_group_join(
    local_node_name := 'node-03',
    node_external_dsn := 'host=node-03',
    join_using_dsn := 'host=node-01',
);
```

Executing DDL

```
postgres=# CREATE TABLE nofail();
postgres=# ALTER TABLE nofail ADD COLUMN bar text;
```

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DDL Replication

- Most database local objects can be replicated
- If not: ERROR
- Global schema lock
- Cluster wide objects can't be replicated!
- Important infrastructure in 9.5! UDR will be able to do it!

Conflicts

- Asynchronous Multi-Master => Conflicts
- Last update wins using unambiguous timestamps
- Conflict triggers/handlers
- Conflicts can be logged to log table

Distributed Sequences

- `CREATE/ALTER SEQUENCE … USING bdr;`
- Chunked sequence allocations
  - Node 01: 1-1000, 3001-4000
  - Node 02: 2001-3000
- Chunks are pre-allocated
- Integrate abstraction into 9.6?

Monitoring

- bdr.pg_stat_bdr
- bdr.bdr_node_slots
- pg_replication_slots
- pg_stat_replication
- bdr.bdr_conflict_history

Physical Copy

- `bdr_init_copy`
- Uses pg_basebackup or existing basebackup
- Only one database setup for replication
- Works while writes are in progress:
  - create base backup
  - create logical slots
  - physical catchup
  - logical catchup

Cross Version Upgrades

- Rolling upgrades, yay!
- Replication protocol version independent
- Fallback to less efficient transport across versions
- DDL replication is harder across versions
- Works with logical clone
- Some work remains for physical clones

When to use BDR

- easier failover/failback
- globally distributed, latency sensitive, applications
-

Where are we going?

- More granular clones/recloning tables upon set changes
- Doc improvements
- Usability improvements
- DDL replication for UDR 9.5
- “2PC Multi-Master” => optional conflict free apply
- Propose minimal version, infrastructure, for integration

Resources

- Docs: bdr-project.org/docs
- Product info: bdr-project.org
- Support available by 2ndQ
- Bugs: github.com/2ndQuadrant/bdr/issues/
- Slides: anarazel.de/talks/sfpug-2015-05-26/bdr-udr.pdf