

Major Features: Postgres 10

BRUCE MOMJIAN



POSTGRES SQL is an open-source, full-featured relational database. This presentation gives an overview of the Postgres 10 release.

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Last updated: February, 2018

Postgres 10 Feature Outline

1. Logical replication
2. Partitioning syntax
3. Crash-safe, faster, and replicated hash indexes
4. ICU library
5. Quorum commit
6. Progress on parallelism
7. Multi-column statistics
8. pg_stat_activity improvements
9. SCRAM-SHA-256 authentication
10. FDW aggregate pushdown
11. More

Full item list at <https://www.postgresql.org/docs/devel/static/release-10.html>

1. Logical Replication

| Cluster 1, port 5432, database 'test' | Cluster 2, port 5433, database 'test' |
|--|--|
| <pre>\$ psql -p 5432 -c 'ALTER SYSTEM SET wal_level = 'logical';' test</pre> | |
| <pre>\$ pg_ctl -p 5432 restart</pre> | |
| <pre>\$ psql -p 5432 test</pre> | <pre>\$ psql -p 5433 test</pre> |
| <pre>CREATE TABLE test (x INT PRIMARY KEY);</pre> | <pre>CREATE TABLE test (x INT PRIMARY KEY);</pre> |
| <pre>INSERT INTO test VALUES (1);</pre> | |
| <pre>CREATE PUBLICATION mypub FOR TABLE test;</pre> | |
| | <pre>CREATE SUBSCRIPTION mysub CONNECTION 'dbname=test port=5432' PUBLICATION mypub;</pre> |

Logical Replication in Action

| Cluster 1 | Cluster 2 |
|------------------------------|-------------------------------|
| | SELECT * FROM test; 1 |
| INSERT INTO test VALUES (2); | |
| | SELECT * FROM test; 1 2 |

Benefits of Logical Replication

Logical replication allows:

- ▶ table-level granularity
- ▶ replication from multiple clusters to a single cluster (aggregation)
- ▶ replication of a single table to multiple clusters (broadcasting)
- ▶ replication and upgrades between major Postgres versions
- ▶ creation of local objects on subscribers, e.g. tables, indexes

2. Partitioning Syntax

```
CREATE TABLE numbers (x INTEGER) PARTITION BY RANGE (x);  
CREATE TABLE negatives PARTITION OF numbers FOR VALUES FROM (UNBOUNDED) TO (0);  
CREATE TABLE positives PARTITION OF numbers FOR VALUES FROM (0) TO (UNBOUNDED);
```

Partition Table Structure

\d+ numbers

```
Table "public.numbers"  
Column | Type | Collation | Nullable | Default | ...  
-----+-----+-----+-----+-----+...  
x      | integer |          | not null |          | ...
```

Partition key: RANGE (x)

Partitions: negatives FOR VALUES FROM (UNBOUNDED) TO (0),
positives FOR VALUES FROM (0) TO (UNBOUNDED)

\d negatives

```
Table "public.negatives"  
Column | Type | Collation | Nullable | Default  
-----+-----+-----+-----+-----  
x      | integer |          | not null |
```

Partition of: numbers FOR VALUES FROM (UNBOUNDED) TO (0)

\d positives

```
Table "public.positives"  
Column | Type | Collation | Nullable | Default  
-----+-----+-----+-----+-----  
x      | integer |          | not null |
```

Partition of: numbers FOR VALUES FROM (0) TO (UNBOUNDED)

Tuple Routing

```
INSERT INTO numbers VALUES (-4), (-1), (7), (12);
```

```
SELECT * FROM numbers;
```

```
x  
----  
-4  
-1  
7  
12
```

```
SELECT * FROM negatives;
```

```
x  
----  
-4  
-1
```

```
SELECT * FROM positives;
```

```
x  
----  
7  
12
```


Partitioning Benefits and Limitations

Partitioning does:

- ▶ Create proper child constraints
- ▶ Route parent INSERTs into child tables

Partitioning does not yet:

- ▶ Hash partitioning
- ▶ Create child tables for values not already covered (it errors instead)
- ▶ Move updated rows that no longer match the partition constraints (it errors instead)
- ▶ Prune child tables faster than PG 9.6
- ▶ Perform executor-stage partition pruning
- ▶ Perform parallel partition processing

3. Crash-Safe, Faster, and Replicated Hash Indexes

Hash indexes is now a first-class feature:

- ▶ Crash safe
- ▶ Replicated
- ▶ Reduced locking during bucket splits
- ▶ Faster lookups
- ▶ More even index growth
- ▶ Single-page pruning

4. ICU Library

- ▶ Uses ICU library instead of OS-supplied internationalization library
- ▶ Allows detection of collation changes that can affect index ordering
- ▶ Enabled via `configure --with-icu`

5. Quorum Commit

- ▶ `synchronous_standby_names = FIRST 1 (s1, s2)` continues when the first active standby replies (pre-10 behavior)
- ▶ Now `synchronous_standby_names = ANY 1 (s1, s2)` continues when the any server from the list replies
- ▶ `synchronous_standby_names = ANY 2 (s1, s2, s3)` is also possible
- ▶ Called quorum commit

6. Progress on Parallelism

Parallelism is now supported in:

- ▶ Btree index scans
- ▶ Bitmap heap scans
- ▶ Merge joins
- ▶ Procedural languages

7. Multi-Column Statistics

- ▶ Previously, `WHERE a=1 AND b=1` multiplied the probabilities of the two columns, assuming they were unrelated
- ▶ Now `CREATE STATISTICS ... WITH (dependencies)` records multi-column correlation
- ▶ The correlation is used when combining single-column probabilities

8. pg_stat_activity Improvements

- ▶ Additional wait tracking
 - ▶ client reads, writes
 - ▶ server reads, writes, fsyncs
 - ▶ synchronous replication
- ▶ Additional process display
 - ▶ auxiliary processes
 - ▶ worker processes
 - ▶ WAL senders

pg_stat_activity Example

```
SELECT wait_event_type, wait_event, count(*)
FROM pg_stat_activity
WHERE backend_type = 'client backend'
GROUP BY wait_event_type, wait_event
ORDER BY 1, 2;
```

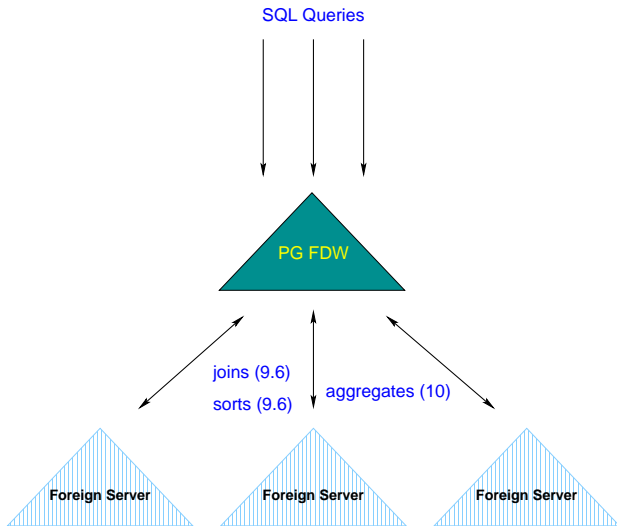
| wait_event_type | wait_event | count |
|-----------------|---------------|-------|
| Client | ClientRead | 2 |
| IO | DataFileWrite | 1 |
| Lock | transactionid | 3 |
| LWLock | WALWriteLock | 19 |
| | | 8 |

9. SCRAM-SHA-256 Authentication

SCRAM-SHA-256 provides a more secure password authentication method than MD5:

- ▶ Make packet replay more difficult (MD5 has a 50% probability of repeating after 64k connections)
- ▶ Make stolen hashed password reuse more difficult
- ▶ Make brute-force attacks more difficult

10. FDW Aggregate Pushdown



11. More

- ▶ Restrictive row-level security policies, provides AND/required policies
- ▶ AFTER trigger transition tables
- ▶ Full text search support for JSON and JSONB
- ▶ Default permissions on schemas
- ▶ Multiple libpq-specified host names, plus write-mode filter

Pending Postgres 11 Features

- ▶ Procedures with transaction control
- ▶ JIT compilation of the executor
- ▶ Parallel query improvements, e.g. parallel CREATE INDEX
- ▶ Partitioning
 - ▶ hash partitioning
 - ▶ partition-wise join, benefits joins between identically-partitioned tables
 - ▶ executor-stage partitioning, benefits join pruning and prepared queries
 - ▶ partition key updates move affected rows to their new partition
 - ▶ default partitioning are committed
 - ▶ foreign keys pointing to a partitioned table

Current as of 2018-01-17

Conclusion



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