PostgreSQL 10

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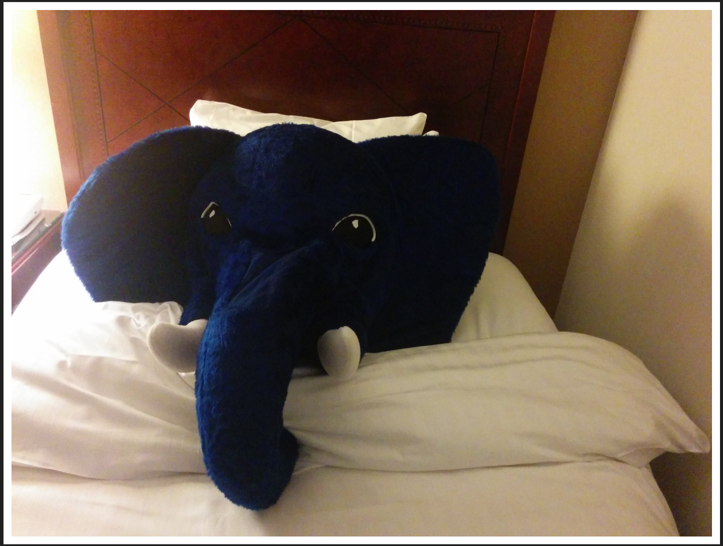

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- Redpill Linpro
  - Principal database consultant
- PostgreSQL
  - Core Team member
  - Committer
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PostgreSQL 10

A new era of versioning

Versioning

- …
- 8.4
- 9.0
- …
- 9.4
- 9.5
- 9.6

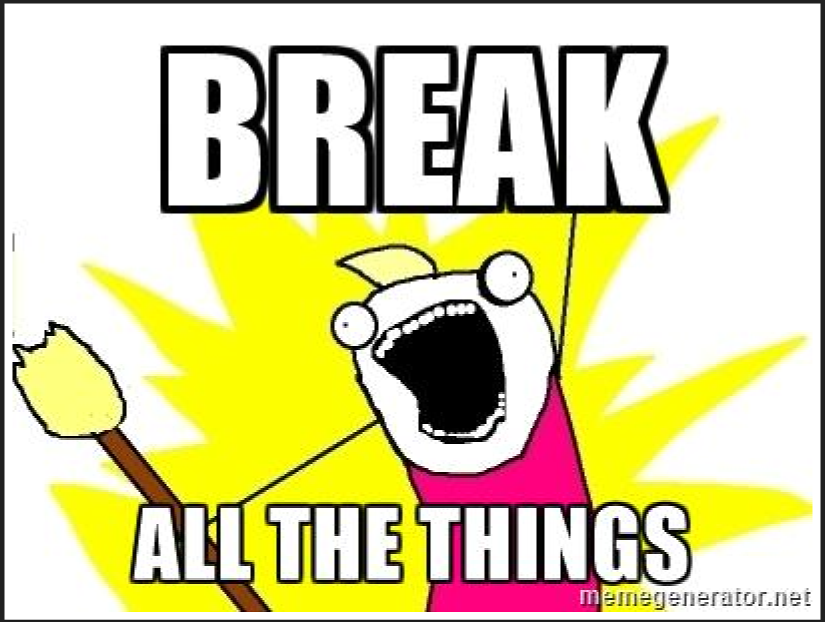
Versioning

- 9.6
  - 9.6.2
- 10
  - 10.1
- 11
- 12

New Features

- DBA and administration
- Monitoring
- Developer and SQL features
- Backup and replication
- Performance

First things first


BREAK
ALL THE THINGS
memegenerator.net

The small things

- Drop support for protocol 1.0
  - (No more clients < 6.3)
- Drop support for floating point timestamps

The bigger things

Directory `pg_xlog` is now `pg_wal`

Directory `pg_clog` is now `pg_xact`

Even bigger...

`pg_switch_xlog()` is now `pg_switch_wal()`
`pg_xlogfile_name()` is now `pg_walfile_name()`
`pg_current_xlog*()` is now `pg_current_wal*`
`pg_last_xlog*()` is now `pg_last_wal*`
`pg_xlog_location_diff()` is now
`pg_wal_location_diff()`

One more...

`pg_receivexlog` is now `pg_receivewal`

`pg_resetxlog` is now `pg_resetwal`

`pg_xlogdump` is now `pg_waldump`

Last one!

(not really)

`pg_basebackup --xlog-method` is now `--wal-method`

`pg_basebackup --xlogdir` is now `--waldir`

OK, some good news

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SCRAM authentication

- Salted Challenge Response Authentication
- Standardized way to do auth
- More secure than md5!
- Switch when your clients support it

libpq enhancements

- Multiple hosts can be specified

```
host=pg1,pg2,pg3 user=bob password=topsecret
```

- Writable host can be requested

```
host=pg1,pg2,pg3 target_session_attrs=read-write
```

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pg_stat_activity

- walsender processes now visible

```
-[ RECORD 2 ]----+---------------------------------
datid            |
datname          |
...
application_name | pg_receivewal
...
backend_start    | 2017-03-19 16:09:59.842833+01
...
wait_event       | WalSenderMain
state            | active
...
backend_type     | walsender
```

pg_stat_activity

- Backgrund worker processes now visible!

```
 datid |  pid  |    backend_type     |       application_name
-------+-------+---------------------+------------------------------
 12295 | 18301 | client backend      | psql
       | 17295 | autovacuum launcher |
       | 17297 | background worker   | logical replication launche
       | 17293 | background writer   |
       | 17292 | checkpointer        |
       | 18615 | walsender           | pg_receivewal
       | 17294 | walwriter           |
(7 rows)
```

New wait events

- Latches
  - Extensions
  - Client/socket
  - Timeout
  - ...
- I/O events
  - Reads
  - Writes
  - Individually identified

Monitoring roles

Avoid superuser!

- pg_read_all_settings
- pg_read_all_stats
- pg_stat_scan_tables
- pg_monitor

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Transition Tables

- Access old and new data in statement triggers
- Available as virtual tables

```
CREATE TRIGGER mytrigger
AFTER UPDATE ON mytable
REFERENCING
  NEW TABLE AS my_new_table
  OLD TABLE AS my_old_table
FOR EACH STATEMENT EXECUTE PROCEDURE foo()
```

IDENTITY columns

- Same functionality as *SERIAL*
  - Minus the permissions gotcha!
- SQL standard

```
CREATE TABLE itest (
   a int GENERATED BY DEFAULT AS IDENTITY,
   b int GENERATED ALWAYS AS IDENTITY
)
```

XMLTABLE

- (almost) per SQL standard
- Convert XML document to resultset
- Mapping XPath etc
- Much faster than individual queries

JSON(b) FTS

- JSON-aware full text search
- Working ts_headline()

```
postgres=# SELECT to_tsvector('{"foo": "bar", "baz": 3}');
 '3':4 'bar':2 'baz':3 'foo':1

postgres=# SELECT to_tsvector('{"foo": "bar", "baz": 3}'::jsonb);
 'bar':1

postgres=# SELECT ts_headline('{"foo": "bar", "baz": 3}', 'foo');
{"<b>foo</b>": "bar", "baz": 3}

postgres=# SELECT ts_headline('{"foo": "bar", "baz": 3}'::jsonb, '
{"baz": 3, "foo": "bar"}
```

ICU collations

- More choice for collations
  - Not just OS ones
- Stable across versions
  - Except ICU major versions
  - But those are *detected*

ICU collations

```
SELECT * FROM t ORDER BY a COLLATE "sv-SE-x-icu";

valle
vera
walle
wera
```

ICU collations

```
SELECT * FROM t ORDER BY a COLLATE "sv-SE-u-co-standard-x-icu";

valle
walle
vera
wera
```

New Features

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New defaults

- New postgresql.conf defaults:
  - wal_level = replica
  - max_wal_senders = 10
  - max_replication_slots = 10
- New pg_hba.conf defaults
  - Replication connections by default

Replication slots

- Support for temporary replication slots
- Automatically dropped at end of session
- Prevents fall-behind with less risk

pg_basebackup

- WAL streaming supported in tar mode (*-Ft*)
- Better excludes
- New defaults
  - WAL streaming (*-X stream*) now default
  - Uses temporary replication slots by default

Quorum based sync replication

- Support *ANY* and *FIRST* mode
- Previously only *FIRST*

```
synchronous_standby_names=
  FIRST 2 (pg1, pg2, pg3, pg4)

synchronous_standby_names=
  ANY 2 (pg1, pg2, pg3, pg4)
```

Logical replication

- Based on WAL
- And logical decoding
- Replicate individual tables
  - Or sets of tables

Logical replication

```
CREATE TABLE testtable (a int PRIMARY KEY, b text);

CREATE PUBLICATION testpub FOR TABLE testtable;
```

Logical replication

```sql
CREATE TABLE testtable (a int PRIMARY KEY, b text);

CREATE SUBSCRIPTION testsub
 CONNECTION 'host=/tmp port=5500 dbname=postgres user=mha'
 PUBLICATION testpub;
```

Logical replication

```
ALTER PUBLICATION testpub ADD TABLE anothertable;
```

```
ALTER SUBSCRIPTION testsub REFRESH PUBLICATION;
```

Limits

- No schema replication
- No sequence replication
- Not suitable for fail-over

Don't forget

- Uses replication slots
  - Blocks WAL recycling
  - *And* VACUUM!
- *Monitor!!*

New Features

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Hash indexes

- Now WAL logged
  - So actually useful
- Many performance enhancements
  - Better caching
  - Supports page-level vacuum
  - ...
- Sometimes better than btree

Partitioning

- Based on existing inheritance
  - Same as old "manual partitioning"
- Automatic tuple routing
  - Easier to use
  - Much faster on INSERT
- More limitations -> more optimizations
  - Many not there yet

Partitioning

- Range partitioning
- List partitioning

Partitioning

```sql
CREATE TABLE testlog (t timestamptz DEFAULT now(), txt text)
PARTITION BY RANGE(t);

CREATE TABLE testlog_2017
  PARTITION OF testlog (t)
  FOR VALUES FROM ('2017-01-01') TO ('2018-01-01');

INSERT INTO testlog (txt) VALUES ('test');
```

Partitioning

```
CREATE TABLE testcat (category text, txt text)
PARTITION BY LIST(category);

CREATE TABLE testcat_cat13
  PARTITION OF testcat (category)
  FOR VALUES IN ('cat1', 'cat2', 'cat3');

INSERT INTO testcat VALUES ('cat1', 'Test1');
```

Partitioning

- Still many limitations
  - No row-movement
  - No cross-partition indexes
  - No cross-partition keys
  - No partition-wise processing
  - No tuple routing for foreign partitions

More parallelism

- 9.6 introduced parallelism
    - Sequential scans
    - Aggregates
    - Hash and loop joins

Usability

- New parameter *max_parallel_workers*
- query string now in workers
  - Shows in pg_stat_activity

```
pid                | 28040
...
wait_event_type    | Timeout
wait_event         | PgSleep
state              | active
query              | select x, pg_sleep(2000) from tt;
backend_type       | background worker
```

Index scans

- Regular index scans (btree)
- Index Only scans (btree)
- Bitmap Heap Scan
  - Index still scanned serially

Joins

- Merge joins

Multi column statistics

- Collect statistics across columns
    - Previously each column individually
- Combinations must be explicitly selected

```
CREATE STATISTICS test_stats ON b,c FROM test
```

- Collects *dependency* and *n_distinct*

That's a lot!

There's always more

- Lots of smaller fixes
- Performance improvements
- etc, etc
- Can't mention them all!

Thank you!

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