New features of PostgreSQL 9.4

In the field of NoSQL and advanced replication

Michael Paquier
Tokyo, Japan
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About the lecturer

- Michael Paquier
  - Working on Postgres for VMware
  - Community hacker and blogger
  - Based in Tokyo
- Contacts
  - Twitter: @michaelpq
  - Blog: http://michael.otacoo.com
  - Contact: michael@otacoo.com

Resources

- planet.postgresql.org
- Blogs
  - Depesz => www.depesz.com
  - Michael Paquier => michael.otacoo.com
  - Documentation: http://www.postgresql.org/docs/devel/static/release-9-4.html

Current status

- Postgres 9.4 RC1 released on 20th Nov
- Beta period
  - 6-months!
  - Beta1 => 11th May
  - Issues related to some key-features

Development quantity

- For 9.4
  - 2183 files changed
  - 374421 insertions(+)
  - 209439 deletions(-)
- For 9.3
  - 2610 files changed
  - 228600 insertions(+)
  - 184221 deletions(-)

```
git diff \
   $(git merge-base REL9_3_STABLE master) \
   $(git merge-base REL9_4_STABLE master) \
   --stat | tail -n 1
```

Categories

- **SQL-related features**
- Administration and DBA things
- Infrastructure and replication

FILTER and aggregates

- Filter tuples evaluated by aggregates in GROUP BY clause
- Forget CASE … THEN NULL!

```
=# CREATE TABLE aggtab AS SELECT generate_series(1,10) as id;
-- No more!
=# SELECT id,
        count(id),
        count(case when id < 5 then id else NULL END)
   FROM aggtab GROUP BY id;
=# SELECT id,
        count(id),
        count(id) FILTER (WHERE id < 5)
   FROM aggtab GROUP BY id;
```

Ordered-set aggregates (1)

- WITHIN GROUP
- Hypothetical aggregates
- mode(), most present value in a subset

```
=# CREATE TABLE modetab (id int);
=# INSERT INTO modetab VALUES (1), (2), (3), (2), (4);
=# SELECT mode() WITHIN GROUP (ORDER BY id)
    FROM modetab;
 mode
---------
     2
(1 row)
```

Ordered-set aggregates (2)

- Percentiles

```
=# CREATE TABLE percent_tab AS
     SELECT generate_series(1,200) AS id;
=# SELECT percentile_cont(0.3) WITHIN GROUP (ORDER BY id),
                percentile_disc(0.3) WITHIN GROUP (ORDER BY id)
    FROM percent_tab;
 percentile_cont | percentile_disc
-----------------+-----------------
            60.7 |              60
(1 row)
```

- Rank

```
=# SELECT rank(8) WITHIN GROUP (ORDER BY id DESC) FROM percent_tab;
 rank
--------
  193
(1 row)
```

unnest() and WITH ORDINALITY

- unnest() through multiple array series
- WITH ORDINALITY => column to order results

```
=# SELECT *
     FROM unnest(array[1,2], array[3,4,5])
              WITH ORDINALITY;
 unnest | unnest  | ordinality
----------+-----------+-------------
      1 |        3 |        1
      2 |        4 |        2
   null |        5 |        3
(3 rows)
```

GIN indexes

- Improved key lookup (common AND rare)
- Improved compression using delta method
  - Less space, up to 6x
  - Cost some extra CPU
- Example, pg_trgm on “Les Misérables”
  - 68116 lines
  - gin_trgm_ops
  - 9.3 => 24MB
  - **9.4 => 8MB!**

JSONB - datatype

- Binary representation of JSON
- Key order not preserved
- Faster than JSON datatype
  - Which only stored text
  - With a format validator
- Key uniqueness: last value wins

```
=# SELECT '{"key1":"val1", "key1":"val1bis"}'::jsonb;
          jsonb
-------------------------
 {"key1": "val1bis"}
(1 row)
```

JSONB - GIN indexing

- Lookup to all keys possible with **1 index**
  - No more index **per** key
- Compact
- Faster than 9.3 and… MongoDB

```
=# SELECT data->population FROM geodata
     WHERE data @> '{"country_code": "JP", "asciiname": "Tokyo"}';
                 […]
 -> Bitmap Index Scan on geodata_gin (cost=0.00..128.86 rows=8648 width=0)
      Index Cond: (data @> '{"asciiname": "Tokyo", "country_code": "JP"}'::jsonb)
```

Auto-updatable views (1)

- Column-base update
- Automatically detected
- Here: a => OK, b => OK, c => No

```
=# CREATE TABLE aa (a int, b int);
=# CREATE TABLE bb (a int);
=# CREATE VIEW aav AS
            SELECT aa.*,
           (SELECT avg(a) FROM bb) AS c FROM aa;
```

Auto-updatable views (2)

- WITH CHECK
  - LOCAL, on current view only
  - CASCADE, with parents (default)
- INSERT and UPDATE control for new tuples

```
=# CREATE VIEW aav2 AS
     SELECT aa.* FROM aa WHERE a > 5 WITH CHECK OPTION;
CREATE VIEW
=# INSERT INTO aav2 VALUES (1,2);
ERROR:  44000: new row violates
          WITH CHECK OPTION for view "aav2"
DETAIL:  Failing row contains (1, 2).
LOCATION:  ExecWithCheckOptions, execMain.c:1676
```

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Materialized views

- Refresh CONCURRENTLY
  - Unique index on relation
  - Share Update Exclusive lock => READ/WRITE OK!
- In 9.3, REFRESH = exclusive lock

```
=# CREATE TABLE basetab AS
     SELECT generate_series(1,100) as id;
=# CREATE MATERIALIZED VIEW matbase
    AS SELECT * FROM basetab;
=# CREATE UNIQUE INDEX mati ON matbase(id);
=# REFRESH MATERIALIZED VIEW
    CONCURRENTLY matbase;
```

ALL IN TABLESPACE

- Move all objects of a database to new place
  - ALTER TABLE (Only table data, **<u>not indexes</u>**)
  - ALTER INDEX
  - ALTER MATERIALIZED VIEW

```
=# CREATE TABLESPACE fast_ssd LOCATION '/to/fast/ssd/path';
CREATE TABLESPACE
=# ALTER TABLE ALL IN TABLESPACE
    pg_default SET TABLESPACE fast_ssd;
ALTER TABLE
=# ALTER INDEX ALL IN TABLESPACE
    pg_default SET TABLESPACE fast_ssd;
ALTER INDEX
```

pg_stat_statements

- Tracking of query ID
  - Hash value
  - Calculated using parse tree
- Save stat file at shutdown

ALTER SYSTEM

- Manipulate configuration settings
- postgresql.auto.conf in PGDATA
  - Takes priority on postgresql.conf
- SIGHUP params OK, but restart tricky

```
=# ALTER SYSTEM
   SET synchronous_standby_names TO 'node_5433';
=# select pg_reload_conf();
```

session_preload_libraries

- Automatically load library for given session
- Can be changed with ALTER ROLE
- Useful for debugging
  - auto_explain
- local_preload_libraries for all sessions
- No need to LOAD

pg_prewarm

- Module in contrib/pg_prewarm
- Useful for tests to avoid/reduce ramp-up
- Preload buffers in OS or Postgres cache

```
=# \dx+ pg_prewarm
          Objects in extension "pg_prewarm"
                  Object Description
-----------------------------------------------------------
 function pg_prewarm(regclass,text,text,bigint,bigint)
(1 row)
```

Stacktrace using pl/pgsql

- Useful for debugging of multiple levels!

```
=# CREATE FUNCTION foo() RETURNS int AS $$
DECLARE
   stack text;
BEGIN
   GET DIAGNOSTICS stack = PG_CONTEXT;
   RAISE NOTICE E'--- Call Stack ---\n%', stack;
   RETURN 1;
END;
$$ LANGUAGE plpgsql;
```

Categories

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- **Infrastructure and replication**

Replication slots

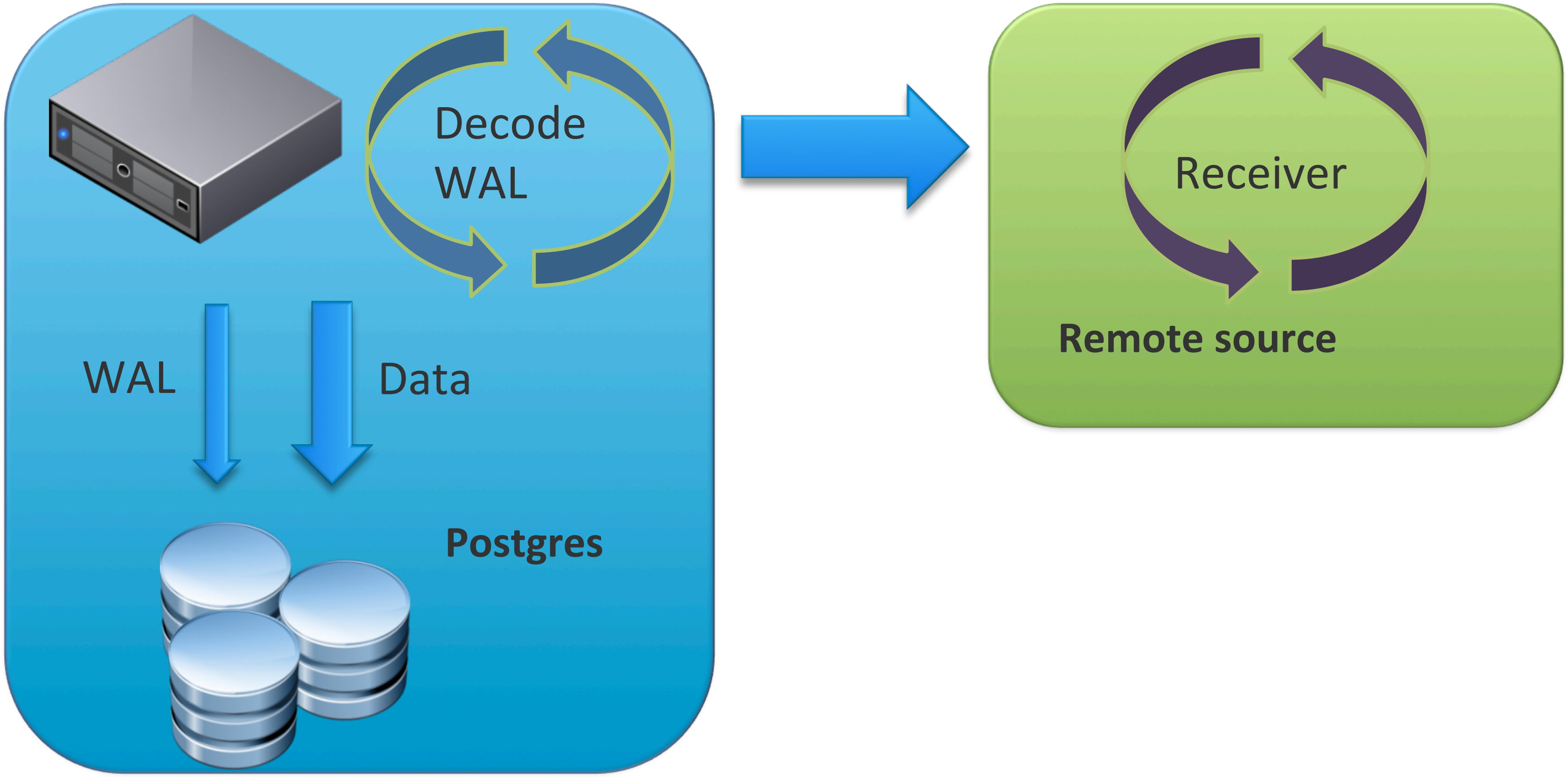
- Block WAL file deletion until consumption
- Prevent replication conflicts with xmin horizon report
- Danger: monitoring of pg_xlog partition.
- **wal_keep_segments** not needed!

Time delayed standbys

- Can fix unfortunate DROP DB, etc.
- Delayed live backups
- WAL replayed, commit delayed
- recovery_min_apply_delay='$TIME'
  in recovery.conf
- With hot_standby_feedback, risk of bloat on master

Logical decoding (1)

- Get logical changes from WAL



Logical decoding (2)

- Examples:
  - Client: pg_recvlogical
  - Output plugin: contrib/test_decoding
- Use cases
  - Online upgrade
  - Replication solutions (BDR, Slony)
  - Audit

Dynamic bgworkers

- 9.3 limitation
  - Spawn at server startup
  - Connection to only one database
- Can be started at will
  - Max with max_worker_processes
- Build your own structure launcher/worker!
- Example: contrib/worker_spi
- Base for parallel query processing

wal_log_hints

- wal_log_hints
- Log hint-bits (TX state on page) to WAL
- Required for rewind tools when not using checksums (pg_rewind!)
- Page checksum does it

Backup features

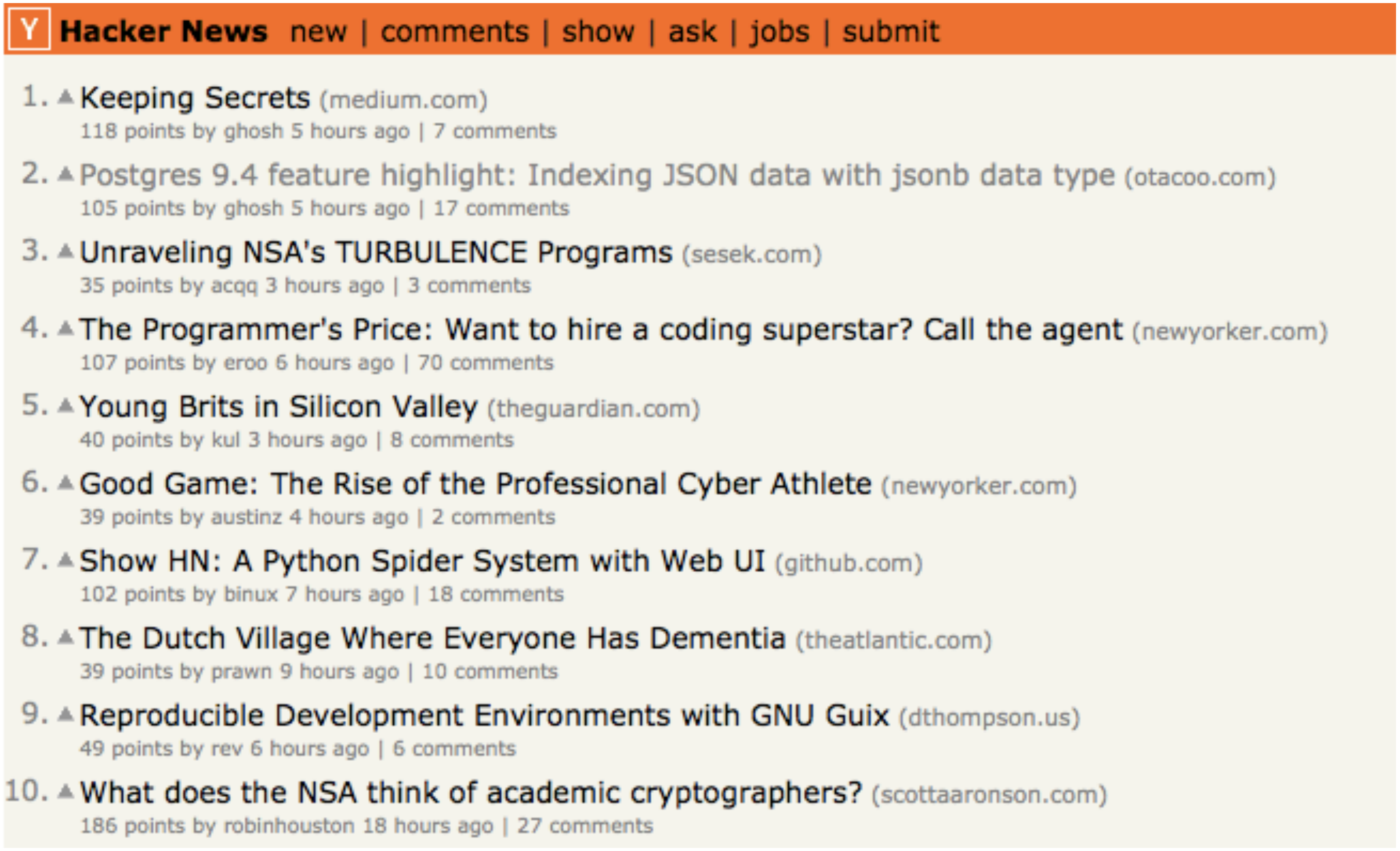
- pg_stat_archiver, view archiving activity
  - Number of WAL files archived
  - Failure/success tracking
- pg_basebackup
  - --xlogdir for custom location of pg_xlog dir
  - Backup throttling with --max-rate
  - Relation of tablespaces in backup copy

And more, far more…

- Huge community work
- Performance improvements
- etc.
- Complete list is here: http://www.postgresql.org/docs/devel/static/release-9-4.html

Thanks!
Questions?

JSONB, No2 on Hacker news!



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