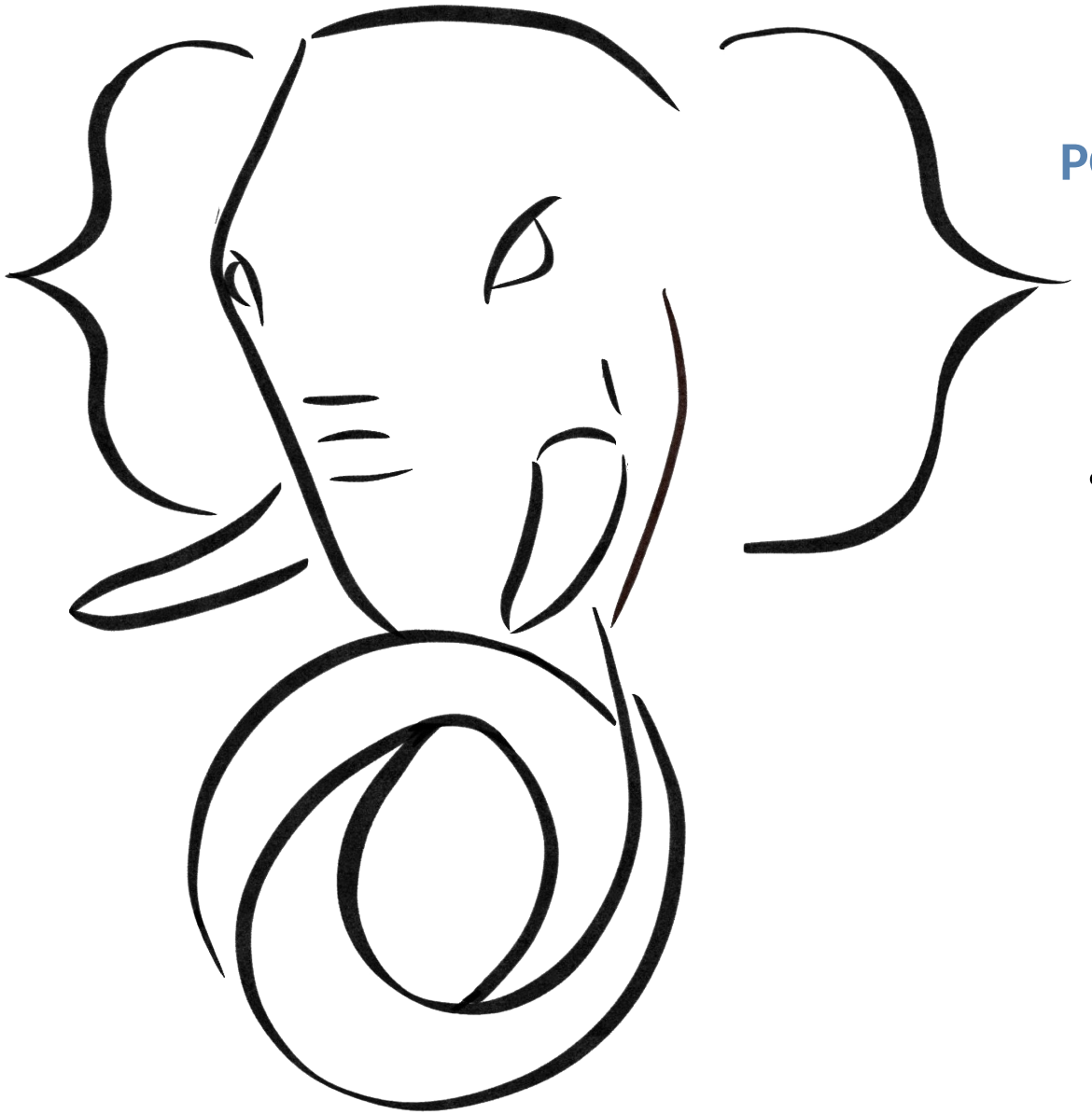

PGConf.Online 2021

PGCONF.Online SPRINT:

Appendable bytea TOAST

Oleg Bartunov
Nikita Glukhov

Postgres PROFESSIONAL

First Postgres Sprint: Toronto, 2006

Motivational example

- A table with 100 MB bytea (uncompressed):

```
CREATE TABLE test (data bytea);
ALTER TABLE test ALTER COLUMN data SET STORAGE EXTERNAL;
INSERT INTO test SELECT repeat('a', 100000000)::bytea data;
```

- Append 1 byte to bytea:

```
EXPLAIN (ANALYZE, BUFFERS, COSTS OFF)
UPDATE test SET data = data || 'x'::bytea;

 Update on test (actual time=1359.229..1359.232 rows=0 loops=1)
   Buffers: shared hit=238260 read=12663 dirtied=25189 written=33840
   ->  Seq Scan on test (actual time=155.499..166.509 rows=1 loops=1)
         Buffers: shared hit=12665
 Planning Time: 0.127 ms
 Execution Time: 1382.959 ms
```

  >1 second to append 1 byte !!!
  Table size doubled to 200 MB, 100 MB of WAL generated.

- Thanks to Alexander ? who raised the problem of (non-effective) streaming into bytea at PGConf.Online !

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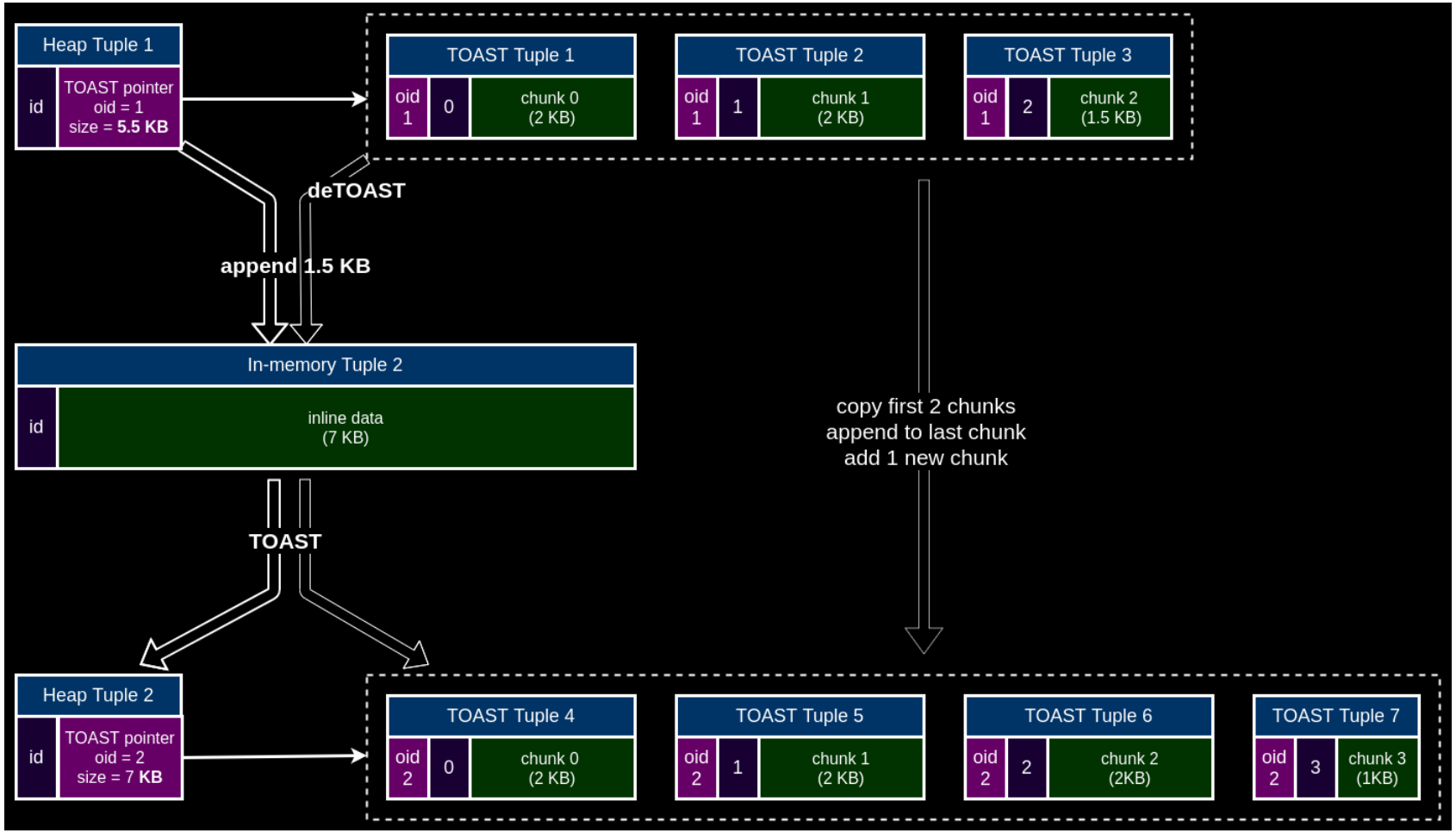
Motivational example (explanation)

- Current TOAST is not sufficient for partial updates
- All data is deTOASTed before in-memory modification
- Updated data is TOASTed back after modification with new TOAST oid



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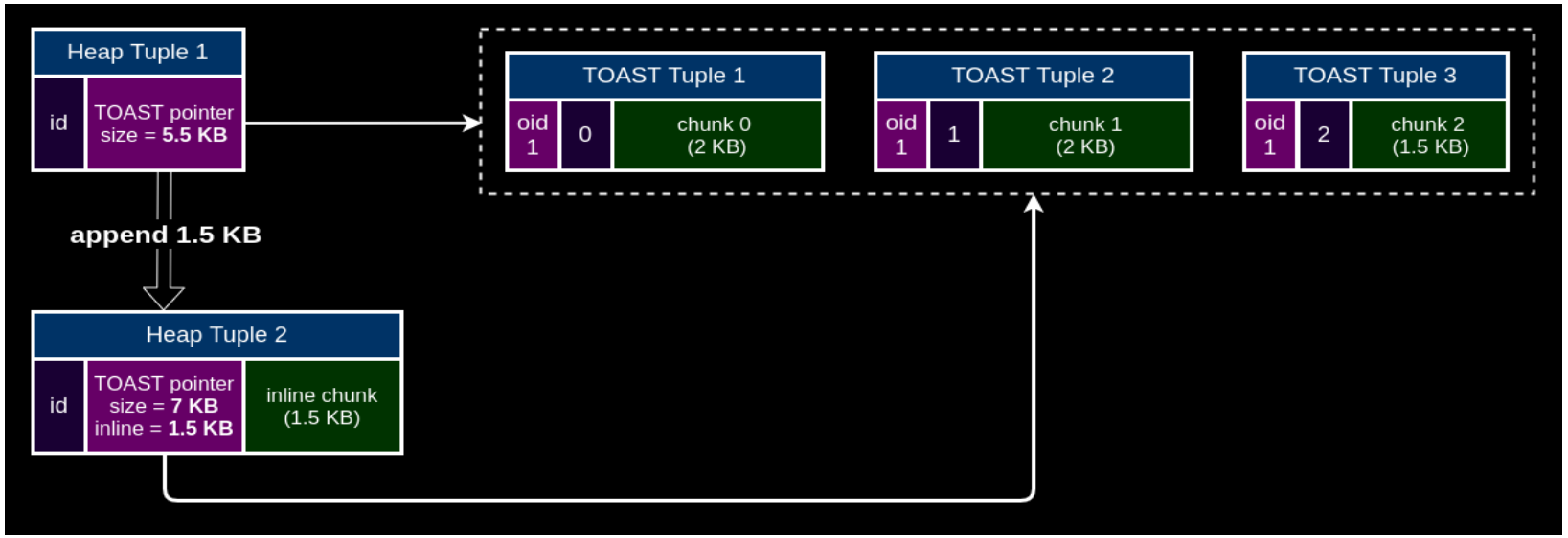
Solution

- Special datum format: TOAST pointer + inline data
- Inline data serves as a buffer for TOASTing
- Operator || does not deTOAST data, it appends inline data producing datum in the new format



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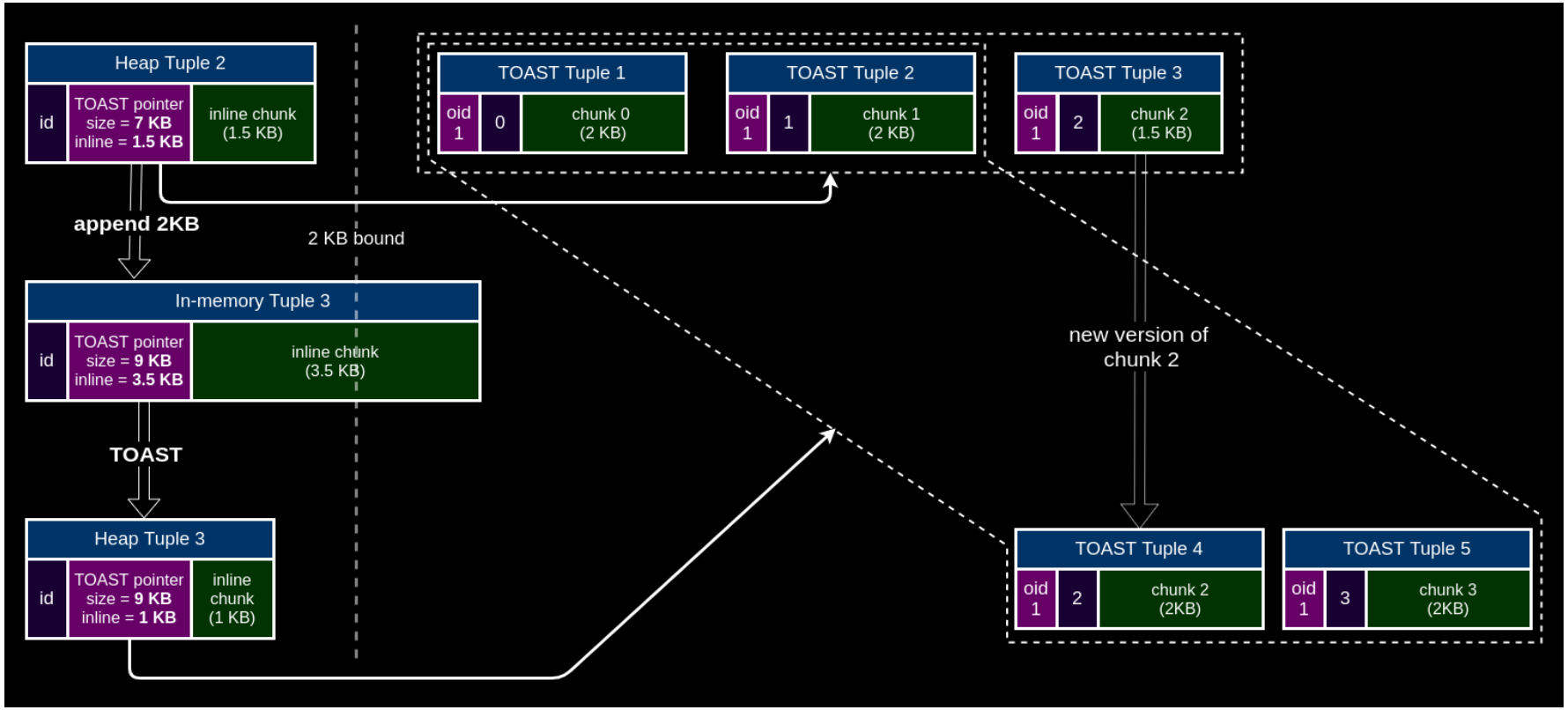
Solution

- When size of inline data exceeds 2 KB, TOASTer recognizes changes in old and new datums and TOASTs only the new inline data with the same TOAST oid
- Last not filled chunk can be rewritten with creation of new tuple version
- First unmodified chunks are shared



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Results – motivational example

- Append 1 byte to bytea:

```
EXPLAIN (ANALYZE, BUFFERS, COSTS OFF)
UPDATE test SET data = data || 'x'::bytea;

 Update on test (actual time=0.060..0.061 rows=0 loops=1)
   Buffers: shared hit=2
   ->  Seq Scan on test (actual time=0.017..0.020 rows=1 loops=1)
         Buffers: shared hit=1
 Planning Time: 0.727 ms
 Execution Time: 0.496 ms (was 1382 ms)
```

  2750x speed up!

- Table size remains 100 MB
- Only 143 bytes of WAL generated (was 100 MB)
- No unnecessary buffer reads and writes

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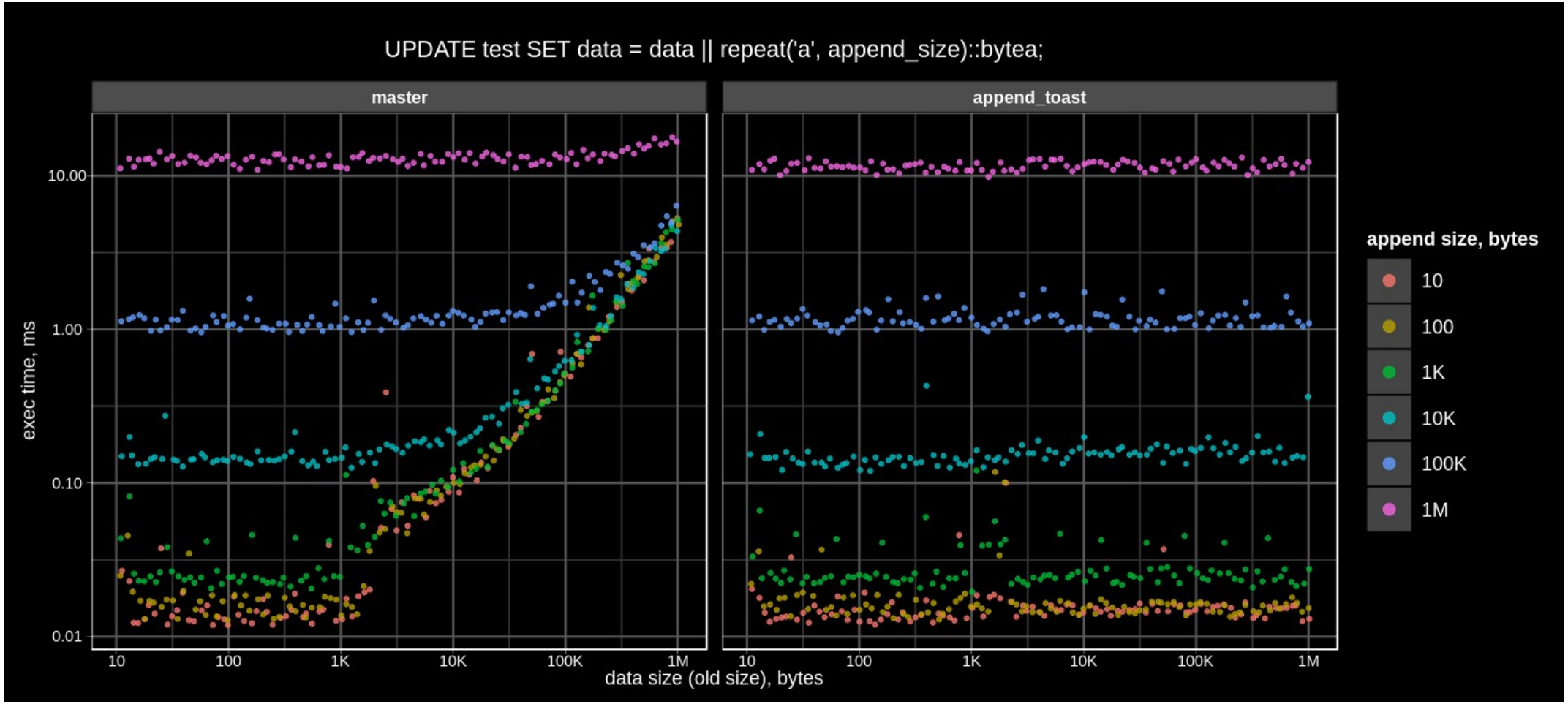
Results – query execution time



- OLD + NEW
- APPEND SIZE

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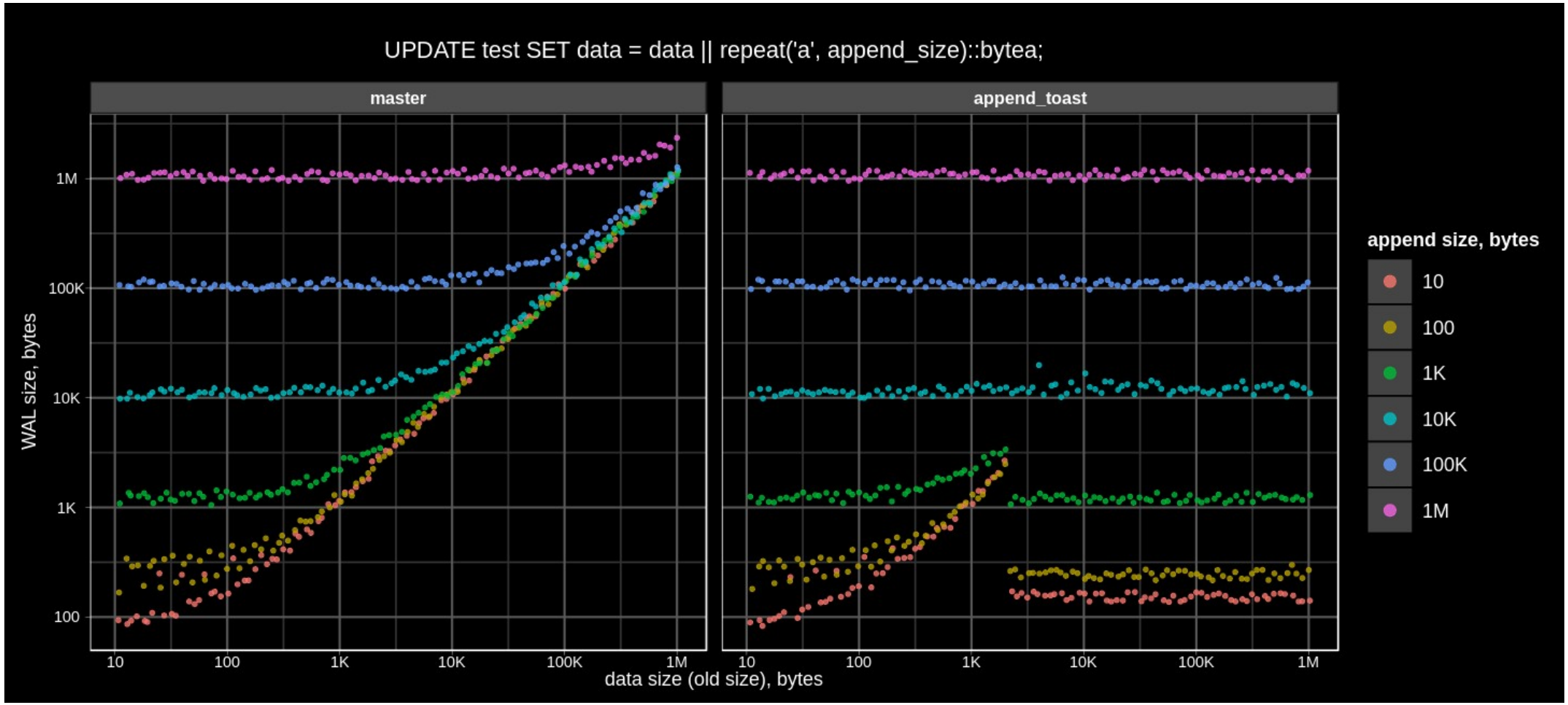
Results – WAL traffic



OLD + NEW

INLINED ~~OLD~~ + NEW

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Quick Summary

- TODO
  - TOAST uses special snapshot and it is not ready for multiple versions of the same chunk. This needs to be fixed.
  - Support for strings, arrays, jsonb arrays (see our main “Jsonb internals” talk).
  - Prepend, truncate, insert, delete support.
  - Compression (now it is applicable only to uncompressed EXTERNAL attributes)
  - Generalized datum format for partial updates of plain data types.
  - Pluggable datum formats with custom TOASTers.
- We demonstrate significant (1000X) performance improvement
  - Branch in our repository (currently based on jsonb_shared_toast branch): https://github.com/postgrespro/postgres/tree/bytea_appendable_toast
  - Slides of this talk (PDF)
  - It’s not PG14 ready
- Contact obartunov@postgrespro.ru, n.gluhov@postgrespro.ru for collaboration.

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Нам нужны Ваши кейсы (тестовые данные и запросы) !

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ALL
YOU
NEED
POSTGRES
IS