What's Missing in Postgres?

BRUCE MOMJIAN

The presentation explains why some features are missing in Postgres. *Title concept from Melanie Plageman*

https://momjian.us/presentations

Last updated: April 2026

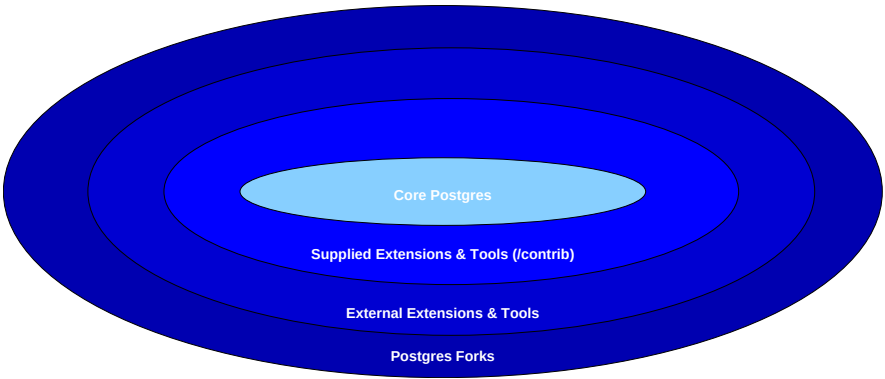
Outline

1. Postgres Feature History Since 2010

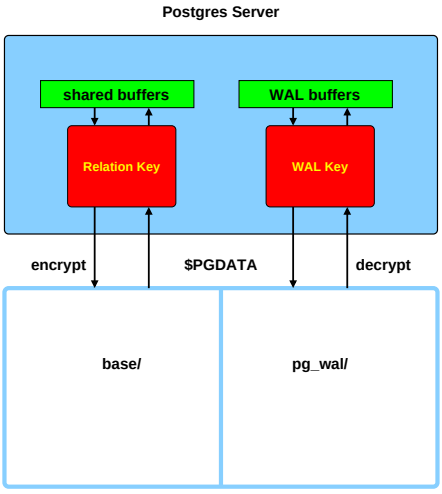
version	reldate	months	changes	C lines	C changes	% C change
9.0	2010-09-20		237	870790		
9.1	2011-09-12	12	203	932936	62146	7
9.2	2012-09-10	12	238	987460	54524	5
9.3	2013-09-09	12	177	1040813	53353	5
9.4	2014-12-18	15	211	1096707	55894	5
9.5	2016-01-07	13	193	1167110	70403	6
9.6	2016-09-29	9	214	1219720	52610	4
10	2017-10-05	12	189	1316447	96727	7
11	2018-10-18	12	170	1369590	53143	4
12	2019-10-03	11	180	1423215	53625	3
13	2020-09-24	12	178	1473738	50523	3
14	2021-09-30	12	220	1558178	84440	5
15	2022-10-13	12	184	1587763	29585	1
16	2023-09-14	11	206	1608031	20268	1
17	2024-09-26	12	182	1673116	65085	4
18	2025-09-25	12	210	1750814	77698	4
Averages		12	200			4.27

https://momjian.us/main/blogs/pgblog/2021.html#April_28_2021

2. Feature Sources



3. Cluster File Encryption, i.e., TDE



https://momjian.us/main/presentations/pending.html#cfe

Cluster File Encryption

Advantages

- Meets regulatory requirements, e.g., PCI
- Does not require coordination with infrastructure teams for storage encryption
- Automatically encrypts file system backups

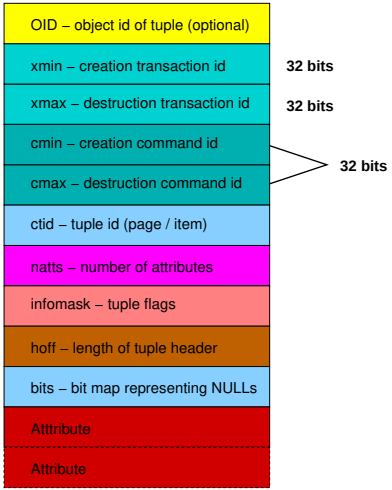
Disadvantages

- Of questionable security value, e.g. the key is in operating system memory
- Requires significant source code changes
- Client-side encryption is more secure

Percona is working on an external open source TDE extension that requires a fork of Postgres, and many Postgres forks support this.

https://momjian.us/main/blogs/pgblog/2025.html#February_22_2025
https://docs.percona.com/pg-tde/

4.1 64-Bit Transaction Ids



https://momjian.us/main/presentations/internals.html#mvcc

64-Bit Transaction Ids

Advantages

- Avoids the need to freeze tuples

Disadvantages

- Could increase the tuple header size by 50%
- Requires significant source code changes

The Postgres Pro fork of Postgres supports this.

4.2 Optimizer Hints

l	count	lookup_letter
p	342	Seq Scan on sample (cost=0.00..21.12 rows=342 width=2)
c	13	Bitmap Heap Scan on sample (cost=4.25..20.69 rows=13 width=2)
r	12	Bitmap Heap Scan on sample (cost=4.24..20.14 rows=12 width=2)
f	6	Bitmap Heap Scan on sample (cost=4.19..17.25 rows=6 width=2)
t	6	Bitmap Heap Scan on sample (cost=4.19..17.25 rows=6 width=2)
s	6	Bitmap Heap Scan on sample (cost=4.19..17.25 rows=6 width=2)
u	5	Bitmap Heap Scan on sample (cost=4.19..15.86 rows=5 width=2)
_	5	Bitmap Heap Scan on sample (cost=4.19..15.86 rows=5 width=2)
d	4	Bitmap Heap Scan on sample (cost=4.18..14.23 rows=4 width=2)
v	4	Bitmap Heap Scan on sample (cost=4.18..14.23 rows=4 width=2)
a	3	Bitmap Heap Scan on sample (cost=4.17..12.31 rows=3 width=2)
e	2	Bitmap Heap Scan on sample (cost=4.16..10.07 rows=2 width=2)
k	1	Index Only Scan using i_sample on sample (cost=0.15..8.17 rows=1 width=2)
i	1	Index Only Scan using i_sample on sample (cost=0.15..8.17 rows=1 width=2)

https://momjian.us/main/presentations/performance.html#optimizer

Optimizer Hints

Advantages

- Useful for quick fixes of optimizer mistakes

Disadvantages

- Locks query plans, preventing data distribution changes and optimizer improvements from using better plans
- While this can fix specific queries, the cause is often imperfect optimizer statistics or server settings
  - a more general fix can improve an entire class of queries, e.g., extended statistics, random_pages_cost
- Often prevents the problem from being diagnosed and reported to the database project

pg_hint_plan is available as an external open source extension. Postgres 19's pg_plan_advice enables optimizer control. The EDB fork of Postgres supports this.

https://momjian.us/main/blogs/pgblog/2018.html#December_12_2018
https://github.com/ossc-db/pg_hint_plan

4.3 Columnar Storage

Column 1

Value 1	Row 2, 7, 9, 12
Value 2	Row 1, 5, 11, 14
Value 3	Row 4, 6, 8, 15
Value 4	Row 3, 10, 13, 16

Column 2

Value 1	Row 4, 6, 11, 16
Value 2	Row 3, 10, 12, 14
Value 3	Row 1, 5, 7, 9
Value 4	Row 2, 8, 13, 15

Column 3

Value 1	Row 4, 7, 11, 14
Value 2	Row 2, 5, 6, 13
Value 3	Row 3, 8, 10, 12
Value 4	Row 1, 9, 15, 16

Columnar Storage

Advantages

- Column values are only stored once per table, reducing storage requirements
- Ideal for columns with many duplicates

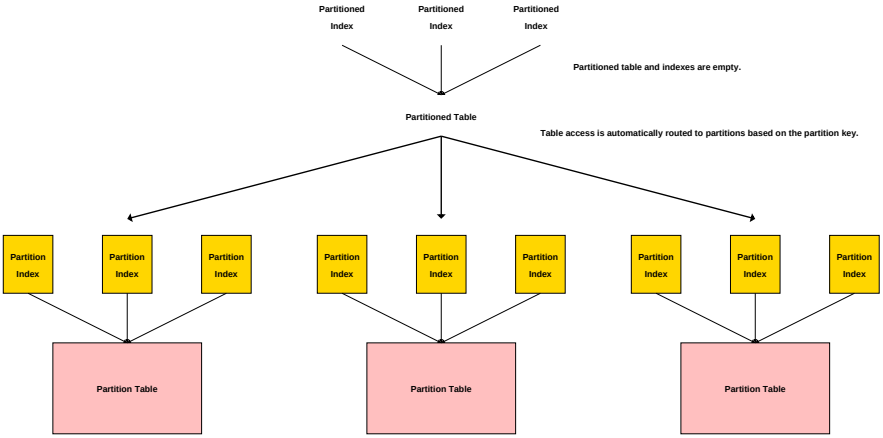
Disadvantages

- Accessing all columns of a row is expensive
- Updates and deletes are expensive
- Requires optimizer and storage changes

Citus is available as an external open source extension.

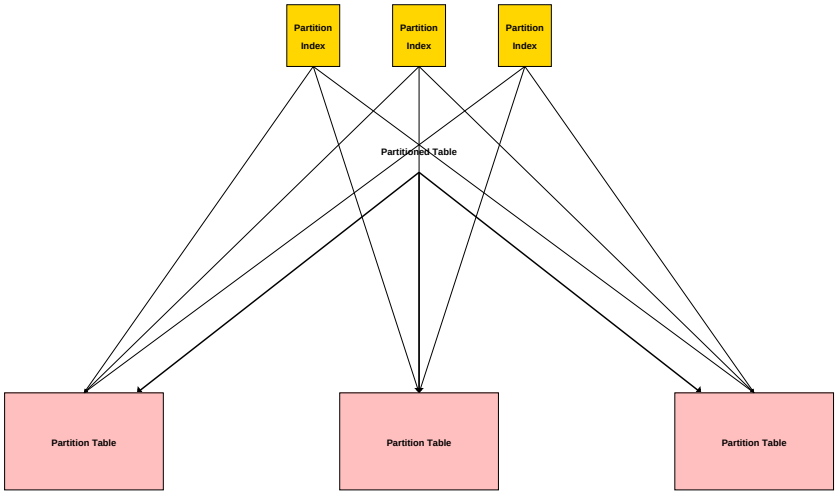
https://wiki.postgresql.org/wiki/ColumnOrientedSTorage
https://www.citusdata.com/product/community

4.4 Global Indexes: Per-Partition Indexes



https://momjian.us/main/presentations/performance.html#partitioning

Global Indexes



https://momjian.us/main/presentations/performance.html#partitioning

Global Indexes

Advantages

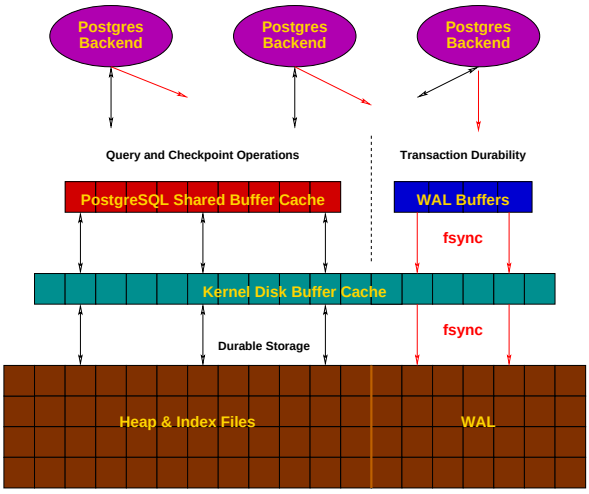
- Allows indexing of values that are not part of the partition key
- Allows unique constraints that are not part of the partition key

Disadvantages

- Partitioning is used to split very large tables, so global indexes would be very large
- Dropping partitions is expensive
- Requires significant source code changes

https://momjian.us/main/blogs/pgblog/2020.html#July_1_2020

4.5 Direct I/O



https://momjian.us/main/presentations/administration.html#wal

Direct I/O

Advantages

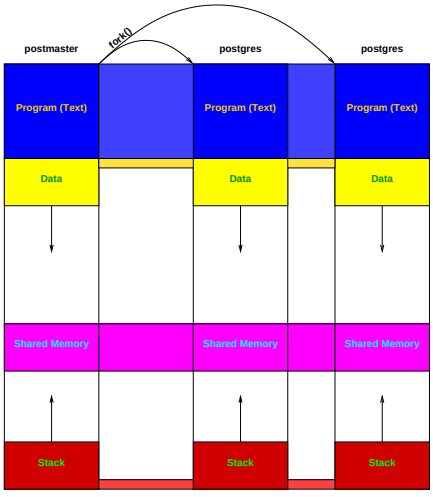
- Prevents double-buffering by the kernel and Postgres shared buffer cache
- Prevents copying of data from kernel buffers to shared buffers

Disadvantages

- Postgres-scheduled reads and writes might conflict with non-Postgres I/O
- Prevents sharing of kernel memory for I/O caching and per-process memory usage

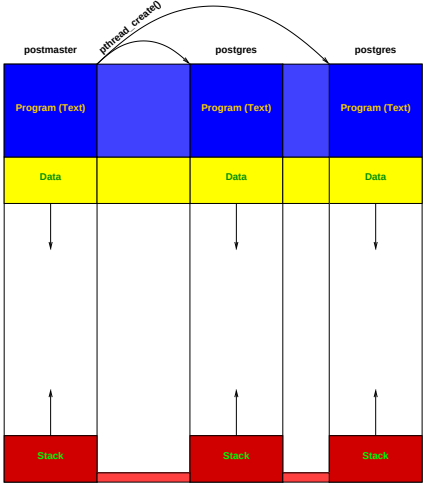
https://momjian.us/main/blogs/pgblog/2017.html#June_5_2017
https://momjian.us/main/blogs/pgblog/2018.html#December_7_2018

4.6 Server-Side Threading: Fork()



https://momjian.us/main/presentations/internals.html#shared_memory

Server-Side Threading



Server-Side Threading

Advantages

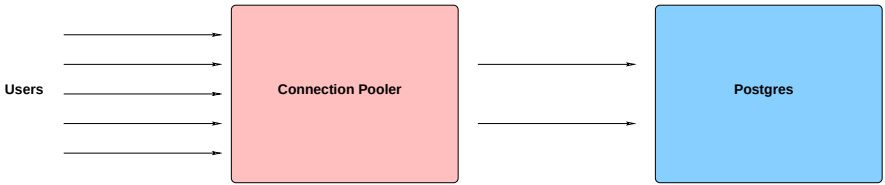
- Reduces task switching time

Disadvantages

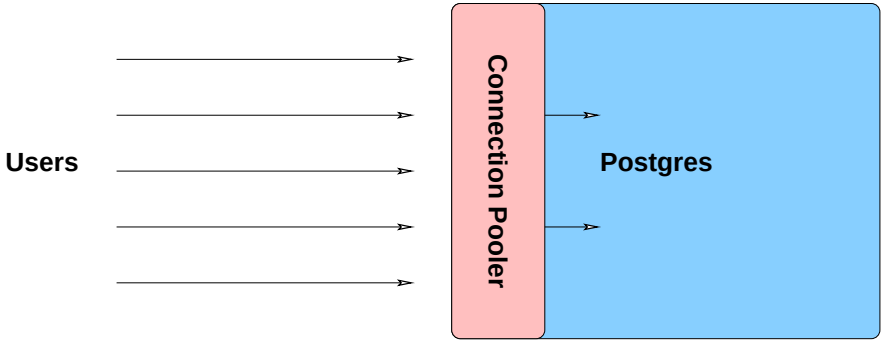
- Makes Postgres sessions less resilient to session failure
- Requires significant source code changes

https://momjian.us/main/blogs/pgblog/2018.html#December_26_2018

4.7 Internal Connection Pooler: External Pooler



Internal Connection Pooler



Internal Connection Pooler

Advantages

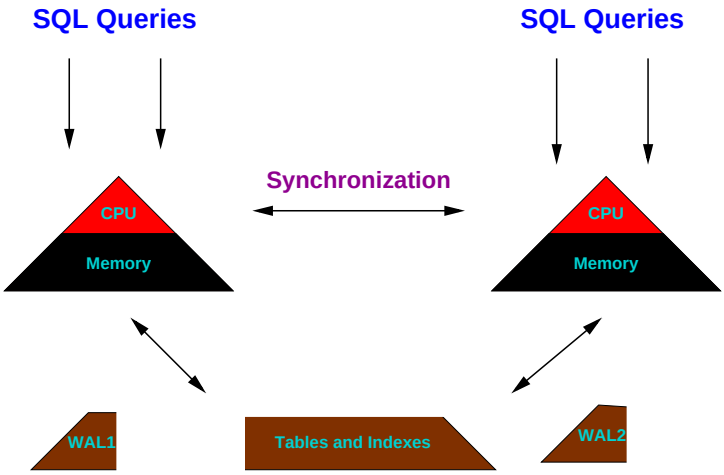
- Reduces latency
- More flexible authentication
- Simpler configuration

Disadvantages

- Insufficient for failover control

https://momjian.us/main/blogs/pgblog/2017.html#April_21_2017
https://momjian.us/main/blogs/pgblog/2019.html#January_25_2019

5.1 Oracle RAC-Like



https://momjian.us/main/presentations/performance.html#scaling

Oracle RAC-Like

Advantages

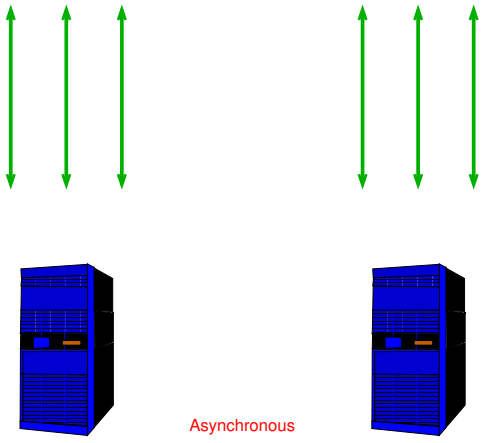
- Scales CPU and memory
- Partial reliability, partial scaling

Disadvantages

- Does not scale I/O
- Communication overhead between hosts requires application workload partitioning
- Complex architecture

https://momjian.us/main/blogs/pgblog/2018.html#July_9_2018

5.2 Multi-Master Replication



https://momjian.us/main/presentations/arch.html#replication

Multi-Master Replication

Advantages

- Allows simple draining of server traffic for maintenance
- Allows read-only scaling without traffic management

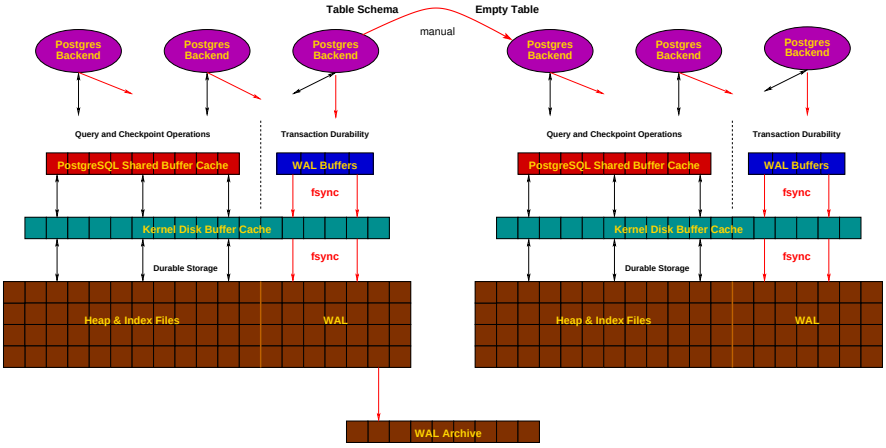
Disadvantages

- Requires conflict resolution management
- Requires DDL management when using Postgres logical replication; see next section

Some Postgres forks support this, e.g., EDB, pgEdge.

https://momjian.us/main/blogs/pgblog/2018.html#July_9_2018

5.3 Logical Replication of DDL



https://momjian.us/main/presentations/administration.html#wal

Logical Replication of DDL

Advantages

- Simplifies administration

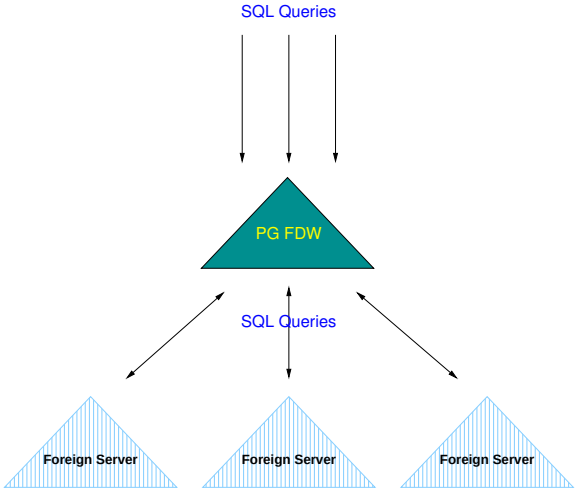
Disadvantages

- Requires regular source code updates to replicate new DDL

Some Postgres forks support this, e.g., EDB, pgEdge.

https://wiki.postgresql.org/wiki/Logical_replication_of_DDLs

5.4 Sharding



https://momjian.us/main/presentations/pending.html#sharding

Sharding

Advantages

- Allows writes to be scaled across multiple servers
- Allows data volumes to exceed a single server

Disadvantages

- Complex setup and administration
- Additional latency
- Limited value for queries that are counter to the sharding key

https://momjian.us/main/blogs/pgblog/2023.html#November_1_2023
https://wiki.postgresql.org/wiki/Built-in_Sharding

6. Current Status

- Cluster file encryption, i.e., TDE, fork
- Single host, performance
  - 64-bit transaction ids, fork
  - optimizer hints, external & fork
  - columnar storage, external
  - global indexes
  - direct I/O
  - server-side threading
  - internal connection pooler
- Multi-host
  - Oracle RAC-like
  - multi-master replication, fork
  - logical replication of DDL, fork
  - sharding

Green is in-progress for core Postgres and supplied extensions and tools; red is no progress. External extensions and Postgres forks are indicated.

Conclusion

https://momjian.us/presentations

https://www.flickr.com/photos/bryanh/