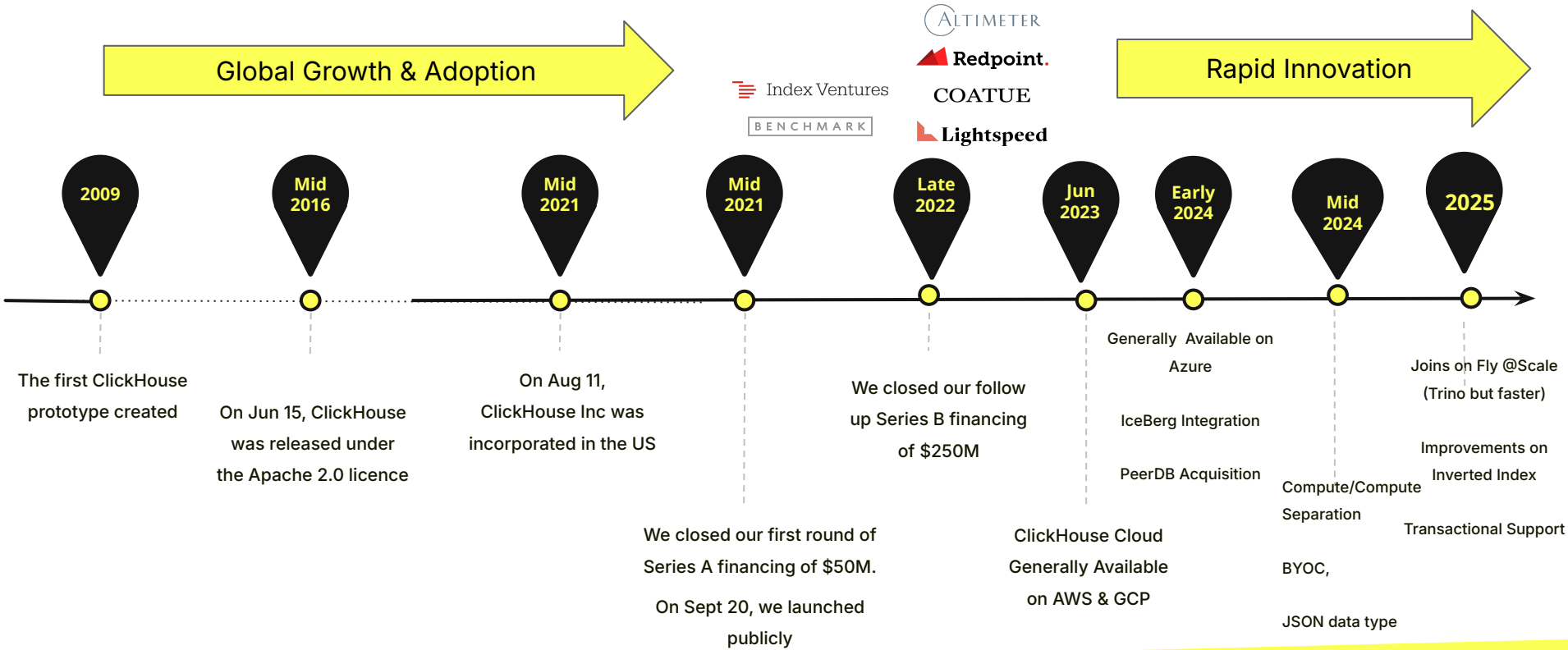
ClickHouse

A Quick Overview

Feb 2025

ClickHouse

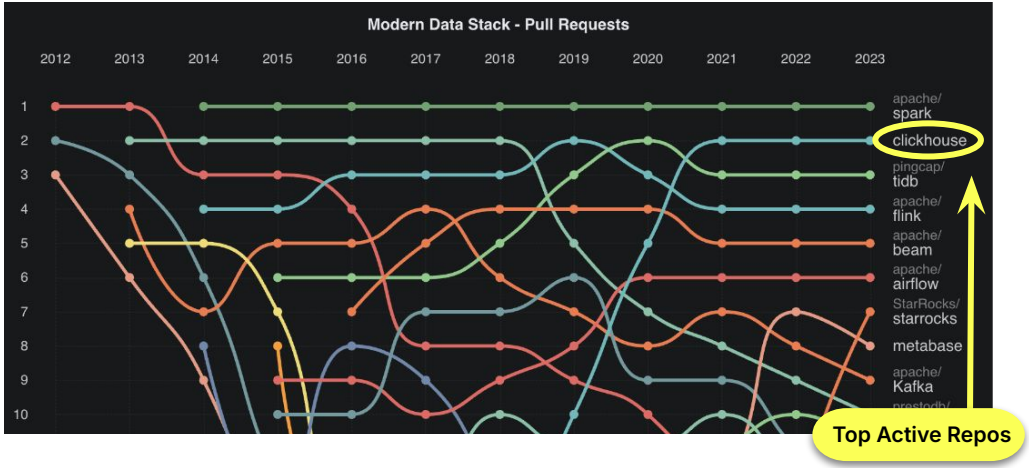
The ClickHouse Journey so far……



Execution & Traction

ClickHouse Open Source

- ✔ 38.7k Stars
- ✔ 6.1k Forks
- ✔ 1.3k Contributors
- ✔ 100k+ Commits
- ✔ 114k active community members



ClickHouse Cloud

aws

Soon

Bloomberg

- ✔ 300+ customers
- ✔ 150 active trials
- ✔ Processed 64+ billion queries, 28 quadrillion records, and 580 PiB of data since launch

NETFLIX Uber Disney+ Spotify Microsoft Deutsche Bank NGINX CLOUDFLARE

cisco COMCAST Walmart ROKT GitLab ebay IBM Contentsquare

What is ClickHouse?

Your (soon-to-be) favorite database!

Open source **column-oriented** **distributed** **OLAP** **database**

Since 2009	Best for aggregations	Replication	Analytics use cases
31,000+ GitHub stars	Files per column	Sharding	Aggregations
1300+ contributors	Sorting and indexing	Multi-master	Visualization
500+ releases	Background merges	Cross-region	Mostly immutable data

Use cases

Real-time Analytics

Power interactive applications and dashboards that analyze and aggregate large amounts of data on the fly. Run complex internal analytics in ms, not mins or hrs.

Disney+ · CLOUDFLARE · Microsoft · lyft · Contentsquare · highlight.io

Logs, events, traces

Monitor with confidence your logs, events, and traces. Detect anomalies, fraud, network or infrastructure issues, and more.

Darwinium · ebay · BENOCS · resmo · zomato · runreveal

Business intelligence

Interactively slice and dice your data for analysis, reporting, and building internal applications. Evaluate user behaviors, ad and media perf, market dynamics, and more.

ROKT · Deutsche Bank · QuickCheck · NANO CORP. · TrillaBit · HIFI

ML and Gen AI

Execute fast and efficient vector search. Plug-and-play Generative AI models from any provider. Use lightning-fast aggregations to power model training at petabyte scale.

denic · DeepL · ADMIXER · ensemble

Key Features

Some of the cool things ClickHouse can do

1 Speaks SQL

Most SQL-compatible UIs, editors, applications, frameworks will just work!

2 Lots of writes

Up to several million writes per second - per server. “1 billion writes per second”

3 Distributed

Replicated and sharded, largest known cluster is 4000 servers.

4 Highly efficient storage

Lots of encoding and compression options - e.g. 20x from uncompressed CSV.

5 Very fast queries

Scan and process even billions of rows per second and use vectorized query execution.

6 Joins and lookups

Allows separating fact and dimension tables in a star schema.

Creating tables

ClickHouse SQL Basics

```
CREATE TABLE customers
(
    name      String,
    age       UInt8,
    address   Array(String),
    city      LowCardinality(String),
    created   DateTime,
    type      Enum8(...),
    attr      JSON
)
ENGINE = MergeTree
ORDER BY (city, name, type)
```

- Other engines:
  - ReplacingMergeTree
  - CollapsingMergeTree
  - AggregatingMergeTree
- Integration engines:
  - Kafka, RabbitMQ
  - MySQL, PostgreSQL, MongoDB
  - JDBC, ODBC
  - S3, HDFS
  - EmbeddedRocksDB
- Adding Replicating- in front makes an engine replicate data (e.g. ReplicatingMergeTree)

Inserting directly

ClickHouse SQL Basics

```
INSERT INTO people VALUES ('Obi-Wan Kenobi', 57, ...) ('Yoda', 900, ...)
(...)
```

- Batching is important! Either batch yourself or turn on asynchronous inserts:

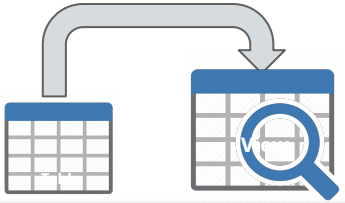
```
SET async_insert = true
INSERT INTO people VALUES ('Obi-Wan Kenobi', 57, ...)
INSERT INTO people VALUES ('Yoda', 900, ...)
INSERT INTO people VALUES (...)
```


Reading data

ClickHouse SQL Basics

- Saving a query as a view (no data movement):

```
CREATE VIEW view AS SELECT ... FROM table ...
```



- Continuously processing new data from a table into another table:

```
CREATE MATERIALIZED VIEW view AS SELECT avg(...) FROM table GROUP BY ...
```

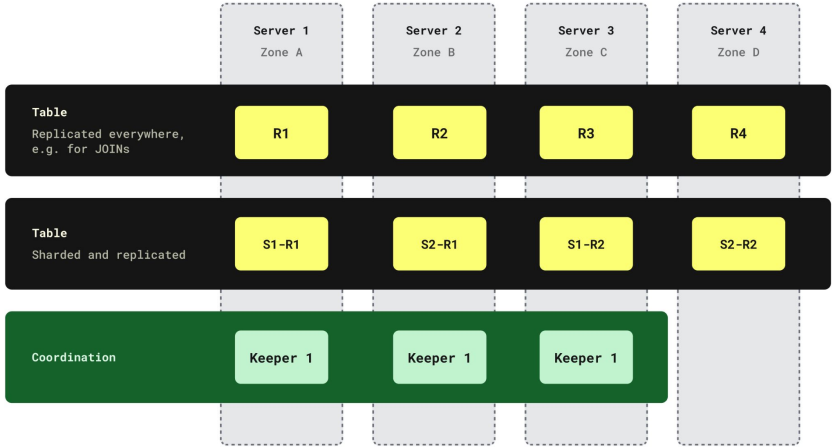
```
CREATE MATERIALIZED VIEW view REFRESH EVERY 1 MINUTE TO table_name AS ..
```

ClickHouse

Self-managed

- ✔ Open-source
- ✔ Flexible architecture
- ✔ Efficient and robust
- ✔ Support contracts available

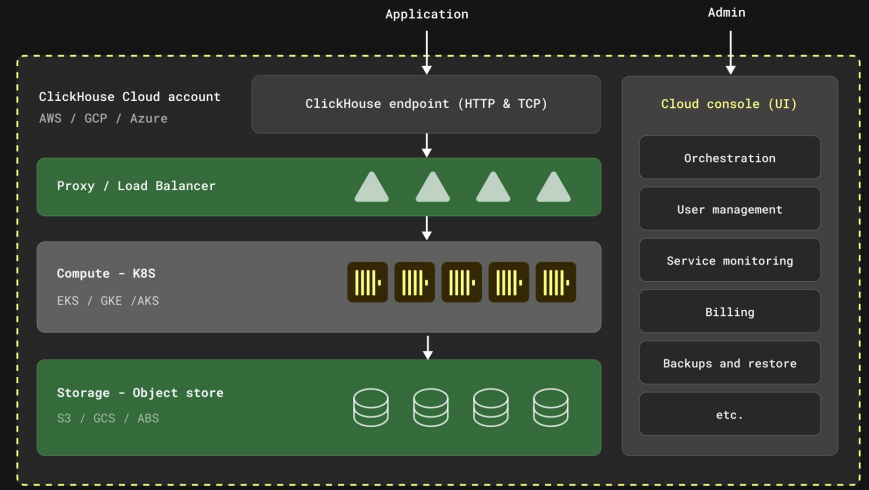
Sample self-managed architecture



ClickHouse Cloud

- ✔ **Easy to use** — Managed for you
- ✔ **Feature-rich** — Cloud-first features & tooling
- ✔ **Fast** — Automatically maximizes performance/efficiency
- ✔ **Scalable** — Scale seamlessly
- ✔ **Reliable** — Ensure reliability
- ✔ **PAYG** — SaaS usage and capacity based pricing

ClickHouse Cloud architecture



What’s new with ClickHouse:
Updates, Integrations & more

Feb 2025

ClickHouse

What’s coming to ClickHouse in 2025

Roadmap 2025 (discussion) #74046

Open

alexey-milovidov
opened 27 days ago · edited by alexey-milovidov

Edits

This is ClickHouse roadmap 2025.

This roadmap does not cover the tasks related to infrastructure, orchestration, documentation, marketing, external integrations, drivers, etc.

See also:

Roadmap 2024: #58392
Roadmap 2023: #44767
Roadmap 2022: #32513
Roadmap 2021: #17623
Roadmap 2020: link

Data Lakes

- [ ] Automatic use of cluster functions Use cluster table functions automatically if parallel replicas are enabled #70659

ClickHouse

What's new in ClickHouse (24.8 - 25.1)

New Features

- ★ Extended Table Aliases
- ★ Function 'translate' can delete characters
- ★ Setting custom HTTP headers
- ★ Cache for primary keys
- ★ Client receives settings from server
- ★ Reverse Table Ordering
- ★ Enum usability improvements .e.g LIKE

Performance improvements

- ★ Parallel Hash Join By Default
- ★ Automatic JOIN Reordering
- ★ Optimization of JOIN expressions
- ★ Faster Inserts of LowCardinality Strings

>36 bug fixes in 24.12

Interesting new features

- ★ Iceberg REST Catalog (24.12)
- ★ TimeSeries Engine (24.8)
- ★ APPEND for Refreshable Materialized Views (24.9)
- ★ JSON Data Type (24.10)
- ★ chDB3.0 (25.1)
- ★ Integrations: Postgres CDC in ClickPipes, private preview (24.12)

YouTube

https://www.youtube.com/@ClickHouseDB

Iceberg REST Catalog 🧊

```
CREATE DATABASE unity_demo
ENGINE = Iceberg('https://dbc-55555555-5555.cloud.databricks.com/api/2.1/unity-catalog/iceberg')
SETTINGS
  catalog_type = 'rest',
  catalog_credential = 'aaaaaaaa-bbbb-cccc-dddd-eeeeeeeeeeee:...',
  warehouse = 'unity',
  oauth_server_uri = 'https://dbc-55555555-5555.cloud.databricks.com/oidc/v1/token',
  auth_scope = 'all-apis,sql';

SHOW TABLES FROM unity_demo;
SELECT * unity_demo."webinar.test";
```

Compatible with Unity, Polaris.

Developer: Kseniia Sumarokova.

Refreshable Materialized Views

23.12 — the first version with experimental feature.

24.9 — support for the **APPEND** clause.

24.10 — support for the Replicated database engine.

In version 24.10, Refreshable Materialized Views are production ready!

Demo

Developer: Michael Kolupaev.

Parallel Hash Join By Default 

Both sides of JOIN are parallelized, with no to minimal memory overhead.
It does not harm even for short queries, and we made it as the default.

TPC-H, SF-100, Q3: 53 sec -> 2.6 sec.

TPC-H, SF-100, Q7: 94 sec -> 21 sec.

Developer: Nikita Taranov.

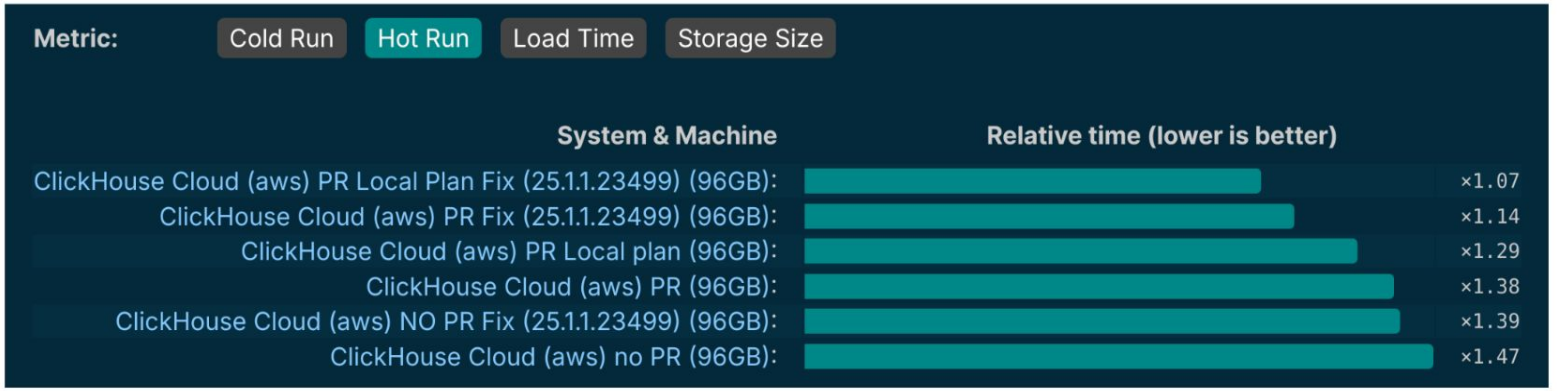
Parallel Replicas

Introduced in version 21.12.

In version 24.10, parallel replicas are in beta!

Developer: Igor Nikonov, Nikita Mikhailov, ...

Faster Parallel Replicas



ClickHouse 25.1 — 40% improvement on ClickBench!

Parallel Replicas (enabled with the enable_parallel_replicas setting) allow to use the resources of all replicas for a single query, to speed up heavy queries, especially in the case of operating on a shared storage.

Developers: Igor Nikonov, Nikita Taranov.

Automatic Spilling To Disk 

ClickHouse supports using disk as a scratch storage when there is not enough memory to perform GROUP BY or ORDER BY.

This is available since 2015, controlled by the settings max_bytes_before_external_group_by, max_bytes_before_external_sort.

It is also configured by default in ClickHouse Cloud with static thresholds.

Now it can be automatic!

Developer: Azat Khuzhin.

Faster Vector Indices

Using the new, secondary index cache, Controlled by server settings, **skipping_index_cache_size** and **skipping_index_cache_max_entries**.

Example: a table with 33,114,778 embeddings of 768 dimensions:

Full scan: 216 sec.
Indexed search (without the cache): 33 sec.
Indexed search (with the cache): 0.064 sec 🚀

Developers: Robert Schulze, Michael Kolupaev.

Variant, Dynamic, And JSON Types 🍰

Are promoted from experimental to the beta stage.

We also backported all fixes to the previous release, 24.11.

Read the blog post about the architecture of the JSON data type:
https://clickhouse.com/blog/a-new-powerful-json-data-type-for-clickhouse.

Now we support ALTER from the deprecated Object type to JSON
to allow easy migrations.

Developer: Pavel Kruglov.

Variant, Dynamic, And JSON Types 🍰

Now we support **subcolumns** for table's primary key and indices:

```
CREATE TABLE log
(
    data JSON
)
ORDER BY data.time;
```

Developer: Pavel Kruglov.

chDB 3.0

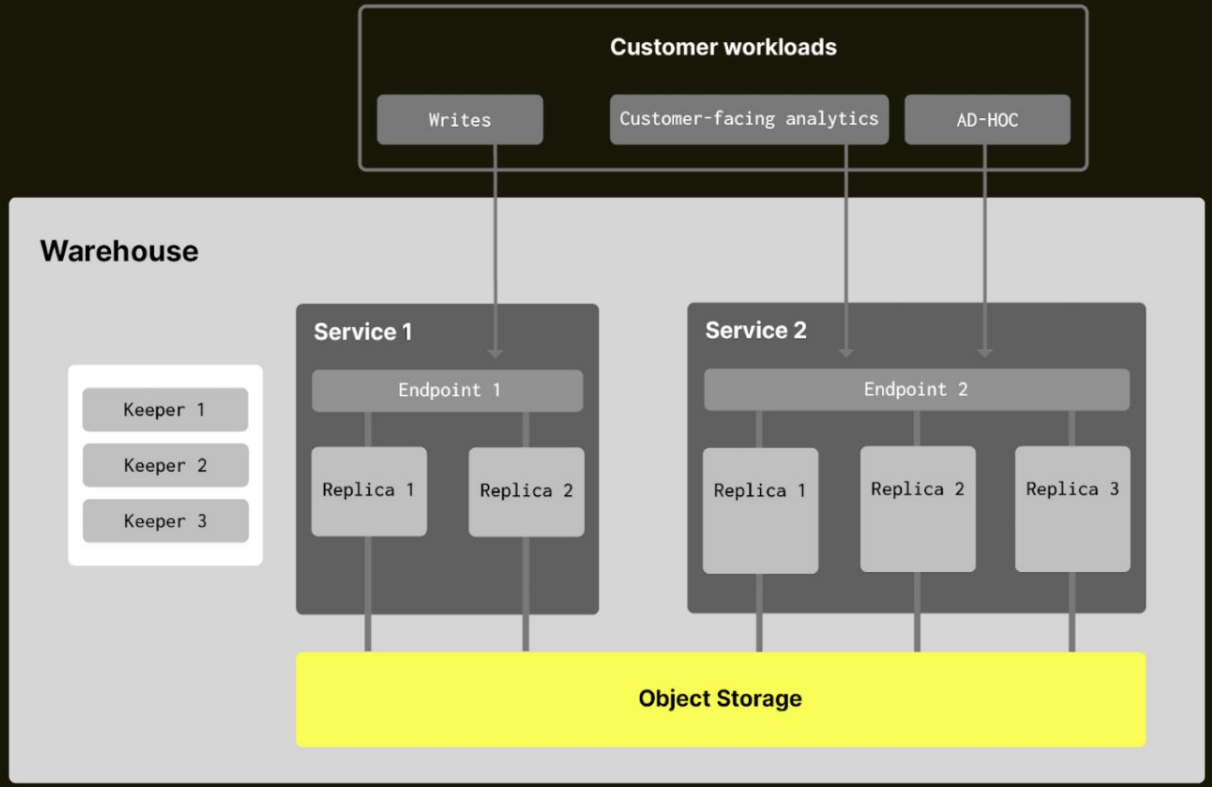
System & Machine	Relative time (lower is better)	
chDB 3.0(Parquet, partitioned) (EPYC 9654, 384G):		×1.17
chDB 2.1(Parquet, partitioned) (EPYC 9654, 384G):		×1.32
DuckDB (Parquet, partitioned) (EPYC 9654, 384G):		×1.33

Detailed Comparison

		chDB 3.0(Parquet, partitioned) (EPYC 9654, 384G)	chDB 2.1(Parquet, partitioned) (EPYC 9654, 384G)	DuckDB (Parquet, partitioned) (EPYC 9654, 384G)
Load time:		0	0	0
Data size:		13.73 GiB (×1.00)	13.73 GiB (×1.00)	**13.73 GiB (×1.00)**
☑	Q0.	**0.078s (×1.00)**	0.093s (×1.17)	0.188s (×2.23)
☑	Q1.	**0.073s (×1.00)**	0.095s (×1.26)	0.180s (×2.29)
☑	Q2.	**0.064s (×1.00)**	0.091s (×1.36)	0.200s (×2.82)
☑	Q3.	**0.069s (×1.00)**	0.088s (×1.24)	0.194s (×2.58)
☑	Q4.	**0.202s (×1.00)**	0.236s (×1.16)	0.262s (×1.28)
☑	Q5.	0.508s (×2.17)	0.511s (×2.19)	**0.228s (×1.00)**
☑	Q6.	**0.070s (×1.00)**	0.084s (×1.18)	0.155s (×2.05)

Bin

Compute-Compute Separation



Postgres CDC with PeerDB and ClickPipes

ClickHouse

What is PeerDB

- Fastest and most cost-efficient ETL tool to stream data from Postgres to ClickHouse (and other destinations)
- Easy to configure, easy to monitor with UI and command-line interface
- Multiple deployment strategies
  - Docker
  - Kubernetes (Helm Charts Available)
  - formerly PeerDB Cloud
- Open Source
  - 2.4k ⭐ on GitHub
  - Several external contributors

Company and culture

ClickHouse acquires PeerDB to boost real-time analytics with Postgres CDC integration

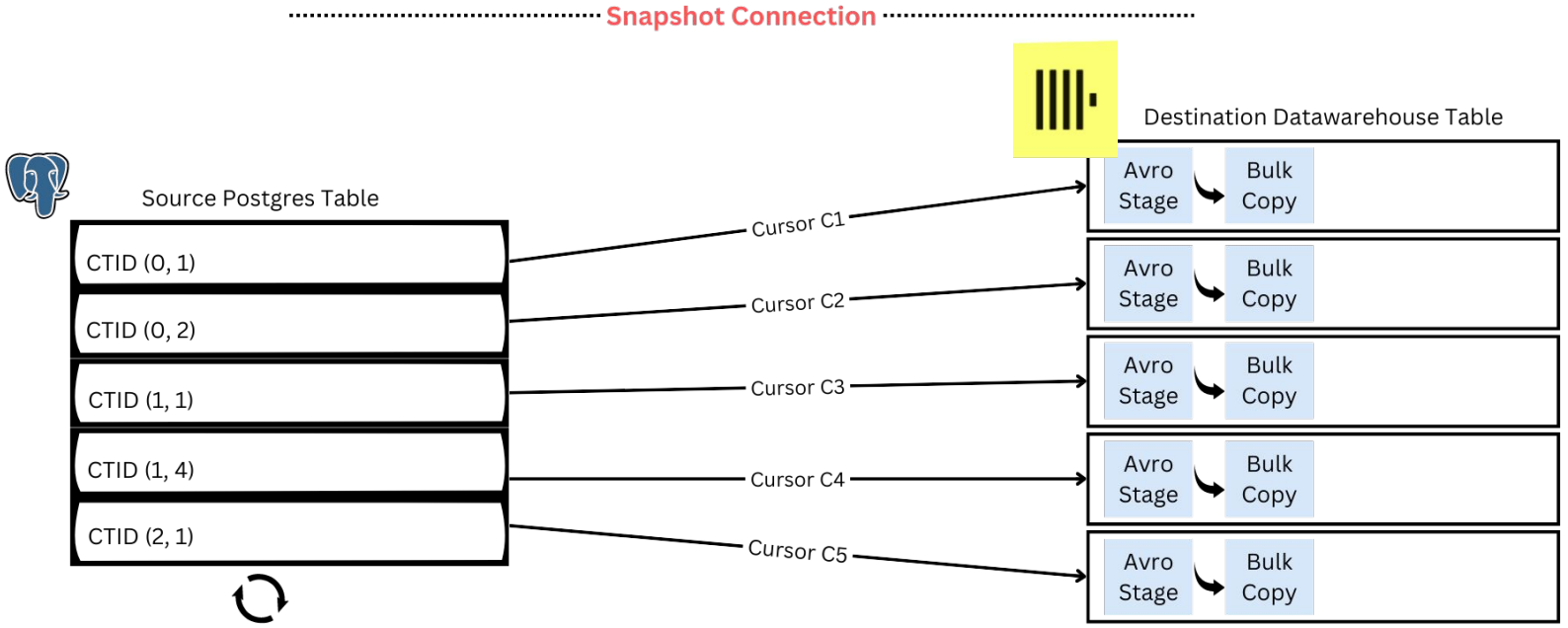
ClickHouse, Inc., the company behind the world's fastest and most popular real-time analytical database, is thrilled to announce the acquisition of PeerDB, a leading provider of change data capture (CDC) solutions

ClickHouse Team
Jul 30, 2024

PeerDB Supported features

- Specify custom order keys on ClickHouse
- Support for Read Replicas
- Partitioned Tables
- Nullable Columns
- Column exclusion
- Automatic Heartbeating for PG14+
- Multiple metrics via OpenTelemetry
- Geospatial Data (PostGIS)

Parallelized Initial Snapshot For CDC



ClickPipes

- Native integration with ClickHouse Cloud
- Supports CDC and 1-time migrations
- Connection to private Postgres instances via SSH Tunneling/AWS PrivateLink
- Out of the Box alerts for slot lag and ClickPipe errors
- Comprehensive 24×7 on-call support

ClickPipes Demo

Upcoming Features

- ClickHouse new JSON Type
- Postgres Logical Replication V2
- MySQL as a Source

Sign up for Private Preview!

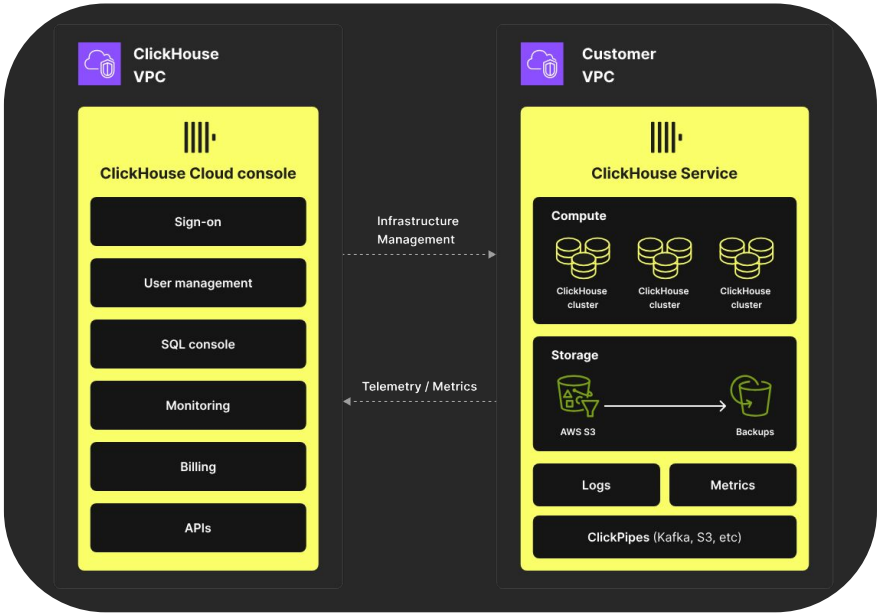
clickpipes.peerdb.io

BYOC on AWS

What is this?
Allows you to experience the advantages of ClickHouse Cloud within your own VPC.

Who is this for?
Organisations with strict data residency and compliance requirements.

https://clickhouse.com/cloud/bring-your-own-cloud



What's New with ClickHouse Academy

Existing Workshops:

Recently Added Workshops:

2-hour getting-started workshop
Level: Beginner

2-hour PostgreSQL to ClickHouse migration
Level: Intermediate

2-hour From BigQuery to ClickHouse migration
Level: Intermediate

KEEP IN TOUCH!

clickhouse.com/slack

@clickhousedb

@clickhouseinc #clickhouseDB

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QUERY OPTIMIZATION WORKSHOP

February 12, 2025 - 9:00 AM IST

clickhou.se/clickhouse-queryoptimise-workshop