Unified data platform with Clickhouse

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Show of Hands

- Have you heard about on-premise/private cloud?
- Do you know about Nutanix ?
- Have you used clickhouse ?
- Any other analytics database ?

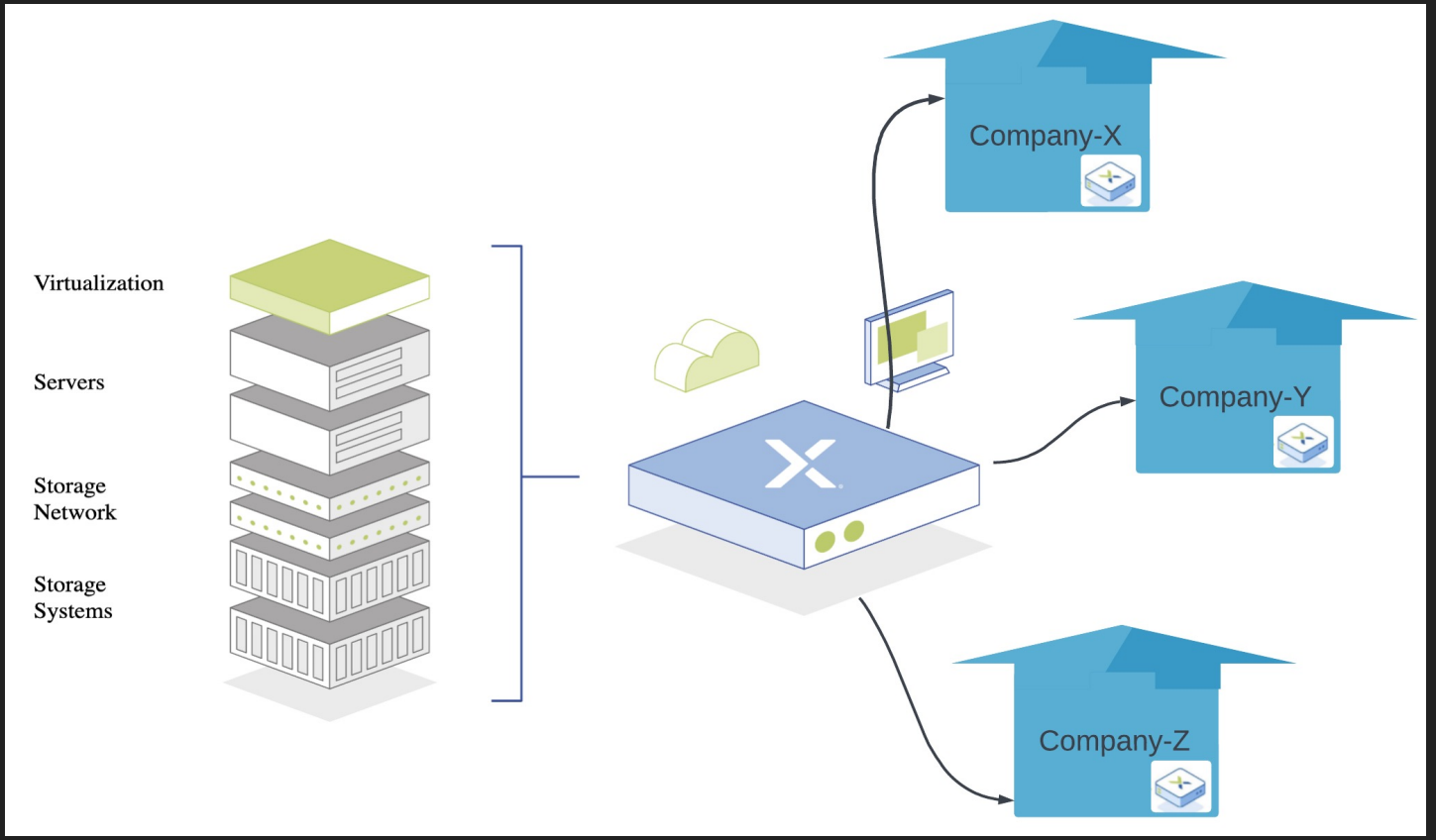
https://www.youtube.com/watch?v=6O7-nzXPAzs
https://www.nutanix.com/company/customers

Agenda

- Setting the context
- Need for Unified Data platform
- Workload and use cases
- Challenges
- Q & A

About Nutanix

- Known for on-premise business
- Provides modern and cost-effective solution to manage data-center



& many more

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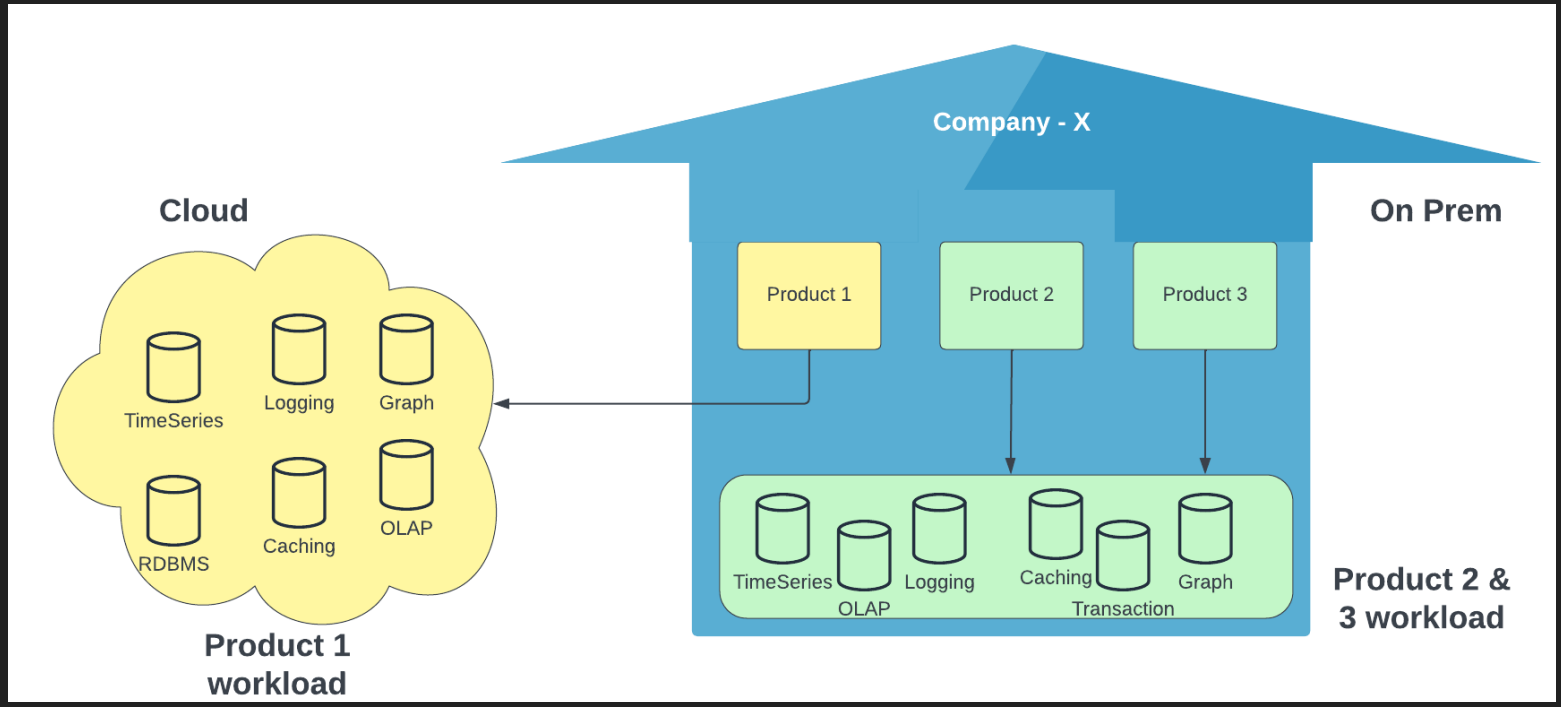
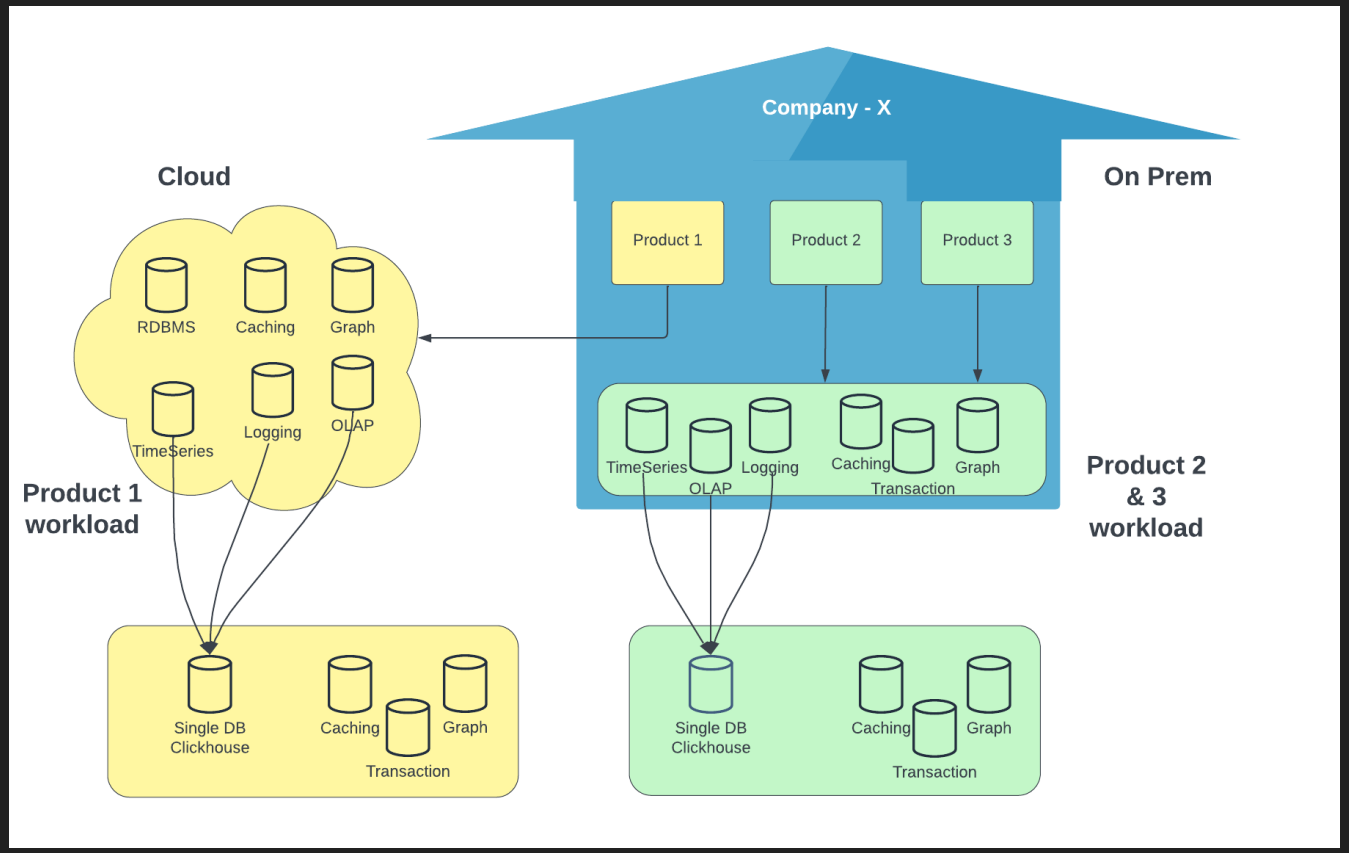
Setting the context

- Multiple database for different use case
  - Analytics – Druid
  - Timeseries - Victoria Metrics, Inhouse DB
  - Logging and tracing – Elastic search



Need for unified data platform

- On-prem and Cloud database challenges
  - So many databases
  - So many components per database
  - Resource intensive
  - Cost intensive
  - Redundant data
- Pros of Unified data platform
  - Ease of Management
  - Less time for day 1 activities
  - Cost effective
  - Resource efficient



Unified data platform

Workload Numbers

Analytics

Data size	#Data sources	# Ingestion tasks (24 hrs)	# Queries (24 hrs)
~20 TB	294	423k	~8m

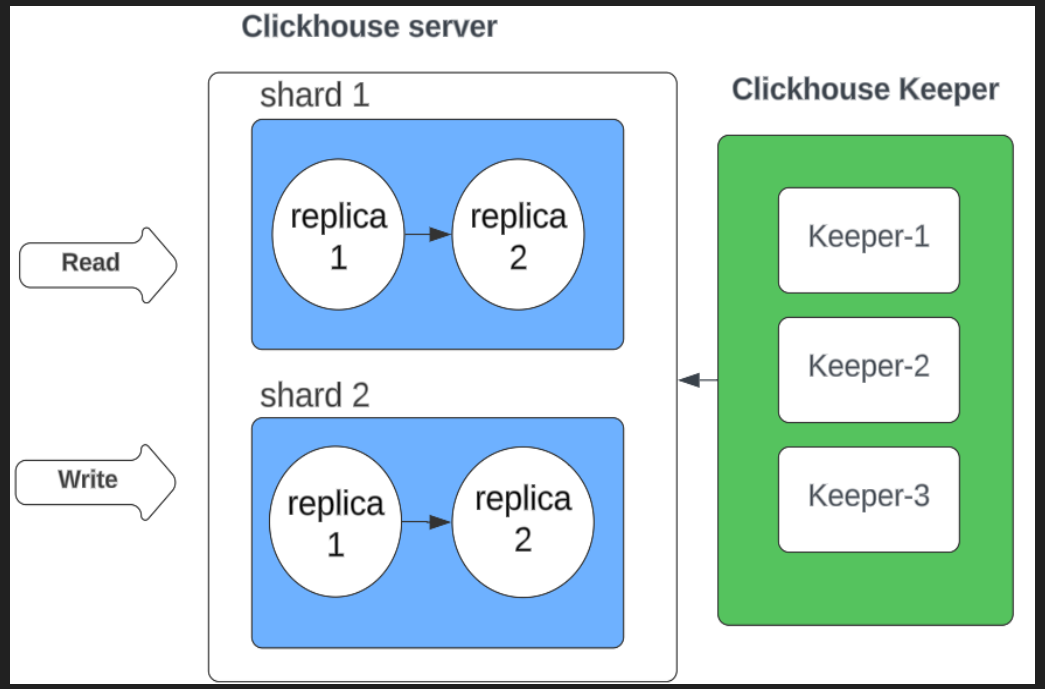
Logging and Tracing

Use case	Data size	Retention
Logging	~60TB	15 days, rest s3
Tracing	~1TB	3 days, rest s3

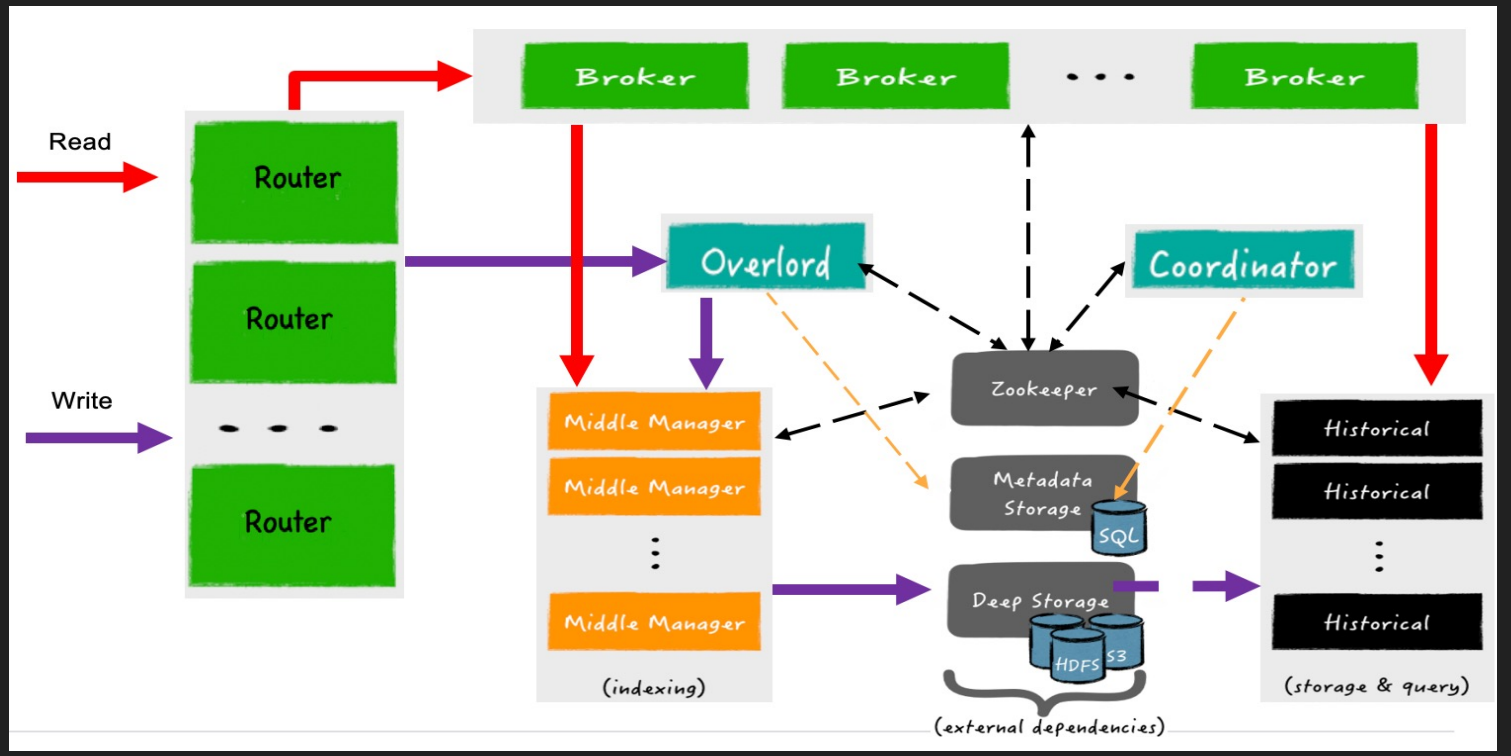
Time Series

Use case	Data size	Active Time series	Data points per 5min
X-Large (current) on-prem	3-5 TB	25m	25m
X-Large (future) on-prem	10-15 TB	50m	110m
Cloud	~7TB	~22m	~150m

Analytics: Clickhouse vs Druid



- 2 components
- Less maintenance
- EBS vs instance store



- 9 components - Resource hungry
- More maintenance in on-prem
- Read-write segregation
- Data rebalance

Analytics: Clickhouse vs Druid

	Clickhouse	Druid	Improvement
P99 Ingestion Task Latency	34.989s(16 parallel tasks)	68.688s*	~50 %**
Memory avg***	4.6 GiB	16 GiB	
CPU avg	1.33 vCPU	6.4 vCPU	

Use case 1:
53.3 million rows
1 month data

	Clickhouse	Druid	Improvement
Ingestion Task Latency	~4.5hrs(with 4 parallel tasks) total time	~9hrs(total time)	~50 %**

Use case 2:
1.2 billion rows
13 months data

*Doesn't include compaction time for druid
**Numbers are from perf environment
***Include resource requirement for Middle manager

Show of Hands

- Have you used any time series DB?
- How many of you have used clickhouse for time-series use case?

https://www.youtube.com/watch?v=6O7-nzXPAzs
https://www.nutanix.com/company/customers

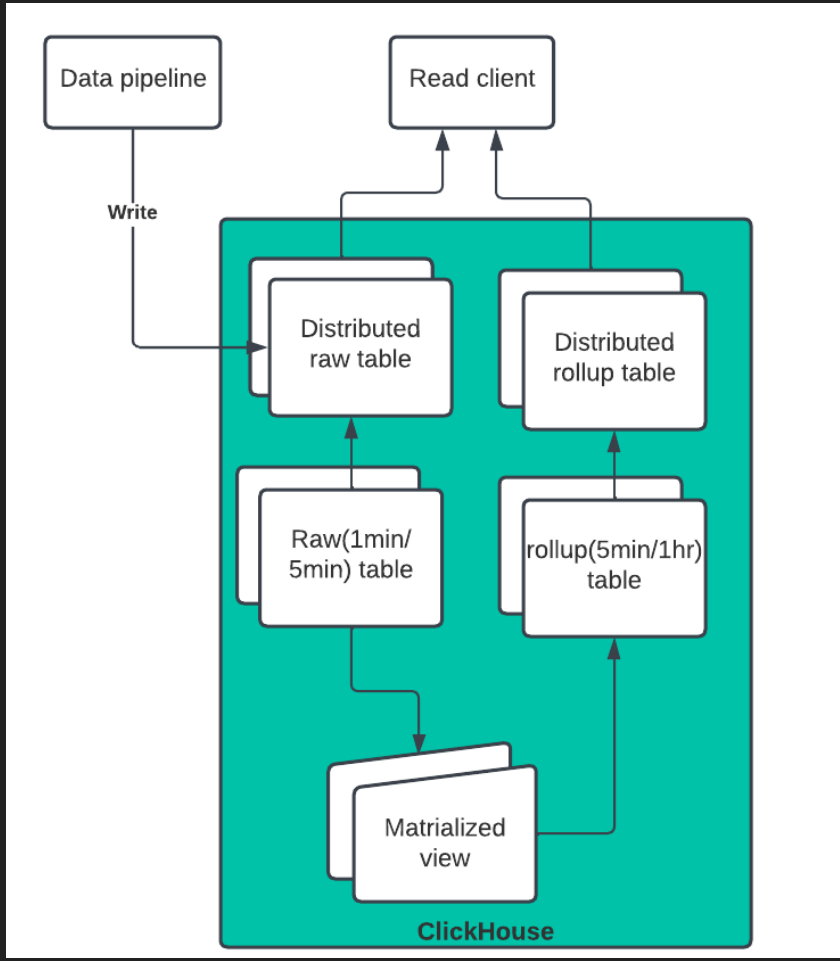
Time Series: Use case

- ClickHouse schema modelling to fit timeseries use case
- Optimized for time-series query patterns and desired latency and QPS
- Optimized the ingestion for our scale
- Optimized the storage

Requirements

Ingestion	Query
• High ingestion rate (40m data points per min) • Batch ingestion • No fix batching • Multiple clients with different rate • Historical ingestion	• 60 Queries per second • Latency requirement(P80) of <200ms • Mix for Time-series and OLAP query

Time Series: ClickHouse Schema



- Distributed table
  - Sharding logic
- Raw tables (ReplicatedMergeTree)
  - Keeps raw data
  - 1-month data (5 min granularity)
- Rollup tables (ReplicatedMergeTree)
  - Populated using materialized view
  - Keeps aggregated data
  - 1-year data (hourly granularity)
- Materialized view
  - Aggregation logic

Time Series: ClickHouse Schema

```
CREATE TABLE test.my_table ON CLUSTER 'test-cluster' (
    timestamp DateTime DEFAULT now(),
    id String,
    type String,
    ....
    domain_id String,
    metric_name String,
    metric_value Float64,
)
ENGINE = ReplicatedMergeTree('<...>', '<...>')
PARTITION BY toYYYYMM(toDate(timestamp))
ORDER BY (domain_id, type, metric_name, id, timestamp)
TTL timestamp + INTERVAL 3 WEEK
```

Order-by Should depend on

- Cardinality (Low to High)
- Query pattern

Time Series: ClickHouse Schema

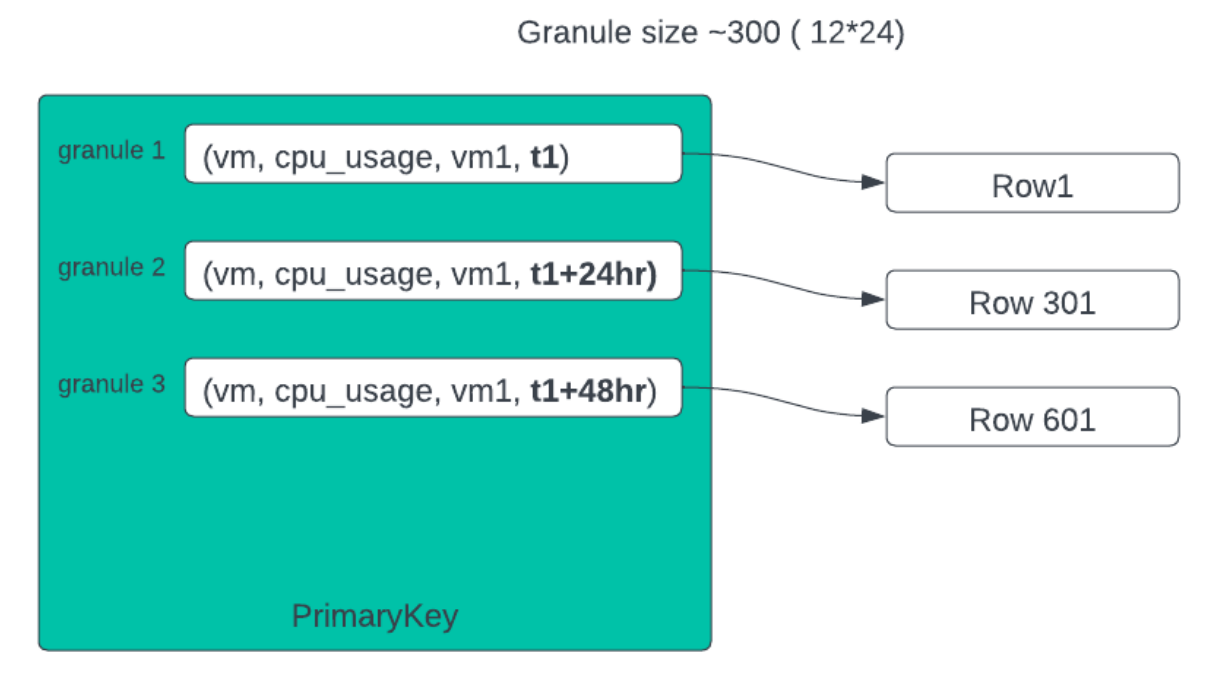
```
CREATE TABLE test.my_table ON CLUSTER 'test-cluster' (
    timestamp DateTime DEFAULT now(),
    eid String,
    etype String,
    domain_id String,
    metric_name String,
    metric_value Float64,
)
ENGINE = ReplicatedMergeTree('<...>', '<...>')
PARTITION BY toYYYYMM(toDate(timestamp))
ORDER BY (domain_id, etype, metric_name, eid, timestamp)
TTL timestamp + INTERVAL 3 WEEK
SETTINGS index_granularity = 300, index_granularity_bytes = 0;
```

Refined Granule Size

Less data scanned

Faster query

Optimizing ClickHouse Query



- Every granule contains 1 day data
- With default granule size(8192) – 28 days data

A granule refers to smallest unit of data storage in a clickhouse table.

Time Series: ClickHouse Schema

```
CREATE TABLE test.my_table ON CLUSTER 'test-cluster' (
    timestamp DateTime DEFAULT now(),
    __timestamp DateTime MATERIALIZED toStartOfInterval(timestamp, INTERVAL 60 second)
    id String,
    type String,
    domain_id String,
    metric_name String,
    metric_value Float64,
)
ENGINE = ReplicatedMergeTree('<...>', '<...>')
PARTITION BY toYYYYMM(toDate(__timestamp))
ORDER BY (domain_id, type, metric_name, id, __timestamp)
TTL timestamp + INTERVAL 3 WEEK
SETTINGS index_granularity = 300, index_granularity_bytes = 0;
```

Normalized timestamp column

Improved Data quality and aggregation

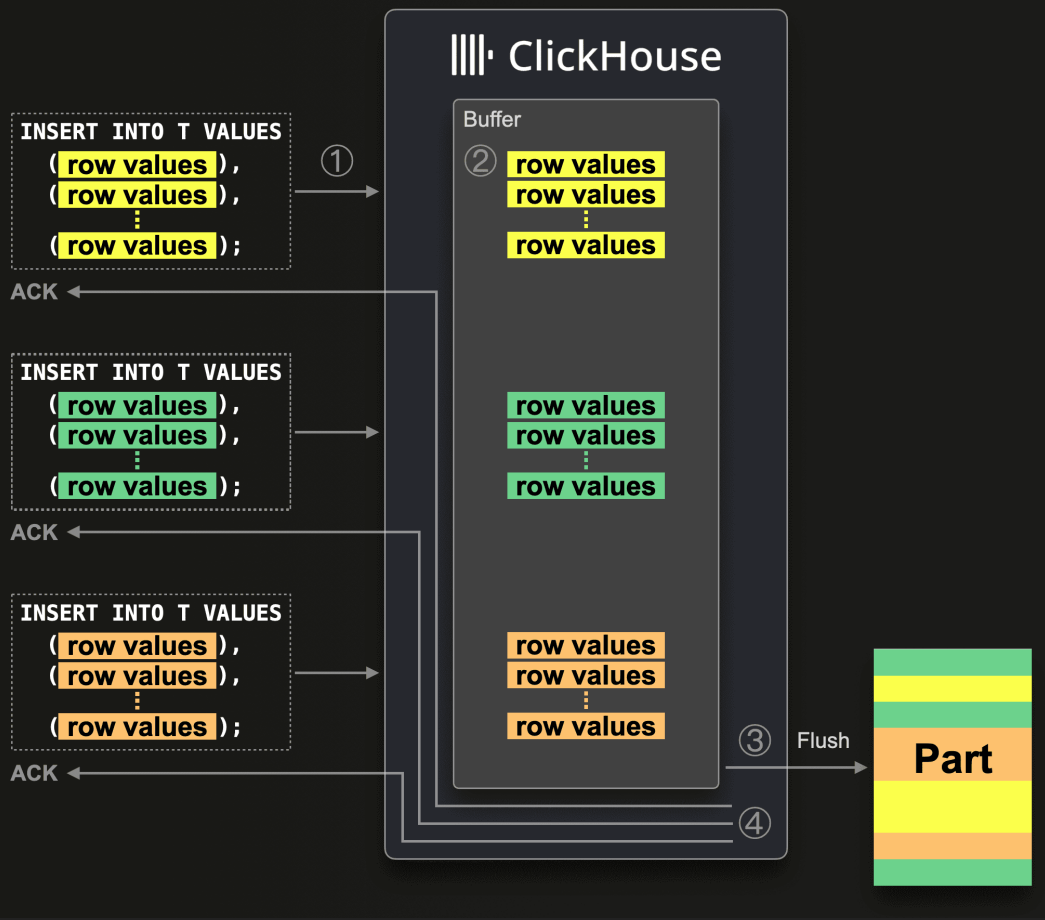
Time Series: ClickHouse Schema

```
CREATE TABLE test.my_table ON CLUSTER 'test' (
    timestamp DateTime DEFAULT now() CODEC(DoubleDelta),
    __timestamp DateTime MATERIALIZED
            toStartOfInterval(timestamp, INTERVAL 300 second) CODEC(DoubleDelta),
    eid FixedString(36),
    etype LowCardinality(String),
    domain_id LowCardinality(FixedString(36)),
    metric_name LowCardinality(String),
    metric_value Float64 CODEC(Gorilla),
)
ENGINE = ReplicatedMergeTree('<...>', '<...>')
PARTITION BY toYYYYMM(toDate(__timestamp))
ORDER BY (domain_id, etype, metric_name, eid, timestamp)
TTL timestamp + INTERVAL 3 WEEK
SETTINGS index_granularity = 300, index_granularity_bytes = 0;
```

Applied compression and encoding

Improved storage in turn improves query latency

Ingesting into ClickHouse for Time Series



Achieved 25% improvement in ingestion using native Async

① async_insert = 1
② wait_for_async_insert = 1
③ async_insert_busy_timeout_ms = 200
④ async_insert_max_data_size = 1_000_000
⑤ async_insert_max_query_number = 20

https://clickhouse.com/blog/asynchronous-data-inserts-in-clickhouse

Ingesting into ClickHouse for Time Series

	Standard sync	Native Sync	Async insert	Native async v23.10+
driver	database/sql driver	Clickhouse-go native driver	Clickhouse-go native driver	Clickhouse-go native driver
Batching support	Yes, using prepared stmt	Yes, using prepareBatch	No, supported using inline sql.	Yes, using preparedBatch
ingestion performance	Baseline	20% improved	Perf degraded	25% improved

Ingestion	Data points (1min scale)	Batch size	Total parts	Ingestion time
Native Async	17m(~900mb)	~10000	1365	~38 sec
Native Sync	17m(~900mb)	~10000	1530	~48 sec

Challenges & Learnings

- Rebalancing after adding more shards
- Read-write segregation
- Lots of knobs (swiss-knife), know your configs!
- Replication & sharding in clickhouse has a steep learning curve.
- Use the Altinity Kubernetes Operator for Replication & Sharding
- If you only have time-series use case, a dedicated Time series DB might be easy

Thank You

Q & A