ClickHouse

Building an Events Lakehouse that supports dynamic schema

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Bengaluru, March 2024

DoctorDroid

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Doctor Droid is a tooling company

Dynamic Playbooks	Define dynamic playbooks that can auto-investigate metrics & logs data from different platforms.
Alert Insights Slack Bot	A tool that assess your existing alerting setup and provides recommendations on how to improve them.
Kenobi	Events Lakehouse that supports dynamic schema

Introductions

Siddarth Jain

– CEO & Co-Founder

– Data Science at Shadowfax

– Investment Analyst at Accel

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Dipesh Mittal

– CTO & Co-Founder

– VP-Engg at Shadowfax

– Engineer at PayPal

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– CEO & Co-Founder

– Data Science at Shadowfax

– Investment Analyst at Accel

Mohit Goyal

– Founding Engineer

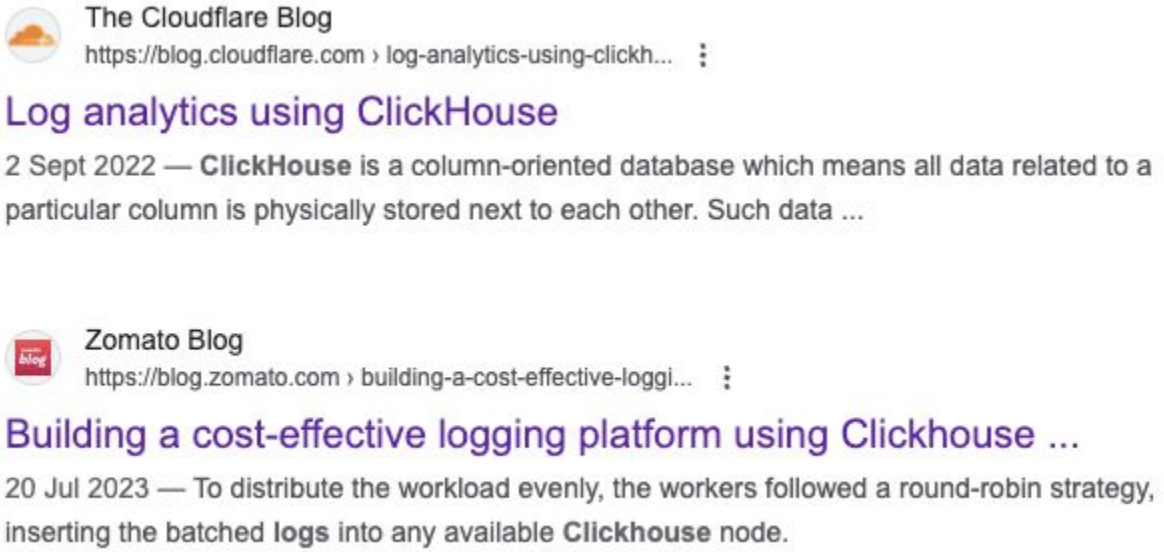
– Ex-Swiggy, BITS Pilani

Jayesh Sadhwani

– MERN Instructor at AccioJob

– DTU

Lot of discussion on Logging



Very Limited Discussion on Lakehouse

Create **a high-performing events storage** with support for dynamic schema and real-time analytics

1. Search
2. Aggregations on events & event_joins
3. Condition based alerts

Dynamic Schema

Java

```
{
 "event_name": "OrderCreated",
 "timestamp": 1677751161120,
 "payload": {
  "order_id": "ekpsHJ9GhQd7OU",
  "city": "Bengaluru",
  "store_code": "PZHT0056",
  "order_value": 435,
  "promised_eta": 23
 }
}
```

Common Use-cases:

- Asynchronous Data pipelines
- E-commerce order states
- Consumer Experience

Current Status

- We have processed **2B+ total events** till date in our platform.
- 150M events/day prod traffic tested
    - Sub 5-seconds search on this data with TTL of 15 days

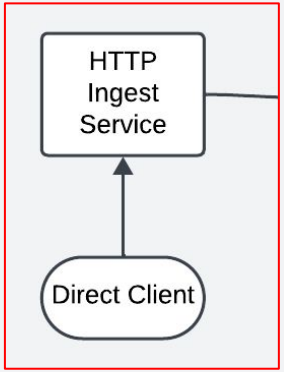
We have clients sending us events via **Segment, SDK, CloudWatch Logs**

- Unique Event Types: 2203
- Unique Keys Processed: ~270 keys

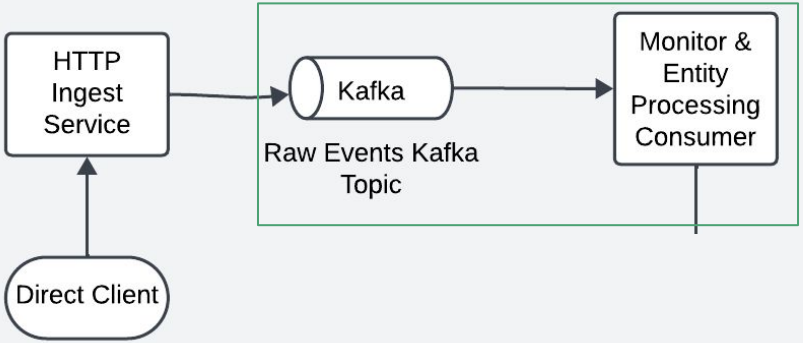
Requirements

Integrations	Ingest	Events Storage	User Features
Segment	Event drop guarantees	Source of Truth	Search
AWS Kinesis Firehose	Real-time processing	Fast-analytics	Metrics
SDK / API	Asynchronous processing	High performance on aggregation & search	Condition based alerts

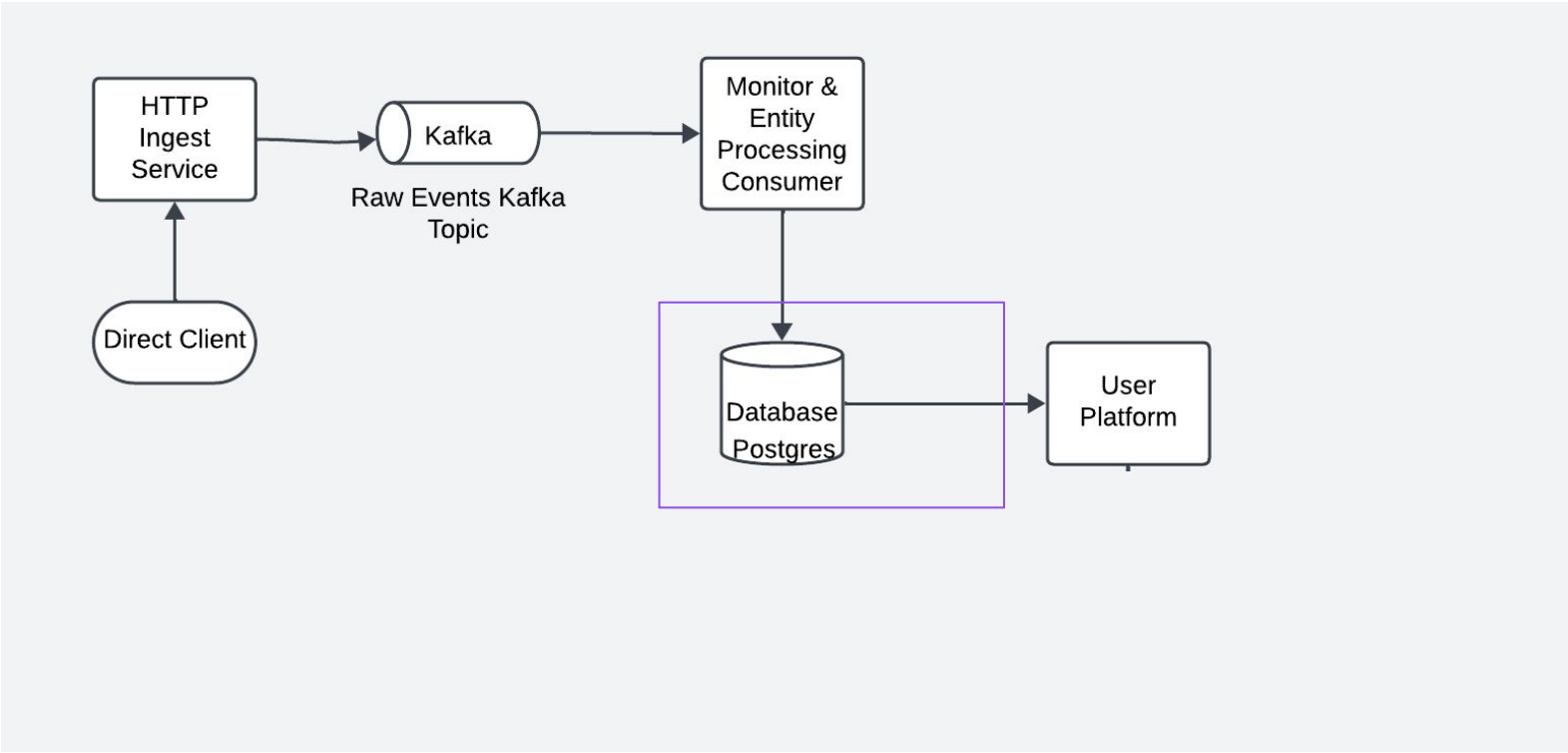
Kenobi v0 Architecture



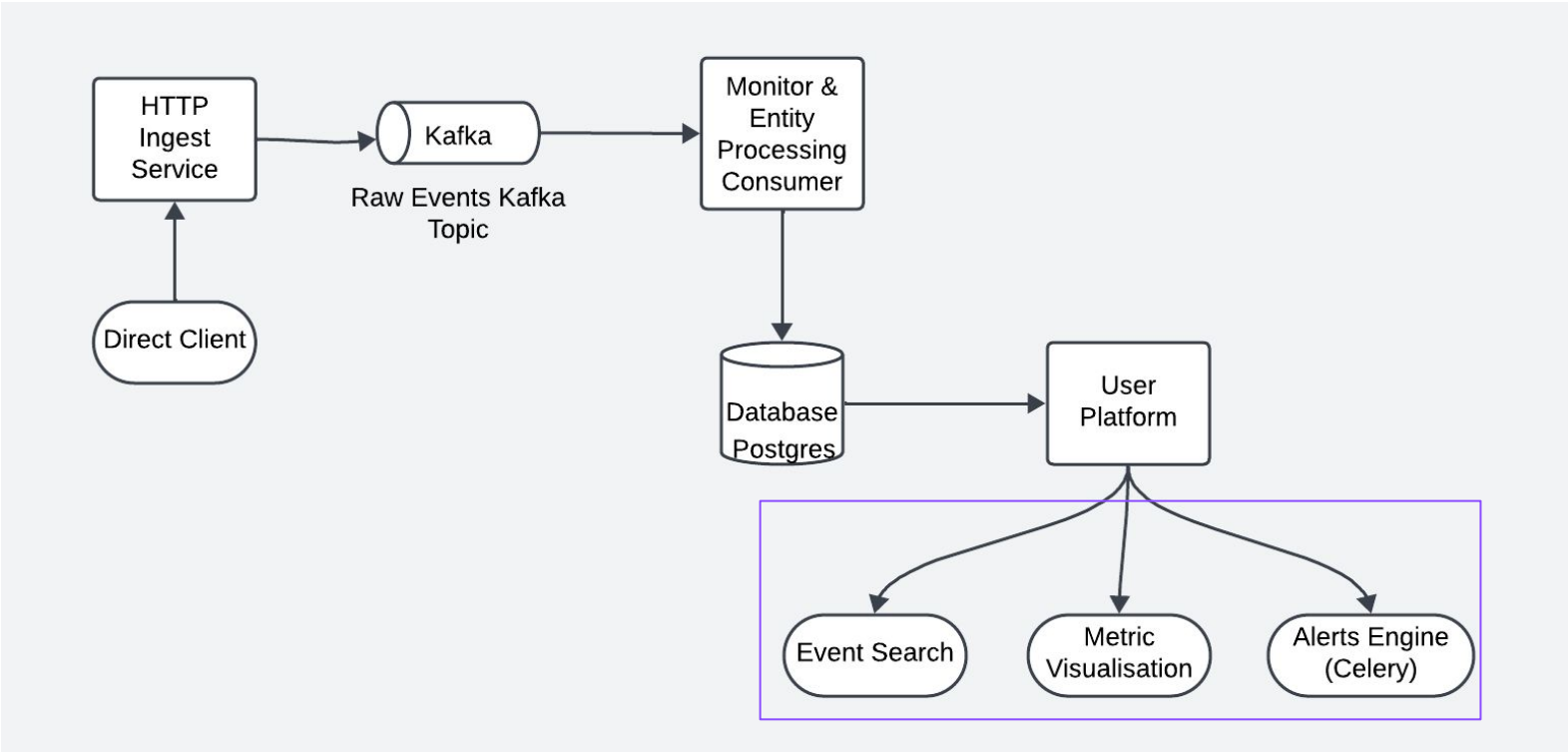
Kenobi v0 Architecture



Kenobi v0 Architecture



Kenobi v0 Architecture



Performance on PostgreSQL

Events Volume:	25-50k events/day
Aggregation API:	
Search API	Asynchronous

Metric	Avg
p50:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	1.78 s
p75:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	4.80 s
p90:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	9.55 s
p95:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	11.84 s
p99:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	13.03 s
p99.9:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	13.46 s

Quiz 1

Open www.DrDroid.io in one browser.

Send your results via Intercom chat.

2:30 timer.

30 seconds buffer to send screenshot.

Quiz 1

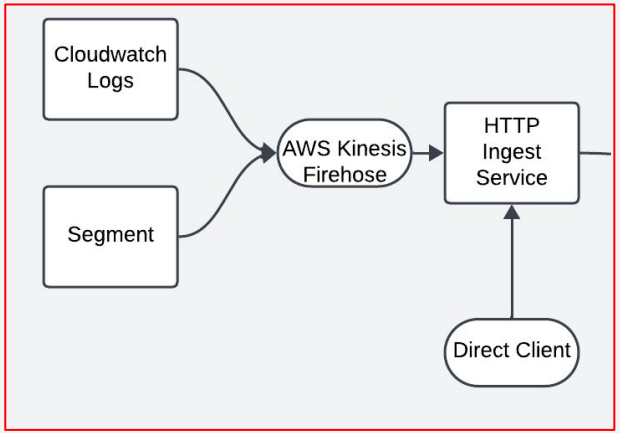
BUFFER SLIDE

Quiz 1

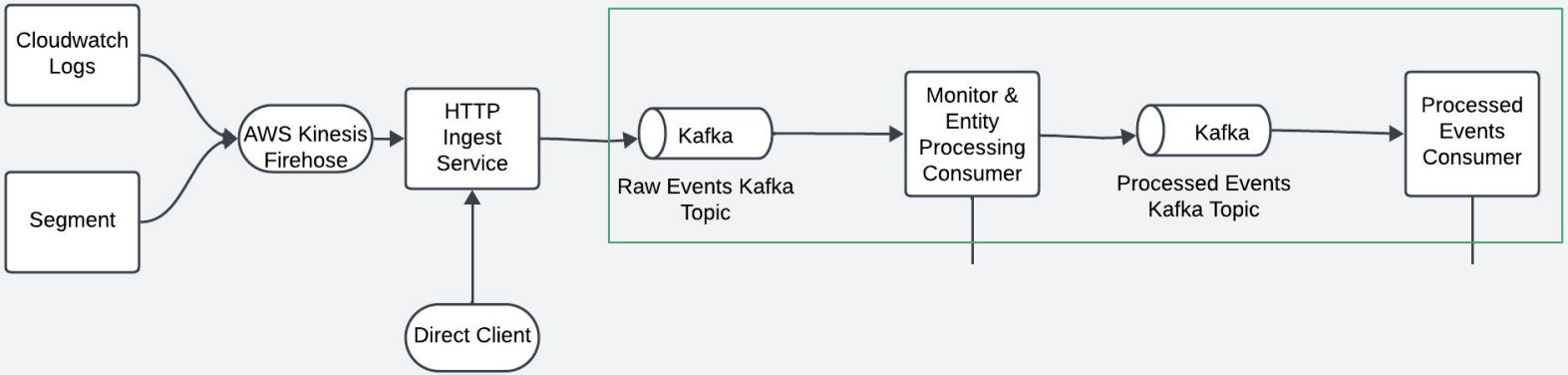
Tool Evaluations

	ClickHouse	**Pinot**	**ElasticSearch**
Storage	Columnar with parts optimised for querying across the dataset	Columnar with chunks with custom index, optimised for max data freshness	Inverted index storage, optimizing for quick full-text search and aggregations.
Maintenance	Single component deployment	Extensive fine-tuning & manual configuration, multiple components (Controller, Zookeeper, Broker, Server)	Difficult with non-strict schema – due to mapping explosion / multi-tenancy issues
Schema Flexibility	High	Low – with manual definition and updation	

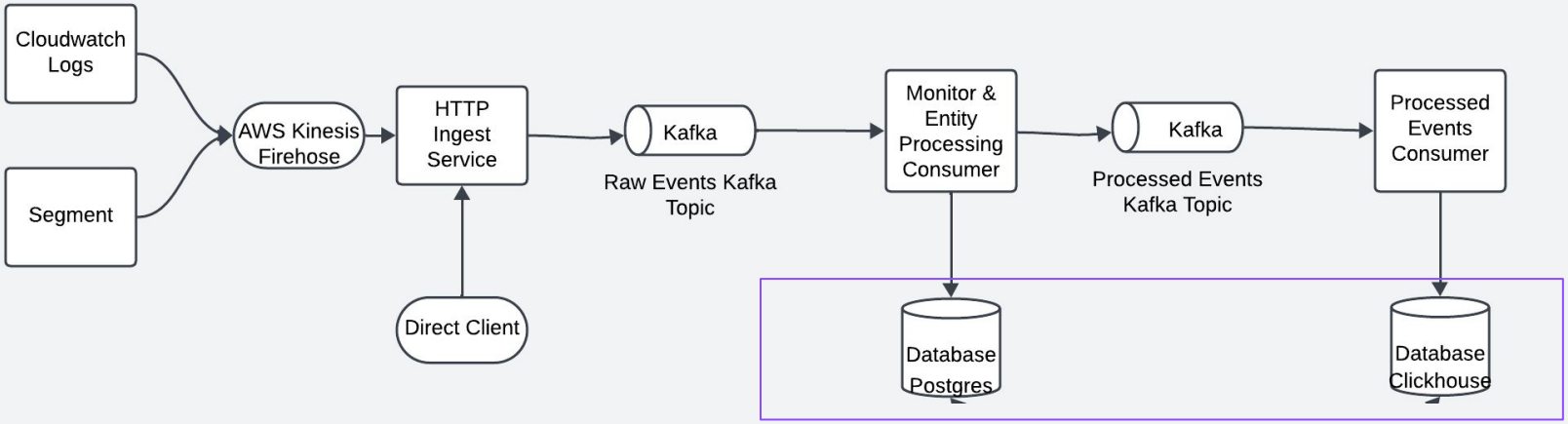
Kenobi v1 – Integration



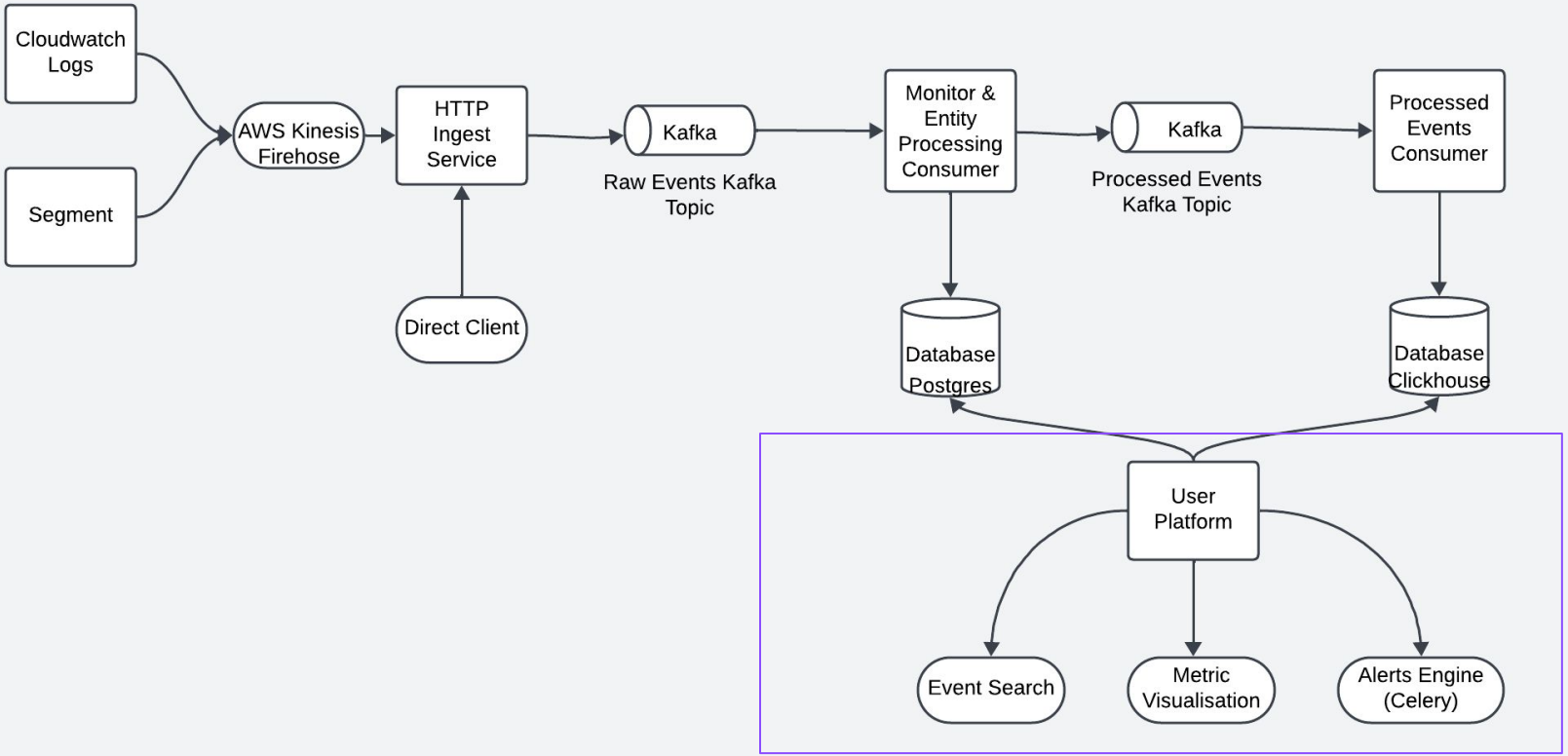
Kenobi v1 – Ingestion



Kenobi v1


Cloudwatch Logs
Segment
AWS Kinesis Firehose
HTTP Ingest Service
Direct Client
Kafka
Raw Events Kafka Topic
Monitor & Entity Processing Consumer
Kafka
Processed Events Kafka Topic
Processed Events Consumer
Database Postgres
Database Clickhouse

Kenobi v1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AWS Kinesis Firehose
HTTP Ingest Service
Direct Client
Kafka
Raw Events Kafka Topic
Monitor & Entity Processing Consumer
Kafka
Processed Events Kafka Topic
Processed Events Consumer
Database Postgres
Database Clickhouse
User Platform
Event Search
Metric Visualisation
Alerts Engine (Celery)

Specs of our current stack

Databases:

- Postgres DB (Main + Replica) : db.m6i.large (2 vCPUs, 8GB Memory)
- Clickhouse Cloud DB : (4 vCPUs, 16GB Memory) X 3 Replicas

Kafka:

- 3 Broker Cluster (Each having 2 vCPUs, 8GB Memory, 200GB Disk)
- Same cluster manages all topics

Platform:

- Python, ReactJs
- Deployed on AWS Kubernetes Engine

Scales we have tested:

- 150M+ logs/day with this config with a TTL of 15 days

JSON Auto-inference:

Given any JSON, it automatically identifies the key/value pairs

- Fast querying
- No column changes (to the eyes)

```
{
  "name": "test_name"
  "timestamp": 1677751261100,
  "payload": {
    "key_1": "new_one",
    "key_2": "44",
    "key_3": "cc"
}
```


```
{
  "name": "test_name"
  "timestamp": 1677751261100,
  "payload": {
    "key_1": "new_one",
    "key_2": "44",
    "key_3": "cc"
}
```

ClickHouse Implementation

```
set allow_experimental_object_type = 1;
create table table_name (
   id UInt64,
   created_at DateTime64(3, 'UTC') default now(),
   timestamp DateTime64(3, 'UTC') default now(),
   event_type_id UInt64,
   event_type_name VARCHAR(256),
   event_source UInt16,
   processed_kvs JSON,
)
engine = MergeTree()
PARTITION BY toDate(timestamp)
primary key (event_type_id, timestamp)
order by (event_type_id, timestamp)
TTL toDateTime(created_at) + INTERVAL 10 DAY DELETE;
```

POST e/api/metrics

Aggregation API

Metric	Avg
p50:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	434 ms
p75:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	622 ms
p90:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	862 ms
p95:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	942 ms
p99:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	1 055 ms
p99.9:trace.django.request{env:prod,resource:98a42b80e2901126,service:prototype}	1 055 ms

Search API

Metric	Avg
p50:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	1.95 s
p75:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	2.20 s
p90:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	2.24 s
p95:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	2.24 s
p99:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	2.24 s
p99.9:trace.django.request{env:prod,resource:ff7f34ad56155191,service:prototype}	2.24 s

Quiz 2

– Open DrDroid.io – first person to respond correctly on intercom wins.

Quiz 2

– *There are 4 events being streamed to ClickHouse. Each event has a JSON field.*

– *Maximum key count in any row in JSON column in CH table?*

Quiz 2 – Max key count in JSON column in CH table?


```
{
  "name": "OrderCreated",
  "timestamp": 1677751161120,
  "payload": {
    "order_id": "ekpsHJ9GhQd7OU",
    "city": "Bengaluru",
    "store_code": "PZHT0056",
    "order_value": 435,
    "promised_eta": 23
  }
}
```

```
{
  "name": "Payment_Started"
  "timestamp": 1677751161100,
  "payload": {
    "transaction_id": "si_LULhDM2vvvt7yZ",
    "amount": 54.8,
    "currency": "usd",
    "card_type": "amex",
    "invoice_id": "in_1KnN0G589O8KAxCGfVSpD0Pj"
}
```

```
{
  "name": "Transfer_Prepared"
  "timestamp": 1677751161100,
  "payload": {
    "recipient_id": "tWaIb3aK3vlHn9",
    "amount": 10323,
    "currency": "inr",
    "recipient_bank": "citi",
    "source_bank": "hdfc"
}
```

```
{
  "name": "Transfer_Completed"
  "timestamp": 1677751461100,
  "payload": {
    "recipient_id": "tWaIb3aK3vlHn9",
    "transaction_id": "98363ixIwXnh07L5DuLvQE6c",
    "transaction_status": "success"
}
```

How the JSON column looks like:

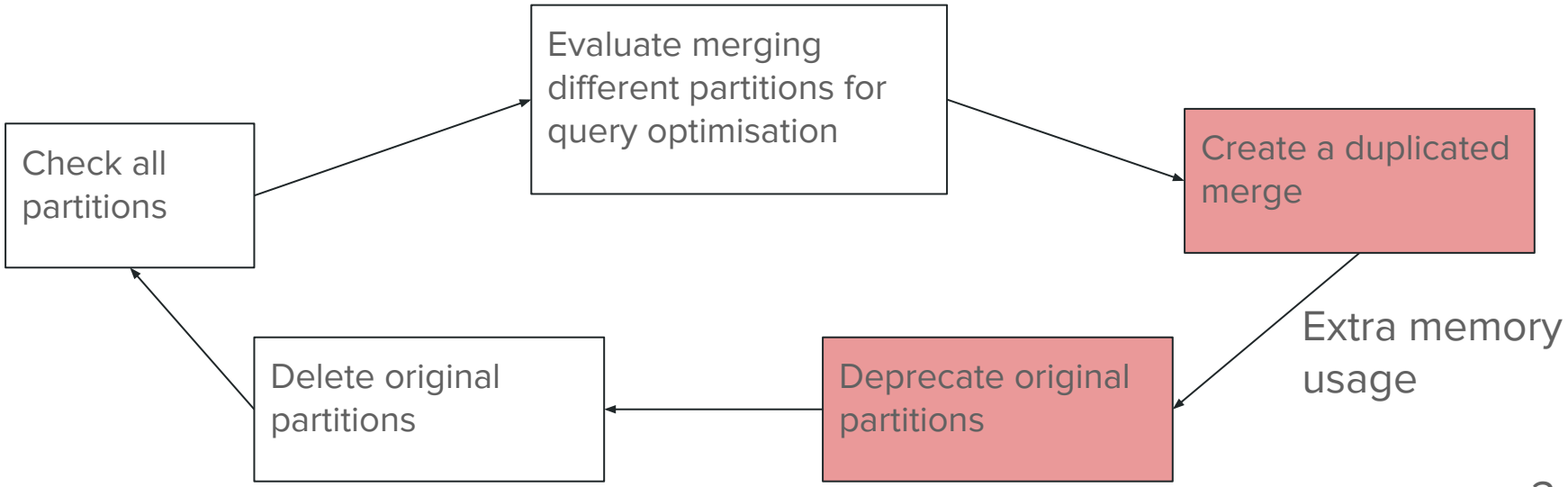
Open Source Setup

We wanted to make it easy for companies to host it in their environment:

- Docker compose based – without any config change, 1Mn events/day. With a few config +machine upgrades – should be able to scale.
    - `Prototype.docker-compose.yml`
- Link

How is CH able to query so fast with dynamic data?

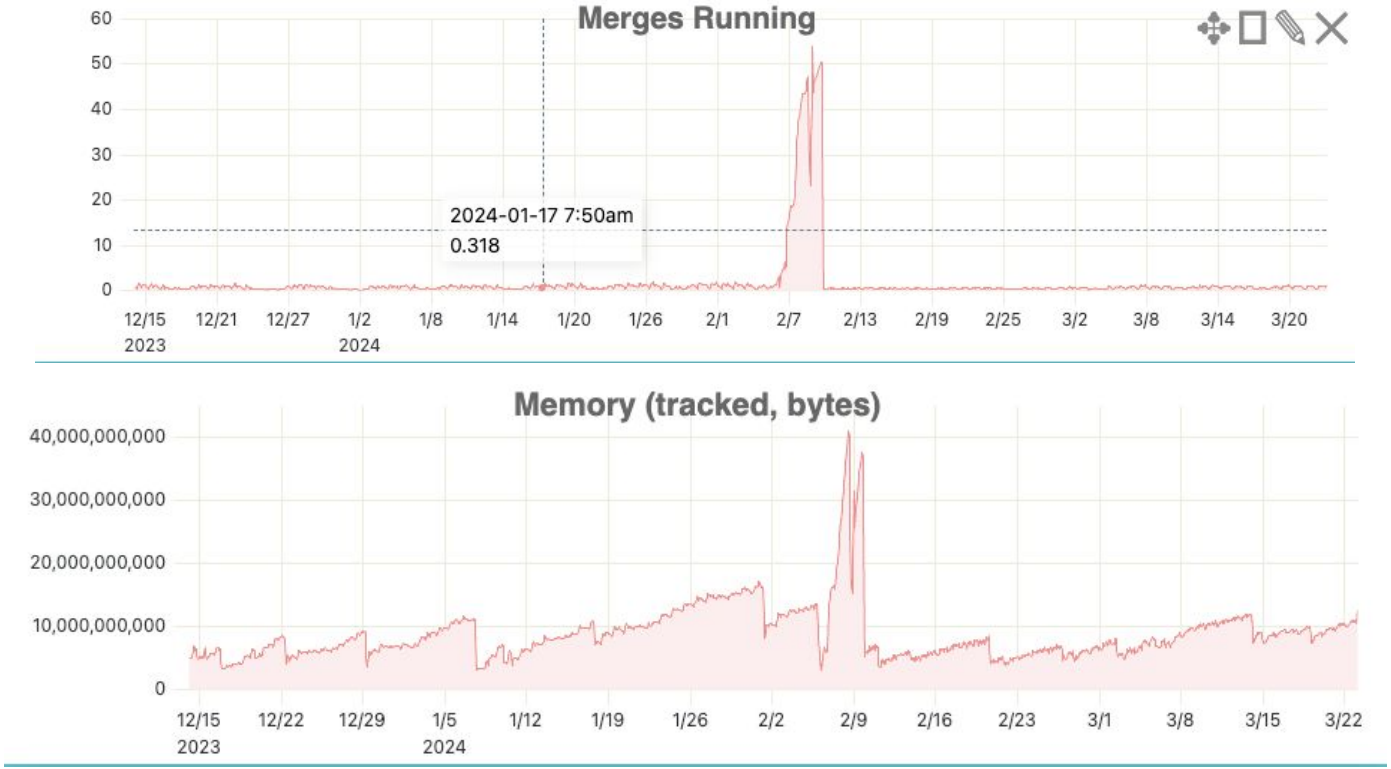
MergeTree – Background Operation to optimise it's partitions:

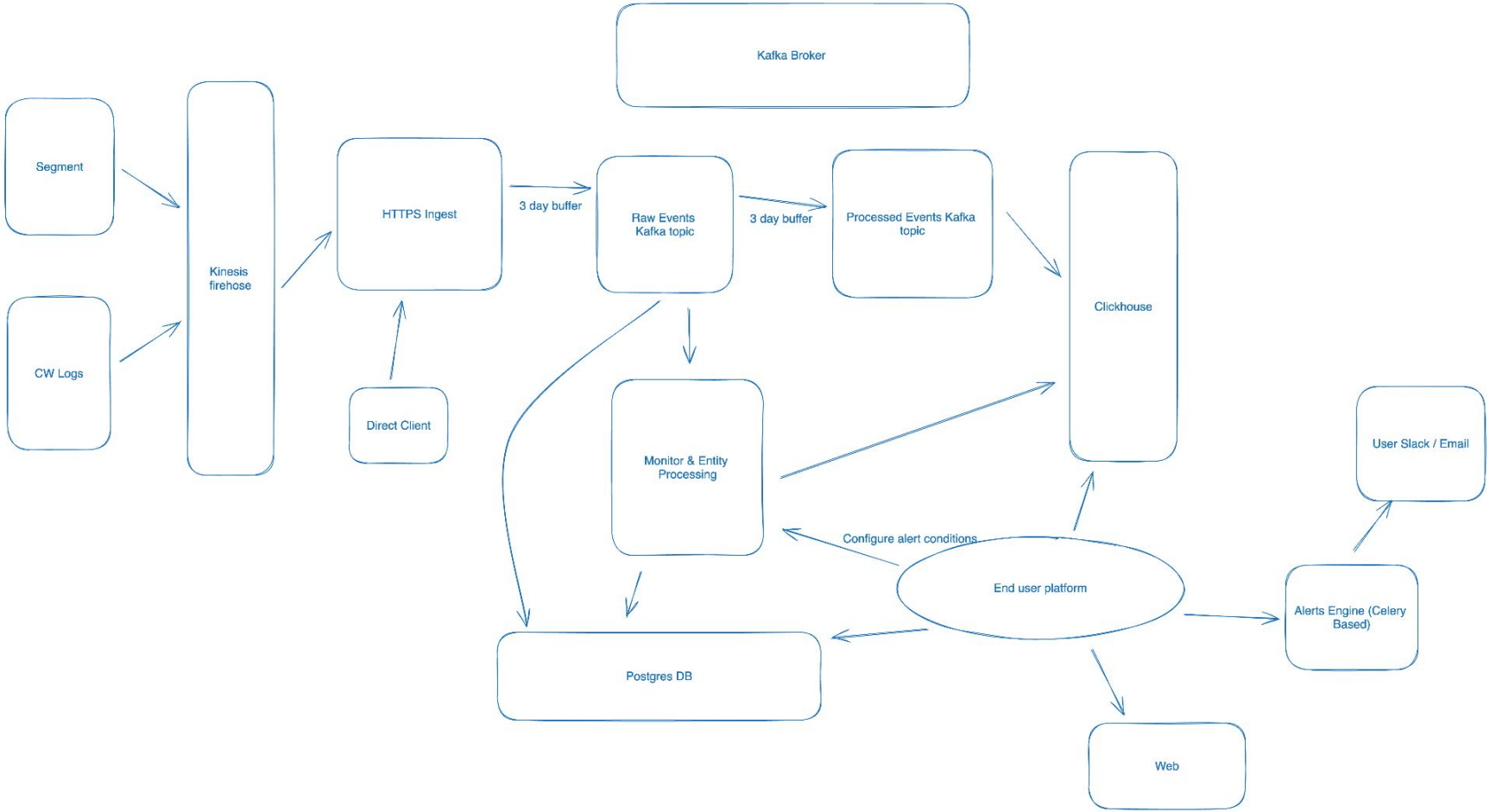


Constraints with JSON experimental feature

- KV Pair limit: 1000 per table
- Risk of breaking in production
- Lot of normal setups break (E.g. CDC Postgres to CH)

Constraints with JSON experimental feature




Kafka Broker
Segment
CW Logs
Kinesis firehose
HTTPS Ingest
3 day buffer
Raw Events Kafka topic
3 day buffer
Processed Events Kafka topic
Clickhouse
Direct Client
Monitor & Entity Processing
User Slack / Email
Configure alert conditions
End user platform
Alerts Engine (Celery Based)
Postgres DB
Web

Quiz 1

BUFFER SLIDE

Quiz 3

How many metro stations in Bangalore as per 2025 plan?

ClickHouse

DoctorDroid

Thank You

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Twitter: TheBengaluruGuy

Indexing

Table Name	Compression Ratio	Volume	Keys
t_1	25.8	1M rows	150
t_2	19.9	10M rows	160
t_3	8.3	200M rows	50

Appendix:

Pgtuning – worked on a read optimised tuning to maximise performance.