Fast, Cheap, DIY Monitoring with Open Source Analytics and Visualization

Robert Hodges - Altinity

ConFoo 2024

Let's make some introductions

Robert Hodges

Database geek for 40 years.
Open source since 2006.
ClickHouse since 2019.

Altinity Engineering

Other database geeks with centuries of experience in DBMS and applications

Authors of Altinity Kubernetes Operator for ClickHouse, Altinity Grafana plugin for ClickHouse, clickhouse-backup project, etc.

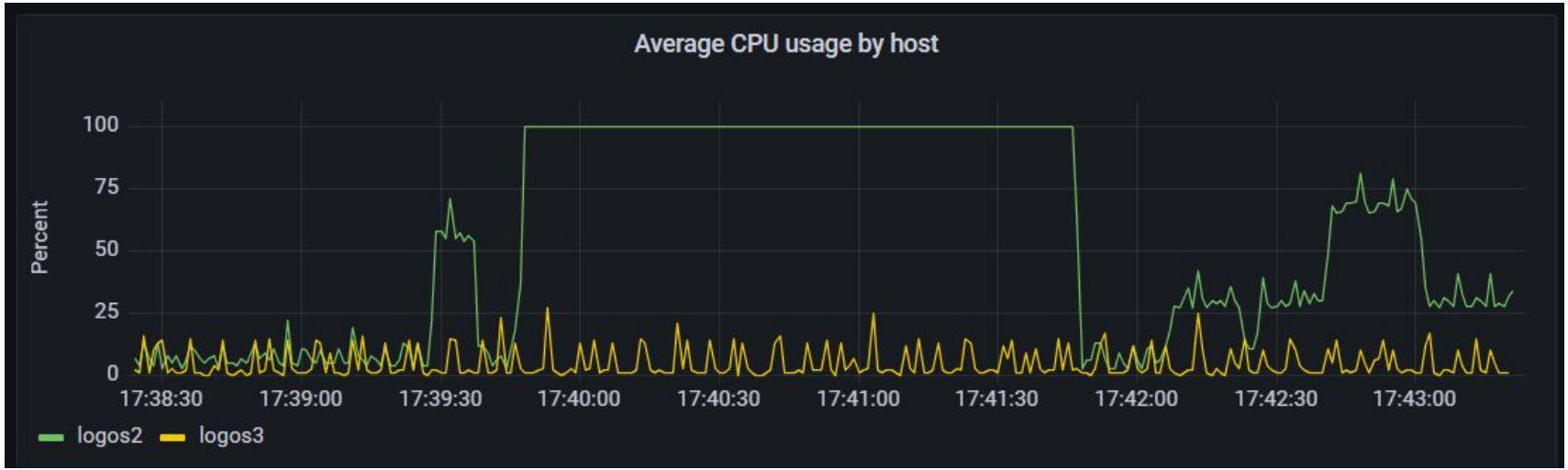
Monitoring is for answering questions

- Why are users seeing performance problems?
- When did it start?
- How many users are affected?
- Which service is at fault?

How we answered those questions in days gone by…

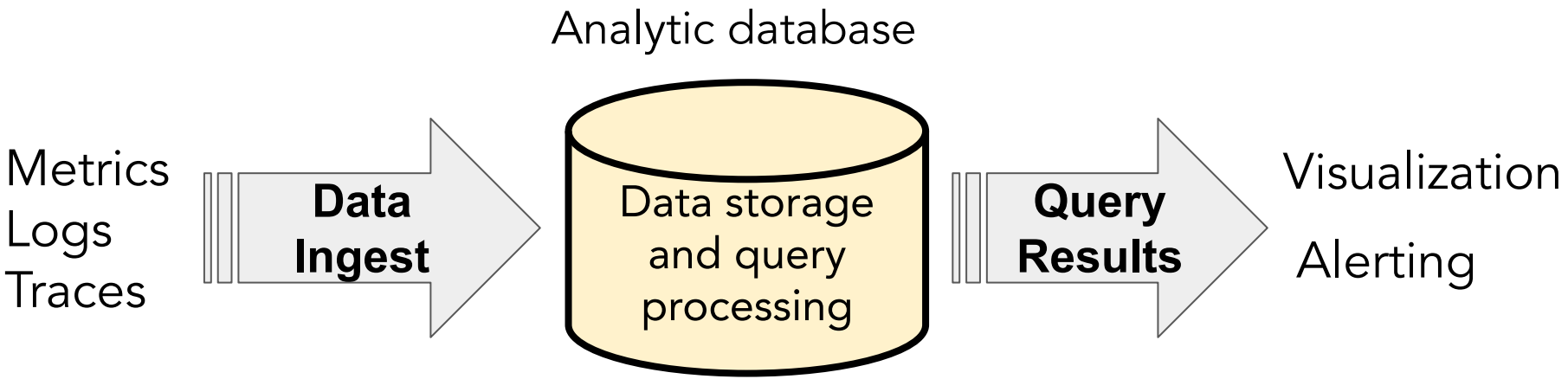
```
$ vmstat -n 2 10
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
 r  b   swpd   free   buff  cache   si   so    bi    bo   in   cs us sy id wa st
 0  0 343296 21690808 2290104 6897160    0    0     3   187    0    2  4  2 94  0  0
 0  0 343296 21690800 2290104 6897160    0    0     0    60 2989 7688  2  1 97  0  0
 0  0 343296 21690140 2290104 6897164    0    0     0    72 4704 13677  3  2 95  0  0
 0  0 343296 21689888 2290104 6897164    0    0     0    14 3132 9364  2  1 97  0  0
 0  0 343296 21690220 2290104 6897168    0    0     0    86 3014 7995  1  1 97  0  0
 0  0 343296 21690448 2290104 6897176    0    0     0    20 2660 7297  1  1 98  0  0
 0  0 343296 21690268 2290104 6897176    0    0     0    12 2695 7222  1  1 98  0  0
 1  0 343296 21690196 2290104 6897180    0    0     0    80 3641 10419  2  1 97  0  0
 0  0 343296 21689696 2290104 6897180    0    0     0    14 4108 12605  3  2 95  0  0
 0  0 343296 21689900 2290104 6897184    0    0     0    60 2688 7270  2  1 97  0  0
```

The modern way is a lot nicer



Off-the-shelf solutions? Perhaps not for you…

Let's build a monitoring system with open source



Introducing ClickHouse, a real-time analytic database

Understands SQL

Runs on bare metal to cloud

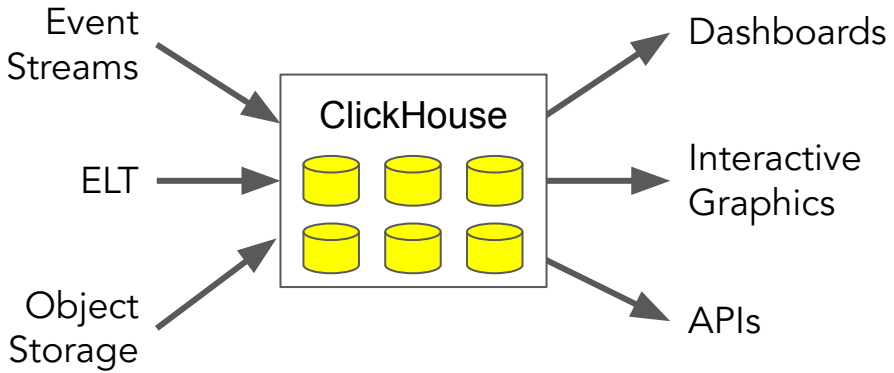
Shared nothing architecture

Stores data in columns

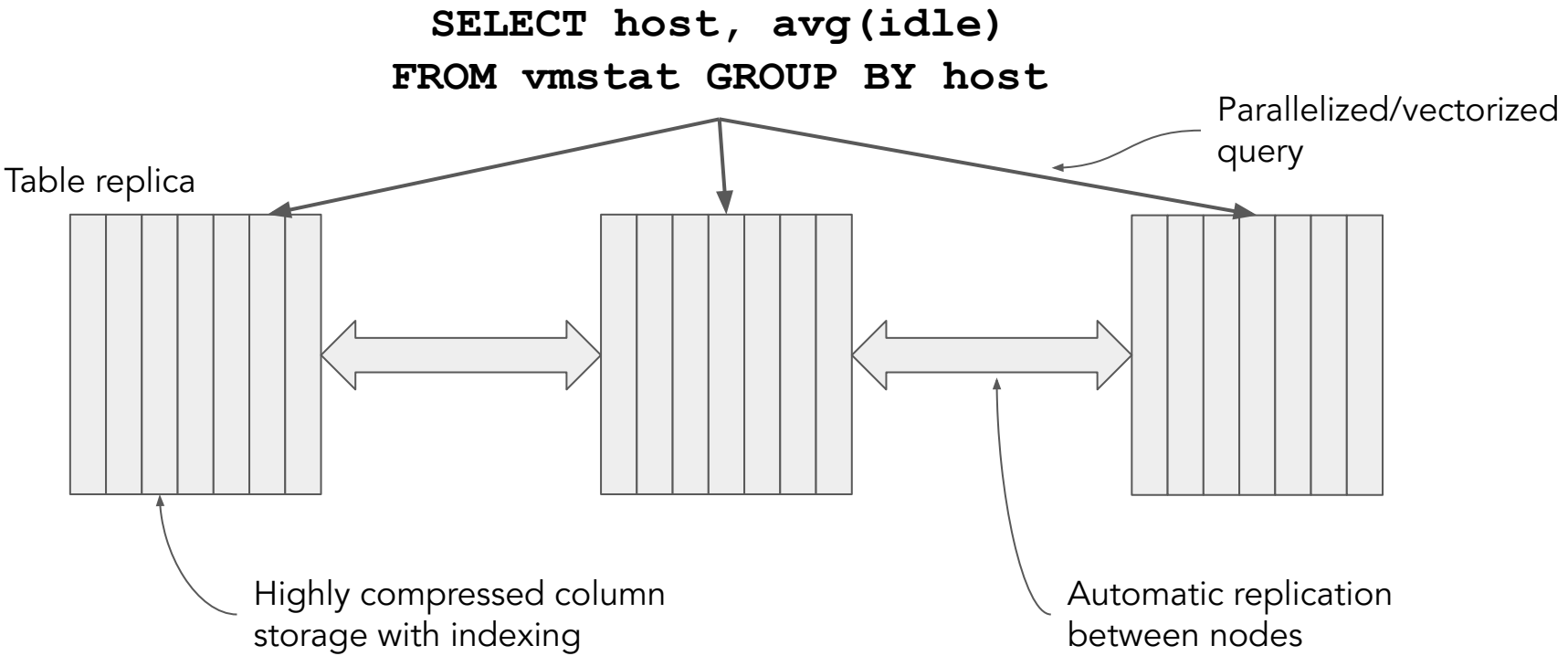
Parallel and vectorized execution

Scales to many petabytes

Is Open source (Apache 2.0)



ClickHouse optimizes for fast response on large datasets



…And supports [many] dozens of input formats

```
INSERT INTO some_table Format <format>

        TabSeparated
        TabSeparatedWithNames
        CSV
        CSVWithNames
        CustomSeparated
        Values
        JSON
        JSONEachRow
        Protobuf
        Parquet
        ...
```

It also has great support for time-ordered data

Date -- Precision to day

DateTime -- Precision to second

DateTime64 -- Precision to nanosecond

BI tools like Grafana like DateTime values

toYear(), toMonth(), toWeek(), toDayOfWeek, toDay(), toHour(), ...

toStartOfYear(), toStartOfQuarter(), toStartOfMonth(), toStartOfHour(), toStartOfMinute(), …, toStartOfInterval()

toYYYYMM()

toYYYYMMDD()

toYYYYMMDDhhmmsss()

And many more!

Grafana pairs well with ClickHouse for observability apps

Understands time series data

Simple installation

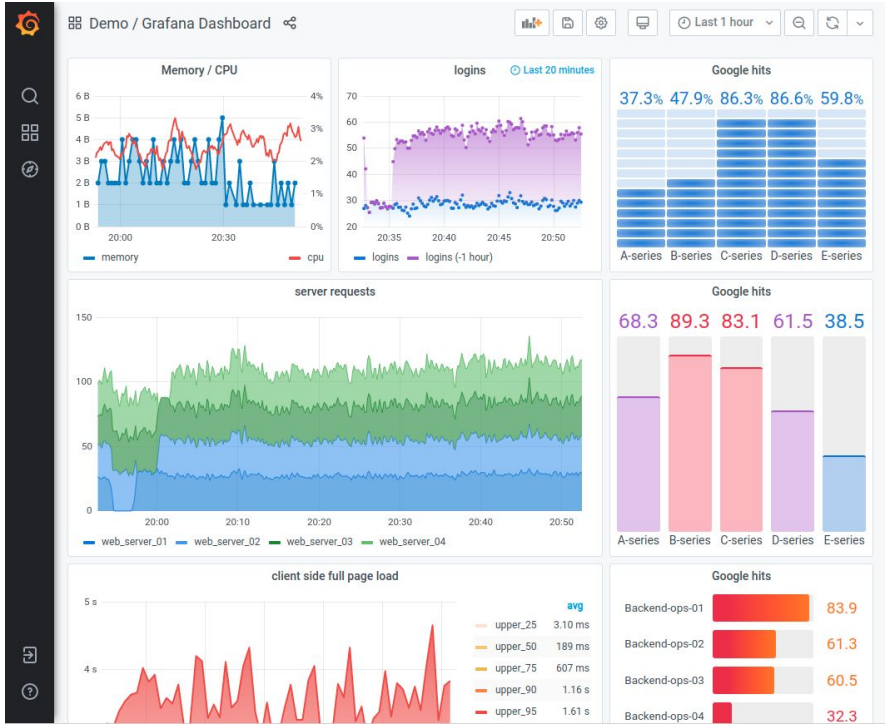
Many data sources

Lots of display plugins

Interactive zoom-in/zoom-out

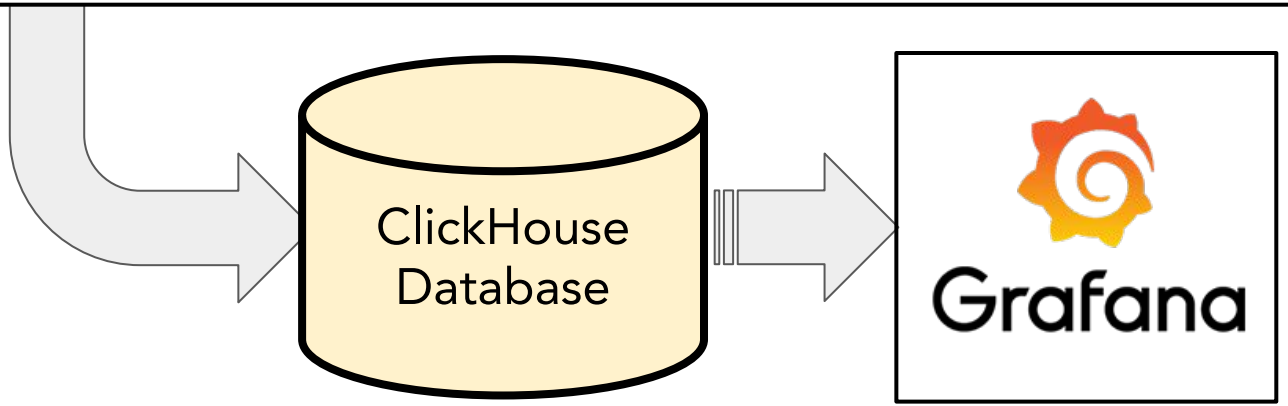
Great for monitoring dashboards

Is open source (AGPL 3.0)



Sooo…How do we ingest vmstat data and display it?

```
$ vmstat 1 -n
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
 r  b    swpd    free    buff  cache    si    so    bi    bo    in    cs us sy id wa st
 0  0 166912 2645740   36792 3360652    0     0     3   101     1     1  2  1 98  0  0
 1  0 166912 2645360   36792 3360652    0     0     0     0 1182 3986  7  1 93  0  0
```



Step 1: Generate vmstat data

```
#!/usr/bin/env python3
import datetime, json, socket, subprocess
host = socket.gethostname()
with subprocess.Popen(['vmstat', '-n', '1'], stdout=subprocess.PIPE) as proc:
    proc.stdout.readline() # discard first line
    header_names = proc.stdout.readline().decode().split()
    values = proc.stdout.readline().decode()
    while values != '' and proc.poll() is None:
        dict = {}
        dict['timestamp'] = datetime.datetime.now().strftime("%Y-%m-%d %H:%M:%S")
        dict['host'] = host
        for (header, value) in zip(header_names, values.split()):
            dict[header] = int(value)
        print(json.dumps(dict), flush=True)
        values = proc.stdout.readline().decode()
```

Here's the output

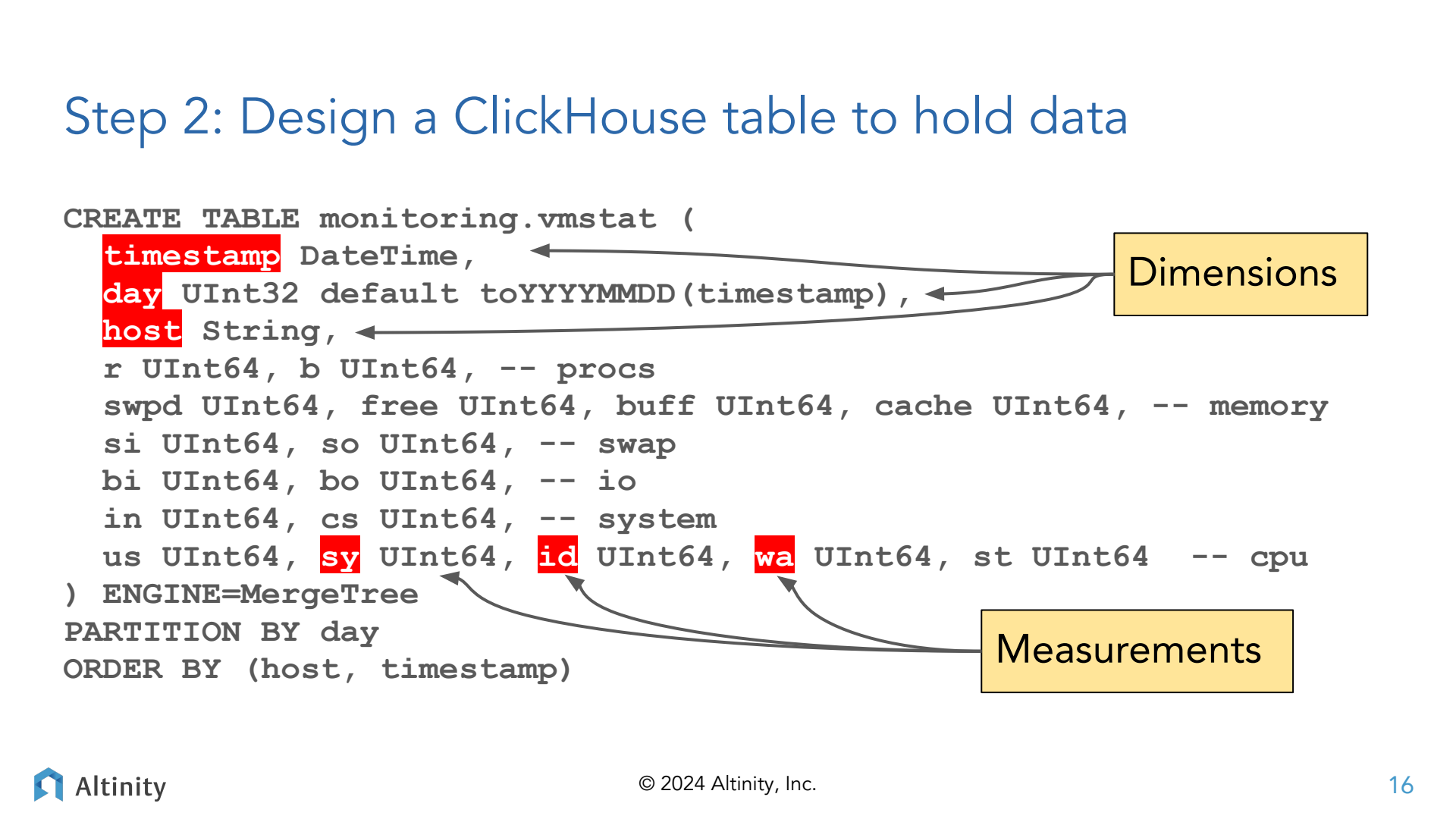

```
{"timestamp": "2024-01-22 18:13:16", "host": "logos3", "r": 0, "b":
0, "swpd": 166912, "free": 2523688, "buff": 41412, "cache": 3408292,
"si": 0, "so": 0, "bi": 3, "bo": 101, "in": 1, "cs": 0, "us": 2,
"sy": 1, "id": 98, "wa": 0, "st": 0}

{"timestamp": "2024-01-22 18:13:17", "host": "logos3", "r": 0, "b":
0, "swpd": 166912, "free": 2523696, "buff": 41412, "cache": 3408316,
"si": 0, "so": 0, "bi": 0, "bo": 216, "in": 1214, "cs": 4320, "us":
1, "sy": 1, "id": 98, "wa": 0, "st": 0}

{"timestamp": "2024-01-22 18:13:18", "host": "logos3", "r": 0, "b":
0, "swpd": 166912, "free": 2527120, "buff": 41412, "cache": 3408572,
"si": 0, "so": 0, "bi": 0, "bo": 0, "in": 1172, "cs": 4162, "us": 2,
"sy": 1, "id": 98, "wa": 0, "st": 0}
```

Step 2: Design a ClickHouse table to hold data

```
CREATE TABLE monitoring.vmstat (
   timestamp DateTime,
   day UInt32 default toYYYYMMDD(timestamp),
   host String,
   r UInt64, b UInt64, -- procs
   swpd UInt64, free UInt64, buff UInt64, cache UInt64, -- memory
   si UInt64, so UInt64, -- swap
   bi UInt64, bo UInt64, -- io
   in UInt64, cs UInt64, -- system
   us UInt64, sy UInt64, id UInt64, wa UInt64, st UInt64  -- cpu
) ENGINE=MergeTree
PARTITION BY day
ORDER BY (host, timestamp)
```



Step 3: Load data into ClickHouse

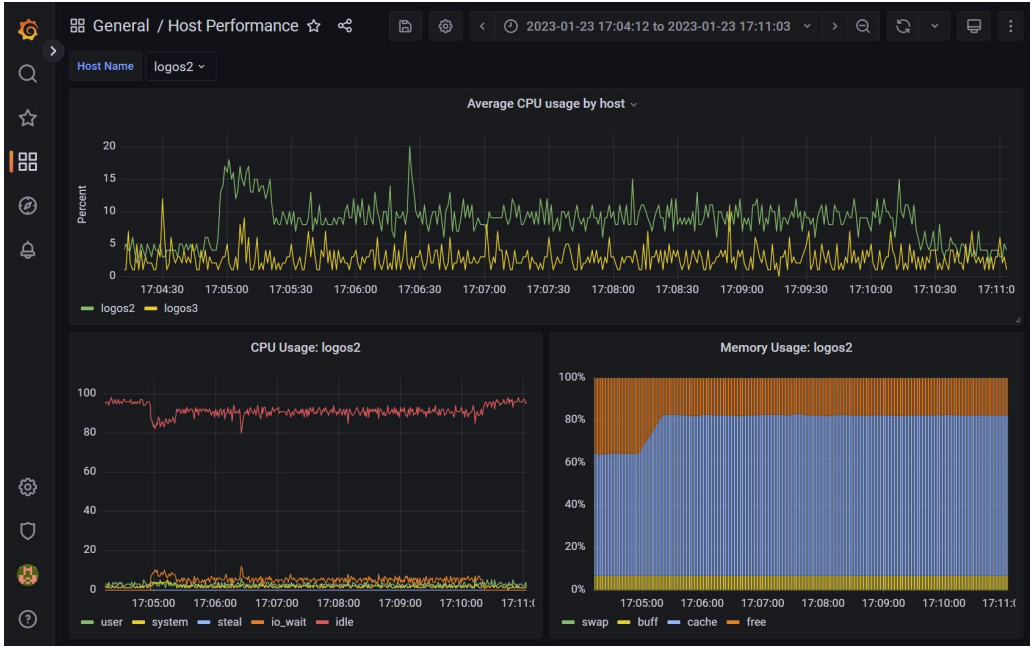
```
INSERT INTO vmstat Format JSONEachRow
```

E.g.

```
INSERT='INSERT%20INTO%20vmstat%20Format%20JSONEachRow'
cat vmstat.dat | curl -X POST --data-binary @- \
  "http://logos3:8123/?database=monitoring&query=${INSERT}"
```

(Or a Python script)

Step 4: Build a Grafana dashboard to show results



[Altinity plugin for ClickHouse]

[ClickHouse data source for Grafana]

Step 5: Go crazy!

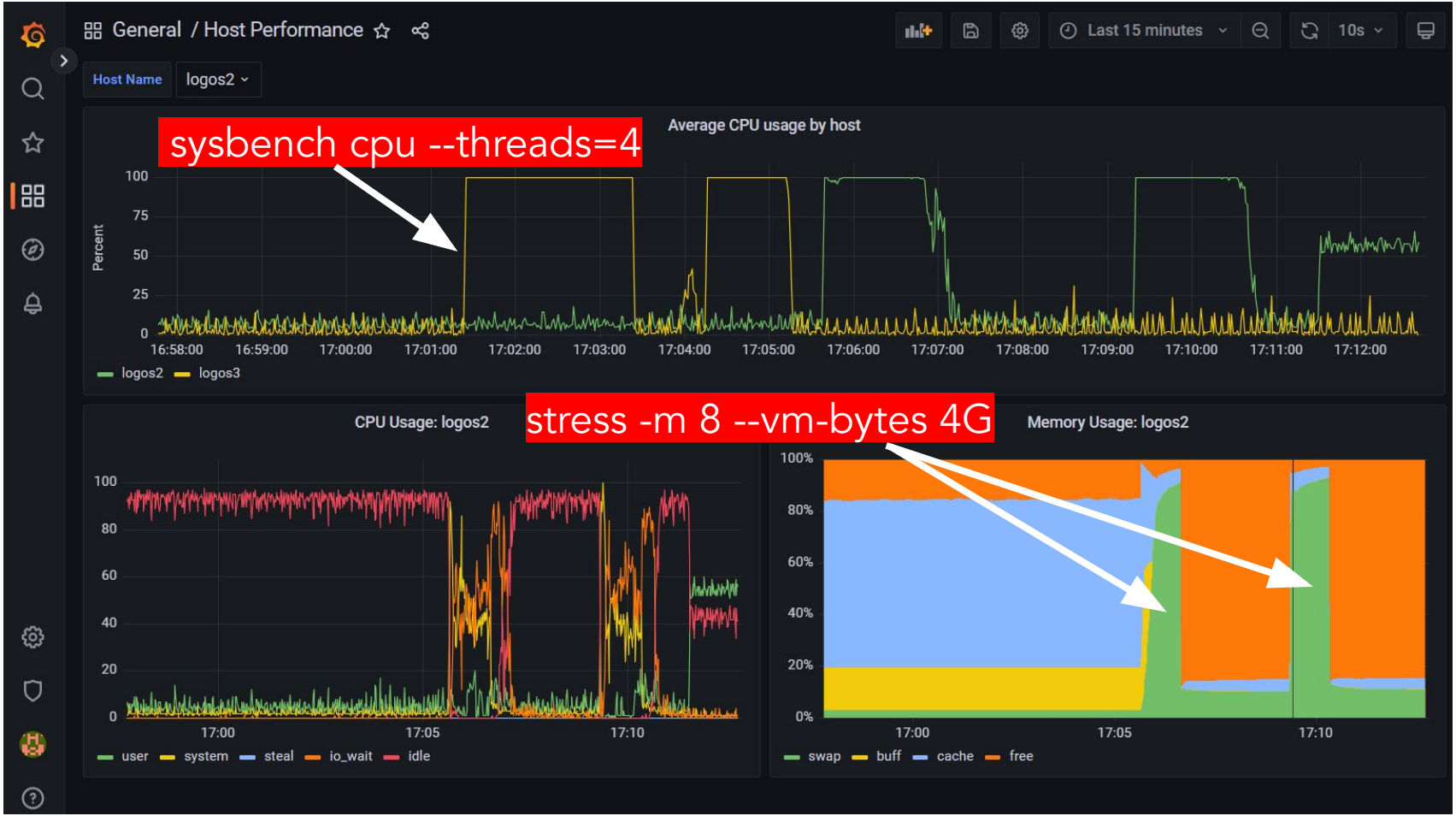
```
SELECT host, count() AS loaded_minutes
FROM (
    SELECT
        toStartOfMinute(timestamp) AS minute, host, avg(100 - id) AS load
    FROM monitoring.vmstat
    WHERE timestamp > (now() - toIntervalDay(1))
    GROUP BY minute, host HAVING load > 25
)
GROUP BY host ORDER BY loaded_minutes DESC
```

host	loaded_minutes
logos3	6
logos2	5

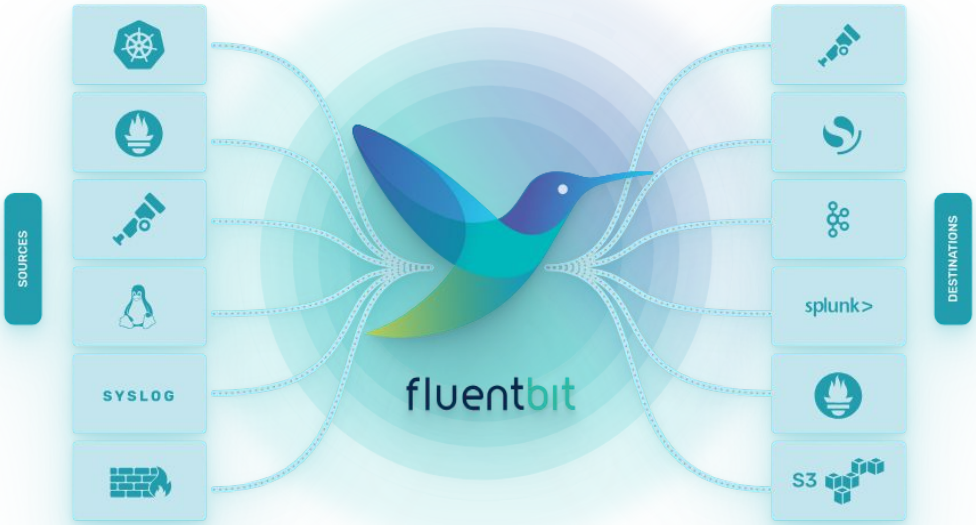
2 hosts had > 25% load for at least a minute in the last 24 hours

DEMO TIME!

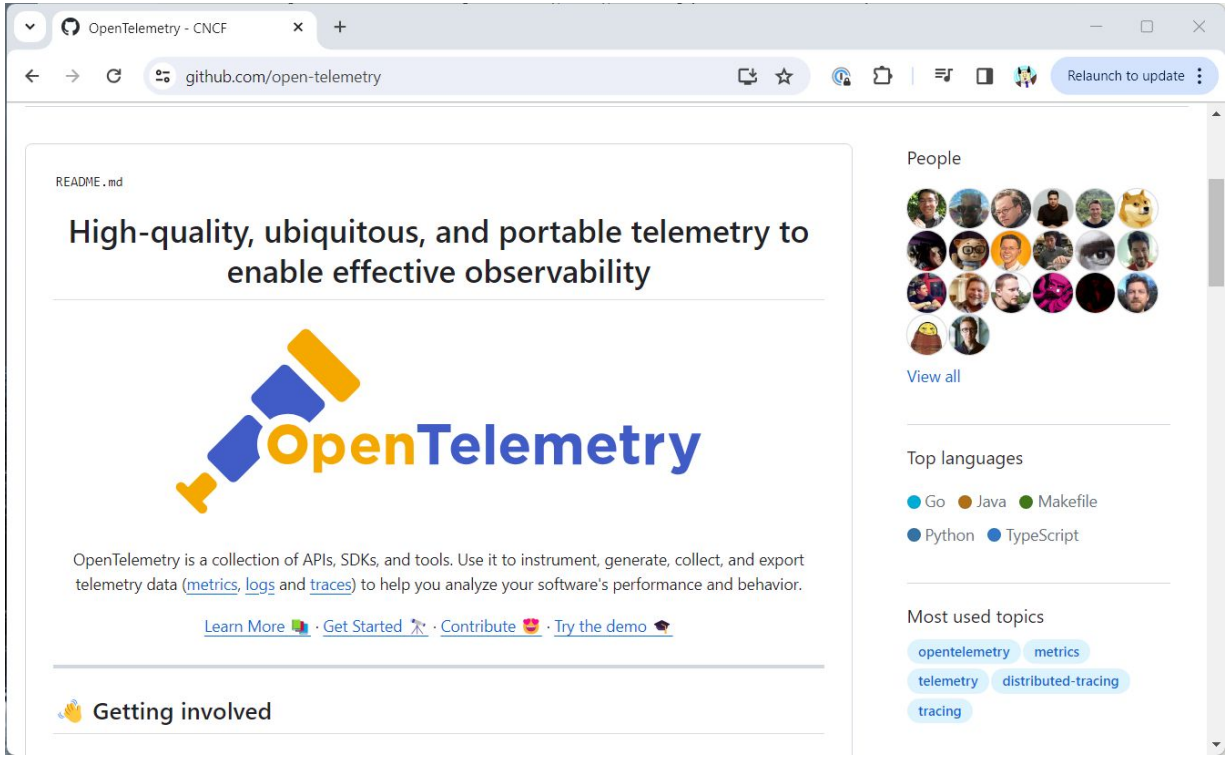
Where's the code?
https://github.com/Altinity/clickhouse-sql-examples



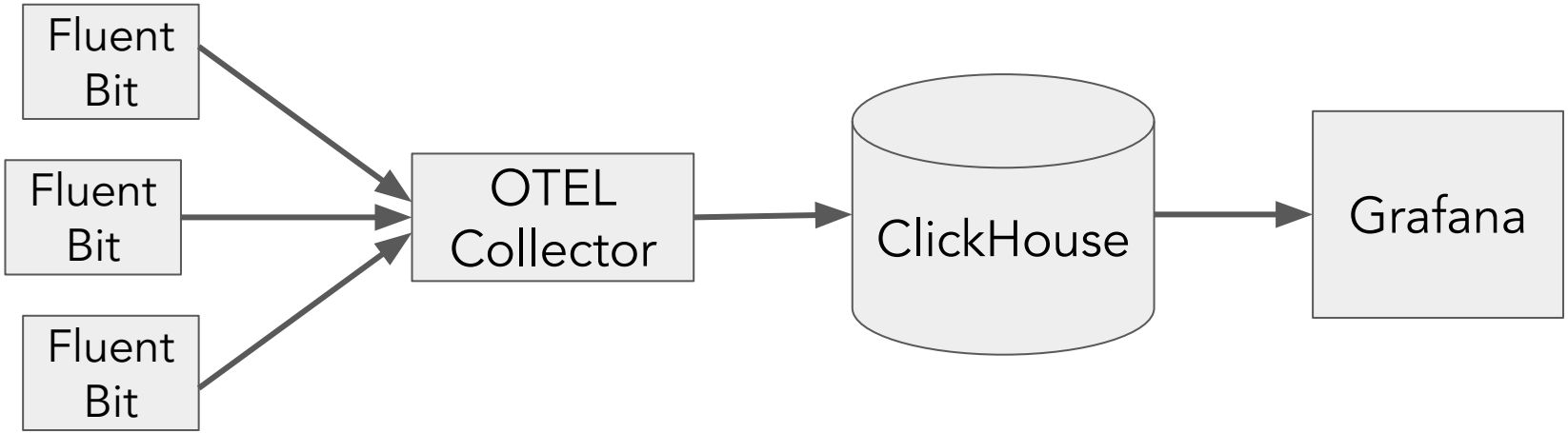
Question 1: Do I really have to write code for everything?



And there's more…



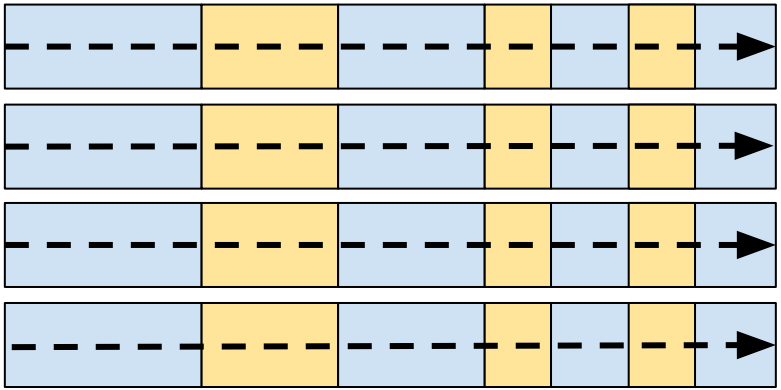
Using Fluentbit and OTEL to collect monitoring data



Question 2: Why not use PostgreSQL?

PostgreSQL, MySQL

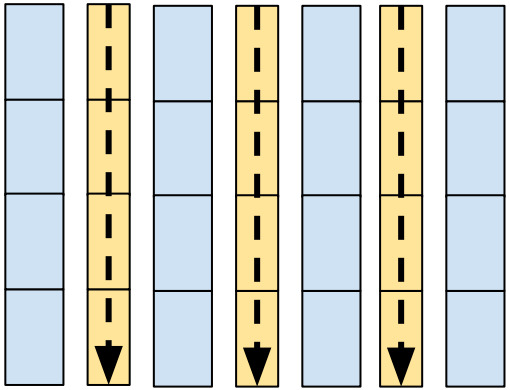
Read all columns in row



Rows minimally or not compressed

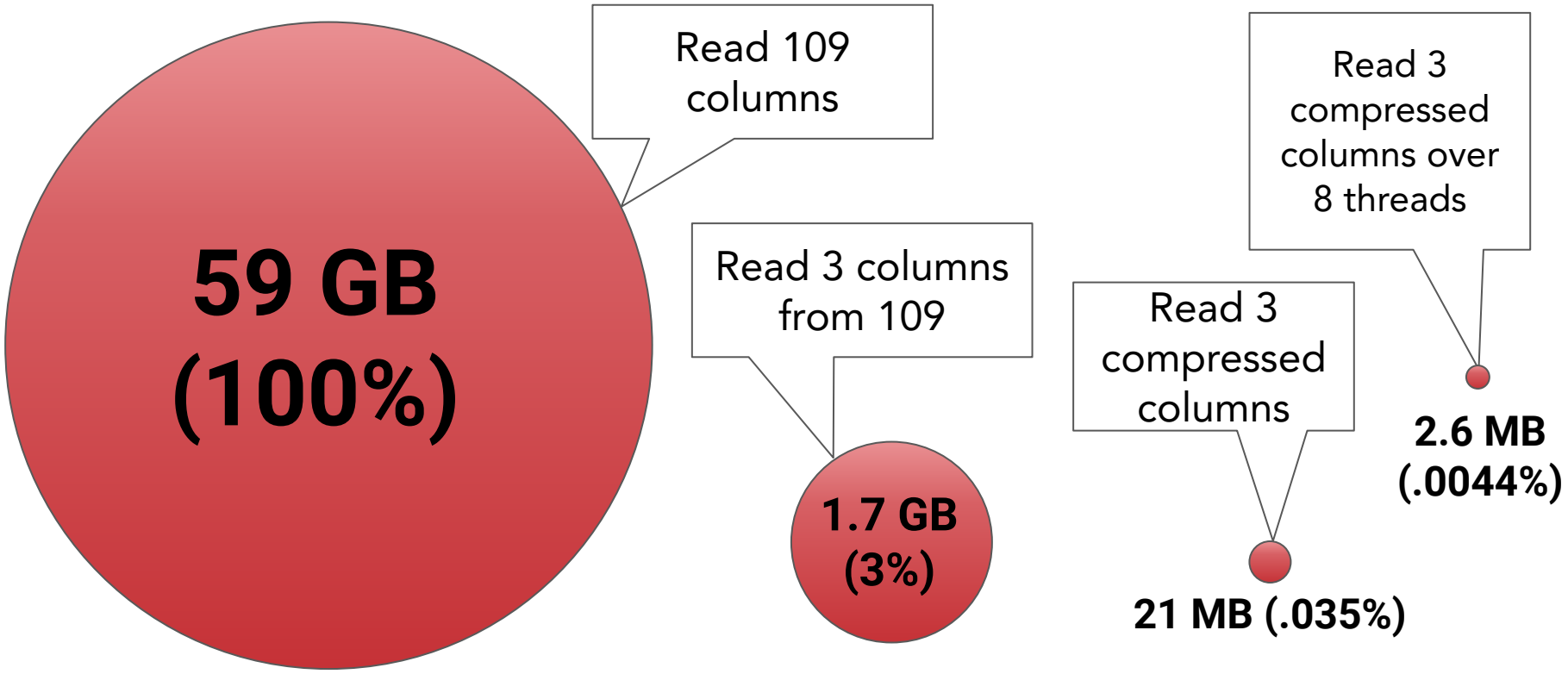
ClickHouse

Read only selected columns

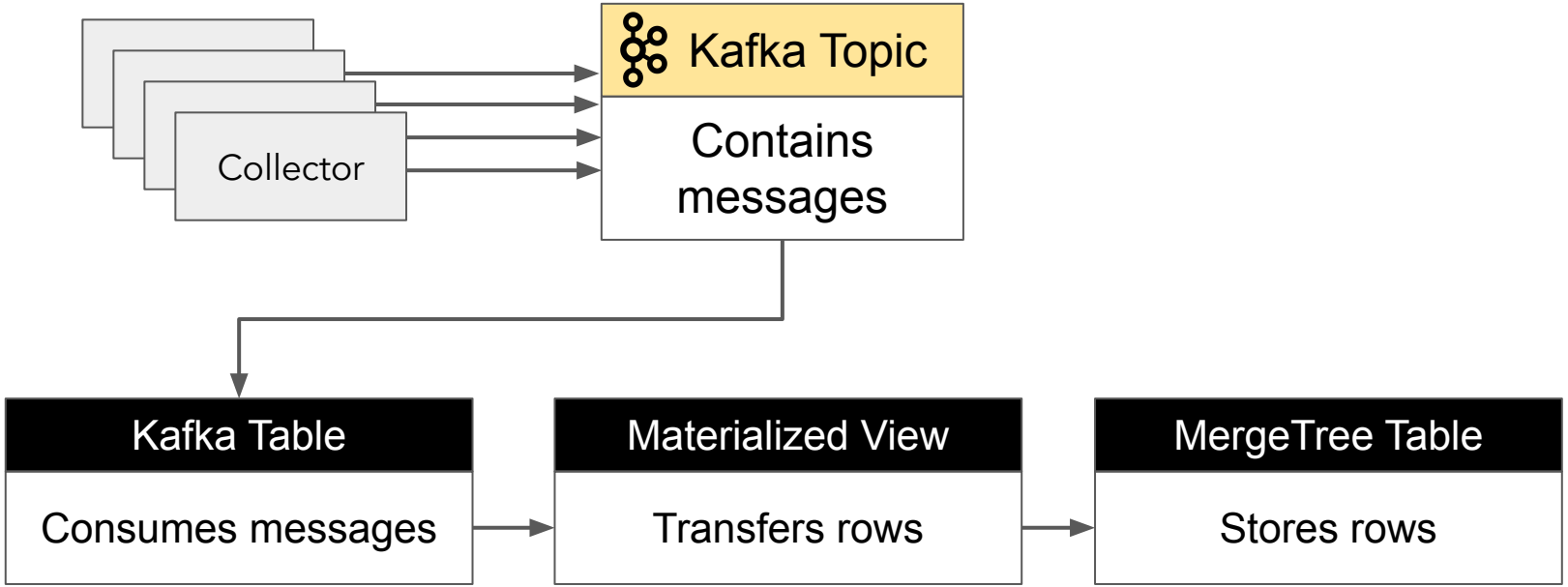


Columns highly compressed

ClickHouse is often 1000x faster on analytic queries

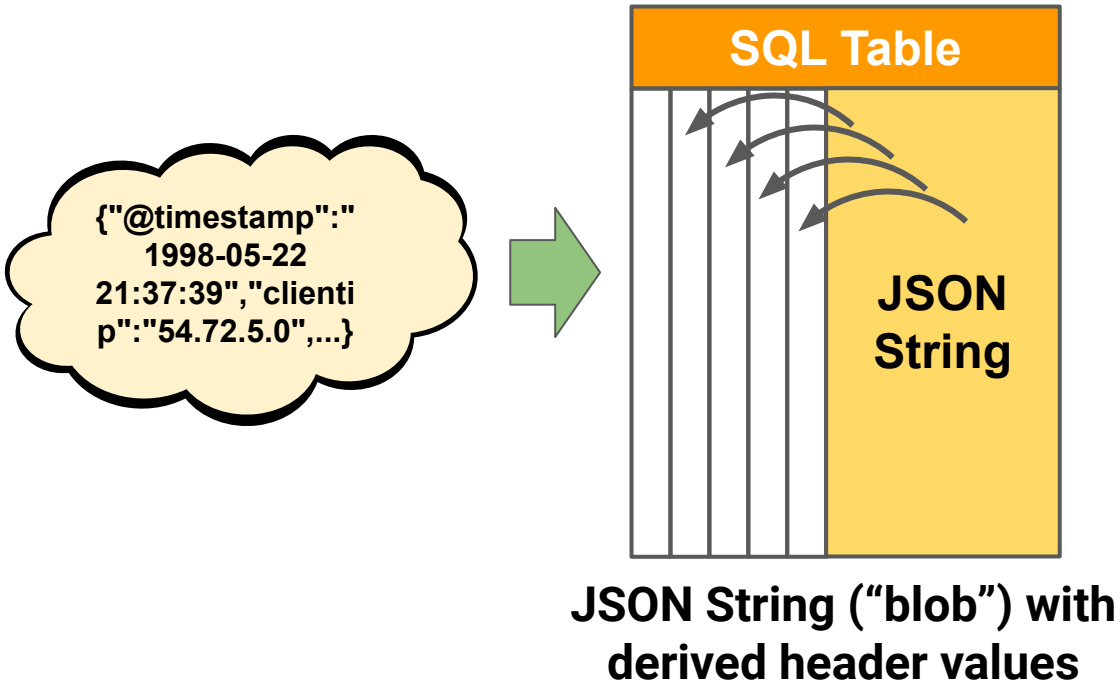


Question 3: How to handle data from many collectors?



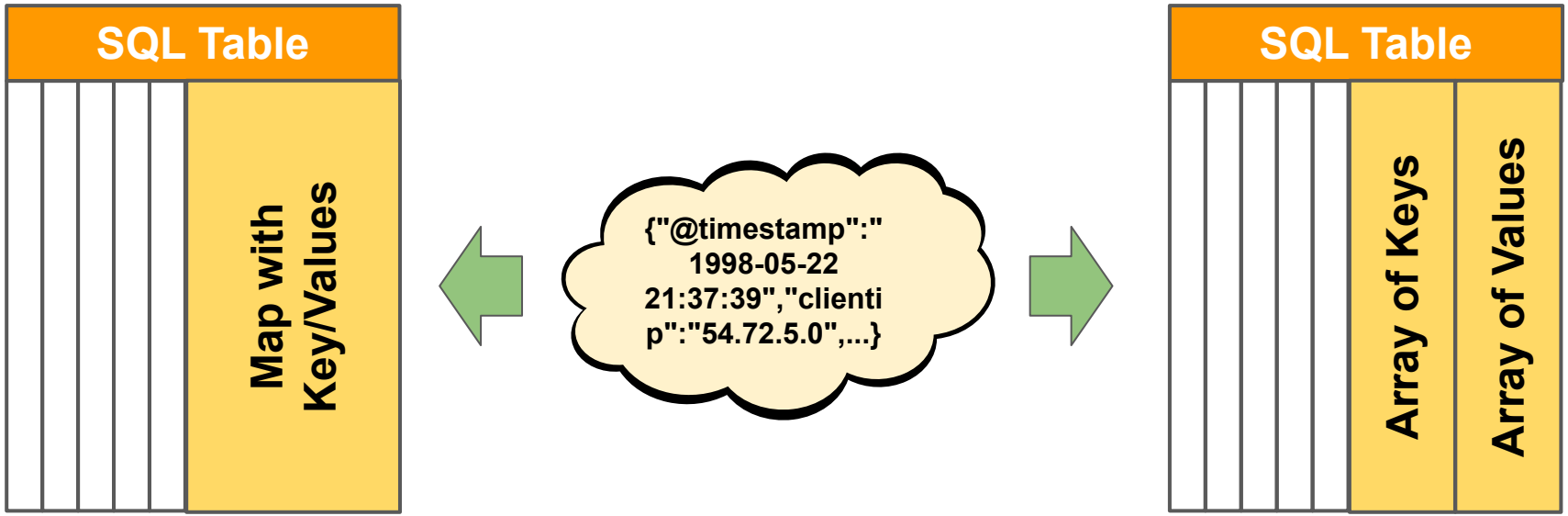
https://kb.altinity.com/altinity-kb-integrations/altinity-kb-kafka/

Question 4: How else can we map JSON to tables?



JSON String (“blob”) with derived header values

Representing JSON as paired arrays and maps



Map: Header values with mapped key value pairs

Arrays: Header values with key-value pairs

Where can I find out more?

Sample code: https://github.com/Altinity/clickhouse-sql-examples

ClickHouse official docs – https://clickhouse.com/docs/

Altinity Grafana Plugin for ClickHouse – https://grafana.com/grafana/plugins/vertamedia-clickhouse-datasource/

Fluentbit docs – https://docs.fluentbit.io/manual/

Open Telemetry docs - https://opentelemetry.io/docs/

Altinity Blog and YouTube Channel - https://altinity.com

Thanks

May the source be with you!

Robert Hodges - Altinity
https://altinity.com

Email: rhodges at altinity dot com
Slack: @Robert Hodges (Kubernetes, ClickHouse, AltinityDB)
LinkedIn: https://www.linkedin.com/in/berkeleybob2105/