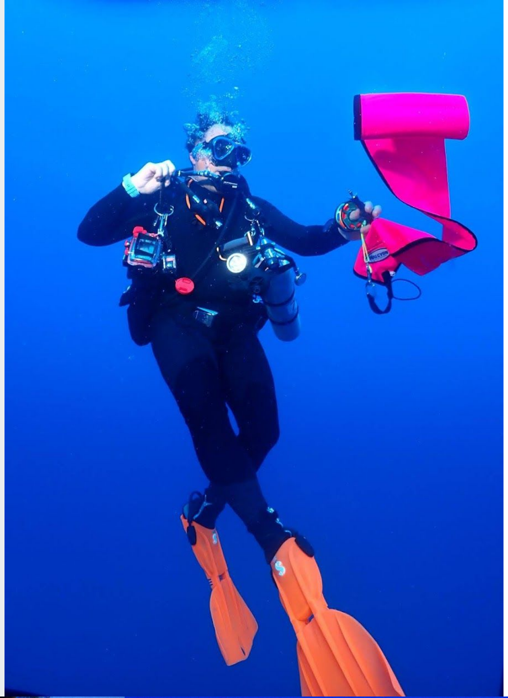
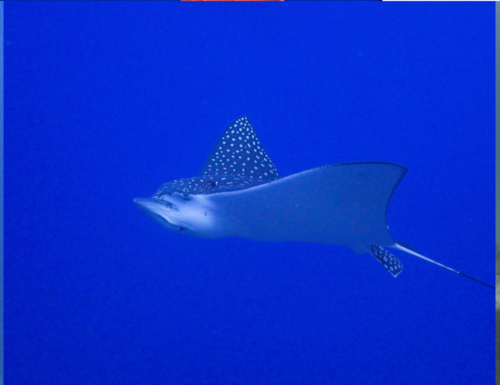
Jaeger: The Future with OpenTelemetry and Metrics

Maintainer Talk - Kubecon EU 2025

Jonah Kowall [@jkowall]
SVP Product and Design - Paessler

Jonah Kowall?





jkowall

Agenda

1. Why Distributed Tracing?
2. Intro to Jaeger + Demo
3. Monitoring with Prometheus + Jaeger
4. Jaeger V2
5. New Key Features + Roadmap for Jaeger
6. Q&A from the audience

Why Distributed Tracing?

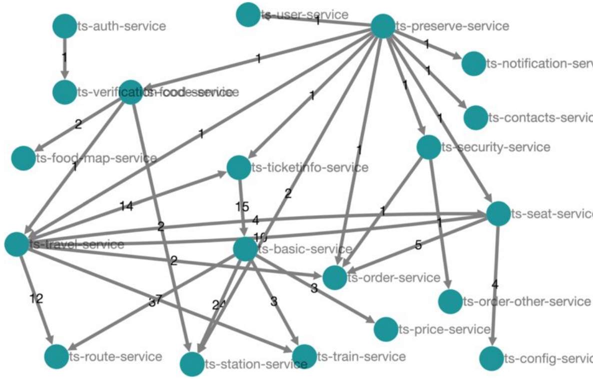
Microservices Architectures

85% of enterprises are using Microservices most often managed by different teams.

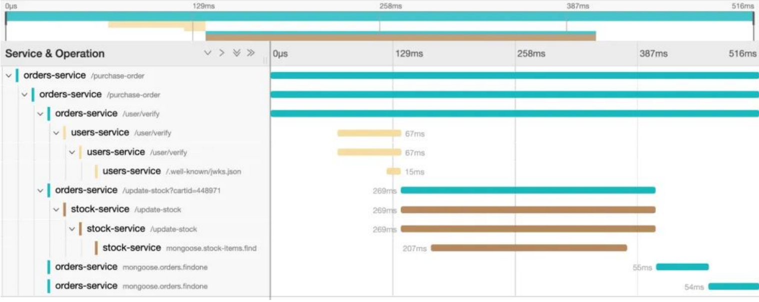
When things **break or are slow**, how do you find the right team to help resolve the problem?

Benefits of Distributed Tracing

- Build a service map of relationships and dependencies

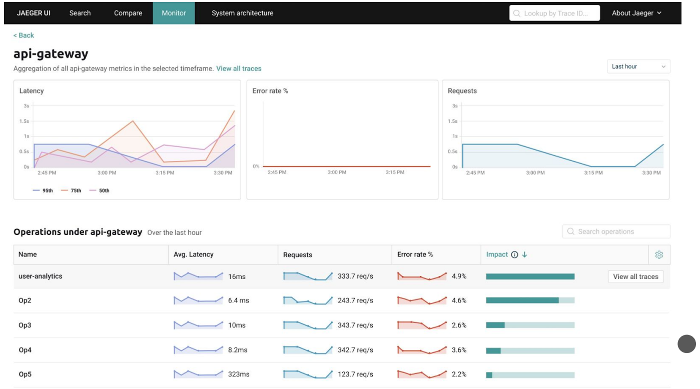


- Root cause analysis of specific user actions



Service & Operation

Service & Operation	
orders-service /purchase-order	
orders-service /purchase-order	
orders-service /user/verify	
users-service /user/verify	67ms
users-service /user/verify	67ms
users-service /.well-known/jwks.json	15ms
orders-service /update-stock?cartid=448971	269ms
stock-service /update-stock	269ms
stock-service /update-stock	269ms
stock-service mongoose.stock-items.find	207ms
orders-service mongoose.orders.findone	55ms
orders-service mongoose.orders.findone	54ms



api-gateway

Aggregation of all api-gateway metrics in the selected timeframe. View all traces

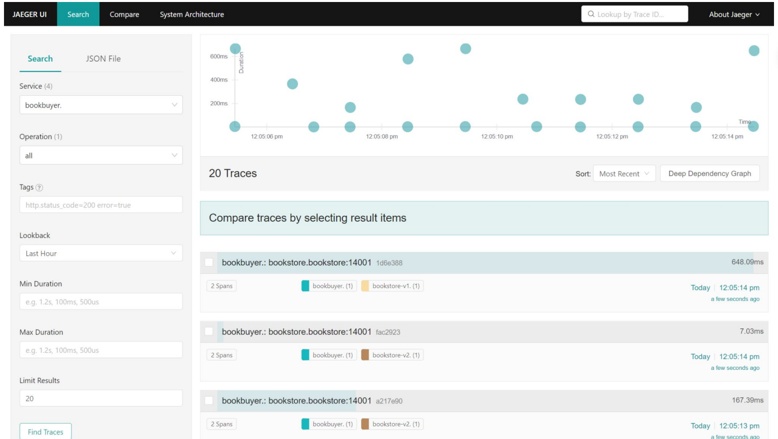
Operations under api-gateway Over the last hour

Name	Avg. Latency	Requests	Error rate %	Impact
user-analytics	16ms	333.7 req/s	4.9%	
Op2	6.4 ms	243.7 req/s	4.6%	
Op3	10ms	343.7 req/s	2.6%	
Op4	8.2ms	342.7 req/s	3.6%	
Op5	323ms	123.7 req/s	2.2%	

- Monitor and maintain SLAs

Tracing Tools

1. Instrumentation
2. Data Collection
3. Storage & Analysis & Visualization



Search | JSON File

Service (4)
bookbuyer.

Operation (1)
all

Tags ?
http.status_code=200 error=true

Lookback
Last Hour

Min Duration
e.g. 1.2s, 100ms, 500us

Max Duration
e.g. 1.2s, 100ms, 500us

Limit Results
20

Find Traces

20 Traces

Sort: Most Recent | Deep Dependency Graph

Compare traces by selecting result items

□ bookbuyer.: bookstore.bookstore:14001 1d6e388 648.09ms
2 Spans | bookbuyer. (1) | bookstore-v1. (1)
Today | 12:05:14 pm
a few seconds ago

□ bookbuyer.: bookstore.bookstore:14001 fac2923 7.03ms
2 Spans | bookbuyer. (1) | bookstore-v2. (1)
Today | 12:05:14 pm
a few seconds ago

□ bookbuyer.: bookstore.bookstore:14001 a217e90 167.39ms
2 Spans | bookbuyer. (1) | bookstore-v2. (1)
Today | 12:05:13 pm
a few seconds ago

Intro to Jaeger

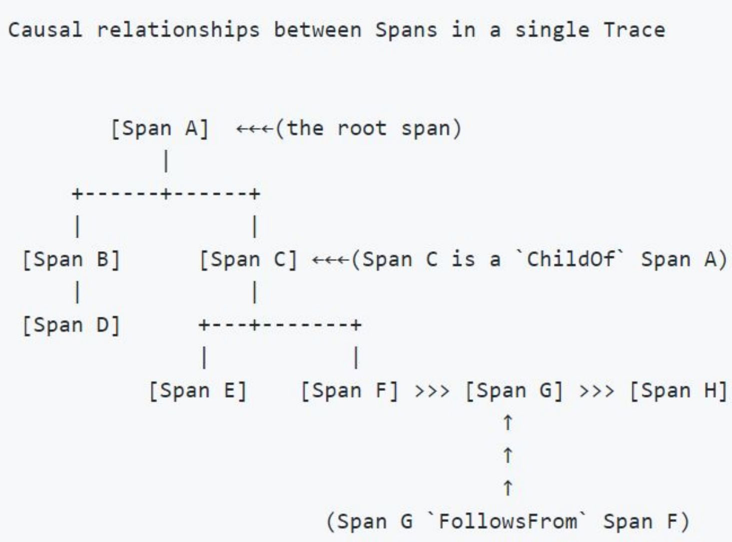
OpenTelemetry Semantics

Trace represents an end-to-end request (and response); made up of single or multiple **Spans**

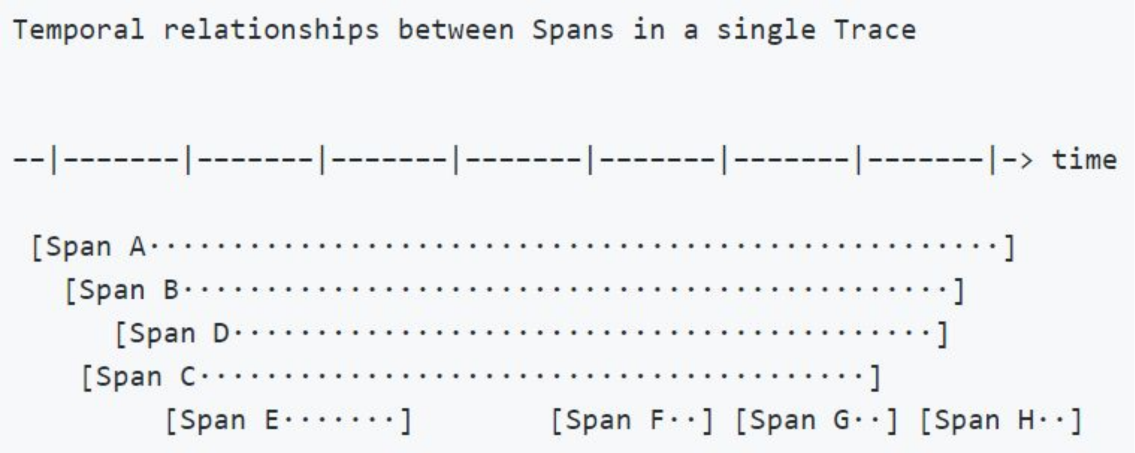
Span represents work done by a single-service or component with time intervals and associated metadata such as **Tags**

Tags/Attributes contain metadata to help contextualize a span

Relationships in tracing



```
Causal relationships between Spans in a single Trace


        [Span A]  ←←←(the root span)
            |
     +------+------+
     |             |
 [Span B]      [Span C] ←←←(Span C is a `ChildOf` Span A)
     |             |
 [Span D]      +---+-------+
               |           |
           [Span E]    [Span F] >>> [Span G] >>> [Span H]
                                       ↑
                                       ↑
                                       ↑
                         (Span G `FollowsFrom` Span F)
```

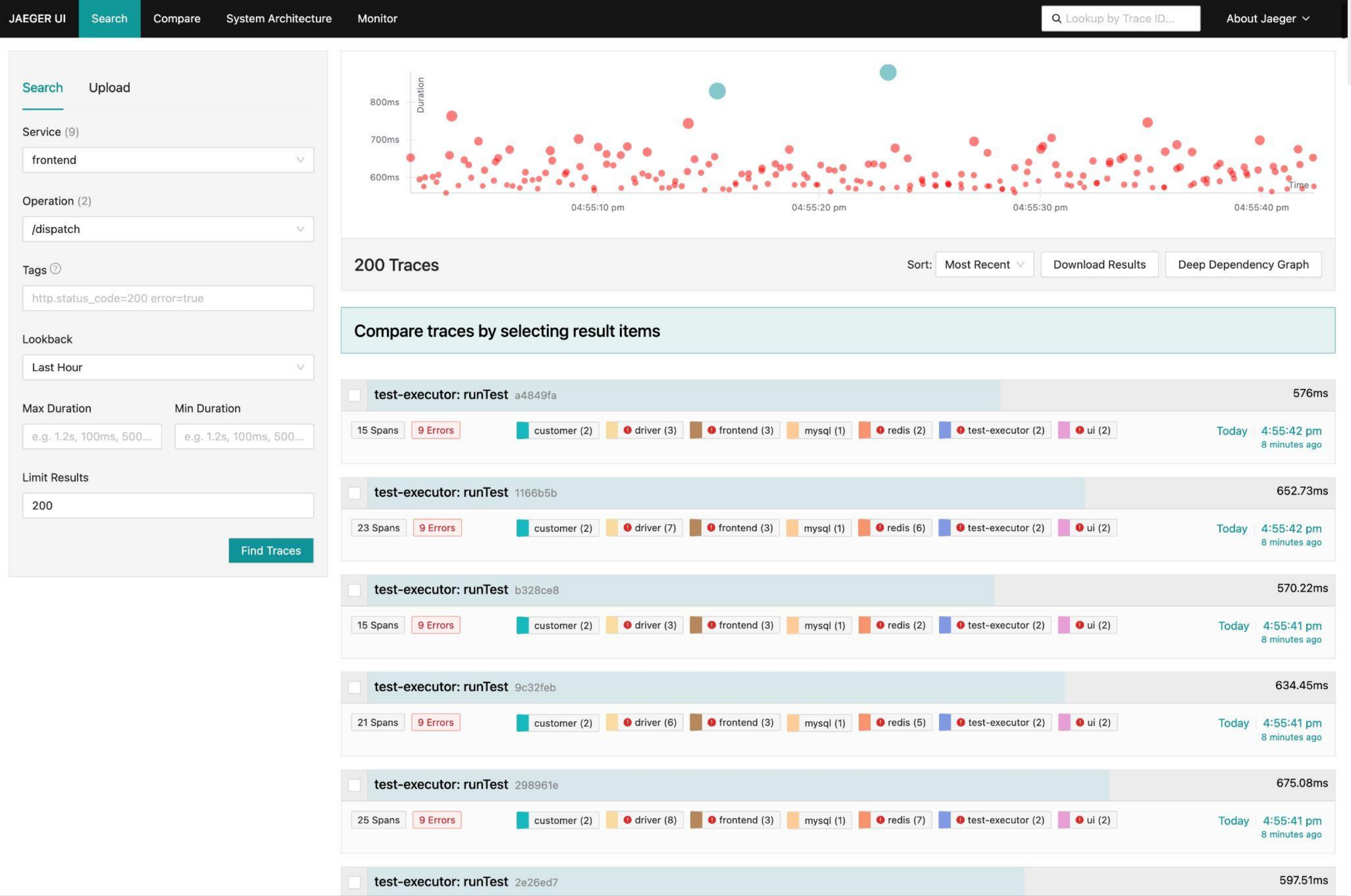


```
Temporal relationships between Spans in a single Trace


--|-------|-------|-------|-------|-------|-------|-------|-> time

 [Span A···················································]
   [Span B··············································]
      [Span D··········································]
    [Span C········································]
         [Span E·······]        [Span F··] [Span G··] [Span H··]
```

Metadata includes errors, latency, and other attributes of each span

Jaeger Demo

Search and drill into specific traces



Search | Upload

Service (9)
frontend

Operation (2)
/dispatch

Tags
http.status_code=200 error=true

Lookback
Last Hour

Max Duration
e.g. 1.2s, 100ms, 500...

Min Duration
e.g. 1.2s, 100ms, 500...

Limit Results
200

Find Traces

200 Traces

Sort: Most Recent | Download Results | Deep Dependency Graph

Compare traces by selecting result items

□ test-executor: runTest a4849fa — 576ms
15 Spans | 9 Errors | customer (2) | driver (3) | frontend (3) | mysql (1) | redis (2) | test-executor (2) | ui (2) | Today | 4:55:42 pm
8 minutes ago

□ test-executor: runTest 1166b5b — 652.73ms
23 Spans | 9 Errors | customer (2) | driver (7) | frontend (3) | mysql (1) | redis (6) | test-executor (2) | ui (2) | Today | 4:55:42 pm
8 minutes ago

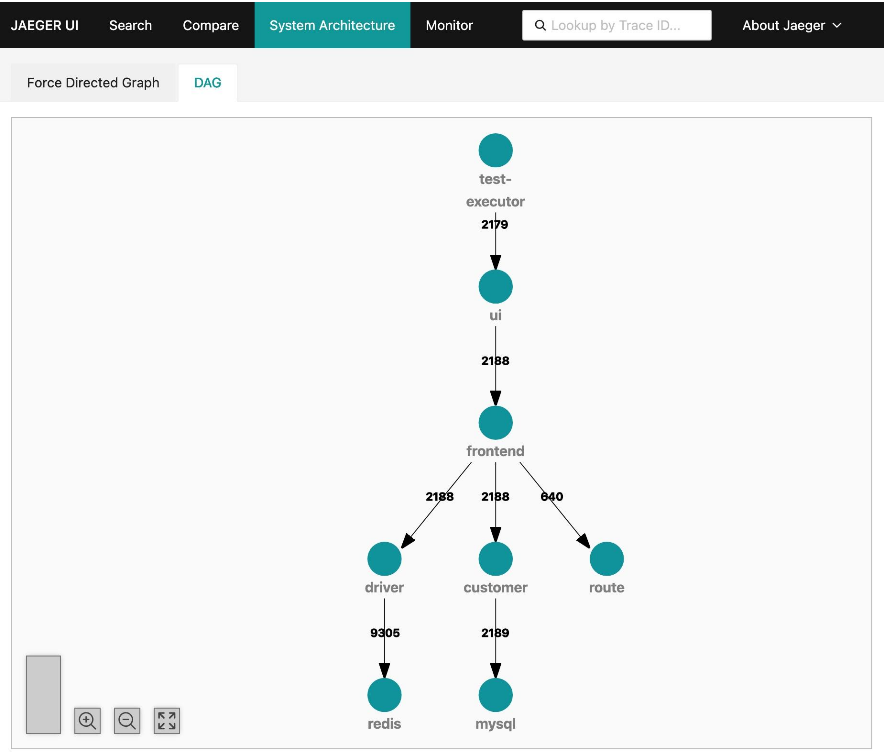
□ test-executor: runTest b328ce8 — 570.22ms
15 Spans | 9 Errors | customer (2) | driver (3) | frontend (3) | mysql (1) | redis (2) | test-executor (2) | ui (2) | Today | 4:55:41 pm
8 minutes ago

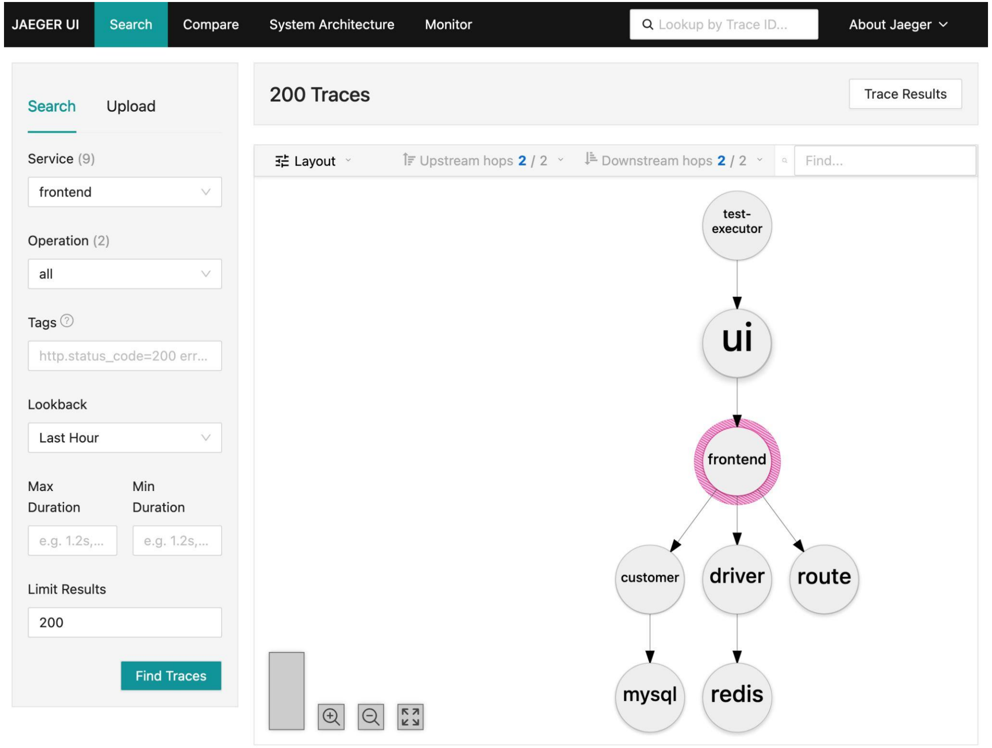
□ test-executor: runTest 9c32feb — 634.45ms
21 Spans | 9 Errors | customer (2) | driver (6) | frontend (3) | mysql (1) | redis (5) | test-executor (2) | ui (2) | Today | 4:55:41 pm
8 minutes ago

□ test-executor: runTest 298961e — 675.08ms
25 Spans | 9 Errors | customer (2) | driver (8) | frontend (3) | mysql (1) | redis (7) | test-executor (2) | ui (2) | Today | 4:55:41 pm
8 minutes ago

□ test-executor: runTest 2e26ed7 — 597.51ms

Relationships between services & components





Service (9): frontend

Operation (2): all

Tags: http.status_code=200 err...

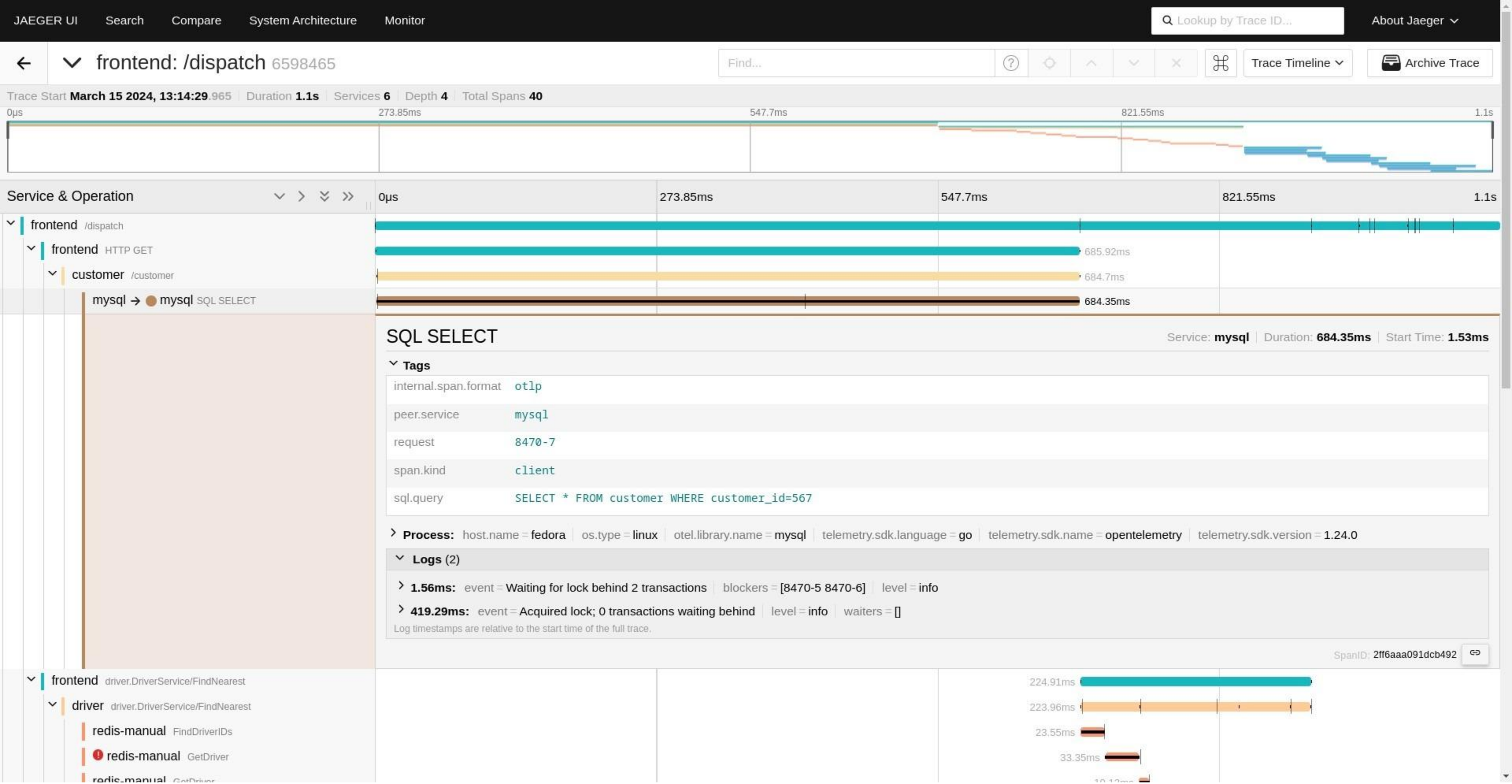
Lookback: Last Hour

Max Duration: e.g. 1.2s,...

Min Duration: e.g. 1.2s,...

Limit Results: 200

200 Traces



frontend: /dispatch 6598465

Trace Start **March 15 2024, 13:14:29**.965 | Duration **1.1s** | Services **6** | Depth **4** | Total Spans **40**

Service & Operation	Duration
frontend /dispatch	
frontend HTTP GET	685.92ms
customer /customer	684.7ms
mysql → mysql SQL SELECT	684.35ms
frontend driver.DriverService/FindNearest	224.91ms
driver driver.DriverService/FindNearest	223.96ms
redis-manual FindDriverIDs	23.55ms
! redis-manual GetDriver	33.35ms
redis-manual GetDriver	10.12ms

SQL SELECT

Service: **mysql** | Duration: **684.35ms** | Start Time: **1.53ms**

Tags

internal.span.format	otlp
peer.service	mysql
request	8470-7
span.kind	client
sql.query	SELECT * FROM customer WHERE customer_id=567

Process: host.name = fedora | os.type = linux | otel.library.name = mysql | telemetry.sdk.language = go | telemetry.sdk.name = opentelemetry | telemetry.sdk.version = 1.24.0

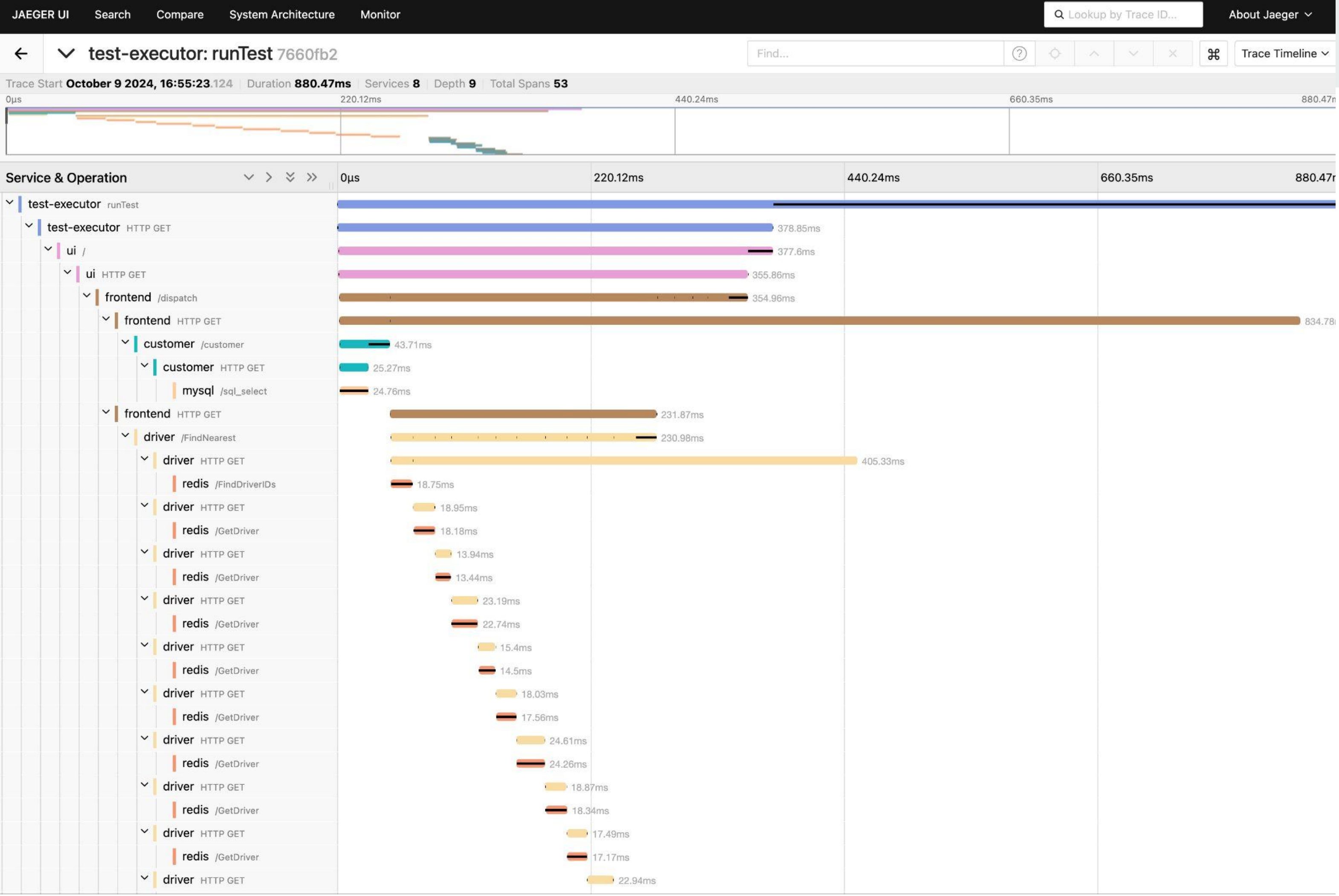
Logs (2)

1.56ms: event = Waiting for lock behind 2 transactions | blockers = [8470-5 8470-6] | level = info

419.29ms: event = Acquired lock; 0 transactions waiting behind | level = info | waiters = []

Log timestamps are relative to the start time of the full trace.

SpanID: 2ff6aaa091dcb492



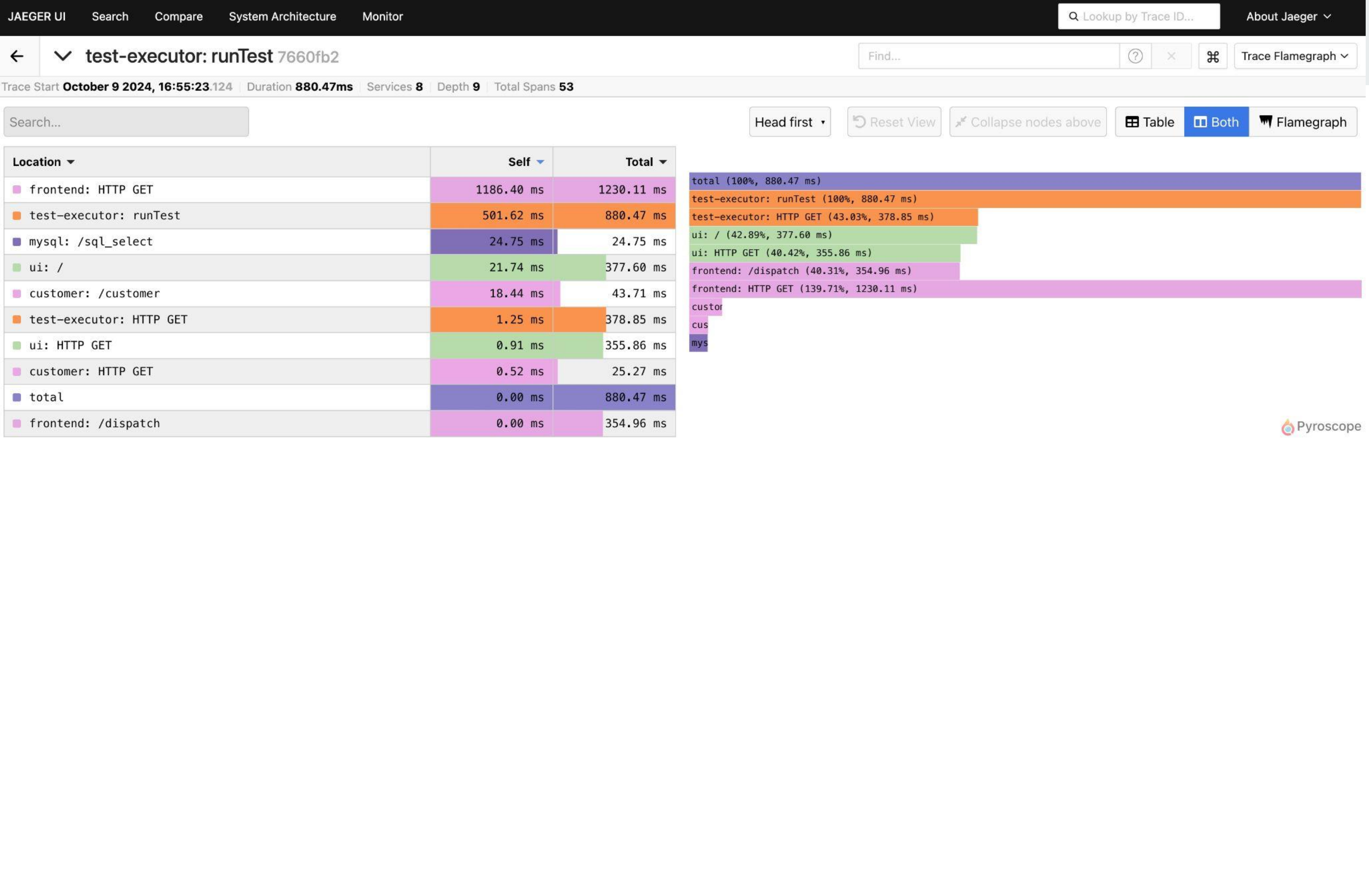
test-executor: runTest 7660fb2

Trace Start **October 9 2024, 16:55:23**.124 | Duration **880.47ms** | Services **8** | Depth **9** | Total Spans **53**

```
test-executor runTest
  test-executor HTTP GET                 378.85ms
    ui /                                 377.6ms
      ui HTTP GET                        355.86ms
        frontend /dispatch               354.96ms
          frontend HTTP GET              834.78
            customer /customer           43.71ms
              customer HTTP GET          25.27ms
                mysql /sql_select        24.76ms
          frontend HTTP GET              231.87ms
            driver /FindNearest          230.98ms
              driver HTTP GET            405.33ms
                redis /FindDriverIDs     18.75ms
              driver HTTP GET            18.95ms
                redis /GetDriver         18.18ms
              driver HTTP GET            13.94ms
                redis /GetDriver         13.44ms
              driver HTTP GET            23.19ms
                redis /GetDriver         22.74ms
              driver HTTP GET            15.4ms
                redis /GetDriver         14.5ms
              driver HTTP GET            18.03ms
                redis /GetDriver         17.56ms
              driver HTTP GET            24.61ms
                redis /GetDriver         24.26ms
              driver HTTP GET            18.87ms
                redis /GetDriver         18.34ms
              driver HTTP GET            17.49ms
                redis /GetDriver         17.17ms
              driver HTTP GET            22.94ms
```

Look at a trace in timeline view

Or as a flamegraph



test-executor: runTest 7660fb2

Trace Start **October 9 2024, 16:55:23**.124 | Duration **880.47ms** | Services **8** | Depth **9** | Total Spans **53**

Location	Self	Total
frontend: HTTP GET	1186.40 ms	1230.11 ms
test-executor: runTest	501.62 ms	880.47 ms
mysql: /sql_select	24.75 ms	24.75 ms
ui: /	21.74 ms	377.60 ms
customer: /customer	18.44 ms	43.71 ms
test-executor: HTTP GET	1.25 ms	378.85 ms
ui: HTTP GET	0.91 ms	355.86 ms
customer: HTTP GET	0.52 ms	25.27 ms
total	0.00 ms	880.47 ms
frontend: /dispatch	0.00 ms	354.96 ms

total (100%, 880.47 ms)

test-executor: runTest (100%, 880.47 ms)

test-executor: HTTP GET (43.03%, 378.85 ms)

ui: / (42.89%, 377.60 ms)

ui: HTTP GET (40.42%, 355.86 ms)

frontend: /dispatch (40.31%, 354.96 ms)

frontend: HTTP GET (139.71%, 1230.11 ms)

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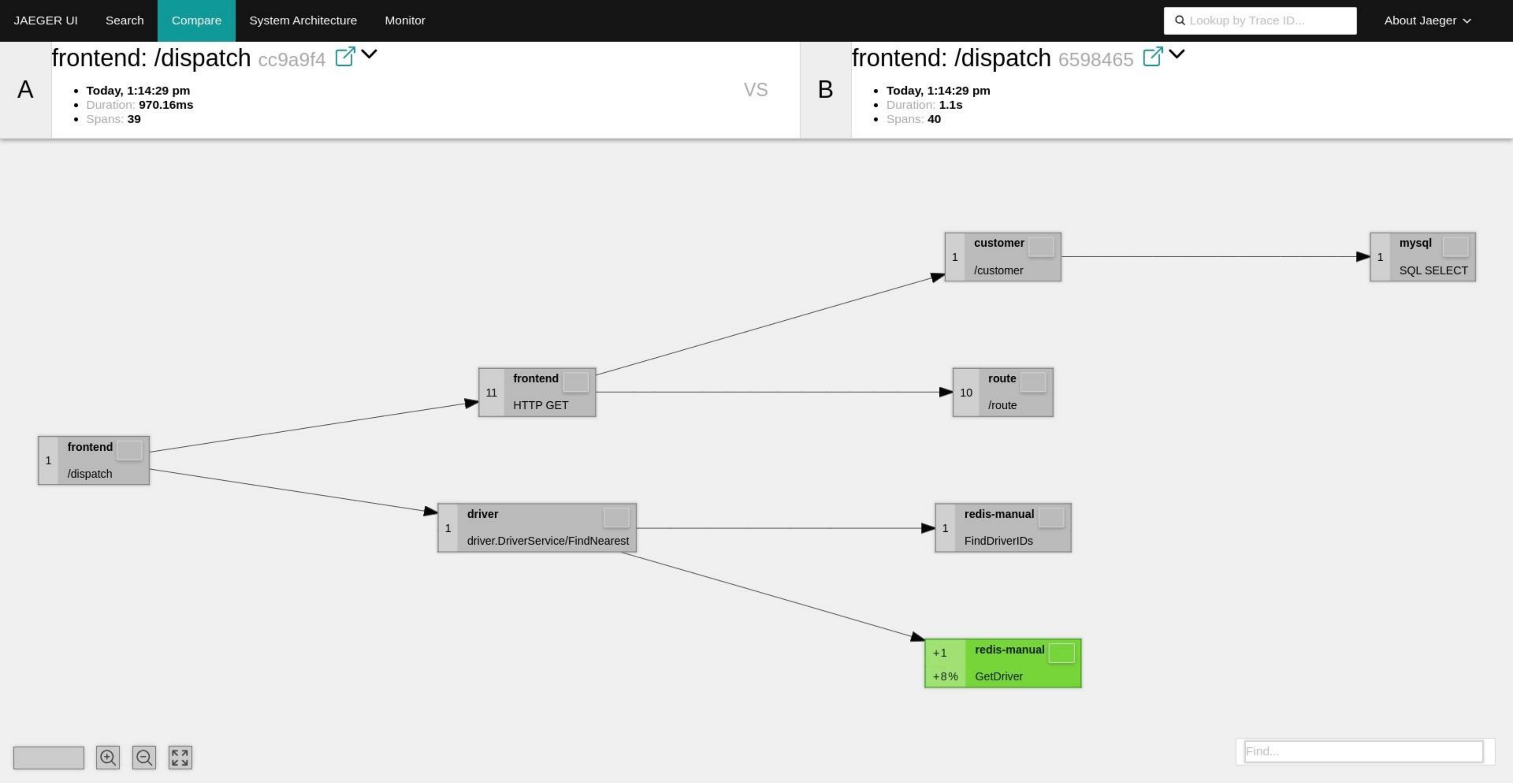


A

frontend: /dispatch cc9a9f4

- Today, 1:14:29 pm
- Duration: 970.16ms
- Spans: 39

VS

B

frontend: /dispatch 6598465

- Today, 1:14:29 pm
- Duration: 1.1s
- Spans: 40

Monitoring with Prometheus + Jaeger

Tracing and Monitoring

- Moving Jaeger from “distributed tracing” towards APM
  - Traces / Events
  - Metrics
- Additional use cases
  - Operational Monitoring
  - Operational Alerting
  - Change Planning

Jaeger Natively emits Prometheus Metrics

Remote write or scrape Prometheus metrics from Jaeger directly to your Prometheus compatible metrics backend.

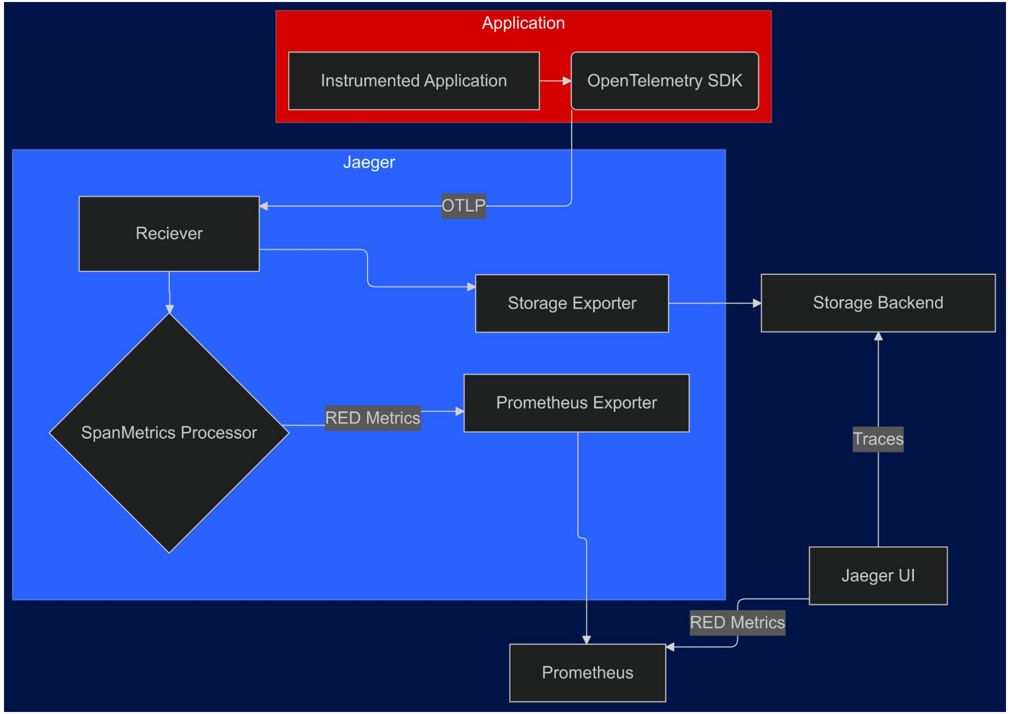
Application level metrics to measure and alert on performance and usage:

- Rate
- Errors
- Duration

Jaeger Metrics Data Flow

Prometheus handles all metrics use cases (monitor, alert, plan)

Can also export to other metric systems with Otel exporters and SpanMetrics Connector



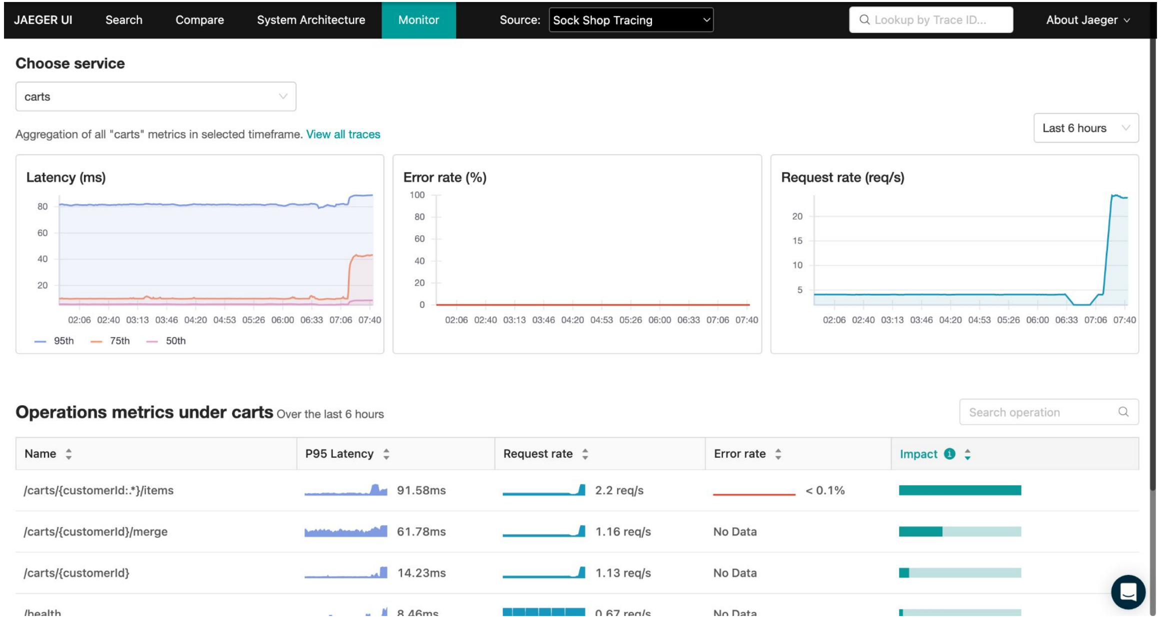
SpanMetrics Connector built into Jaeger v2

```
connectors:
  spanmetrics:
    exemplars:
      enabled: true

service:
  pipelines:
    traces:
      receivers: [otlp]
      exporters: [otlp/traces, spanmetrics]
    metrics:
      receivers: [spanmetrics]
      exporters: [otlphttp/metrics] #export data to Prometheus
```

Visualize app performance R.E.D metrics

The “monitor” page in Jaeger to provides the status and health of transactions and application components

Deeper analysis can be done with Perces or Grafana.



Source: Sock Shop Tracing

Choose service

carts

Aggregation of all "carts" metrics in selected timeframe. View all traces

Last 6 hours

Operations metrics under carts Over the last 6 hours

Name	P95 Latency	Request rate	Error rate	Impact
/carts/{customerId:.*}/items	91.58ms	2.2 req/s	< 0.1%	
/carts/{customerId}/merge	61.78ms	1.16 req/s	No Data	
/carts/{customerId}	14.23ms	1.13 req/s	No Data	
/health	8.46ms	0.67 req/s	No Data	

Jaeger Monitor Demo

NOW AVAILABLE!

Jaeger v2

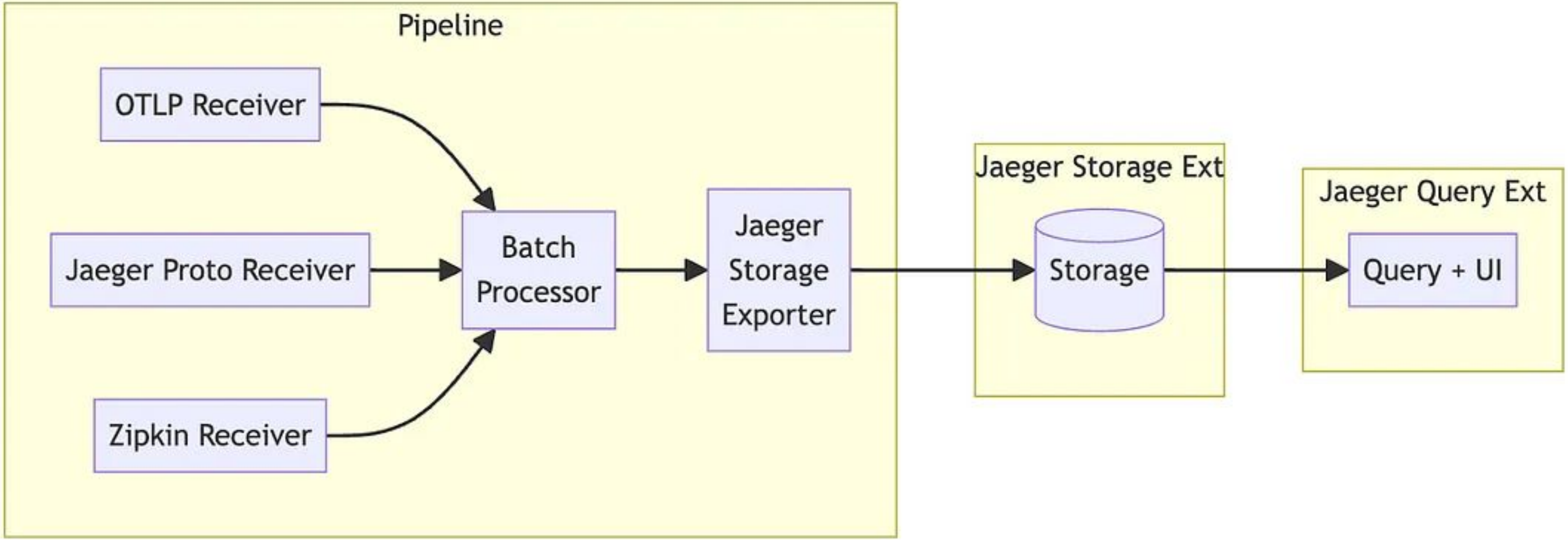
based on OpenTelemetry collector

Jaeger V2 Goals

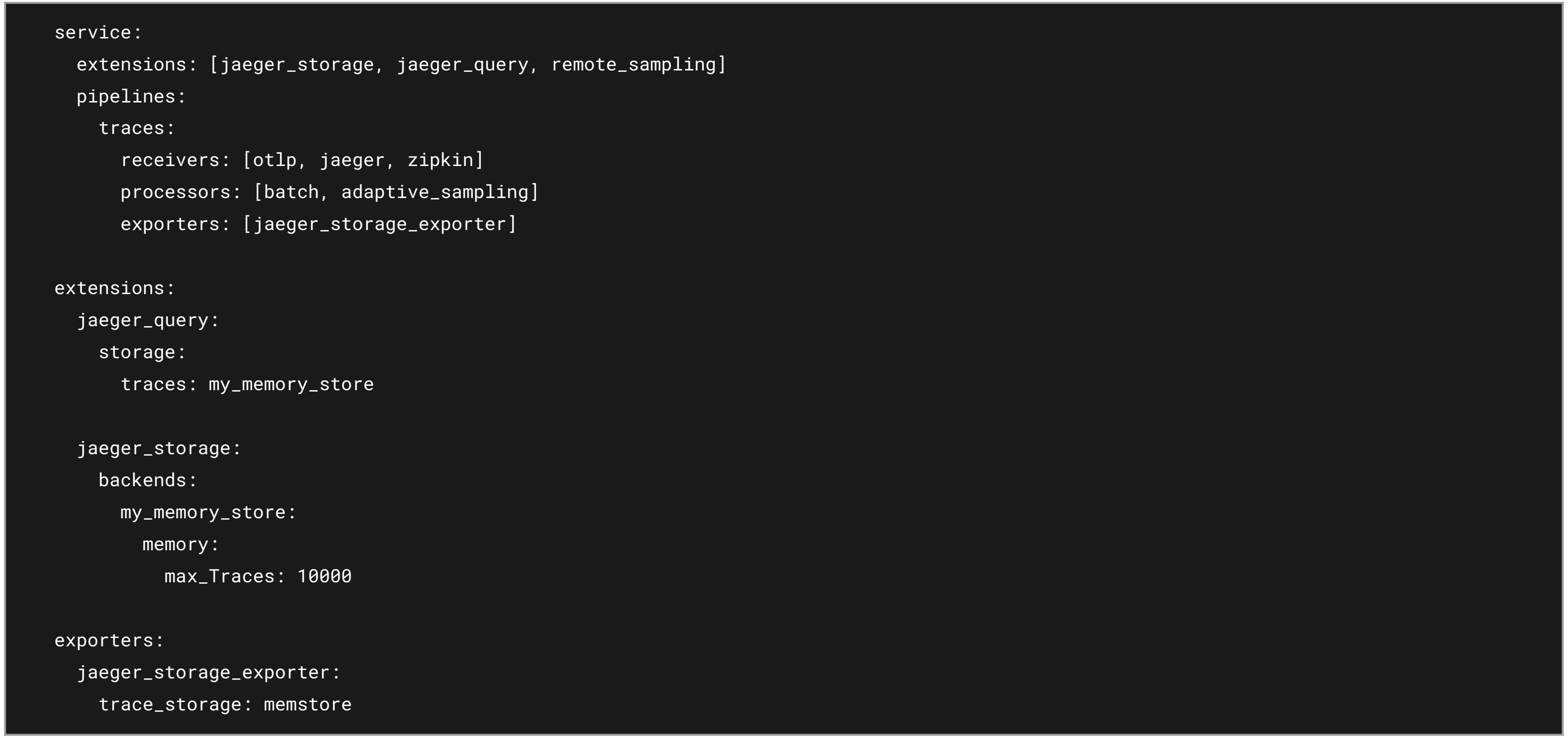
- Adapt Jaeger to OpenTelemetry by moving the collector into the core
- New storage APIs for Jaeger v2.x
- Allow for backwards compatibility to Jaeger v1.x storage
- Native OLTP support for storage

- Single binary for all components
- Configuration is via configuration file not CLI flags (similar to OpenTelemetry)

Jaeger v2 Binary Architecture

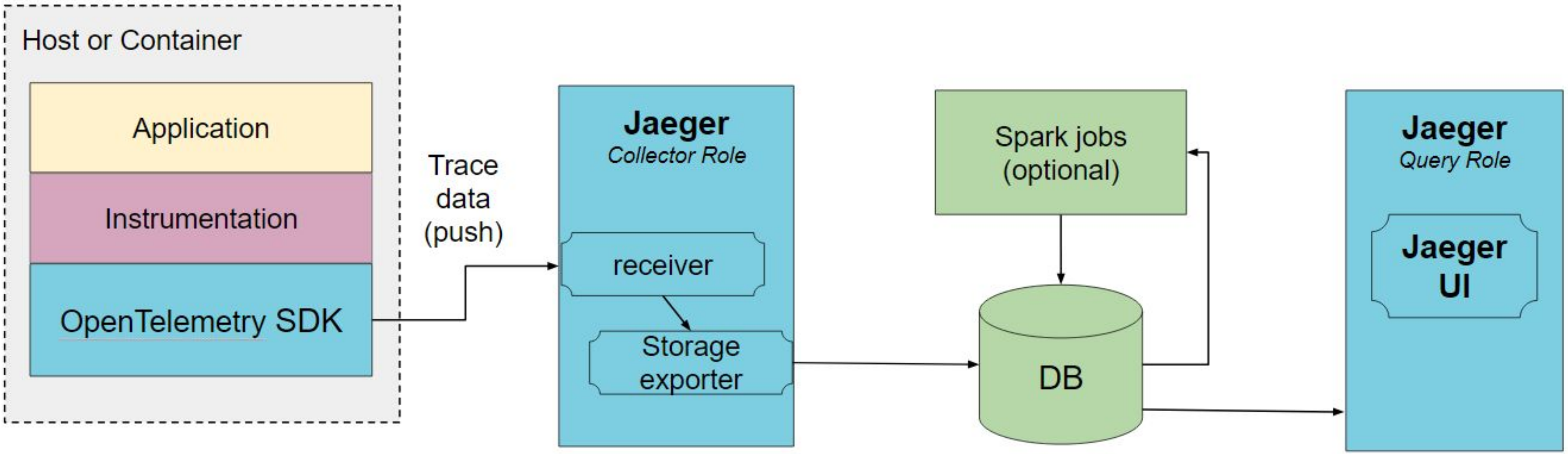


V2 Configuration

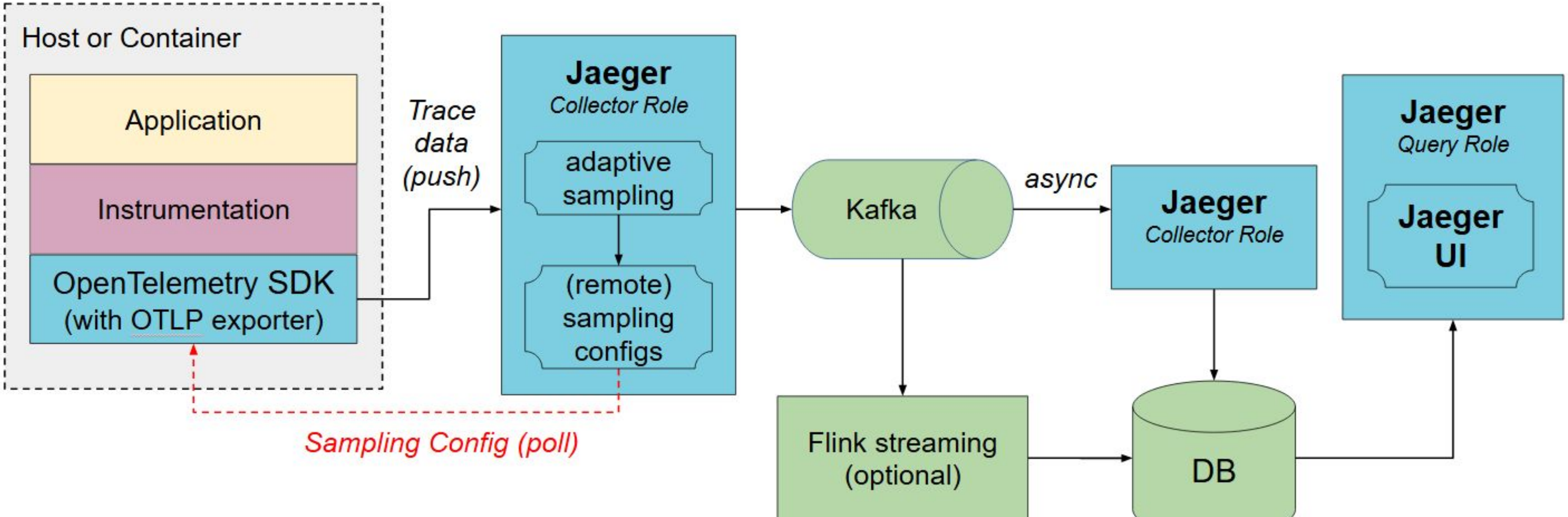


```
service:
  extensions: [jaeger_storage, jaeger_query, remote_sampling]
  pipelines:
    traces:
      receivers: [otlp, jaeger, zipkin]
      processors: [batch, adaptive_sampling]
      exporters: [jaeger_storage_exporter]

extensions:
  jaeger_query:
    storage:
      traces: my_memory_store

  jaeger_storage:
    backends:
      my_memory_store:
        memory:
          max_Traces: 10000

exporters:
  jaeger_storage_exporter:
    trace_storage: memstore
```

Jaeger v2 deployment architecture



Jaeger v2 deployment architecture with queuing



New Key Features Since Kubecon EU + Roadmap

New Features (Backend)

- Jaeger V2 based on OpenTelemetry collector
  - OpenTelemetry-native data pipeline
  - Full native Kafka support
- Support for ElasticSearch v8.x
- Jaeger V3 query API exposes stable V1 OTLP
- Sampling store support for Badger, ElasticSearch, OpenSearch
- Helm Chart for Jaeger v2
- Kubernetes operator for Jaeger v2
- Native OLTP within Jaeger backend for data structures
- Lots of bug fixes and improvements

New Features (UI)

- UI: Zoom in/out controls in graphs
- UI: SPM add span kind selector
- UI: ability to upload OLTP
- UI: Critical path visualization in trace view

Roadmap

- Support ClickHouse as official storage backend
- Refactoring and improving visualizations for topology
- Upgrading UI to use OpenTelemetry data natively
- Upgrading UI to normalize dependency views

And more useful and interesting capabilities coming in the future

Q&A

Resources

jaegertracing.io/docs

monthly community call and Notes

CNCF Slack #jaeger : https://slack.cncf.io

@jaegertracing

medium.com/jaegertracing

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