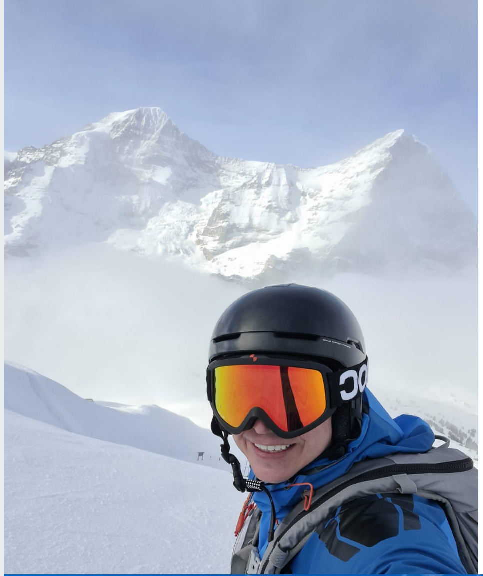
Jaeger: The Future with OpenTelemetry and Metrics

Maintainer Talk - Kubecon NA 2023

Pavol Loffay [@ploffay]

Pavol Loffay?



ploffay

Agenda

1. Why Distributed Tracing?
2. Jaeger demo
3. Service performance monitoring / Monitor tab
4. OpenTelemetry collector vs Jaeger
5. Jaeger V2
6. OpenTelemetry auto instrumentation
7. New Key Features + Roadmap for Jaeger
8. Q&A from the audience

Why Distributed Tracing?

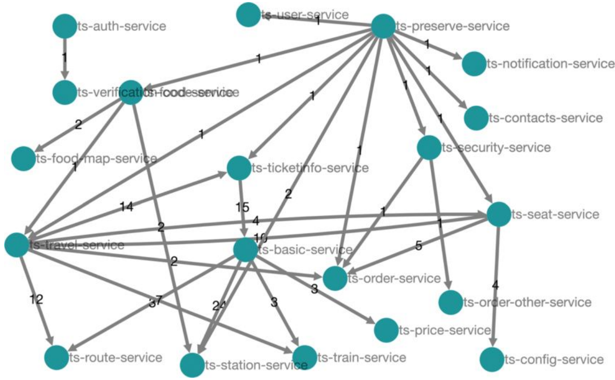
Microservices Architectures

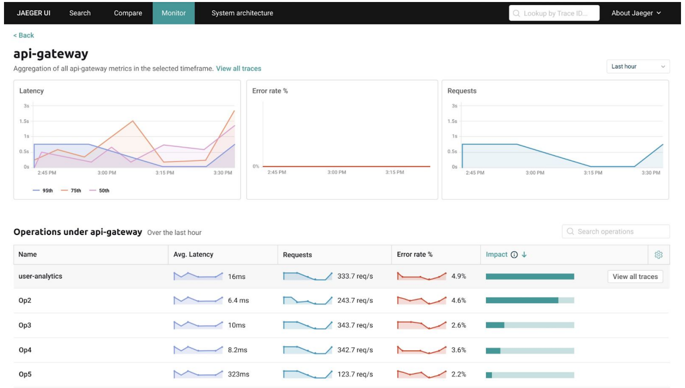
63% of enterprises are using Microservices most often managed by different teams.

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

Benefits of Distributed Tracing

- Root cause analysis
- Build a service map of relationships and dependencies
- Measure and drill into specific user actions
- Collaborate across teams
- Monitor and maintain SLAs



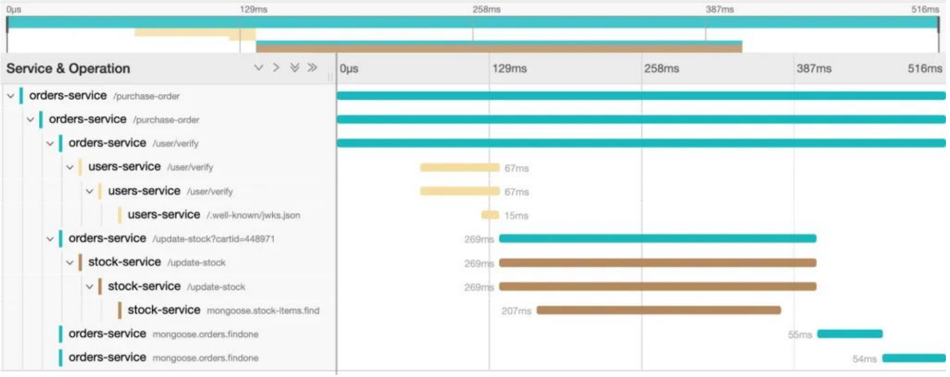


api-gateway

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

Operations under api-gateway Over the last hour

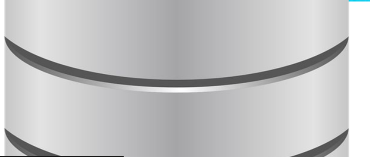
Name	Avg. Latency	Requests	Error rate %	Impact
user-analytics	16ms	333.7 req/s	4.9%	
Op2	6.4 ms	243.7 req/s	4.6%	
Op3	10ms	343.7 req/s	2.6%	
Op4	8.2ms	342.7 req/s	3.6%	
Op5	323ms	123.7 req/s	2.2%	

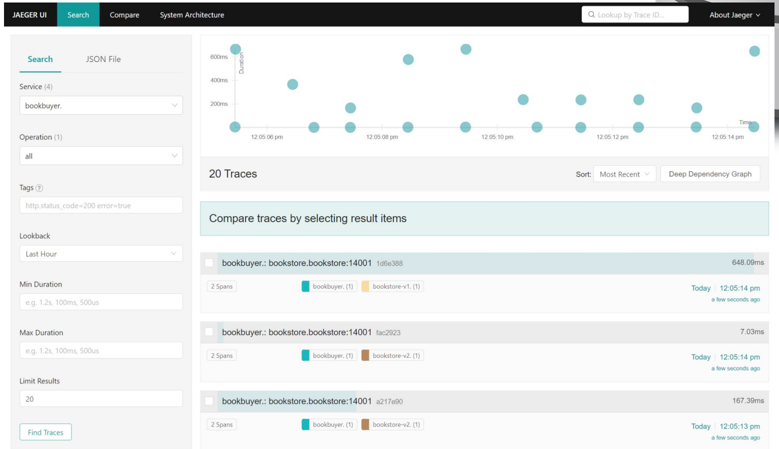


```
orders-service /purchase-order
  orders-service /purchase-order
    orders-service /user/verify
      users-service /user/verify                      67ms
        users-service /user/verify                    67ms
          users-service /.well-known/jwks.json        15ms
    orders-service /update-stock?cartid=448971        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
```

Tracing Tools

- Instrumentation
- Data Collection
- Storage & Analysis & Visualization





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

20 Traces

Sort: Most Recent

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 and demo

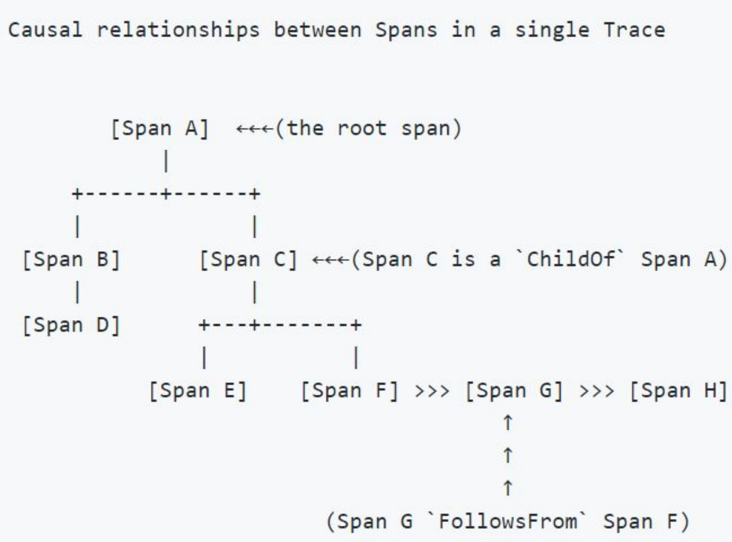
OpenTelemetry Semantics

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

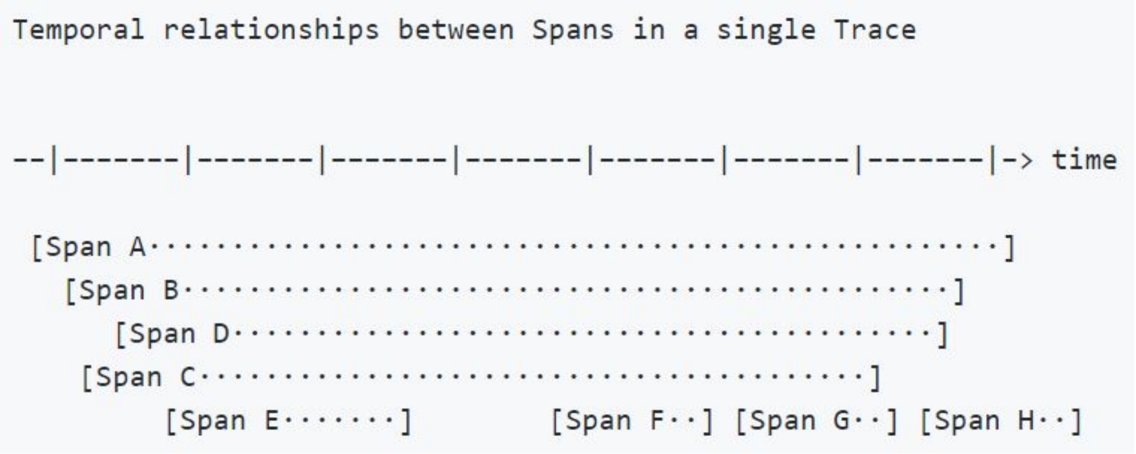
Span represents work done by a single-service or component with time intervals and associated metadata such as **Tags**

Tags/Attributes contain metadata to help contextualize a span

Relationships in tracing

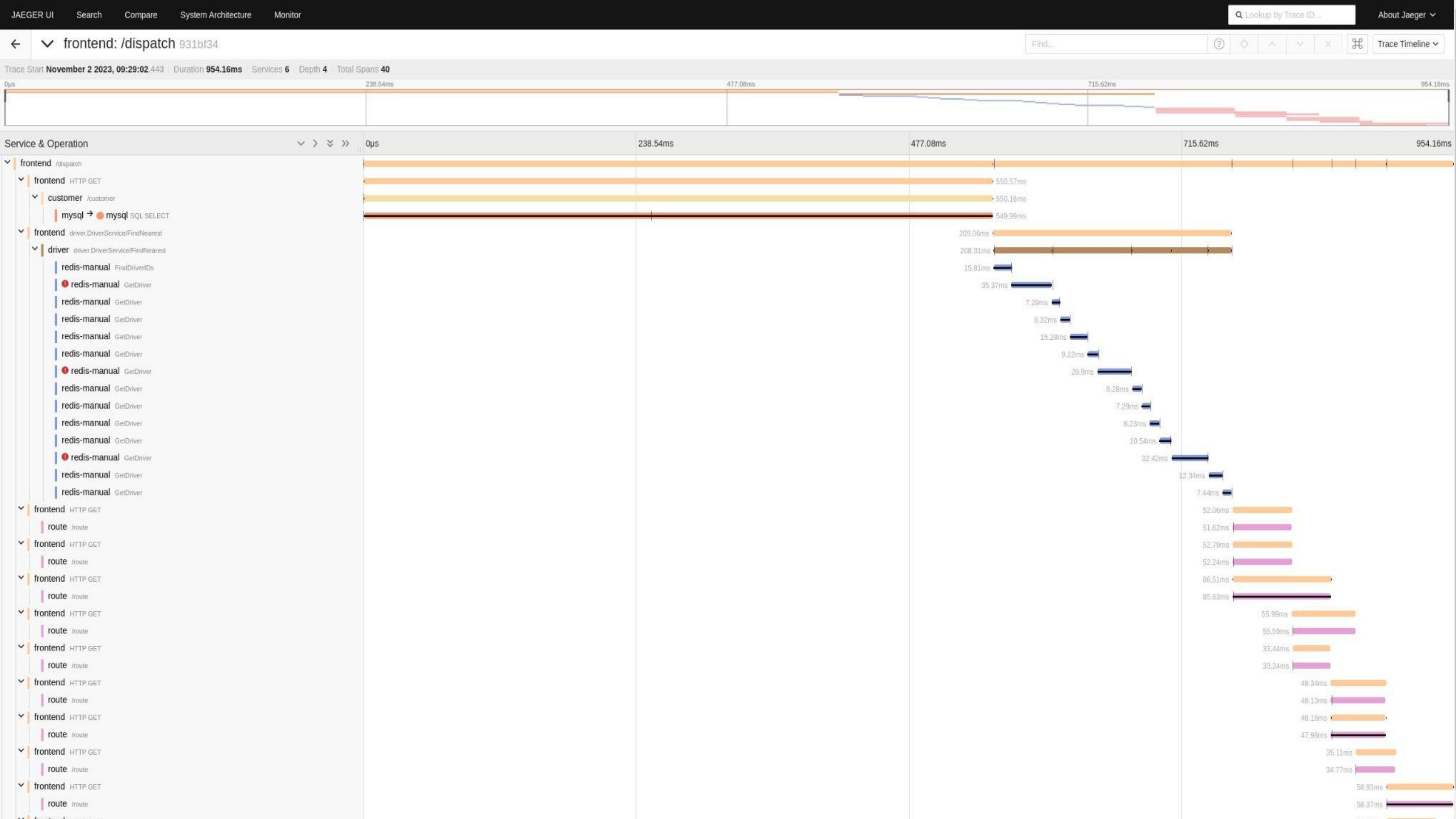


```
Causal relationships between Spans in a single Trace


        [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··]
```

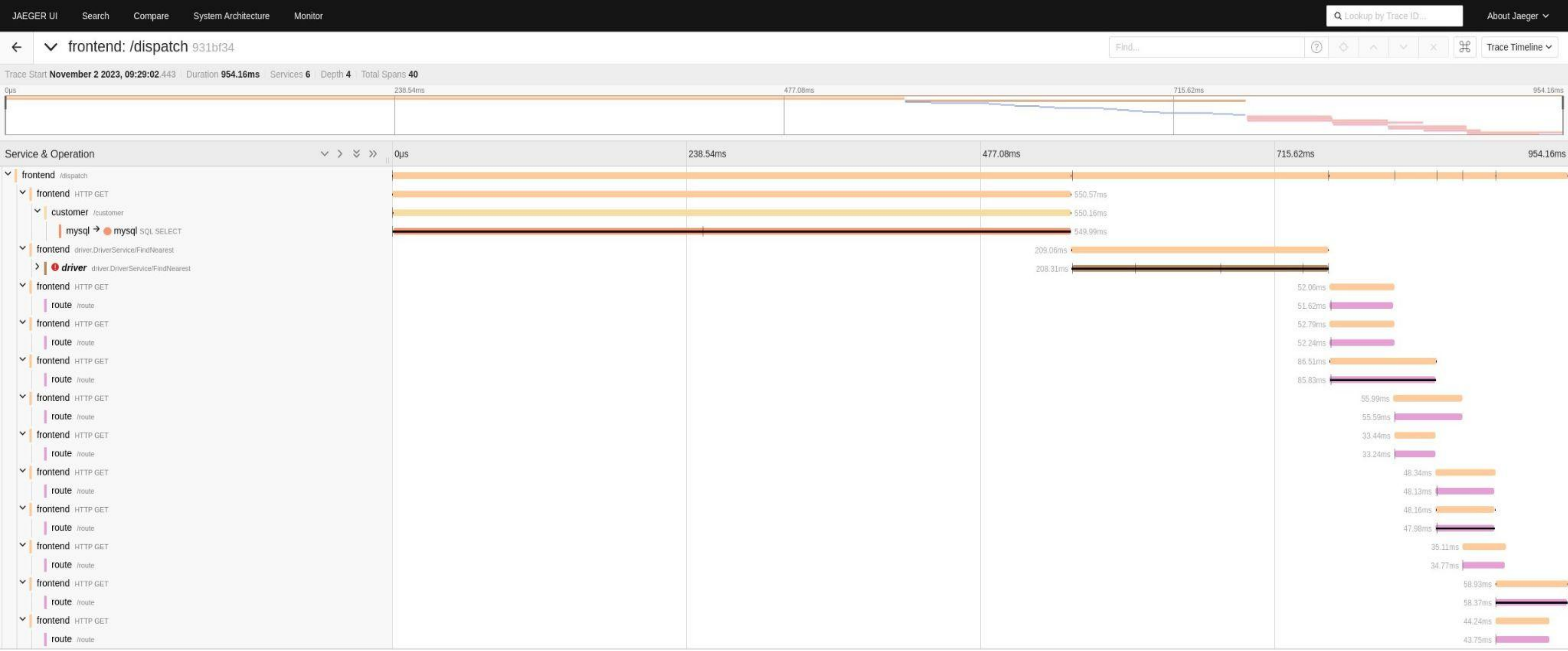
Measure errors, latency, and other indicators across each span



frontend: /dispatch 931bf34

Trace Start November 2 2023, 09:29:02.443 | Duration 954.16ms | Services 6 | Depth 4 | Total Spans 40

```
Service & Operation
frontend /dispatch
  frontend HTTP GET                                   550.57ms
    customer /customer                                550.16ms
      mysql → mysql SQL SELECT                        549.99ms
  frontend driver.DriverService/FindNearest           209.06ms
    driver driver.DriverService/FindNearest           208.31ms
      redis-manual FindDriverIDs                      15.81ms
      redis-manual GetDriver                          35.37ms
      redis-manual GetDriver                          7.29ms
      redis-manual GetDriver                          8.32ms
      redis-manual GetDriver                          15.28ms
      redis-manual GetDriver                          9.22ms
      redis-manual GetDriver                          29.9ms
      redis-manual GetDriver                          8.28ms
      redis-manual GetDriver                          7.29ms
      redis-manual GetDriver                          8.23ms
      redis-manual GetDriver                          10.54ms
      redis-manual GetDriver                          32.42ms
      redis-manual GetDriver                          12.34ms
      redis-manual GetDriver                          7.44ms
  frontend HTTP GET                                   52.06ms
    route /route                                      51.62ms
  frontend HTTP GET                                   52.79ms
    route /route                                      52.24ms
  frontend HTTP GET                                   86.51ms
    route /route                                      85.83ms
  frontend HTTP GET                                   55.99ms
    route /route                                      55.59ms
  frontend HTTP GET                                   33.44ms
    route /route                                      33.24ms
  frontend HTTP GET                                   48.34ms
    route /route                                      48.13ms
  frontend HTTP GET                                   48.16ms
    route /route                                      47.98ms
  frontend HTTP GET                                   35.11ms
    route /route                                      34.77ms
  frontend HTTP GET                                   58.93ms
    route /route                                      58.37ms
```



frontend: /dispatch 931bf34

Trace Start **November 2 2023, 09:29:02**.443 | Duration **954.16ms** | Services **6** | Depth **4** | Total Spans **40**

```
Service & Operation                                   0µs   238.54ms   477.08ms   715.62ms   954.16ms
frontend /dispatch
  frontend HTTP GET                                   550.57ms
    customer /customer                                550.16ms
      mysql → mysql SQL SELECT                        549.99ms
  frontend driver.DriverService/FindNearest           209.06ms
    driver driver.DriverService/FindNearest           208.31ms
  frontend HTTP GET                                   52.06ms
    route /route                                      51.62ms
  frontend HTTP GET                                   52.79ms
    route /route                                      52.24ms
  frontend HTTP GET                                   86.51ms
    route /route                                      85.83ms
  frontend HTTP GET                                   55.99ms
    route /route                                      55.59ms
  frontend HTTP GET                                   33.44ms
    route /route                                      33.24ms
  frontend HTTP GET                                   48.34ms
    route /route                                      48.13ms
  frontend HTTP GET                                   48.16ms
    route /route                                      47.98ms
  frontend HTTP GET                                   35.11ms
    route /route                                      34.77ms
  frontend HTTP GET                                   58.93ms
    route /route                                      58.37ms
  frontend HTTP GET                                   44.24ms
    route /route                                      43.75ms
```

New Monitoring tab and Prometheus support in Jaeger

Tracing and Monitoring

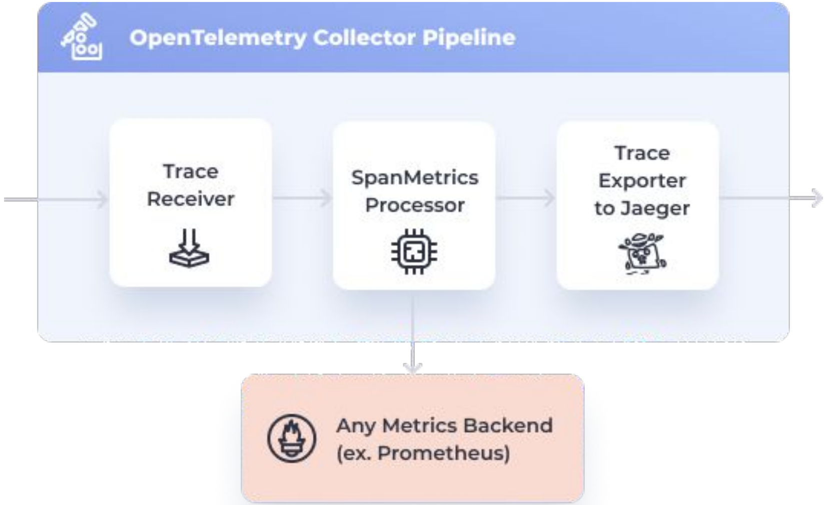
- Moving Jaeger from “distributed tracing” towards APM
  - Traces / Events
  - Metrics
- Additional use cases
  - Operational Monitoring
  - Operational Alerting
  - Change Planning

SpanMetrics Connector Flow

Prometheus handles all metrics use cases (monitor, alert, plan)
So can many other metrics platforms…

OpenTelemetry to derive aggregated metrics from traces

SpanMetrics Connector


OpenTelemetry Collector Pipeline
Trace Receiver
SpanMetrics Processor
Trace Exporter to Jaeger
Any Metrics Backend (ex. Prometheus)

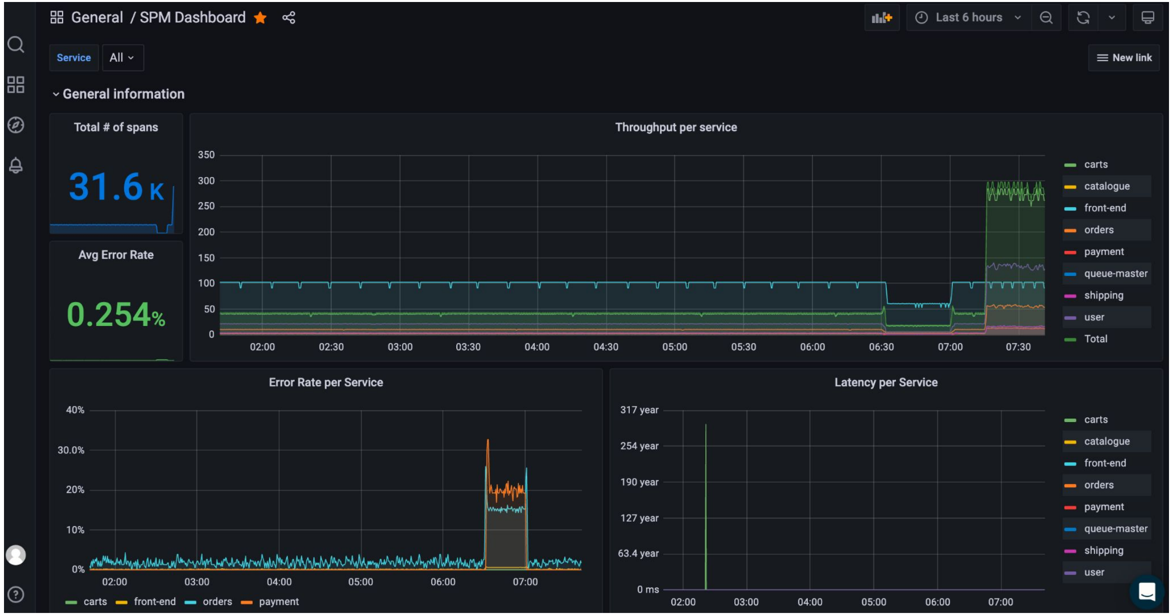
SpanMetrics Connector in OpenTelemetry

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

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

Using Prometheus Metrics in Grafana

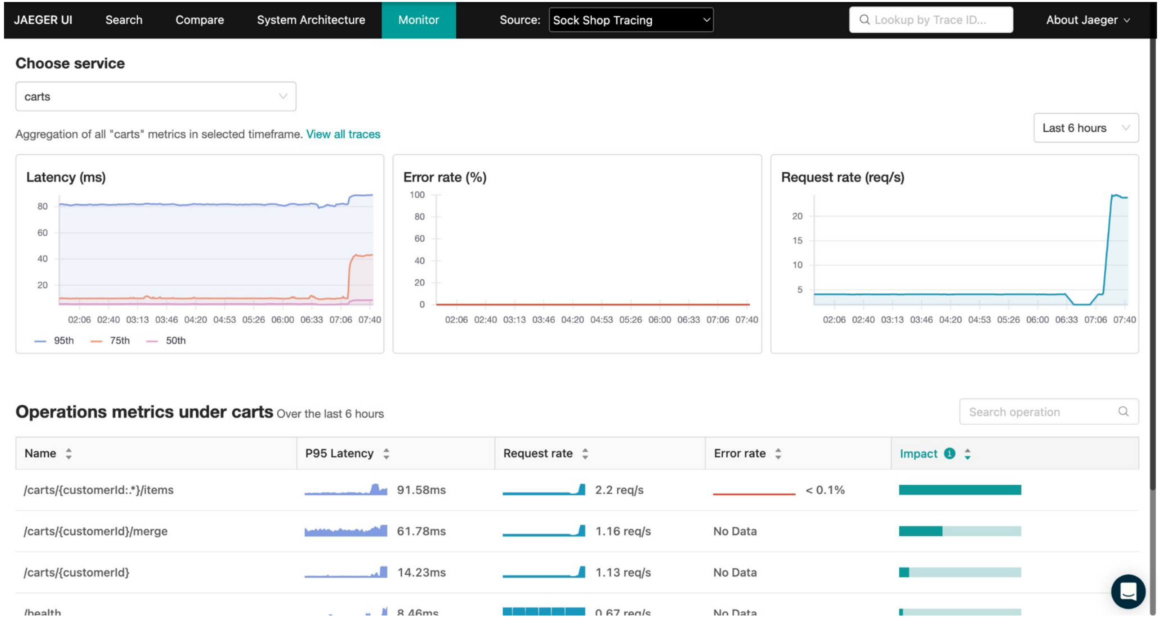
MetricQuery service in Jaeger to query metric backends.

- Any promql compatible backend (ex: Prometheus, Cortex, Thanos, M3DB, and Mimir)
- Community can add other metric systems as needed



Using Prometheus Metrics inside Jaeger UI

- New “monitor” homepage in Jaeger to provide status and health of transactions



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

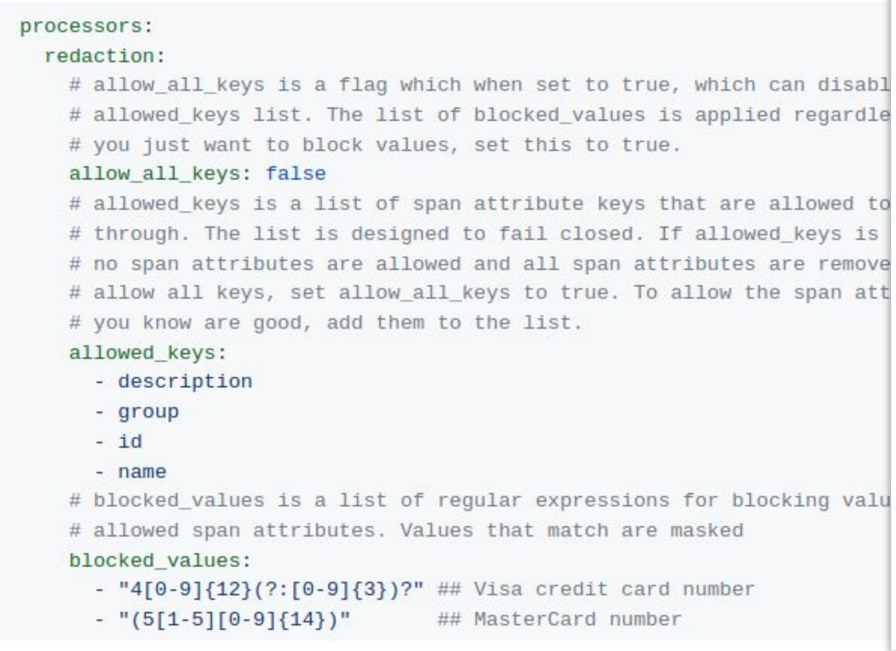
Name	P95 Latency	Request rate	Error rate	Impact
/carts/{customerId:.*}/items	91.58ms	2.2 req/s	< 0.1%	
/carts/{customerId}/merge	61.78ms	1.16 req/s	No Data	
/carts/{customerId}	14.23ms	1.13 req/s	No Data	
/health	8.46ms	0.67 req/s	No Data	

Pipelines with Jaeger and OpenTelemetry

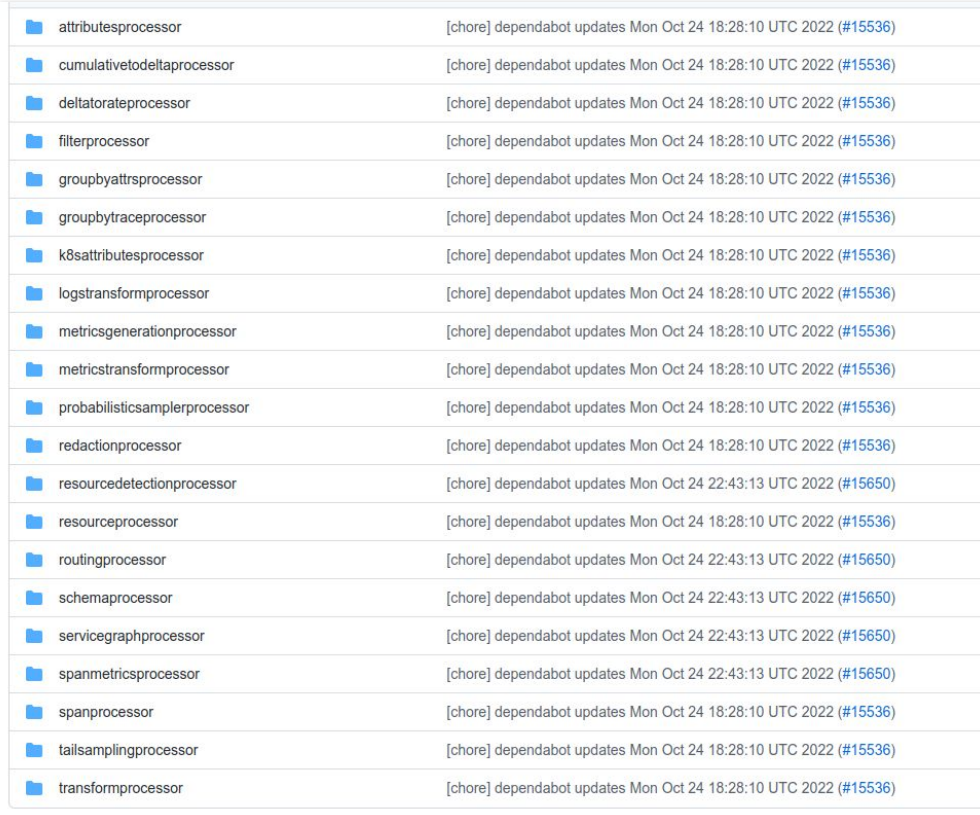
OTel Collector + OTel Clients + Jaeger

- OTel Supports Jaeger ingestion protocols
    - Agent (legacy)
        - thrift compact (6831)
        - thrift binary (6832)
    - Collector
        - protobuf/gRPC (14250)
        - thrift over HTTP (14268)
- Jaeger remote sampler extension (HTTP 5778, 14250 gRPC)
- Can also write to Kafka in supported Jaeger formats

OTel Processors



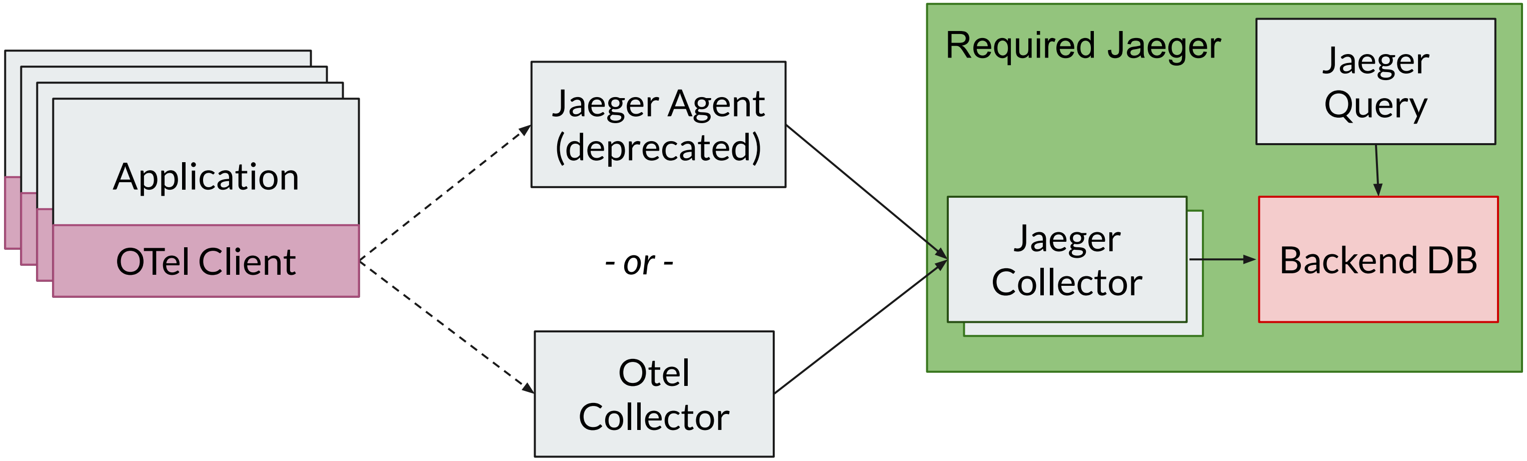
```
processors:
  redaction:
    # allow_all_keys is a flag which when set to true, which can disabl
    # allowed_keys list. The list of blocked_values is applied regardle
    # you just want to block values, set this to true.
    allow_all_keys: false
    # allowed_keys is a list of span attribute keys that are allowed to
    # through. The list is designed to fail closed. If allowed_keys is
    # no span attributes are allowed and all span attributes are remove
    # allow all keys, set allow_all_keys to true. To allow the span att
    # you know are good, add them to the list.
    allowed_keys:
      - description
      - group
      - id
      - name
    # blocked_values is a list of regular expressions for blocking valu
    # allowed span attributes. Values that match are masked
    blocked_values:
      - "4[0-9]{12}(?:[0-9]{3})?" ## Visa credit card number
      - "(5[1-5][0-9]{14})"       ## MasterCard number
```



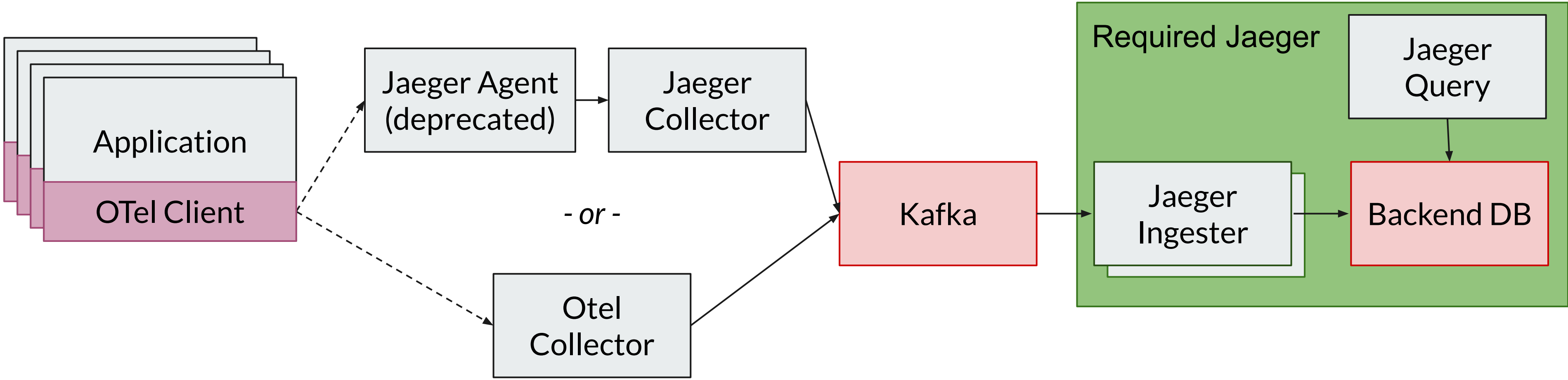
attributesprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
cumulativetodeltaprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
deltatorateprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
filterprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
groupbyattrsprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
groupbytraceprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
k8sattributesprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
logstransformprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
metricsgenerationprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
metricstransformprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
probabilisticsamplerprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
redactionprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
resourcedetectionprocessor	[chore] dependabot updates Mon Oct 24 22:43:13 UTC 2022 (#15650)
resourceprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
routingprocessor	[chore] dependabot updates Mon Oct 24 22:43:13 UTC 2022 (#15650)
schemaprocessor	[chore] dependabot updates Mon Oct 24 22:43:13 UTC 2022 (#15650)
servicegraphprocessor	[chore] dependabot updates Mon Oct 24 22:43:13 UTC 2022 (#15650)
spanmetricsprocessor	[chore] dependabot updates Mon Oct 24 22:43:13 UTC 2022 (#15650)
spanprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
tailsamplingprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)
transformprocessor	[chore] dependabot updates Mon Oct 24 18:28:10 UTC 2022 (#15536)

https://github.com/open-telemetry/opentelemetry-collector-contrib/tree/main/processor

Without Queueing



With Queueing



Jaeger operator

“operates” Jaeger on Kubernetes

Getting Started

- jaegertracing.io/docs/latest/operator
- Storage schema creation
- Jaeger upgrades
- Auto recognizes available APIs - OpenShift/Kubernetes, ES/Strimzi
- Can generate plain Kubernetes manifest files

Jaeger CRD

- CRD - Custom Resource Definition

```
apiVersion: jaegertracing.io/v1
kind: Jaeger
metadata:
  name: jaeger-cluster
spec:
  strategy: allInOne | production | streaming

  storage:
    type: memory|elasticsearch|cassandra|badger|grpc-plugin|kafka
```

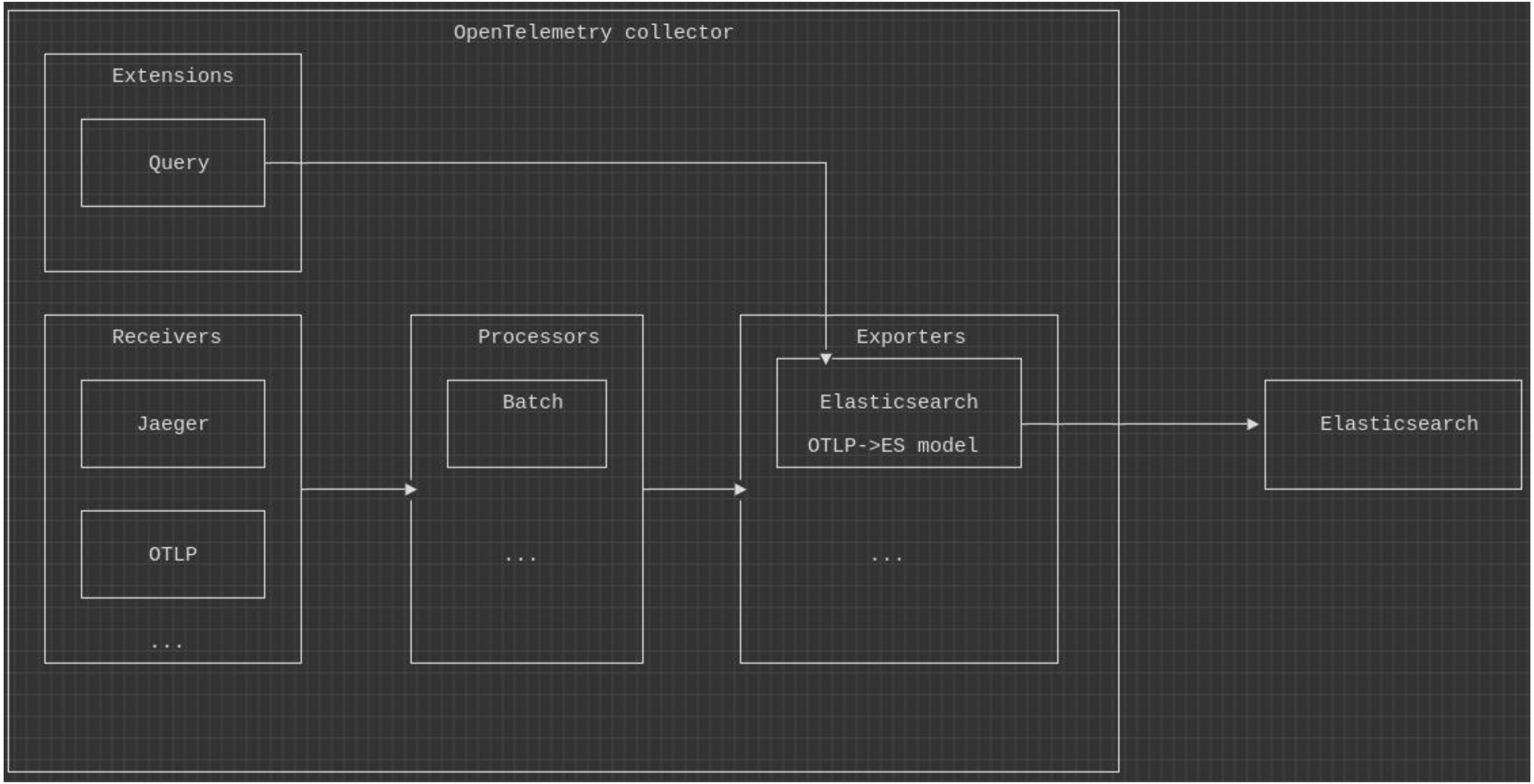
- `kubectl get jaegers`

Jager agent sidecar injection

- Jaeger agent has been deprecated in Jaeger 1.50.
  - it will be removed in ~April/May 2024

- Use OpenTelemetry operator!
  - Jaeger receiver *gRPC, Thrift binary/compact/HTTP)

Jaeger v2 based on OpenTelemetry collector

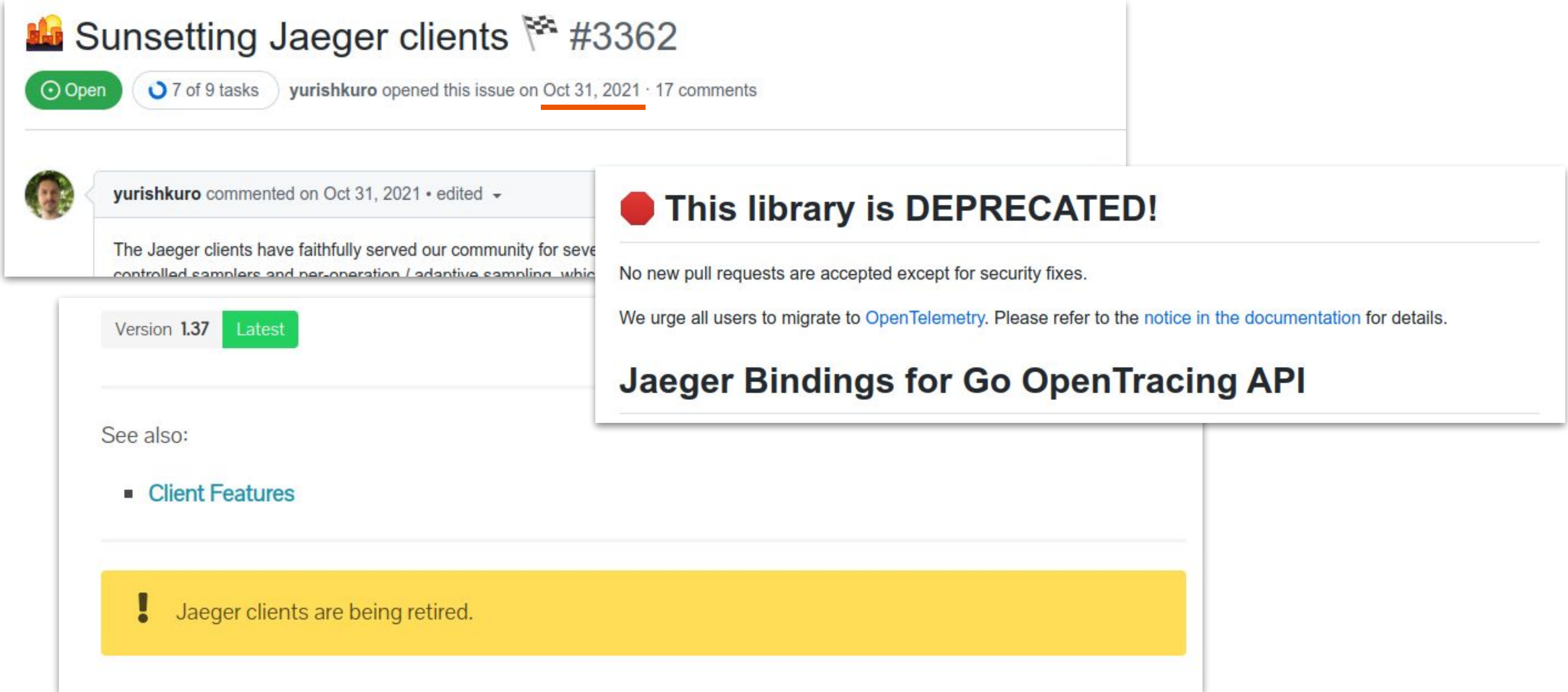

OpenTelemetry collector
Extensions
Query
Receivers
Jaeger
OTLP
...
Processors
Batch
...
Exporters
Elasticsearch
OTLP->ES model
...
Elasticsearch

V2 Configuration

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

extensions:
  jaeger_query:
    trace_storage: memstore

  jaeger_storage:
    memory:
      memstore:
        max_traces: 100000

exporters:
  jaeger_storage_exporter:
    trace_storage: memstore
```

OpenTelemetry (auto) instrumentation

Deprecated Clients & Jaeger agent



Sunsetting Jaeger clients 🏁 #3362

Open · 7 of 9 tasks · **yurishkuro** opened this issue on Oct 31, 2021 · 17 comments

yurishkuro commented on Oct 31, 2021 • edited

The Jaeger clients have faithfully served our community for seve
controlled samplers and per-operation / adaptive sampling, whic

🛑 This library is DEPRECATED!

No new pull requests are accepted except for security fixes.

We urge all users to migrate to OpenTelemetry. Please refer to the notice in the documentation for details.

Jaeger Bindings for Go OpenTracing API

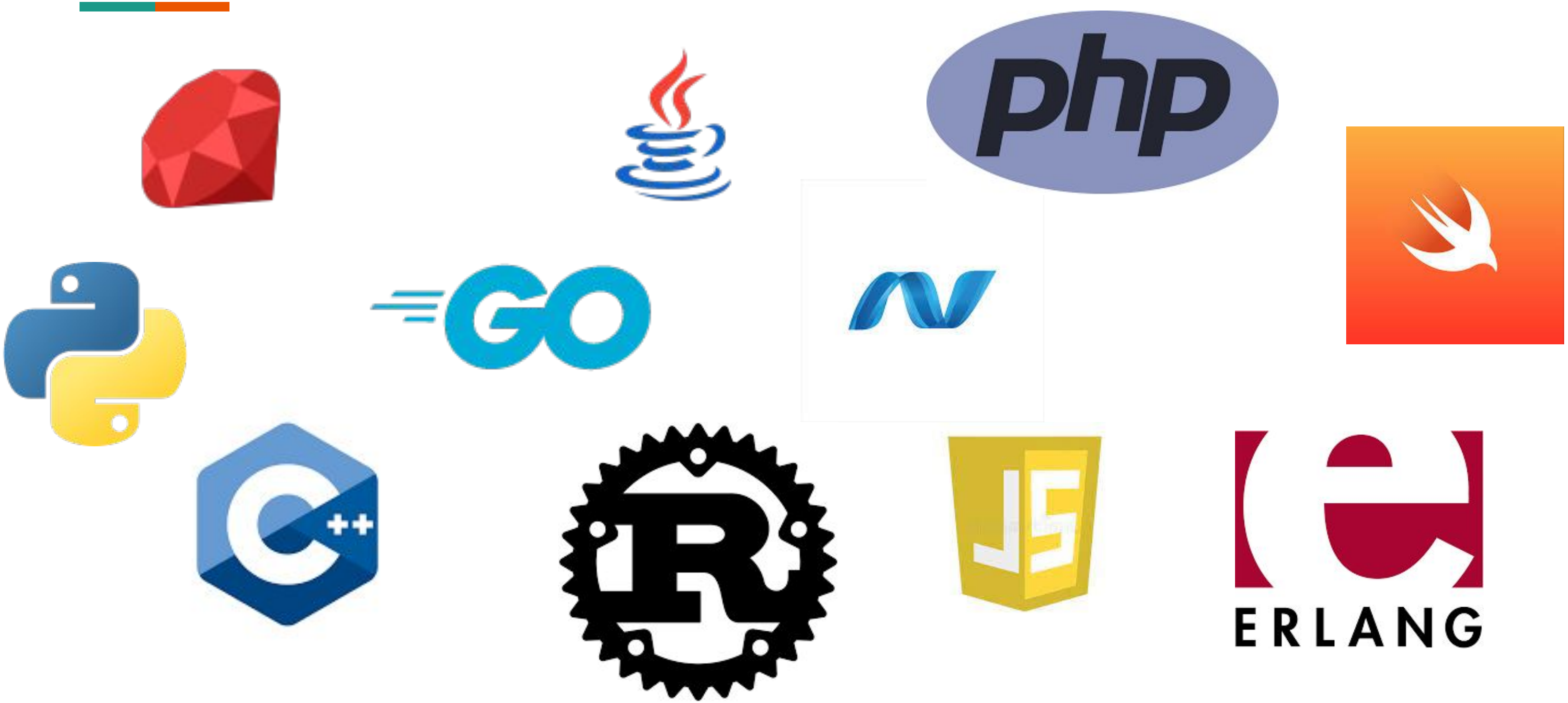
Version 1.37 Latest

See also:

- Client Features

❗ Jaeger clients are being retired.

Wide Language Support (OpenTracing Shim)



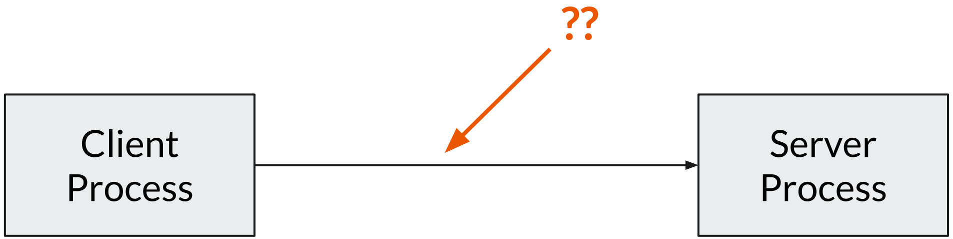
https://opentelemetry.io/docs/migration/opentracing/

Environment Variable Based Config

JAEGER_SERVICE_NAME		OTEL_SERVICE_NAME
JAEGER_TAGS		OTEL_RESOURCE_ATTRIBUTES
JAEGER_AGENT_HOST	→	OTEL_TRACES_EXPORTER
		OTEL_TRACES_SAMPLER
		OTEL_TRACES_SAMPLER_ARG
JAEGER_SAMPLER_TYPE		OTEL_PROPAGATORS
JAEGER_SAMPLER_PARAM		
JAEGER_PROPAGATION		

https://opentelemetry.io/docs/reference/specification/sdk-environment-variables/

Trace Propagation



OTEL_PROPAGATORS

default:	tracecontext,baggage (w3c)
supported:	jaeger, b3, b3multi

https://opentelemetry.io/docs/reference/specification/sdk-environment-variables/

(Auto) Instrumentation

Auto!

- Java
- Python
- .NET
- Node.JS

Less Auto!

- Go

  eBPF auto-inst
- Ruby

  minor global code change
- C++, PHP, Rust...

https://opentelemetry.io/docs/instrumentation/

New Key Features Since Kubecon Europe + Roadmap

Other New Features

- OTLP ingestion is enabled by default
  - OpenTelemetry collector removed support for Jaeger exporter
- Support for spanmetrics connector
- Jaeger V2 based on OpenTelemetry collector
- Jaeger V3 query API exposes stable V1 OTLP
- UI: Critical path visualization
- UI: In-page search on key value pairs
- UI: batch download of traces

Roadmap

- Jaeger V2 based on OpenTelemetry collector
  - Kafka support
  - OpenTelemetry collector builder (OCB)
  - Testing & Docs & Release
- Native Clickhouse storage support in Jaeger V2
- Elasticsearch 8 storage support

And more 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

Leave feedback on this session