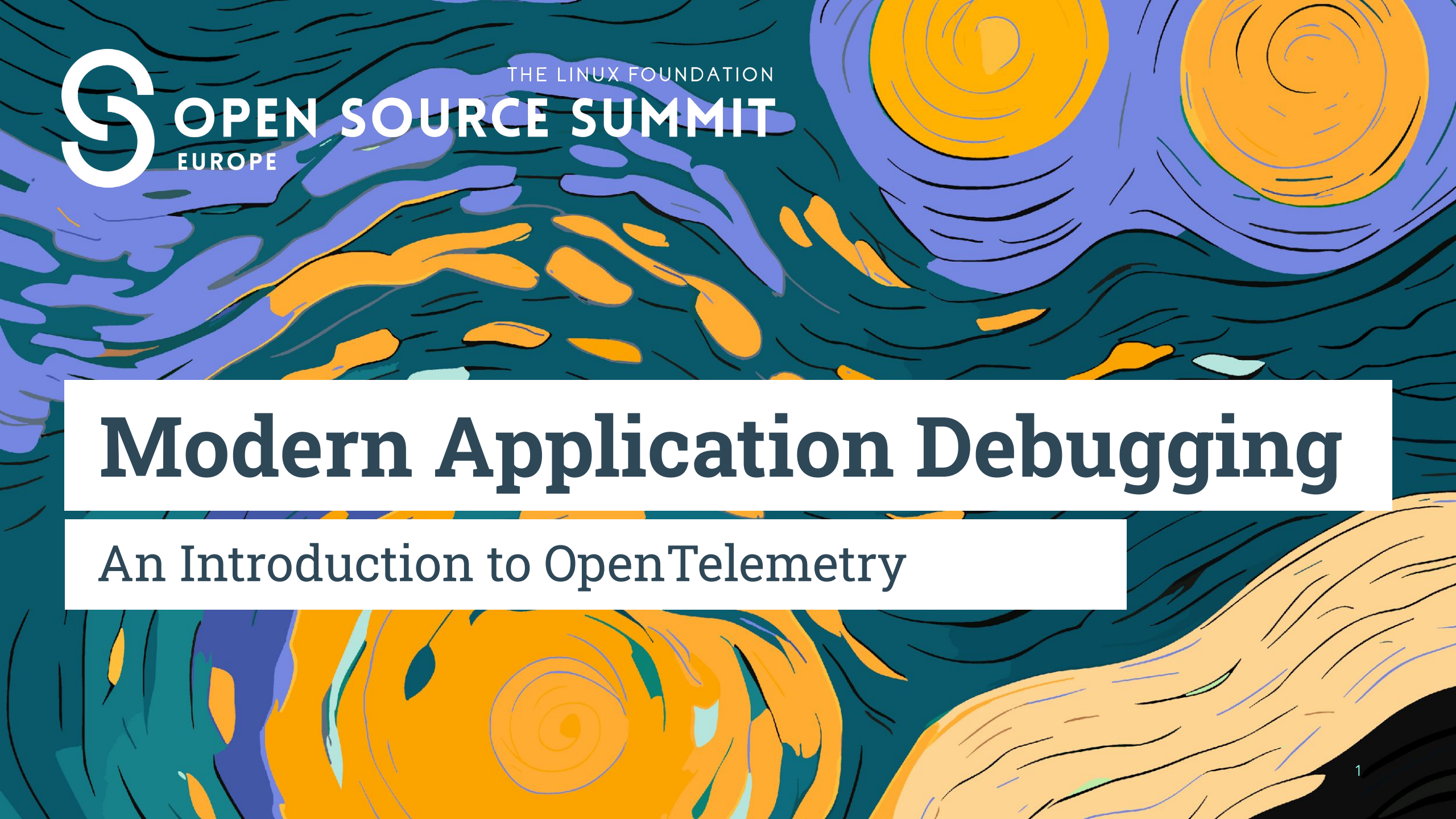


Modern Application Debugging

An Introduction to OpenTelemetry

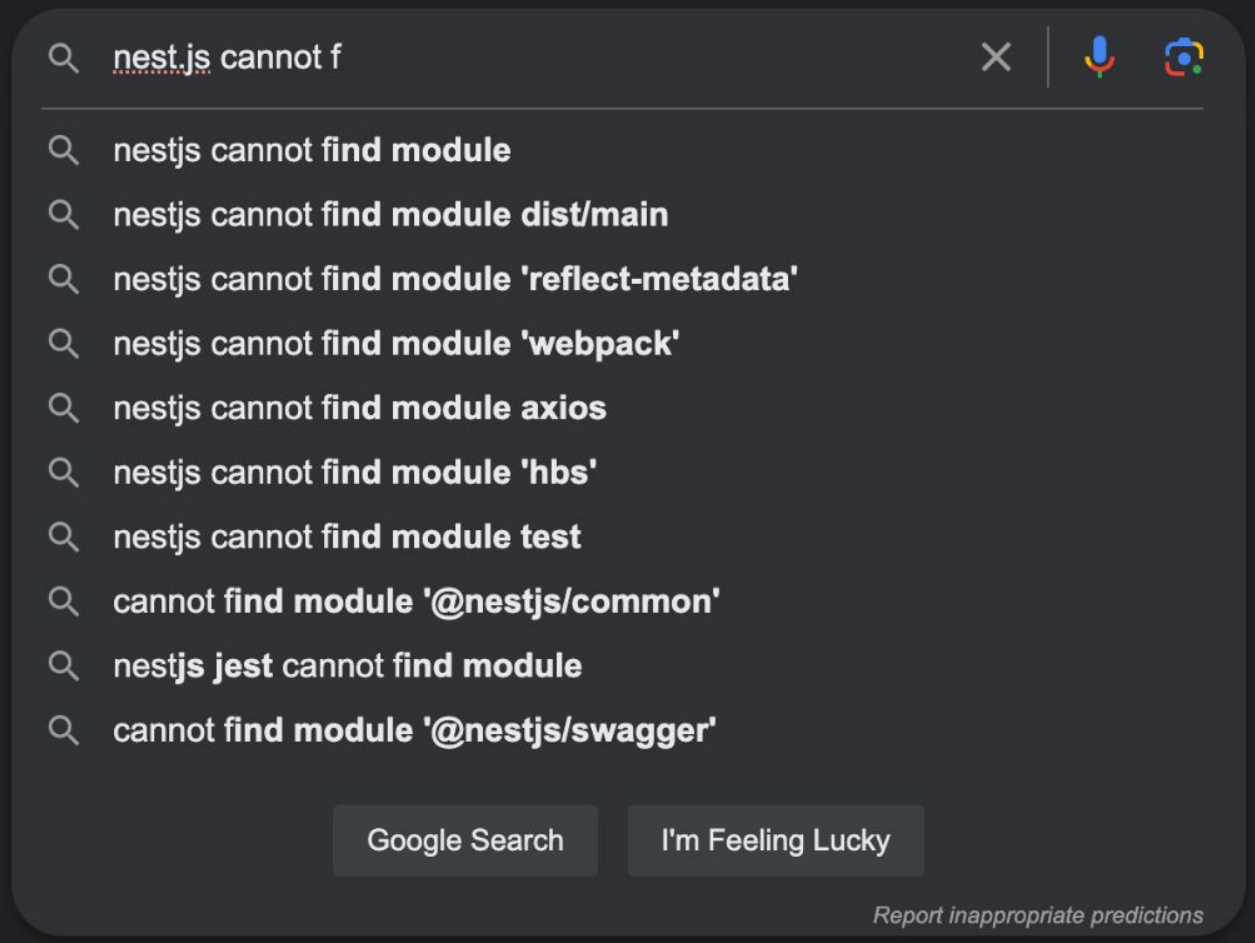
Josh Lee

Open Source Advocate

Altinity

We are but humble open source contributors


How do we debug our applications?
THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
EUROPE


Google
nest.js cannot f
nestjs cannot find module
nestjs cannot find module dist/main
nestjs cannot find module 'reflect-metadata'
nestjs cannot find module 'webpack'
nestjs cannot find module axios
nestjs cannot find module 'hbs'
nestjs cannot find module test
cannot find module '@nestjs/common'
nestjs jest cannot find module
cannot find module '@nestjs/swagger'
Google Search
I'm Feeling Lucky
Report inappropriate predictions

Observability is our ability to understand a system from its outputs alone


FUEL TRANSFER IN FLIGHT PROHIBITED
PROPELLER FEATHERING BUTTONS
GENERATOR LOAD PANEL
HEATER CONTROL PANEL
PRESSURIZATION CONTROL PANEL

Observability is not any one signal…

Metrics

Aggregable

Is there a problem?

Traces

Request-Scoped

Where is the problem?

Logs

Verbose, time-stamped records

What is the problem?

“There are only two signals: metrics and (structured) logs”

— paraphrased from Charity Majors, Honeycomb

A Typical Request Log

```
2024-07-01 09:35:34 GET /home 200 ...
```

Adding Duration

```
2024-07-01 09:35:34 231ms GET /home 200
```

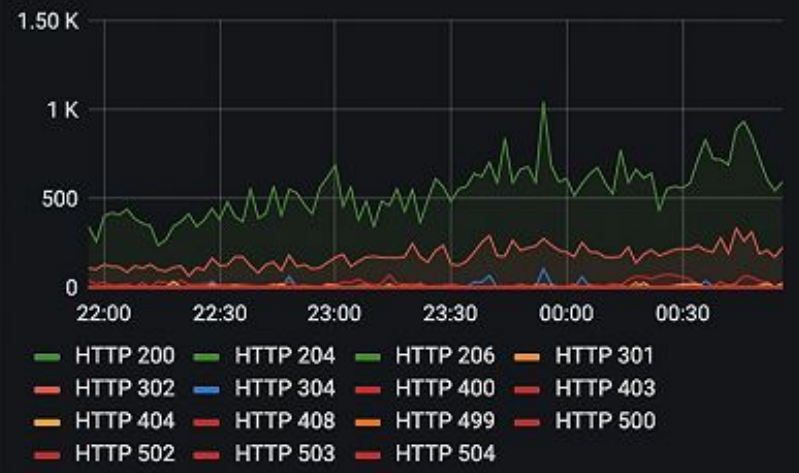
Controller Class: All | Namespace: live | Ingress: All | Ingress Pod: All | Config Reloads

Overview

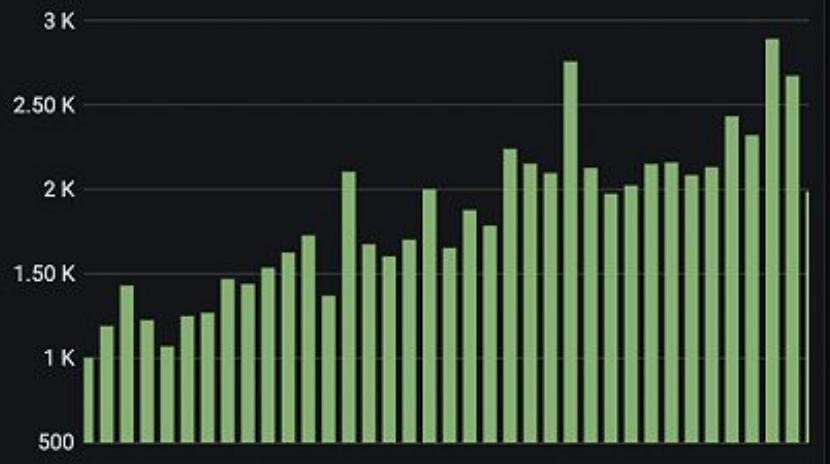
Requests (period)	% Succe...	Conns (...	Reqs (2...	% Success (2m)	HTTP 1/2xx (2m)	HTTP 3xx (2m)	HTTP 4xx (2m)	HTTP 5xx (2m)
67.3 K	97.0%	311	850	99.3%	592	228	30	0

HTTP Requests / Ingress

HTTP Status Codes



Total HTTP Requests

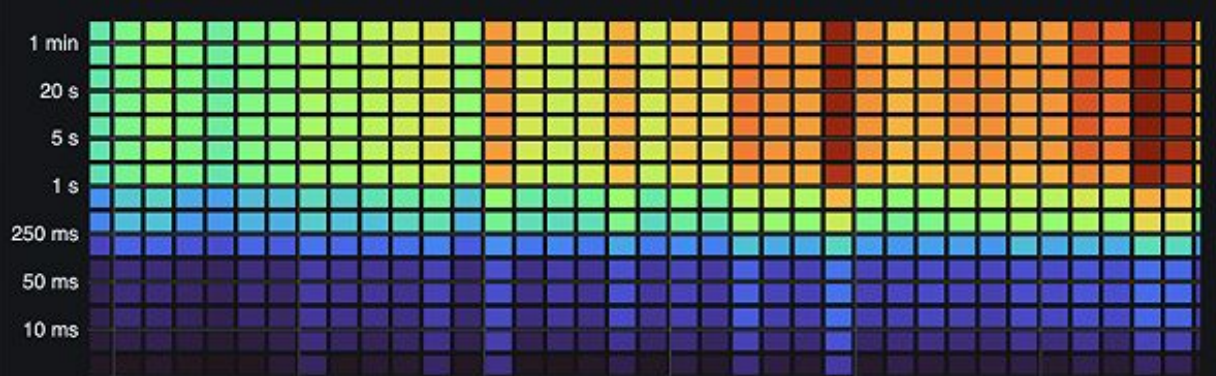


Latency

Latency (Average Percentiles)

	min	max	avg
0.99	4.3 s	42.3 s	6.5 s
0.95	2.4 s	4.5 s	2.8 s
0.9	2.1 s	2.7 s	2.3 s
0.5	357.2 ms	631.6 ms	443.7 ms
0.75	1.0 s	1.8 s	1.5 s
Average	3.2 s	5.1 s	4.1 s

Latency Heatmap



Back to our log…

```
2024-07-01 09:35:34 231ms GET /home 200
```

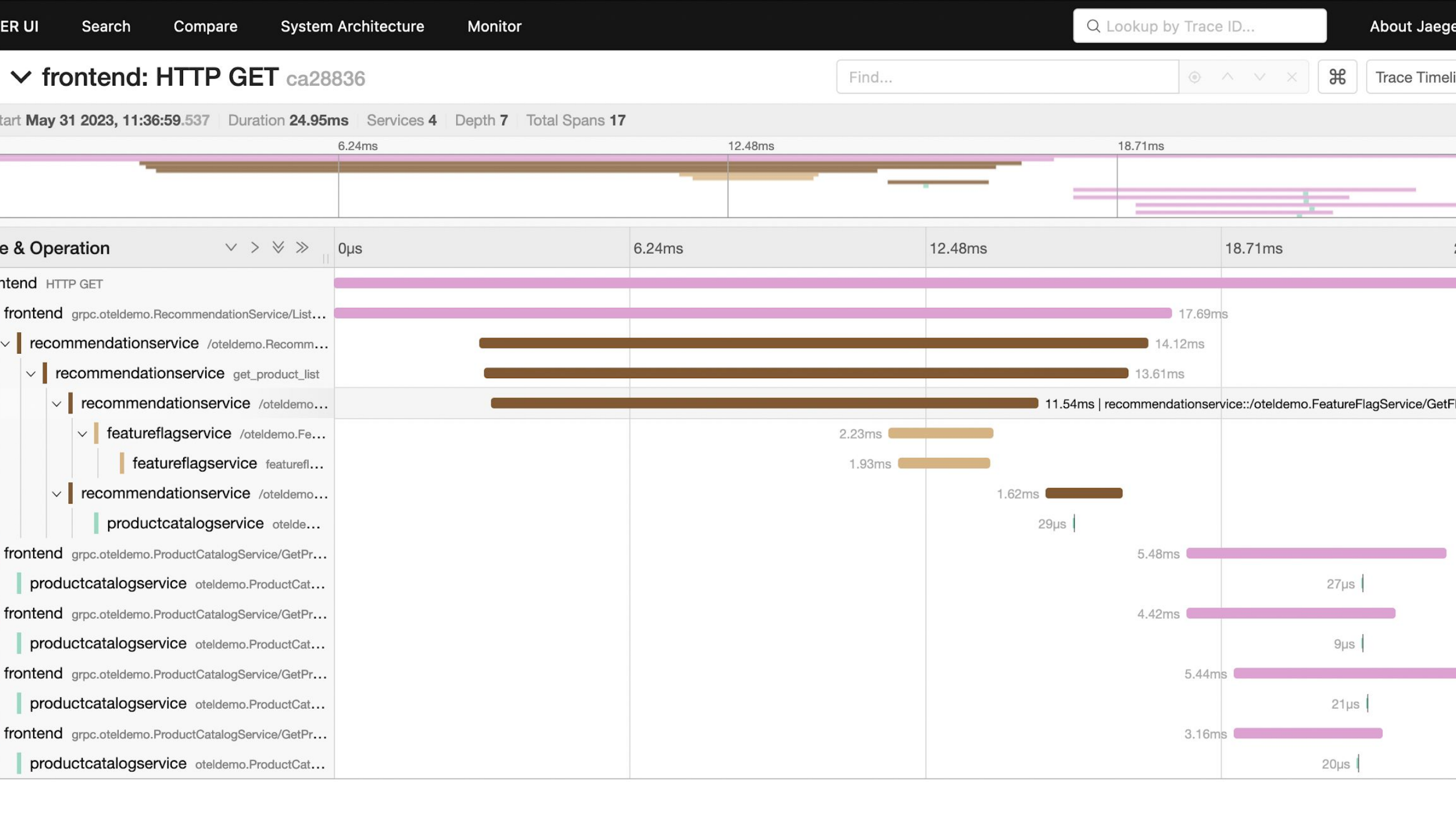
Back to our log…

```
Request:123 2024-07-01 09:35:34 231ms GET /home
200
```

Connecting the trace:

```
Trace:4ea3 Span:123 2024-07-01 09:35:34 231ms GET
/home 200

Trace:4ea3 Span:456 ParentSpan:123 2024-07-01
09:35:34 201ms GET /api/users 201
```


ER UI
Search
Compare
System Architecture
Monitor
Lookup by Trace ID...
About Jaege
frontend: HTTP GET ca28836
Find...
Trace Timeli
tart May 31 2023, 11:36:59.537
Duration 24.95ms
Services 4
Depth 7
Total Spans 17
6.24ms
12.48ms
18.71ms
e & Operation
0µs
6.24ms
12.48ms
18.71ms
ntend HTTP GET
frontend grpc.oteldemo.RecommendationService/List...
17.69ms
recommendationservice /oteldemo.Recomm...
14.12ms
recommendationservice get_product_list
13.61ms
recommendationservice /oteldemo...
11.54ms | recommendationservice::/oteldemo.FeatureFlagService/GetF
featureflagservice /oteldemo.Fe...
2.23ms
featureflagservice featurefl...
1.93ms
recommendationservice /oteldemo...
1.62ms
productcatalogservice otelde...
29µs
frontend grpc.oteldemo.ProductCatalogService/GetPr...
5.48ms
productcatalogservice oteldemo.ProductCat...
27µs
frontend grpc.oteldemo.ProductCatalogService/GetPr...
4.42ms
productcatalogservice oteldemo.ProductCat...
9µs
frontend grpc.oteldemo.ProductCatalogService/GetPr...
5.44ms
productcatalogservice oteldemo.ProductCat...
21µs
frontend grpc.oteldemo.ProductCatalogService/GetPr...
3.16ms
productcatalogservice oteldemo.ProductCat...
20µs

Observability is not any one signal…

Traces

Where is the problem?

Who can help resolve it?

Distributed Tracing is the *"Killer App"*

Understand complete request flows

Create a real-time map of system topology and dependencies

Derive metrics from the richness of trace metadata

Enrich logs and metrics with context

18

Introducing OpenTelemetry

OpenTelemetry Language-Specific SDKs

Metrics

Stable SDKs:
C++
.NET
Go
Java
JavaScript
Python
PHP

Development/Beta SDKs:
Erlang/Elixir
Ruby
Rust
Swift

Traces

Stable SDKs:
C++
.NET
Erlang / Elixir
Go
Java
JavaScript
Python
Ruby
PHP
Swift

Beta SDKs:
Rust

Logs

Stable SDKs:
C++
.NET
Java
PHP

Development/Beta SDKs:
Erlang / Elixir
Go
JavaScript
Python
Ruby
Rust
Swift

What is OpenTelemetry?

Specifications

- W3C Trace Context
- Language APIs
- OTLP
- Semantic Conventions

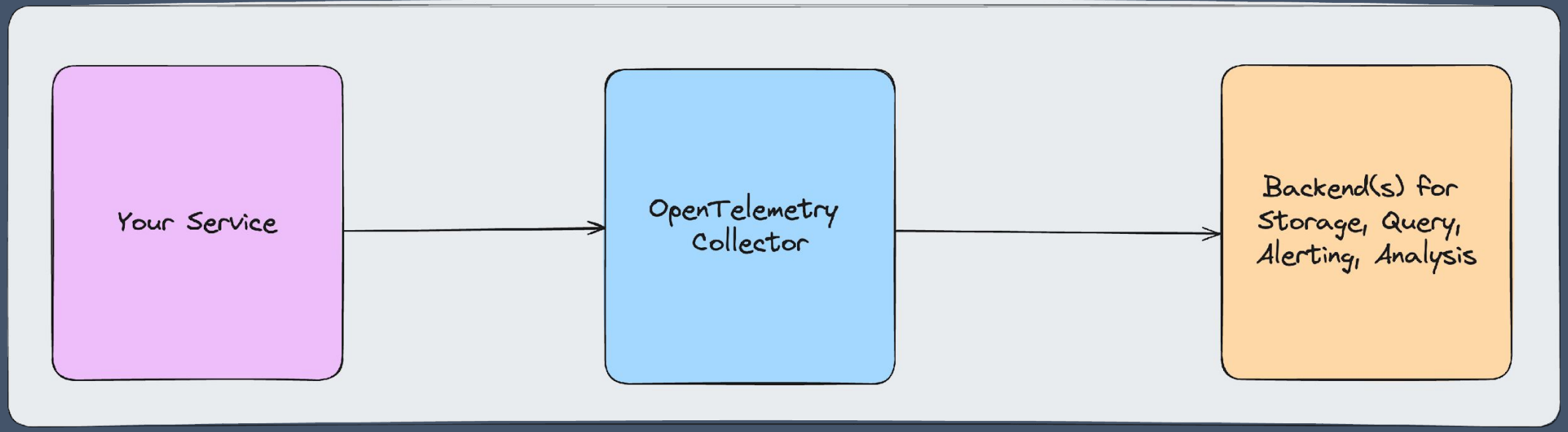
Libraries & Tools

- Language SDKs
- Instrumentation Libraries
- The Collector
- Kubernetes Operator

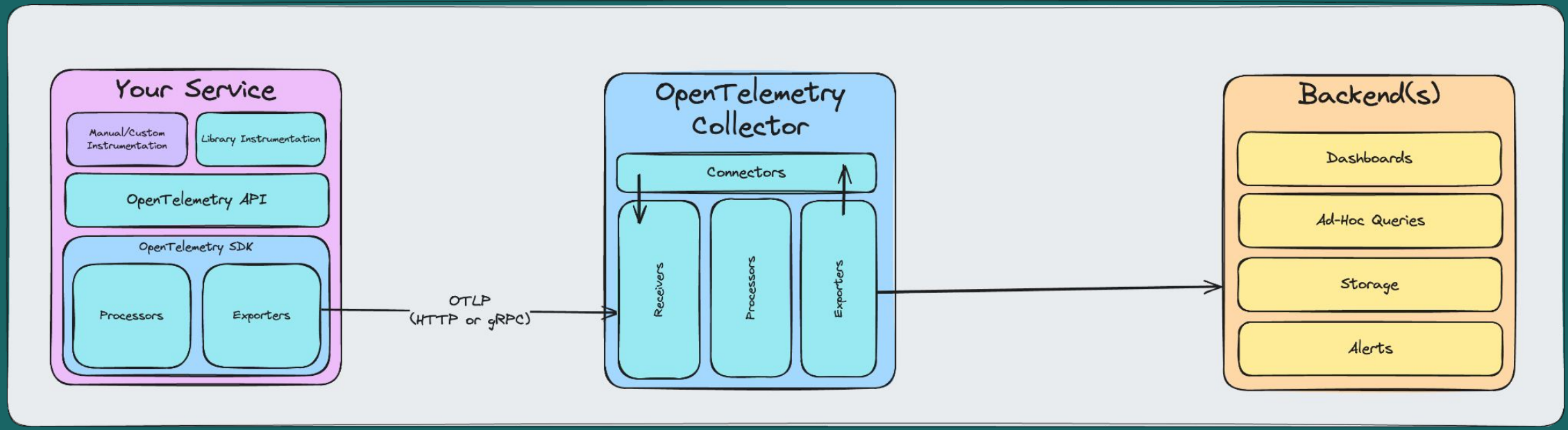
Community

- CNCF
- Events & Meetups
- OpenTelemetry End User WG (+ other WGs/SIGs)

OpenTelemetry Stack



OpenTelemetry Stack



OpenTelemetry Stack

In your code

- ➔ Language API & SDK
- ➔ Processors & exporters
- ➔ Instrumentation libraries
- ➔ Manual instrumentation

On your node*

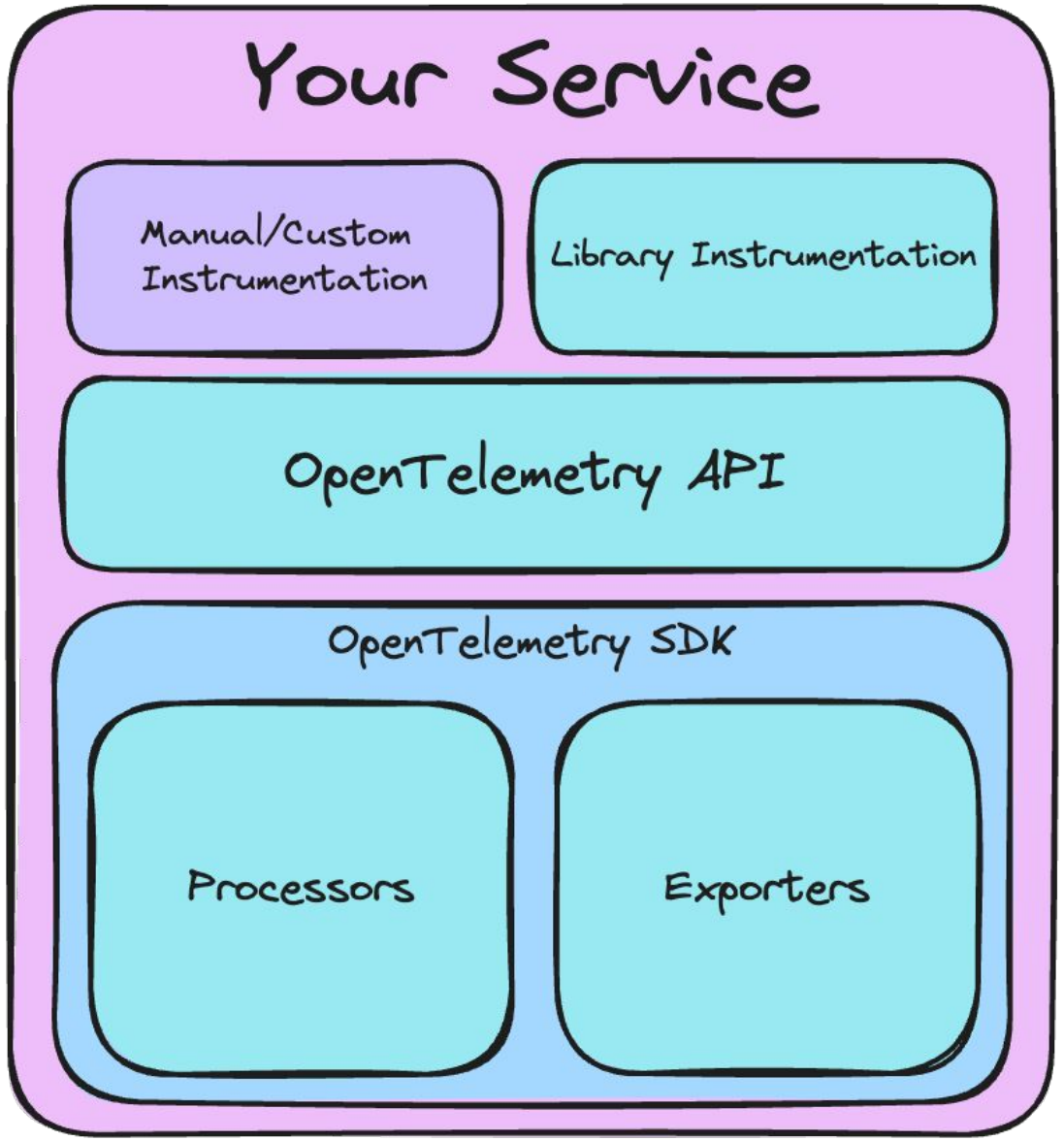
- ➔ The OpenTelemetry Collector
- ➔ Receivers, processors, & exporters
- ➔ Host metrics & logs
- ➔ Automatic instrumentation

Somewhere else…

Storage, querying, analysis, alerting
e.g. Prometheus, Grafana, Jaeger, OpenSearch, ClickHouse, DataDog…

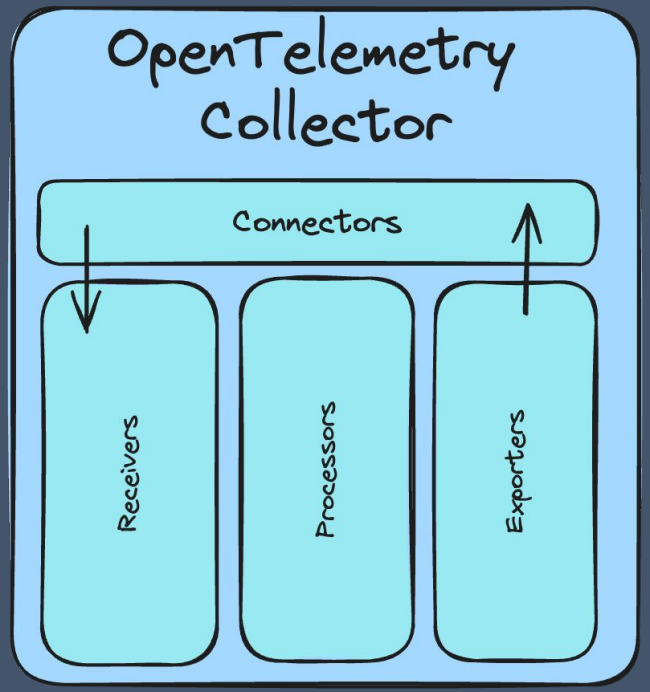
In your code

- Explicit API Calls / Manual Instrumentation
- Instrumentation Libraries
- OpenTelemetry API
- OpenTelemetry SDK



The OpenTelemetry Collector

The OpenTelemetry Collector



The OpenTelemetry Collector

Gather and forward telemetry

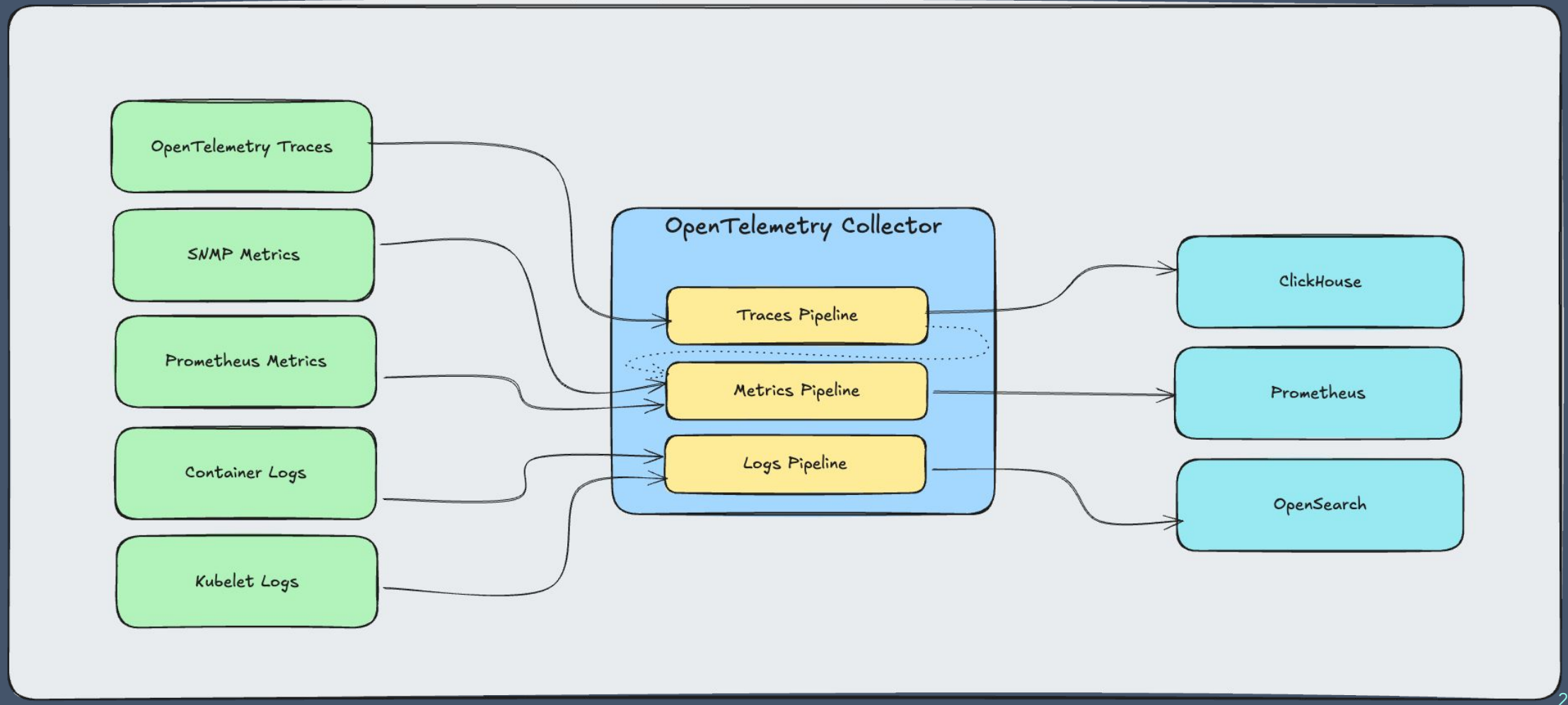
Apply filtering, sampling, and batching rules

Translate between any compatible sources and destinations

Gather node- and cluster-level telemetry

Deep dive article

Your O11y Multi Tool



Using OpenTelemetry

1

Instrument your application using the OTel API, SDK, and instrumentation libraries for your language.

2

Add additional manual instrumentation and context.

3

Collect and process the exported data with the OpenTelemetry Collector.

4

Forward the data to your backend(s) of choice for storage and analysis.

1. Instrument your application using the OTel API, SDK, and instrumentation libraries for your language.

```
const opentelemetry = require('@opentelemetry/sdk-node');
const {getNodeAutoInstrumentations} =
   require('@opentelemetry/auto-instrumentations-node');
const {OTLPTraceExporter} = require('@opentelemetry/exporter-trace-otlp-grpc');
const {OTLPMetricExporter} = require('@opentelemetry/exporter-metrics-otlp-grpc');
const {PeriodicExportingMetricReader} = require('@opentelemetry/sdk-metrics');
```

2. Add additional manual instrumentation and context

```
1 const span = trace.getSpan(context.active()) as Span;
2 span.setAttribute("ProductId", productId);
```

3.1 - Deploy a Collector

```yaml
receivers:
  otlp:
    protocols:
      grpc:
      http:
processors:
  batch:
exporters:
  otlp:
    endpoint: otelcol:4317
```

```yaml
service:
  pipelines:
    traces:
      receivers: [otlp]
      processors: [batch]
      exporters: [otlp]
...
```

3.2 (Optional) -
Gather and process additional telemetry with the Collector

```
receivers:
    prometheus:
      config:
        scrape_configs:
          - job_name: k8s
            kubernetes_sd_configs:
            - role: pod
            metric_relabel_configs:
            - source_labels: [__name__]
              regex: "(request_duration_seconds.*|response_duration_seconds.*)"
              action: keep
```

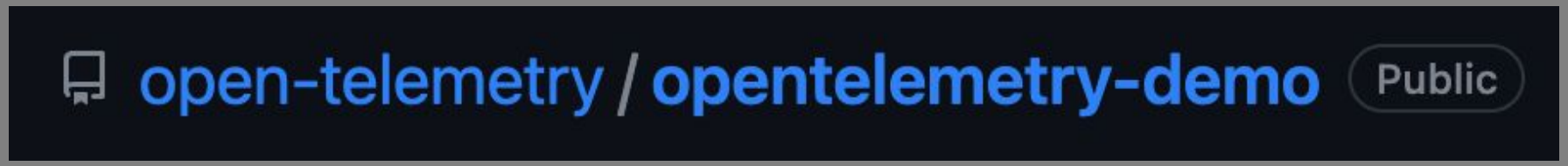
4. Export the telemetry to your backend(s) of choice

```
exporters:
  clickhouse:
    endpoint: tcp://127.0.0.1:9000?dial_timeout=10s
    database: otel
    async_insert: true
```

EVERYTHING IS AWESOME!

Pitfalls & Warnings

- Many libraries and tools to stitch together
- Specifications are semi-stable
- SDKs are idiomatic to the source language
- Duplicate data can confuse tools
- Preference for high-cardinality, low-granularity time-series metrics
- ~~Lack of examples~~

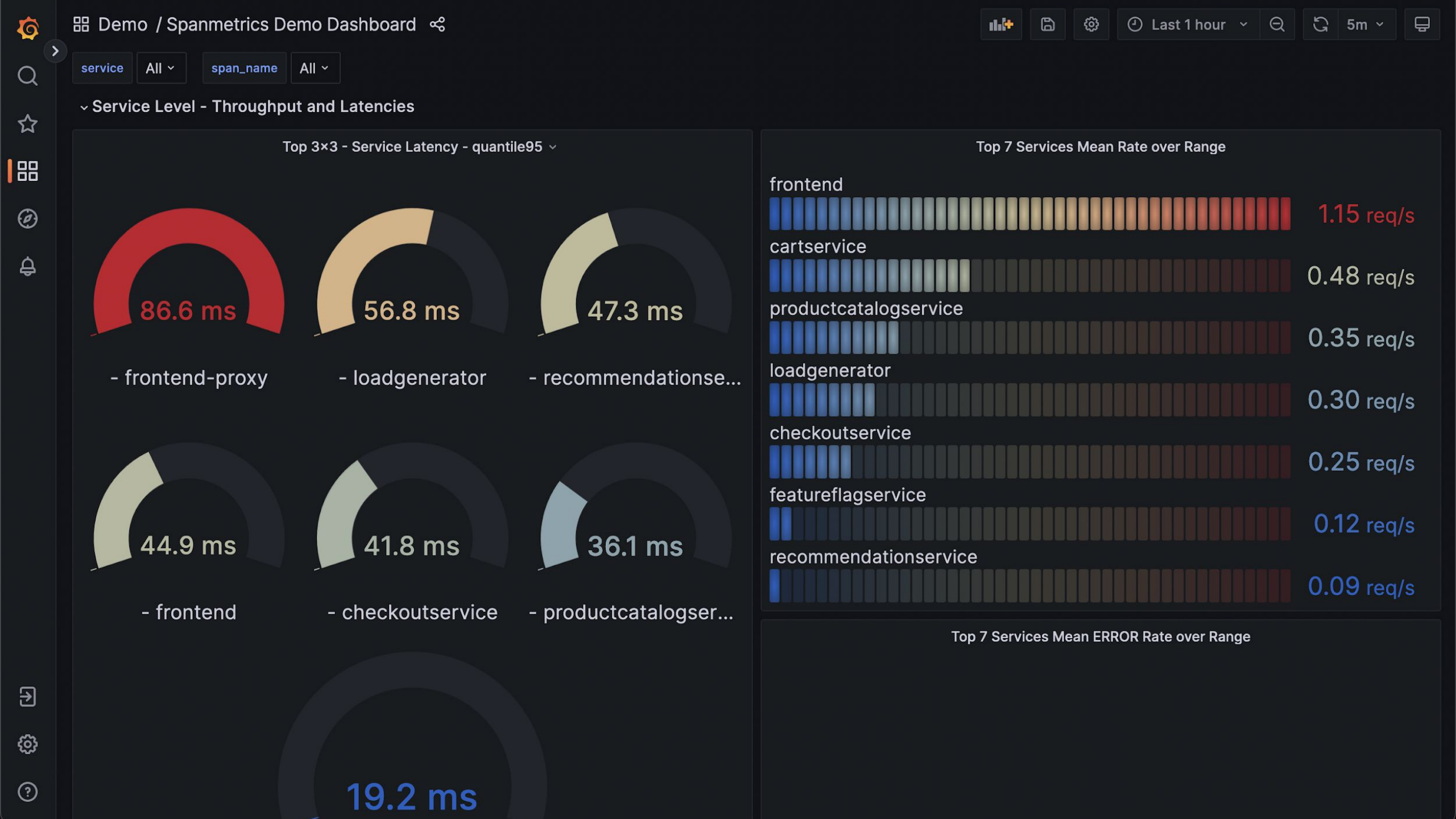

open-telemetry / opentelemetry-demo
Public

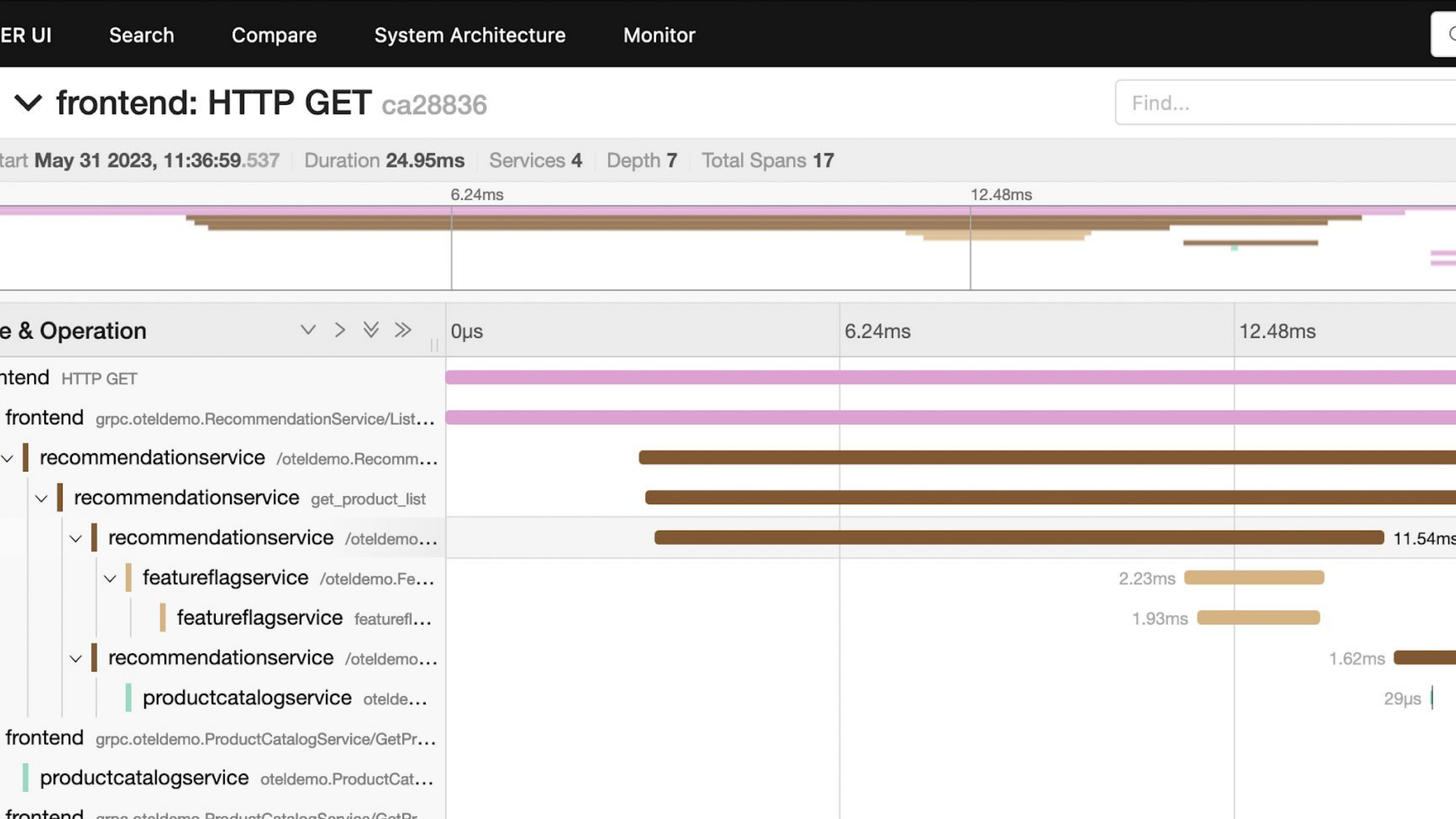
OpenTelemetry demo

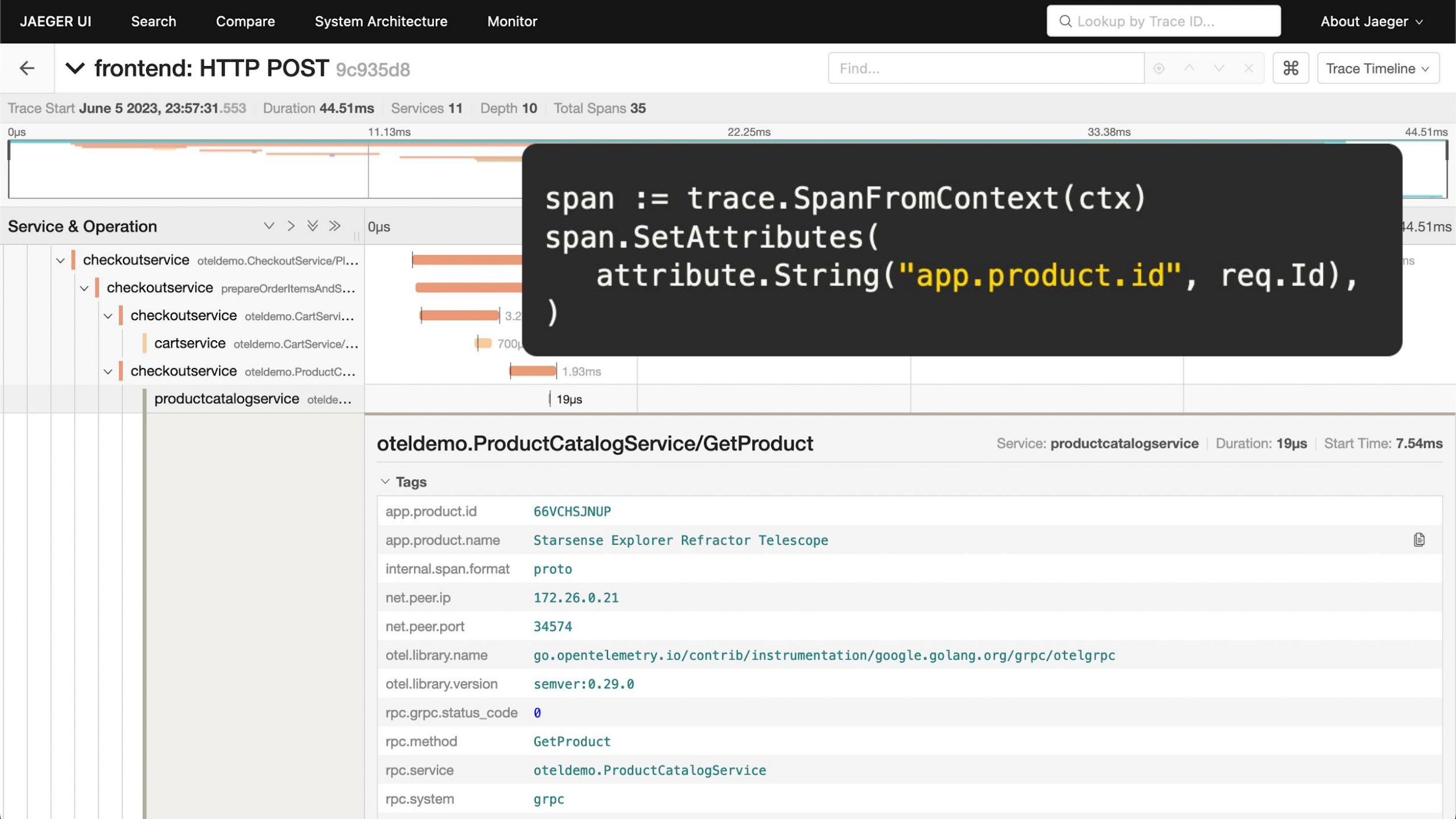
$ USD

The best telescopes to see the world closer

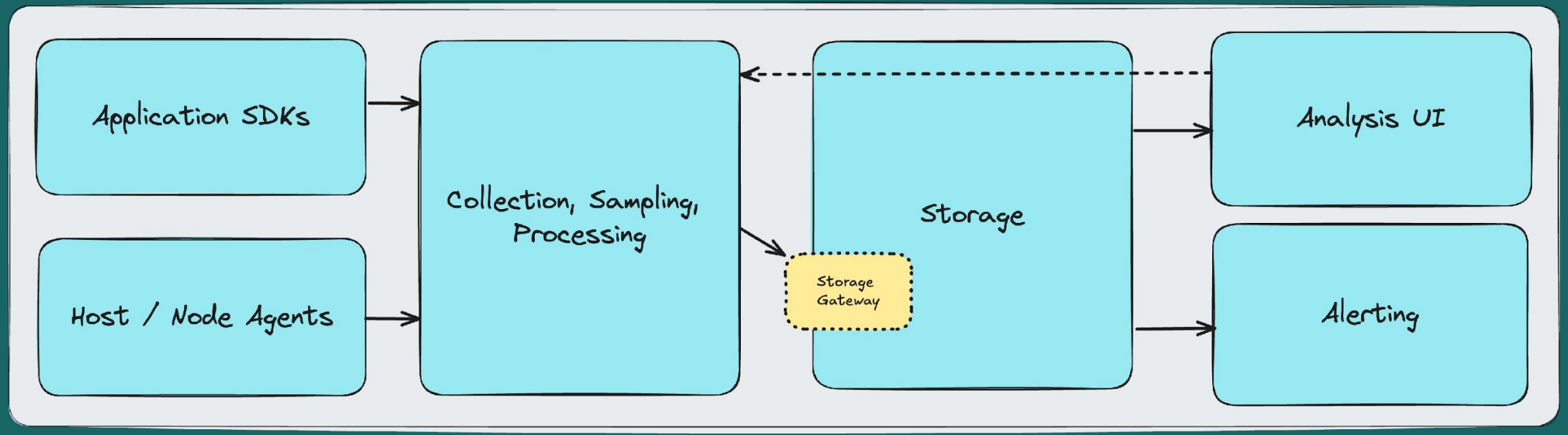
Go Shopping


Demo / Spanmetrics Demo Dashboard
Last 1 hour
5m
service
All
span_name
All
Service Level - Throughput and Latencies
Top 3×3 - Service Latency - quantile95
86.6 ms
- frontend-proxy
56.8 ms
- loadgenerator
47.3 ms
- recommendationse...
44.9 ms
- frontend
41.8 ms
- checkoutservice
36.1 ms
- productcatalogser...
19.2 ms
Top 7 Services Mean Rate over Range
frontend
1.15 req/s
cartservice
0.48 req/s
productcatalogservice
0.35 req/s
loadgenerator
0.30 req/s
checkoutservice
0.25 req/s
featureflagservice
0.12 req/s
recommendationservice
0.09 req/s
Top 7 Services Mean ERROR Rate over Range


ER UI
Search
Compare
System Architecture
Monitor
frontend: HTTP GET ca28836
Find...
tart May 31 2023, 11:36:59.537
Duration 24.95ms
Services 4
Depth 7
Total Spans 17
6.24ms
12.48ms
e & Operation
0µs
6.24ms
12.48ms
ntend HTTP GET
frontend grpc.oteldemo.RecommendationService/List...
recommendationservice /oteldemo.Recomm...
recommendationservice get_product_list
recommendationservice /oteldemo...
11.54ms
featureflagservice /oteldemo.Fe...
2.23ms
featureflagservice featurefl...
1.93ms
recommendationservice /oteldemo...
1.62ms
productcatalogservice otelde...
29µs
frontend grpc.oteldemo.ProductCatalogService/GetPr...
productcatalogservice oteldemo.ProductCat...


JAEGER UI
Search
Compare
System Architecture
Monitor
Lookup by Trace ID...
About Jaeger
frontend: HTTP POST 9c935d8
Find...
Trace Timeline
Trace Start June 5 2023, 23:57:31.553 | Duration 44.51ms | Services 11 | Depth 10 | Total Spans 35
0µs
11.13ms
22.25ms
33.38ms
44.51ms
span := trace.SpanFromContext(ctx)
span.SetAttributes(
attribute.String("app.product.id", req.Id),
)
Service & Operation
checkoutservice oteldemo.CheckoutService/Pl...
checkoutservice prepareOrderItemsAndS...
checkoutservice oteldemo.CartServi...
cartservice oteldemo.CartService/...
checkoutservice oteldemo.ProductC...
productcatalogservice oteldemo...
1.93ms
19µs
oteldemo.ProductCatalogService/GetProduct
Service: productcatalogservice | Duration: 19µs | Start Time: 7.54ms
Tags
app.product.id 66VCHSJNUP
app.product.name Starsense Explorer Refractor Telescope
internal.span.format proto
net.peer.ip 172.26.0.21
net.peer.port 34574
otel.library.name go.opentelemetry.io/contrib/instrumentation/google.golang.org/grpc/otelgrpc
otel.library.version semver:0.29.0
rpc.grpc.status_code 0
rpc.method GetProduct
rpc.service oteldemo.ProductCatalogService
rpc.system grpc

A complete observability solution



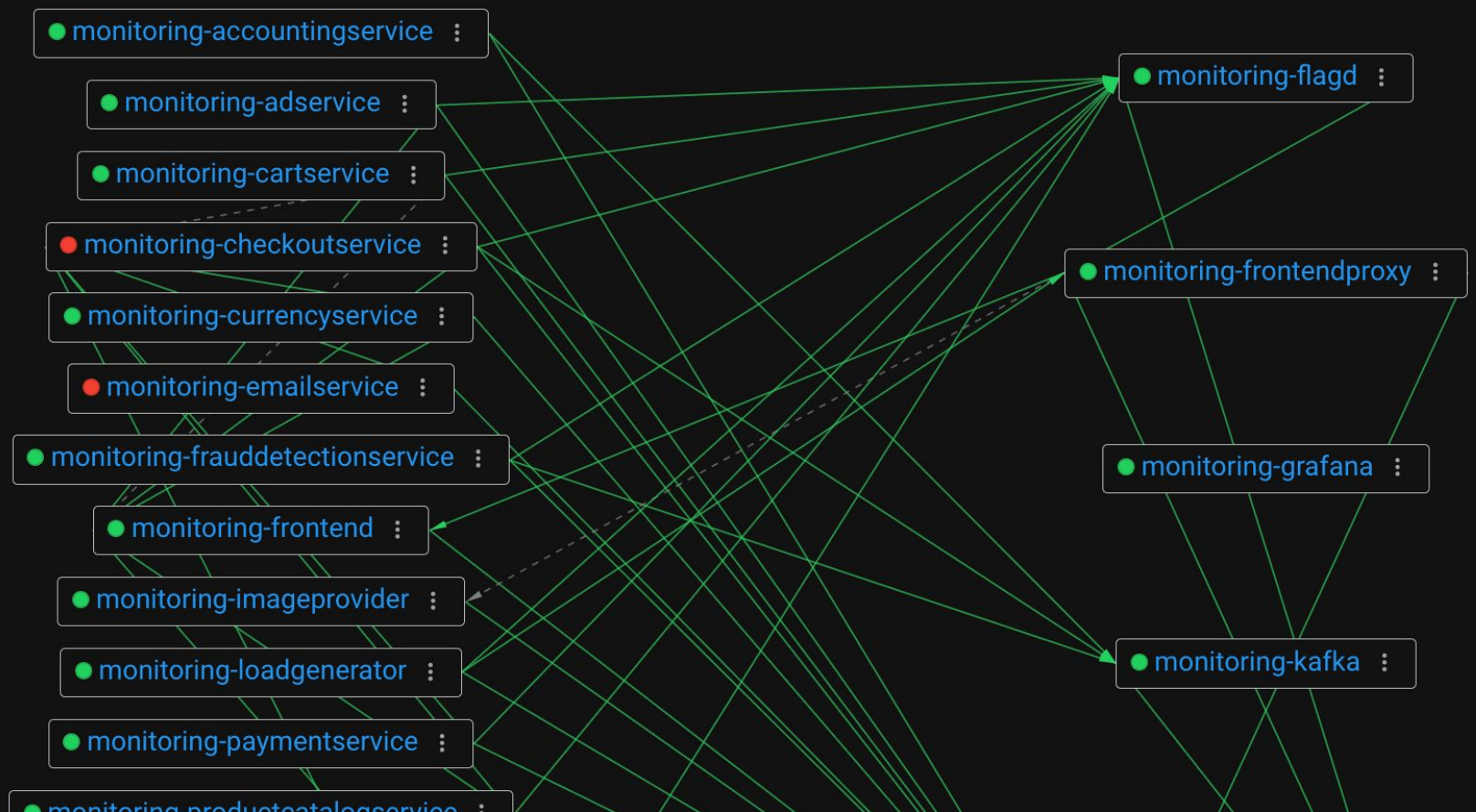
Coroot 1.5.0 is available 🎉 Changelog (how to upgrade)

coroot :~# | default | search for apps and nodes | last hour

Overview

HEALTH | SERVICE MAP | TRACES | NODES | DEPLOYMENTS | COSTS

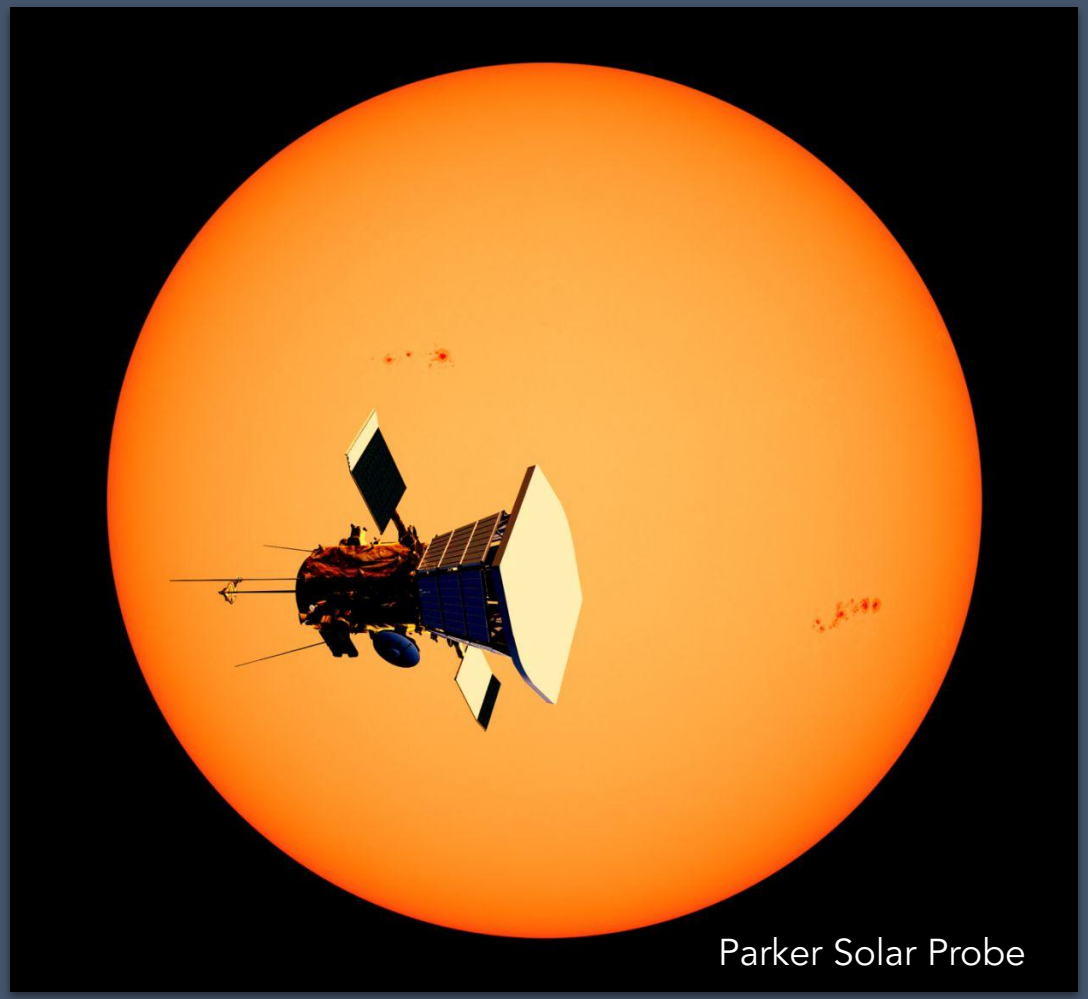
search | namespaces: monitoring | application | control-plane | monitoring | +



eBPF

Provides external observability into any syscalls made by a target process.

Allows network request mapping.




Why Open Source Observability?
THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
EUROPE

Why Open Source Observability?

Vendor-neutral instrumentation

Portable telemetry formats

Interoperable toolchains

Learning & growing together

Connect with me:

- 🦋 @joshleecreates.bsky.social
- 🐘 @joshleecreates@hachyderm.io
- 🧳 linkedin.com/in/joshuamlee
- 💬 altinity.com/slack

Resources & Slides