A practical introduction to Open Telemetry

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Me, myself and I

- Developer
- Developer advocate

In the good old days…

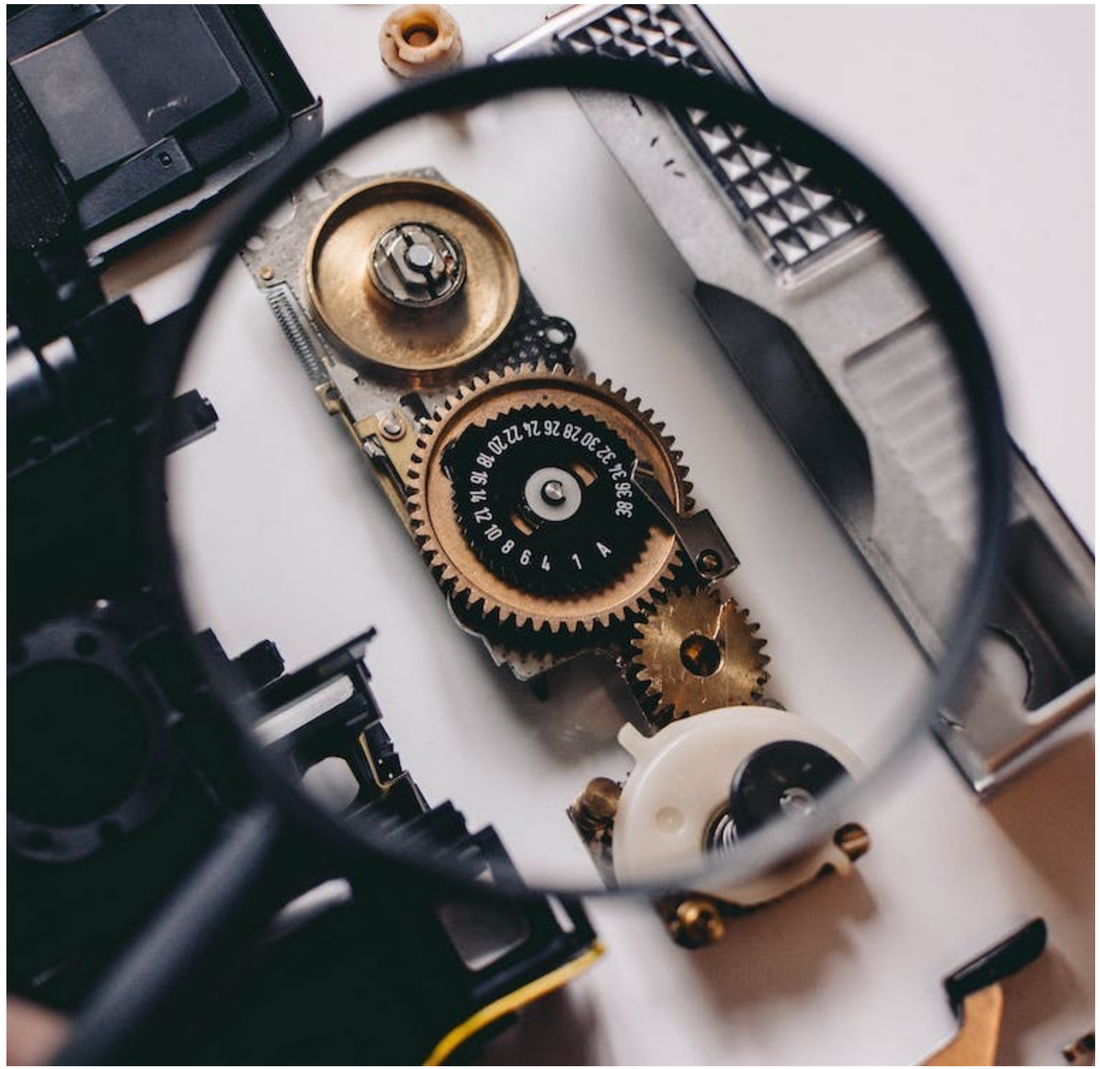
- Monitoring
- Lots of people looking at screens
- Alerting

Then systems became more distributed

Observability

“In *distributed systems*, observability is the ability to collect data about program execution, internal states of modules, and communication between components. To improve observability, software engineers use a wide range of *logging* and *tracing* techniques and tools.”

-- https://en.wikipedia.org/wiki/Event_monitoring

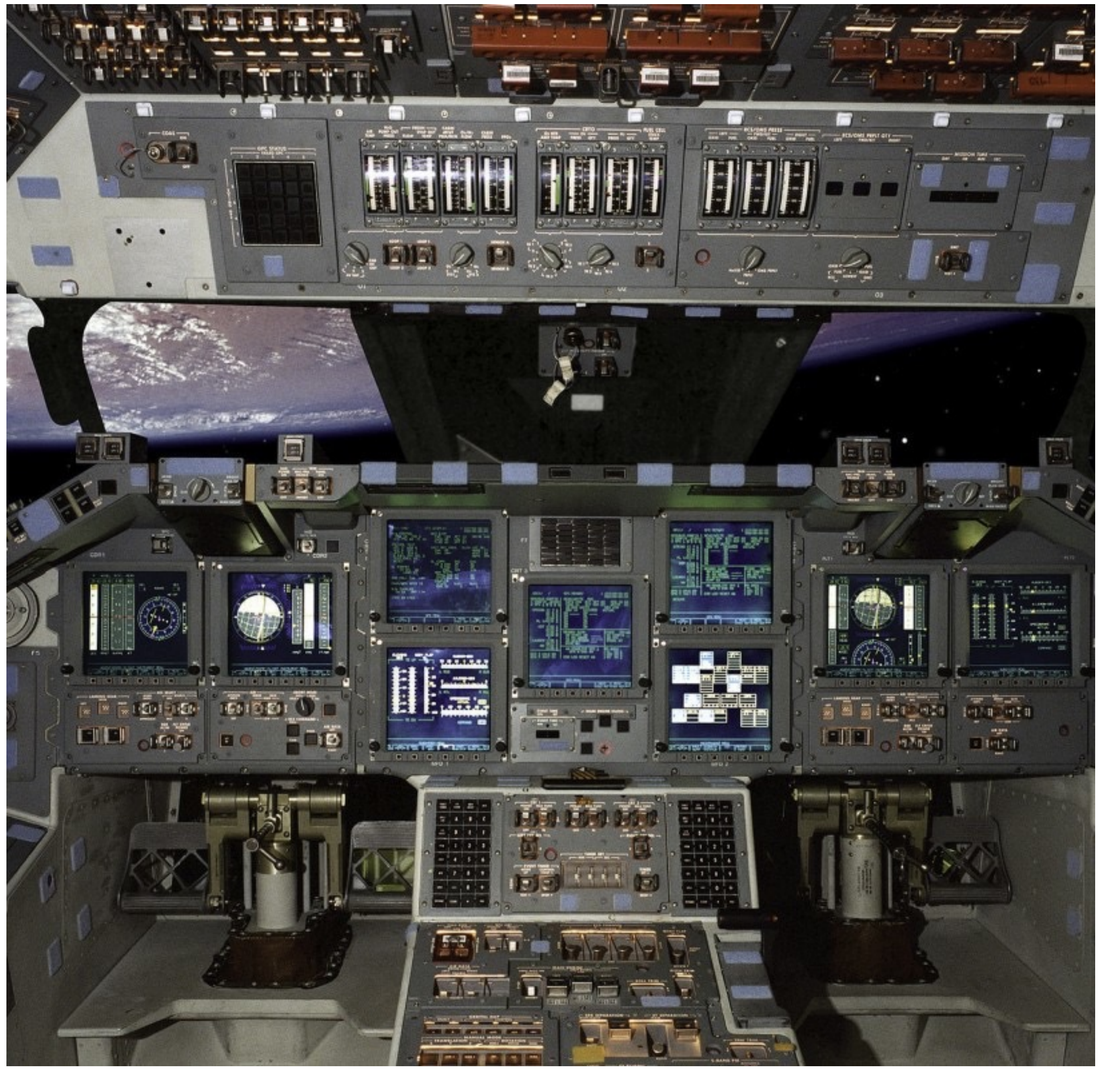


The 3 pillars of Observability

1. Metrics
2. Logging
3. Tracing

Metrics

- System metrics
  - CPU, memory, etc.
- Higher-level metrics
  - Requests per second, HTTP status code, etc.

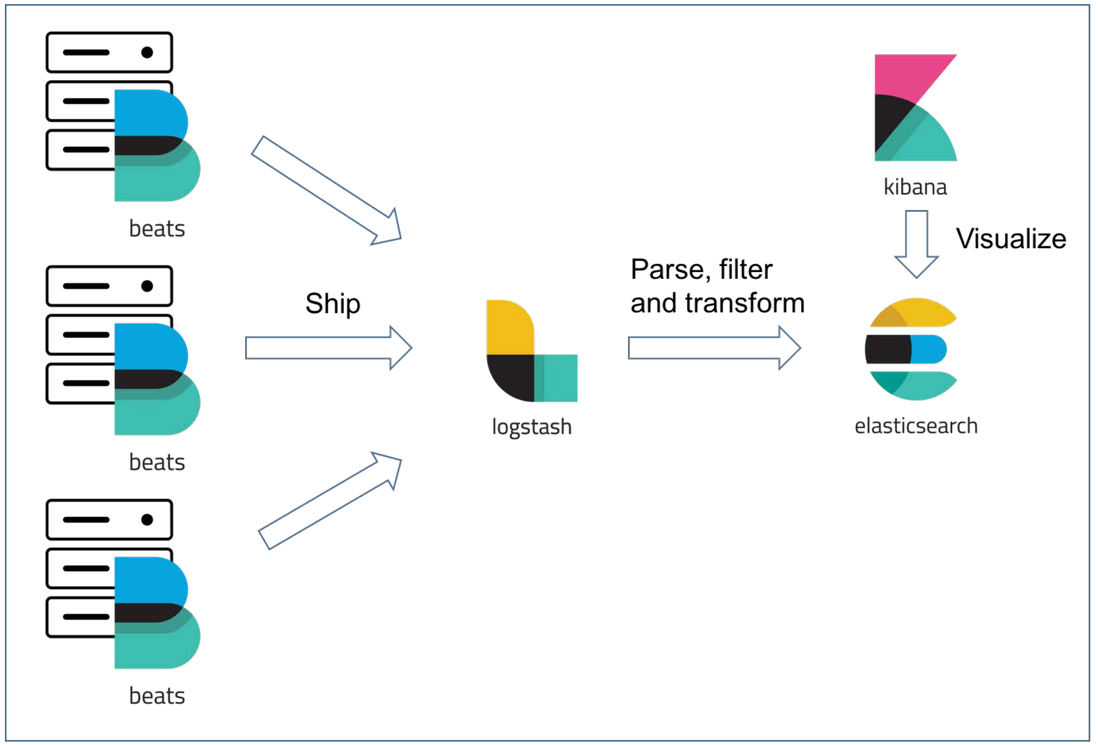


Logging

- What to log
  - Auto vs. manual
  - Sensitive data
- Logging format
  - Human readable vs. JSON
- Where to log
  - Console vs. log files
- Logs aggregation FTW

Centralized logging systems

- Get the log
  - Scrape vs. Send
- Parse the log
  - Structured vs. unstructured
- Store the log
- Search the log
- Display the log



Some centralized logging systems

Tracing

“In software engineering, tracing involves a specialized use of logging to record information about a program's execution. […] Tracing is a cross-cutting concern.”

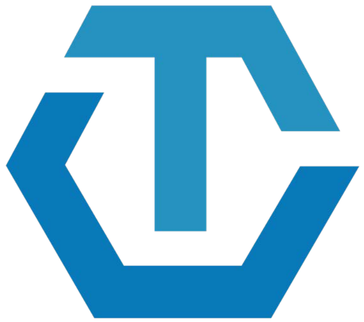
-- https://en.wikipedia.org/wiki/Tracing_(software)

Tracing

"Set of techniques and tools that help follow a business request through multiple components across the network"

-- Me
(inspired by lots of others I don't remember the name of)

Tracing pioneers



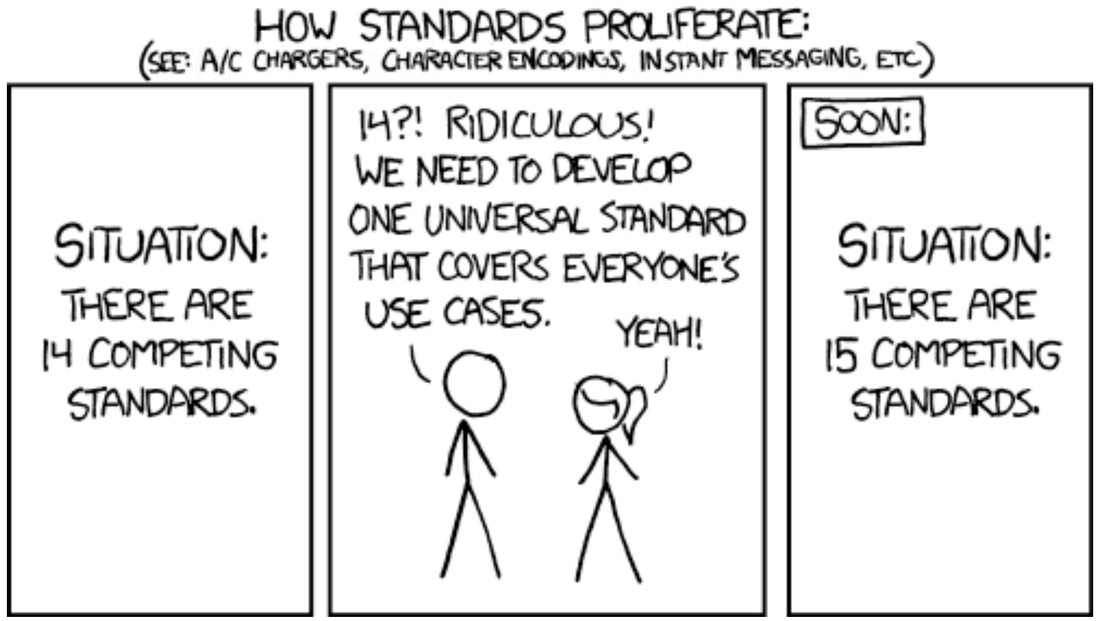
OPENTRACING

JAEGER

The W3C Trace Context specification

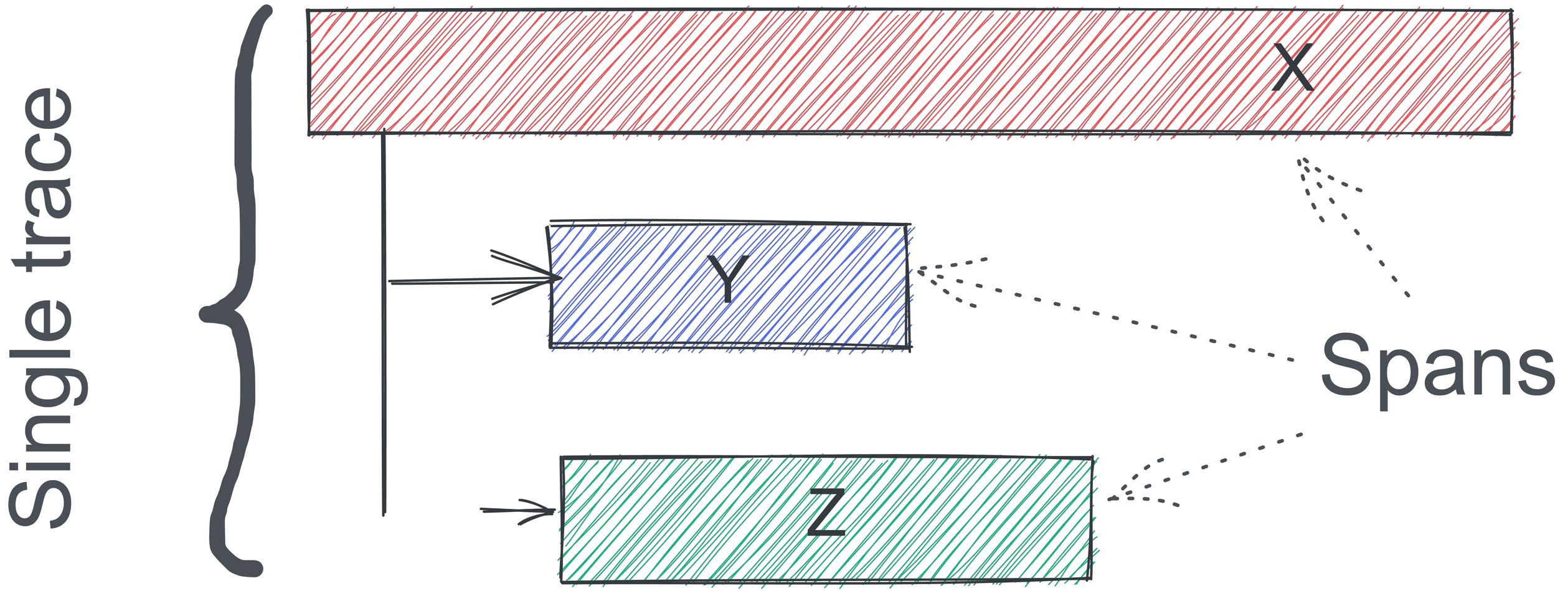
“This specification defines standard HTTP headers and a value format to propagate context information that enables distributed tracing scenarios. The specification standardizes how context information is sent and modified between services. Context information uniquely identifies individual requests in a distributed system and also defines a means to add and propagate provider-specific context information.”

— *https://www.w3.org/TR/trace-context/*



Base concepts

- Trace: follows the path of a request that spans multiple components
- Span: bound to a single component and linked to another span by a child-parent relationship


Single trace
X
Y
Z
Spans

OpenTelemetry

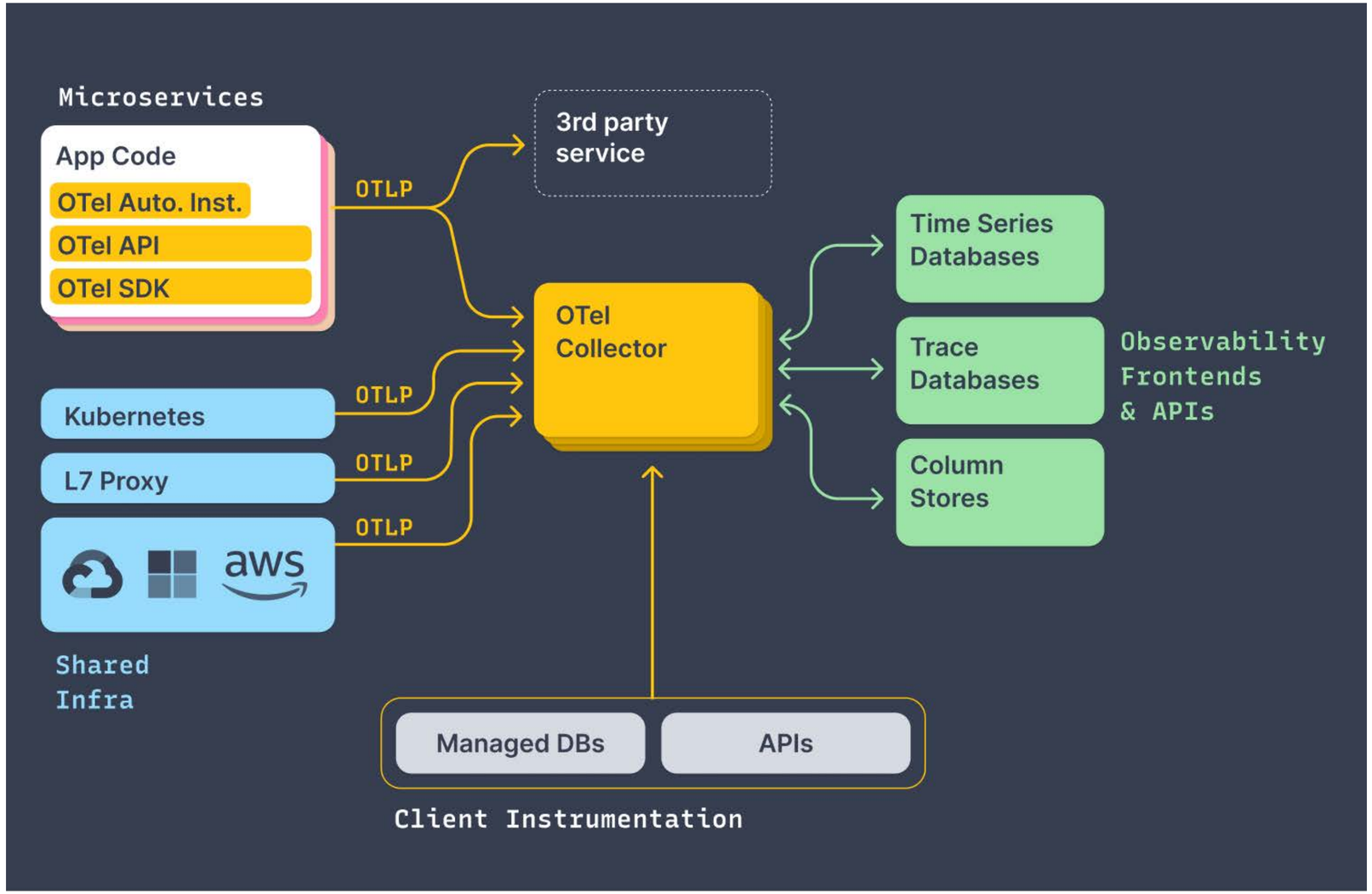
“OpenTelemetry is a collection of tools, APIs, and SDKs. Use it to instrument, generate, collect, and export telemetry data (metrics, logs, and traces) to help you analyze your software’s performance and behavior.”

-- https://opentelemetry.io/

OpenTelemetry

- Implements W3C Trace Context
- Merge of OpenTracing and OpenCensus
- CNCF project
- Apache v2 license
- 1.3k followers on GitHub

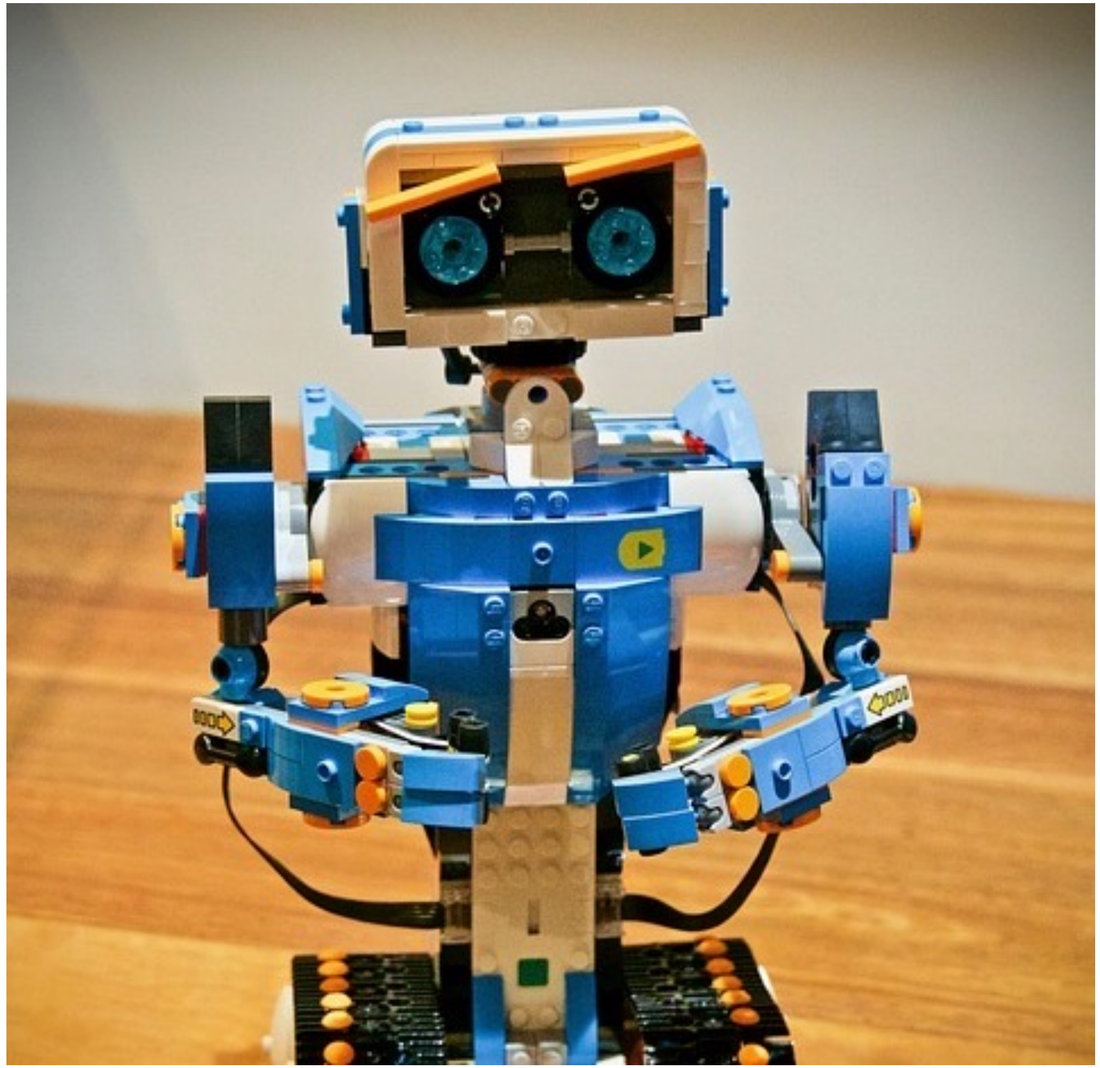
OpenTelemetry architecture



Life after the OTEL collector

- OTEL provides a collector
- Jaeger and Zipkin provide compatible collectors
  - Continue using your existing tracing provider!

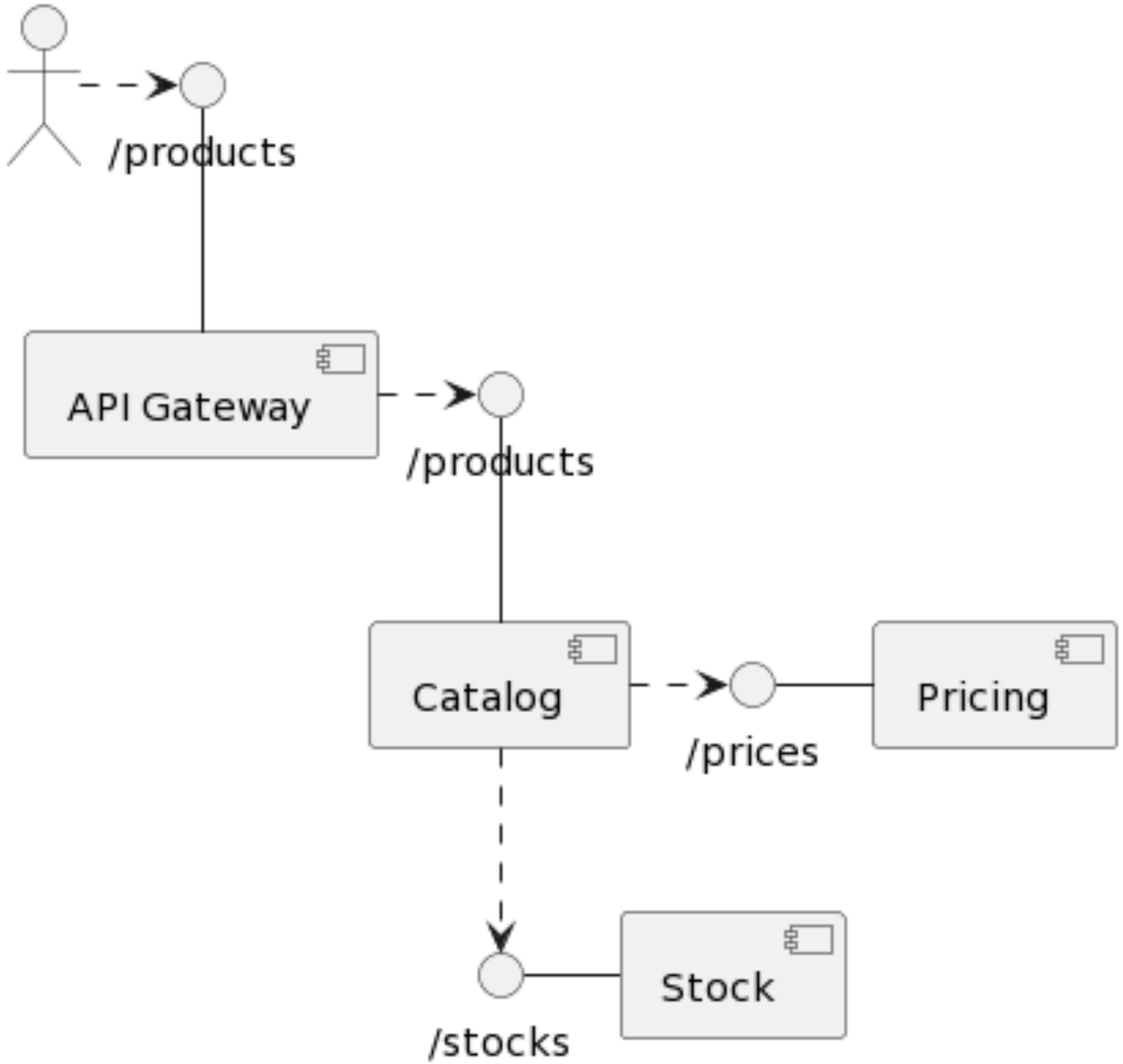
Auto-instrumentation vs. manual instrumentation



- Auto-instrumentation
  - Via the runtime
- Manual instrumentation
  - Library dependency + API

Benefits of auto-instrumentation

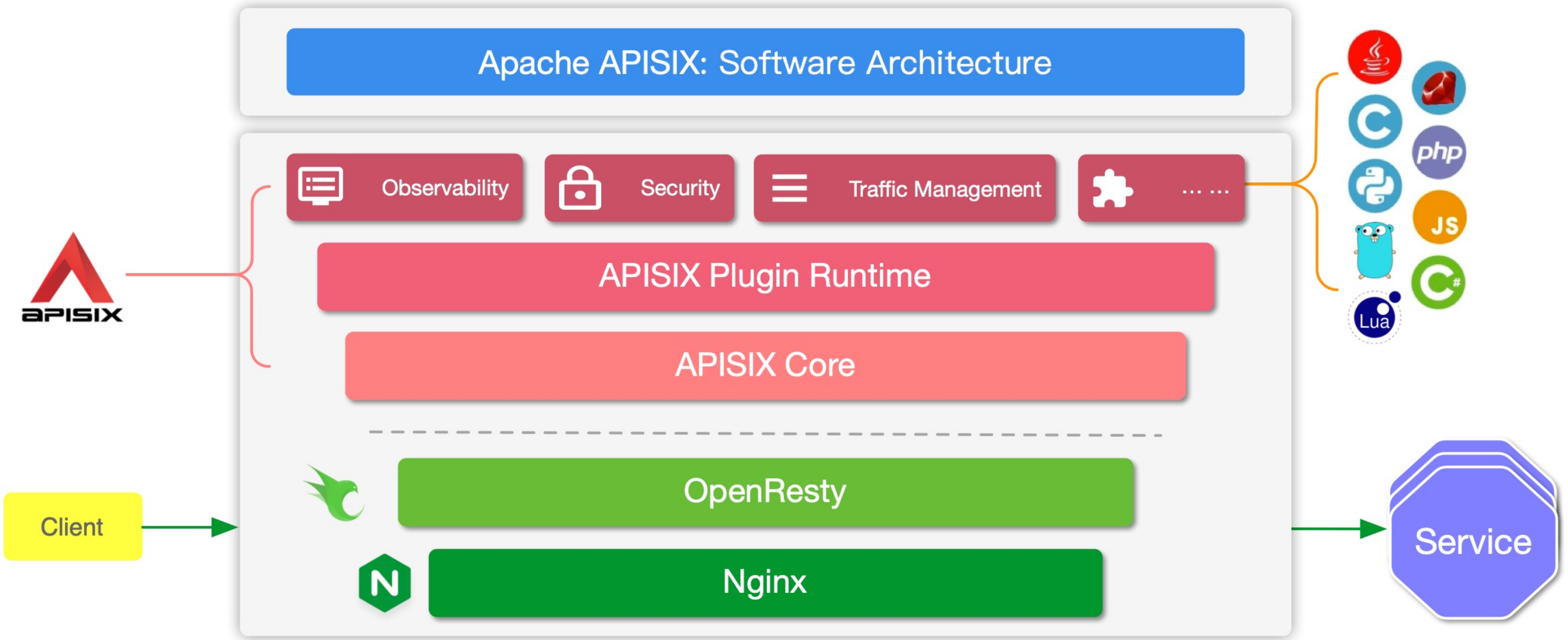
- Low-hanging fruit
- No coupling


/products
API Gateway
/products
Catalog
/prices
Pricing
/stocks
Stock

The entrypoint

- The most important part as it generates the first ID
  - Reverse proxy/API Gateway

Apache APISIX, an API Gateway the Apache way

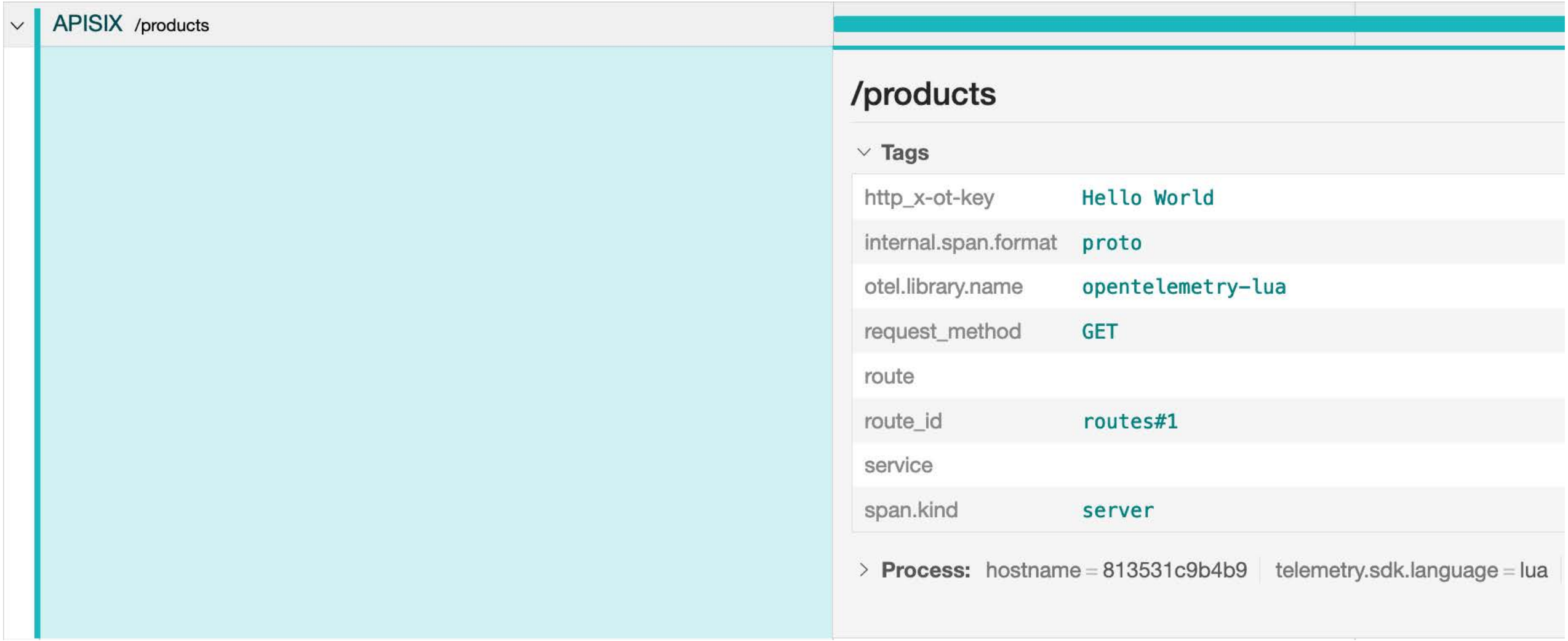


General configuration

```yaml
plugins:
  - opentelemetry
plugin_attr:
  opentelemetry:
    resource:
      service.name: APISIX
    collector:
      address: jaeger:4318
```

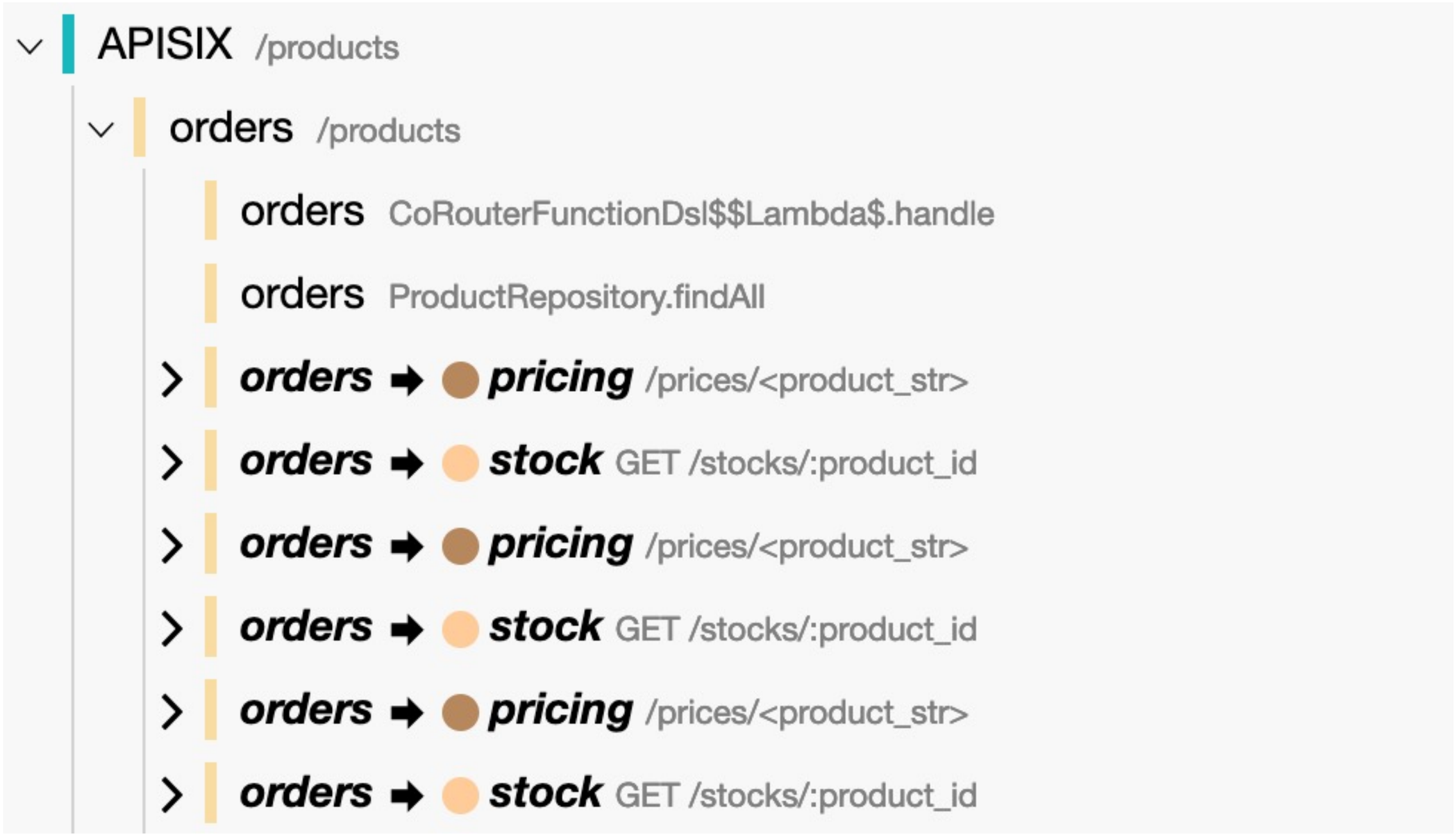
Per-route (or global rule) configuration

```yaml
plugins:
  opentelemetry:
    sampler:
      name: always_on
    additional_attributes:
      - route_id
      - request_method
      - http_x-ot-key
```


APISIX /products
/products
Tags
http_x-ot-key Hello World
internal.span.format proto
otel.library.name opentelemetry-lua
request_method GET
route
route_id routes#1
service
span.kind server
Process: hostname = 813531c9b4b9 telemetry.sdk.language = lua

JVM auto-instrumentation implementation

- Via a Java agent:
  - `-javaagent:otel.jar`
- Regardless of:
  - The language
  - The framework

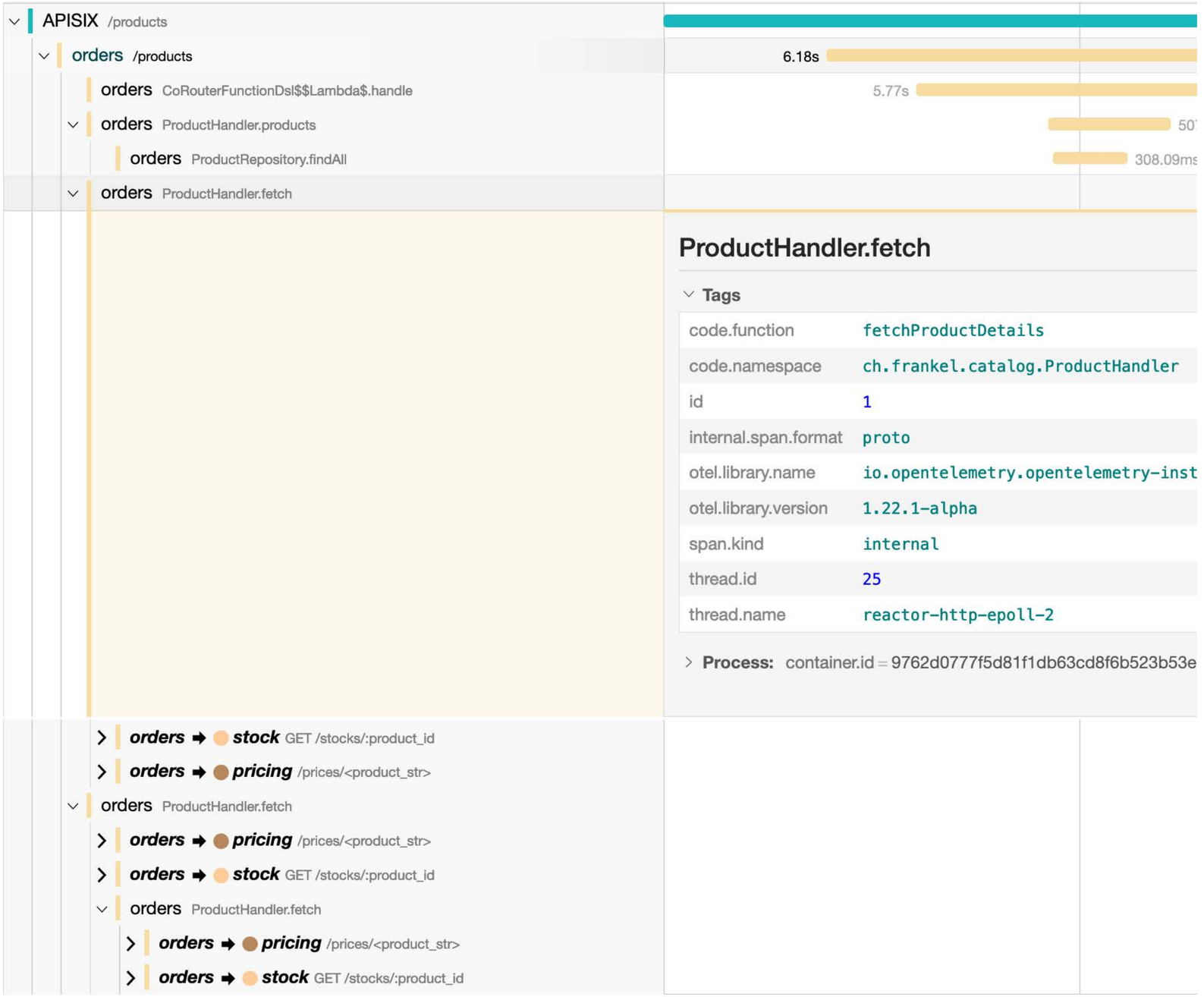

APISIX /products
orders /products
orders CoRouterFunctionDsl$$Lambda$.handle
orders ProductRepository.findAll
orders ➡ pricing /prices/<product_str>
orders ➡ stock GET /stocks/:product_id
orders ➡ pricing /prices/<product_str>
orders ➡ stock GET /stocks/:product_id
orders ➡ pricing /prices/<product_str>
orders ➡ stock GET /stocks/:product_id

JVM explicit instrumentation

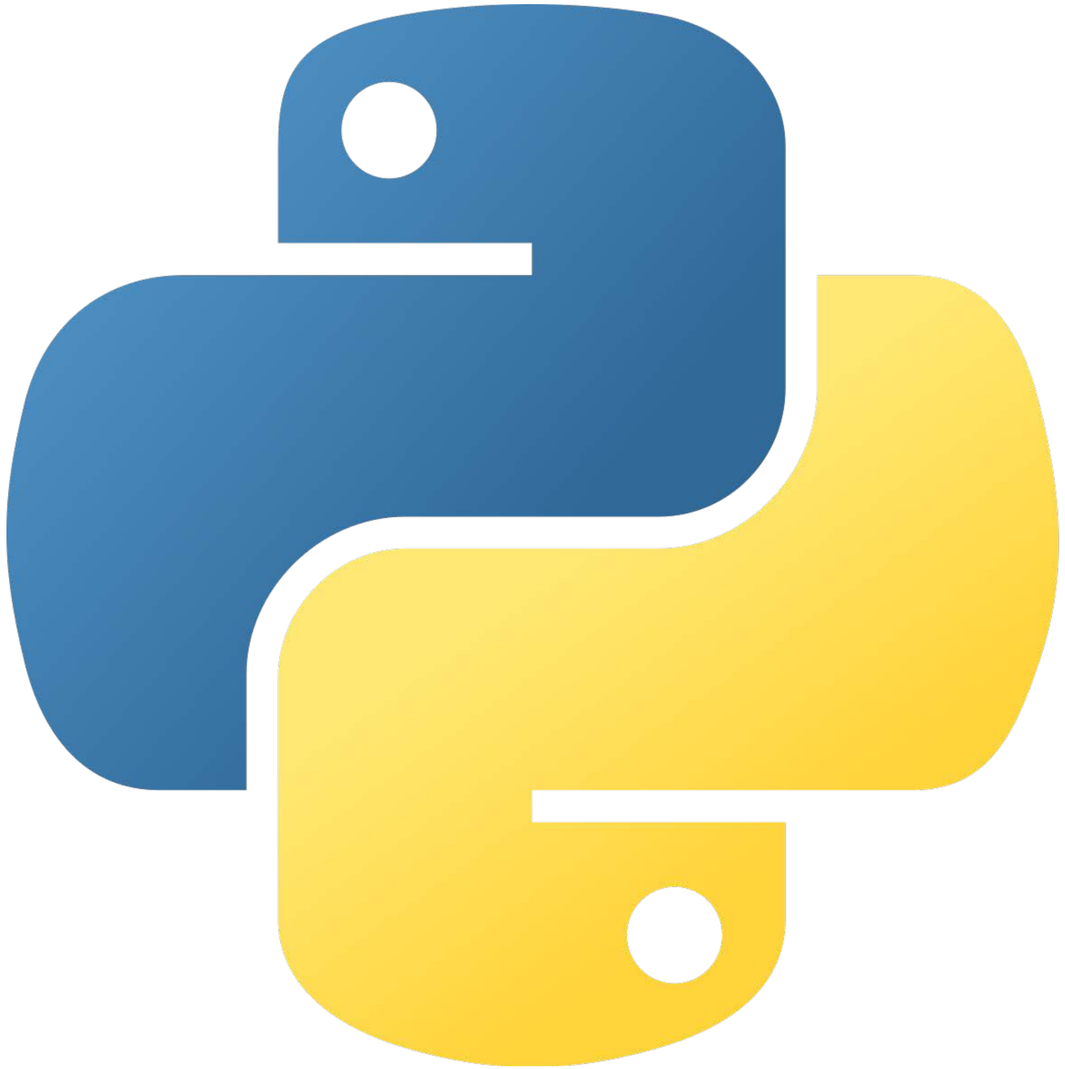
- Requires the OTEL dependency
- Usage:
  - Annotations
  - API call

Annotations


```
@WithSpan("ProductHandler.fetch")
private suspend fun fetchProductDetails(
    @SpanAttribute("id") id: Long,
    product: Product) {
    // ...
}
```

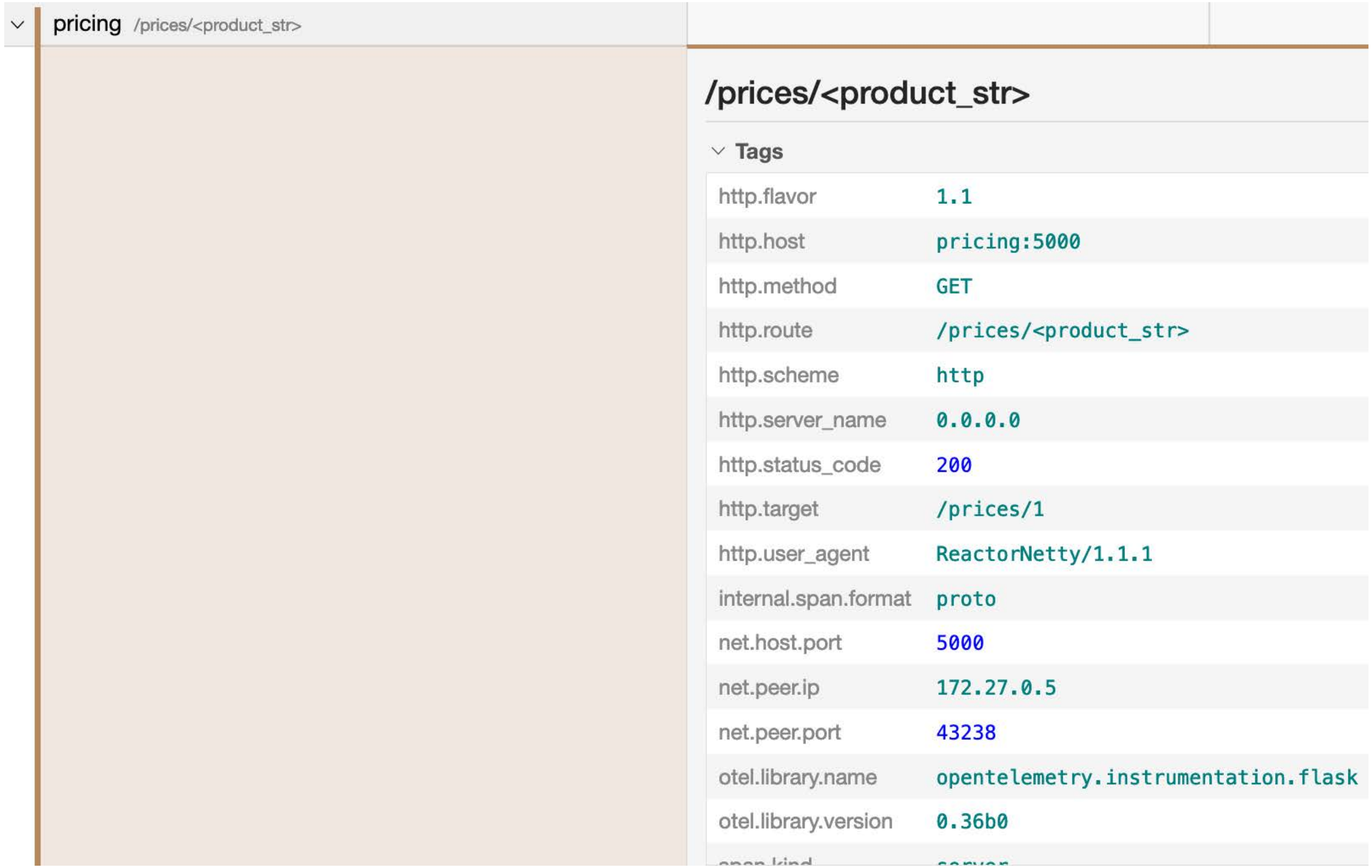

APISIX /products
orders /products
orders CoRouterFunctionDsl$$Lambda$.handle
orders ProductHandler.products
orders ProductRepository.findAll
orders ProductHandler.fetch
6.18s
5.77s
308.09ms
ProductHandler.fetch
Tags
code.function fetchProductDetails
code.namespace ch.frankel.catalog.ProductHandler
id 1
internal.span.format proto
otel.library.name io.opentelemetry.opentelemetry-inst
otel.library.version 1.22.1-alpha
span.kind internal
thread.id 25
thread.name reactor-http-epoll-2
Process: container.id = 9762d0777f5d81f1db63cd8f6b523b53e
orders stock GET /stocks/:product_id
orders pricing /prices/<product_str>
orders ProductHandler.fetch
orders pricing /prices/<product_str>
orders stock GET /stocks/:product_id
orders ProductHandler.fetch
orders pricing /prices/<product_str>
orders stock GET /stocks/:product_id

Python auto-instrumentation



- Add the OTEL dependency
- Run with the instrumentation:

```
>opentelemetry-instrument flask run
```

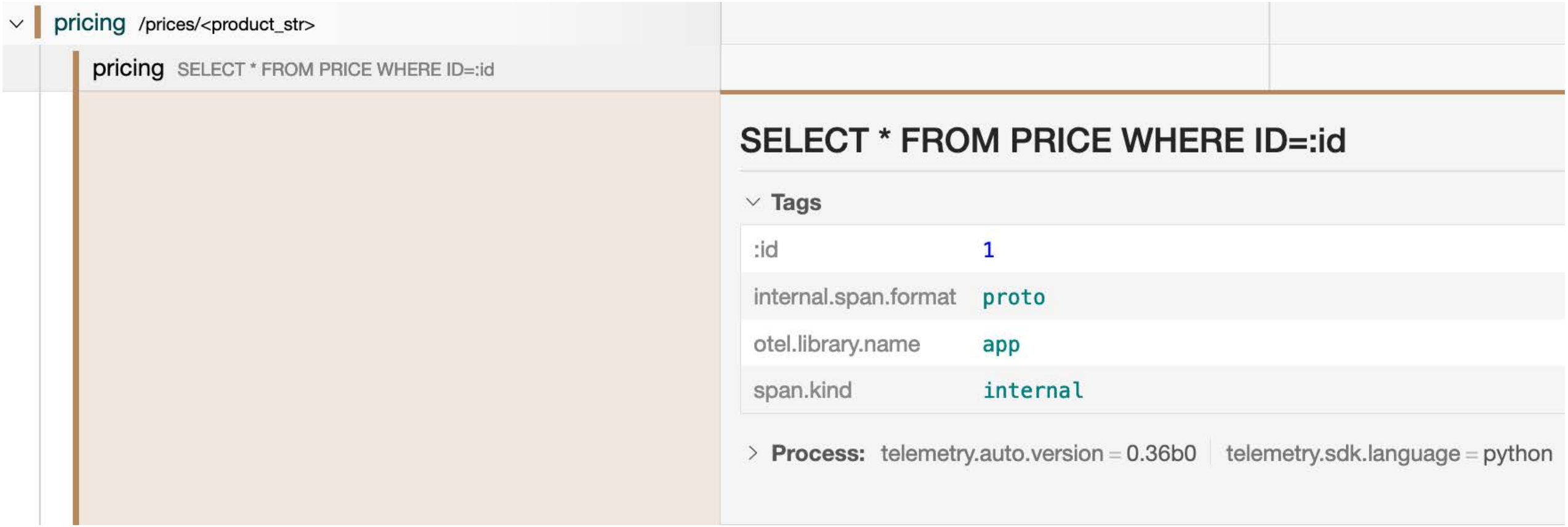


Explicit API

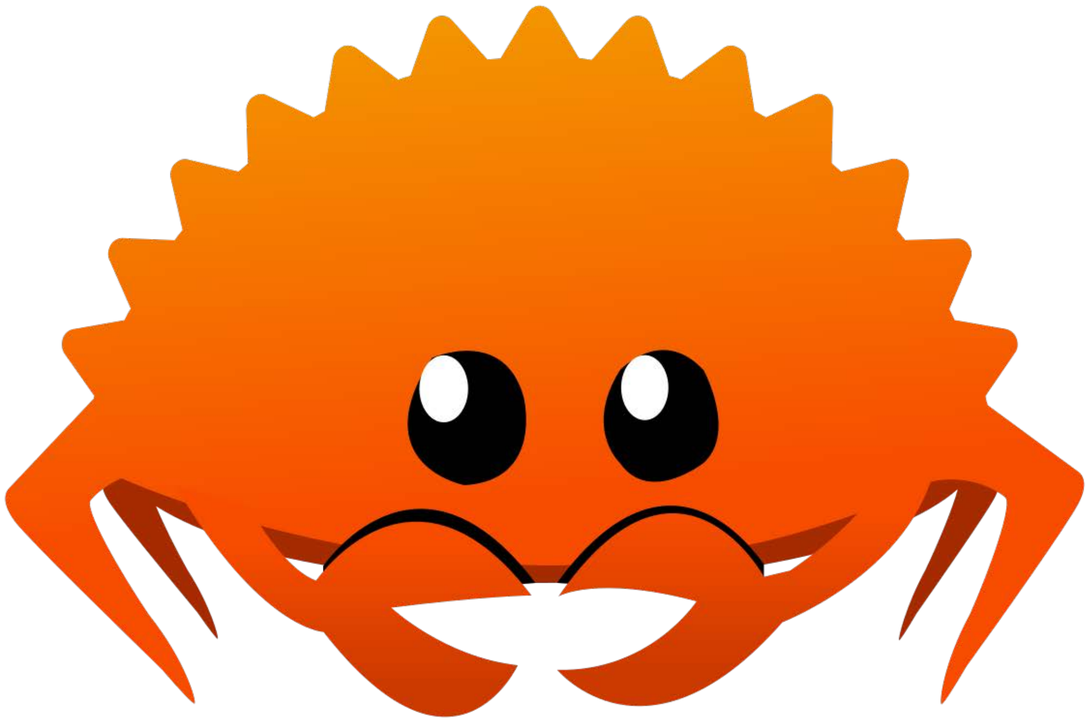

```
from opentelemetry import trace

tracer = trace.get_tracer(__name__)

with tracer.start_as_current_span(
    "SELECT * FROM PRICE WHERE ID=:id",
    attributes={":id": 1}):
    #do under the span
```


pricing /prices/<product_str>
pricing SELECT * FROM PRICE WHERE ID=:id
SELECT * FROM PRICE WHERE ID=:id
Tags
:id 1
internal.span.format proto
otel.library.name app
span.kind internal
Process: telemetry.auto.version = 0.36b0 telemetry.sdk.language = python

Rust



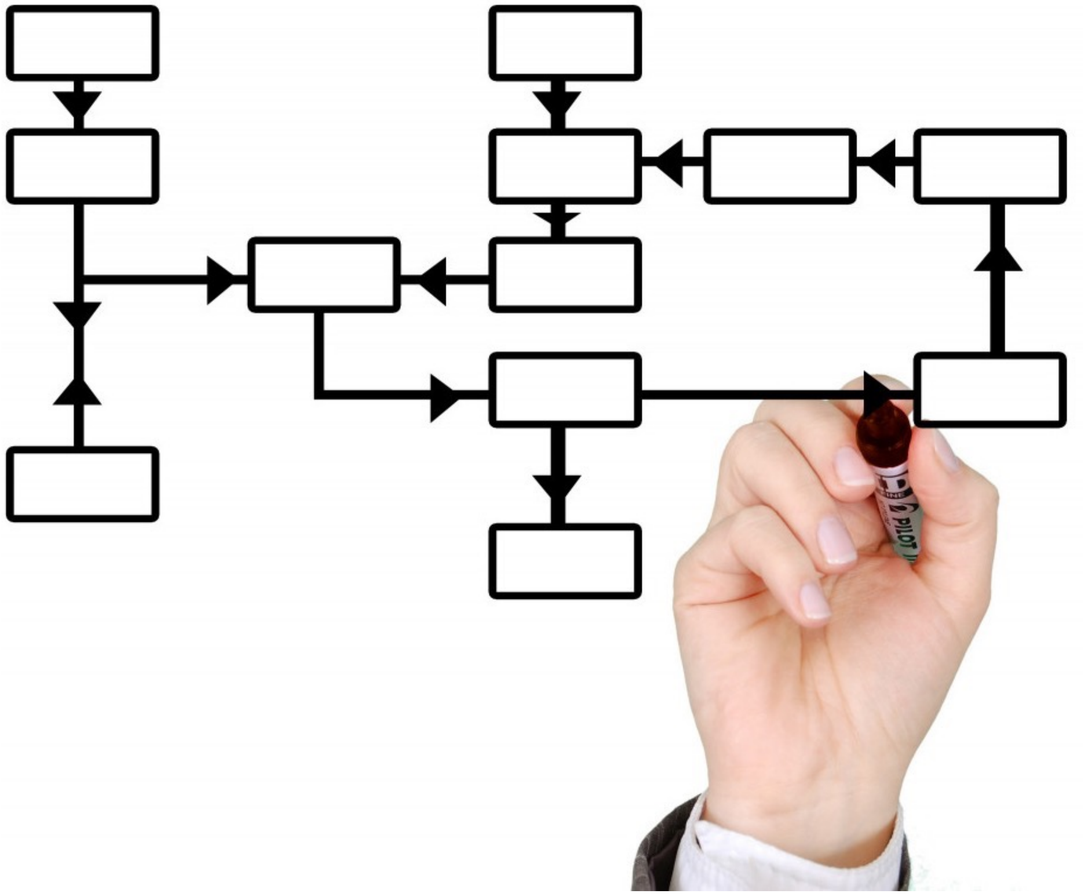
- Rust compiles to native:
  - No runtime
  - Needs explicit calls

Finding the relevant Cargo dependency

- It’s not trivial!

```
axum-tracing-opentelemetry = { version =
"0.7", features = ["otlp"] }
```

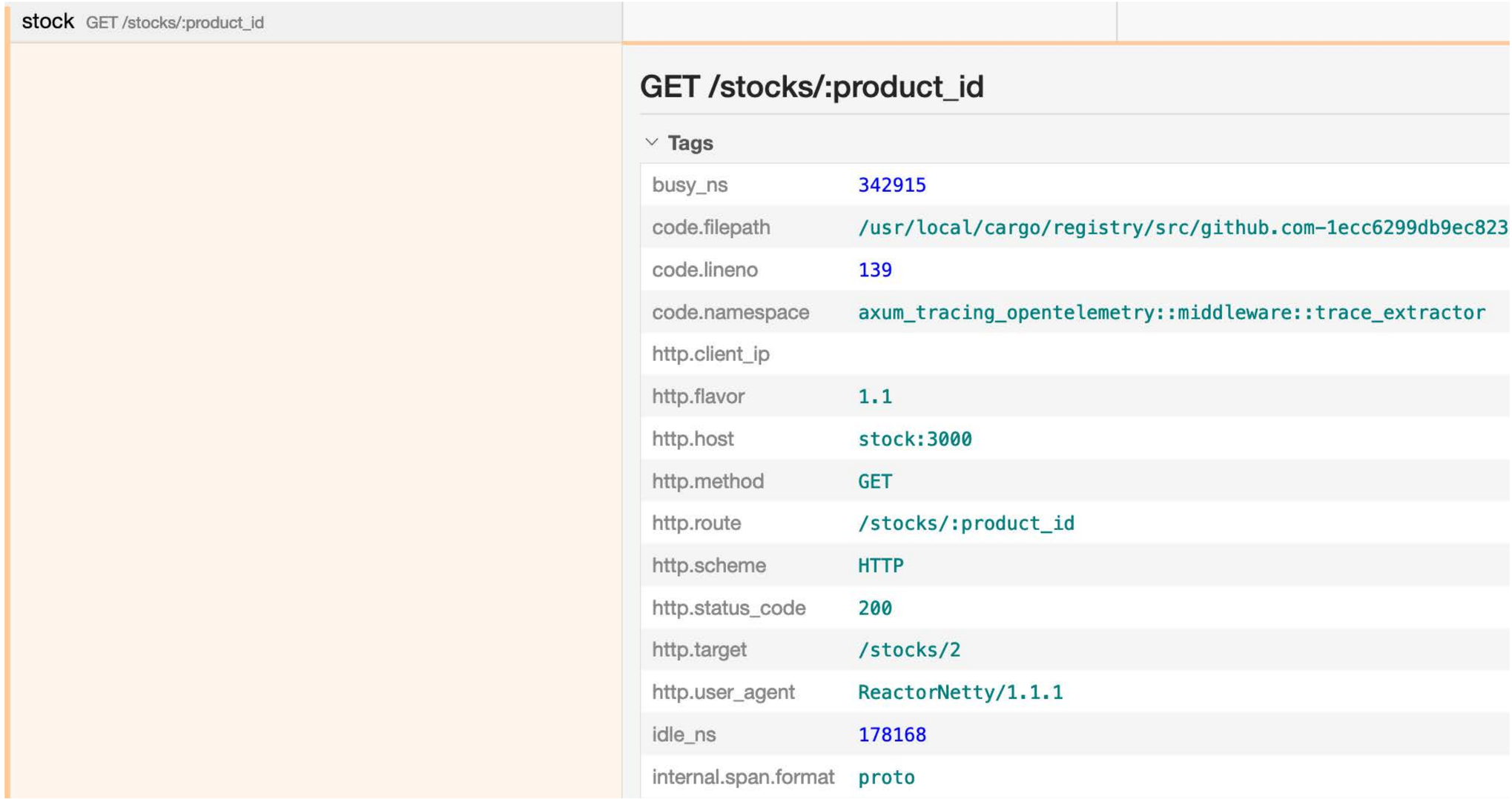
Usage



- Initialize the library
- Configure axum
- Clean stop

Configure axum


```
let app = axum::Router::new()
    .route("/stocks/:id", get(get_by_id))
    .layer(response_with_trace_layer())
    .layer(opentelemetry_tracing_layer());
```


stock GET /stocks/:product_id
GET /stocks/:product_id
Tags
busy_ns 342915
code.filepath /usr/local/cargo/registry/src/github.com-1ecc6299db9ec823
code.lineno 139
code.namespace axum_tracing_opentelemetry::middleware::trace_extractor
http.client_ip
http.flavor 1.1
http.host stock:3000
http.method GET
http.route /stocks/:product_id
http.scheme HTTP
http.status_code 200
http.target /stocks/2
http.user_agent ReactorNetty/1.1.1
idle_ns 178168
internal.span.format proto


Time for DEMO

Thanks for your attention!

- @nicolas_frankel
- @nico@frankel.ch
- https://blog.frankel.ch/end-to-end-tracing-opentelemetry/
- https://bit.ly/otel-demo
- https://apisix.apache.org/