



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



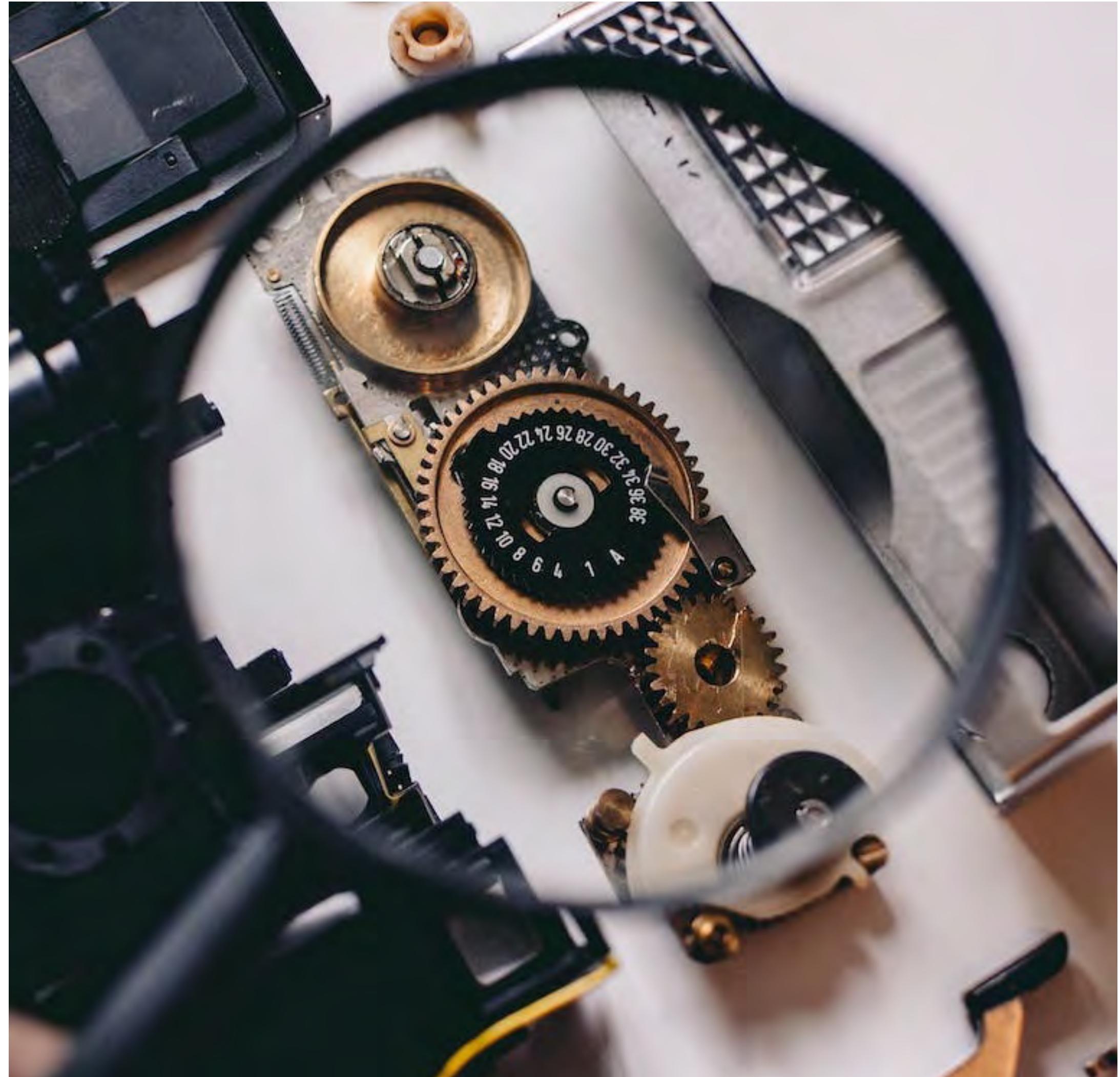
Then systems became more distributed



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

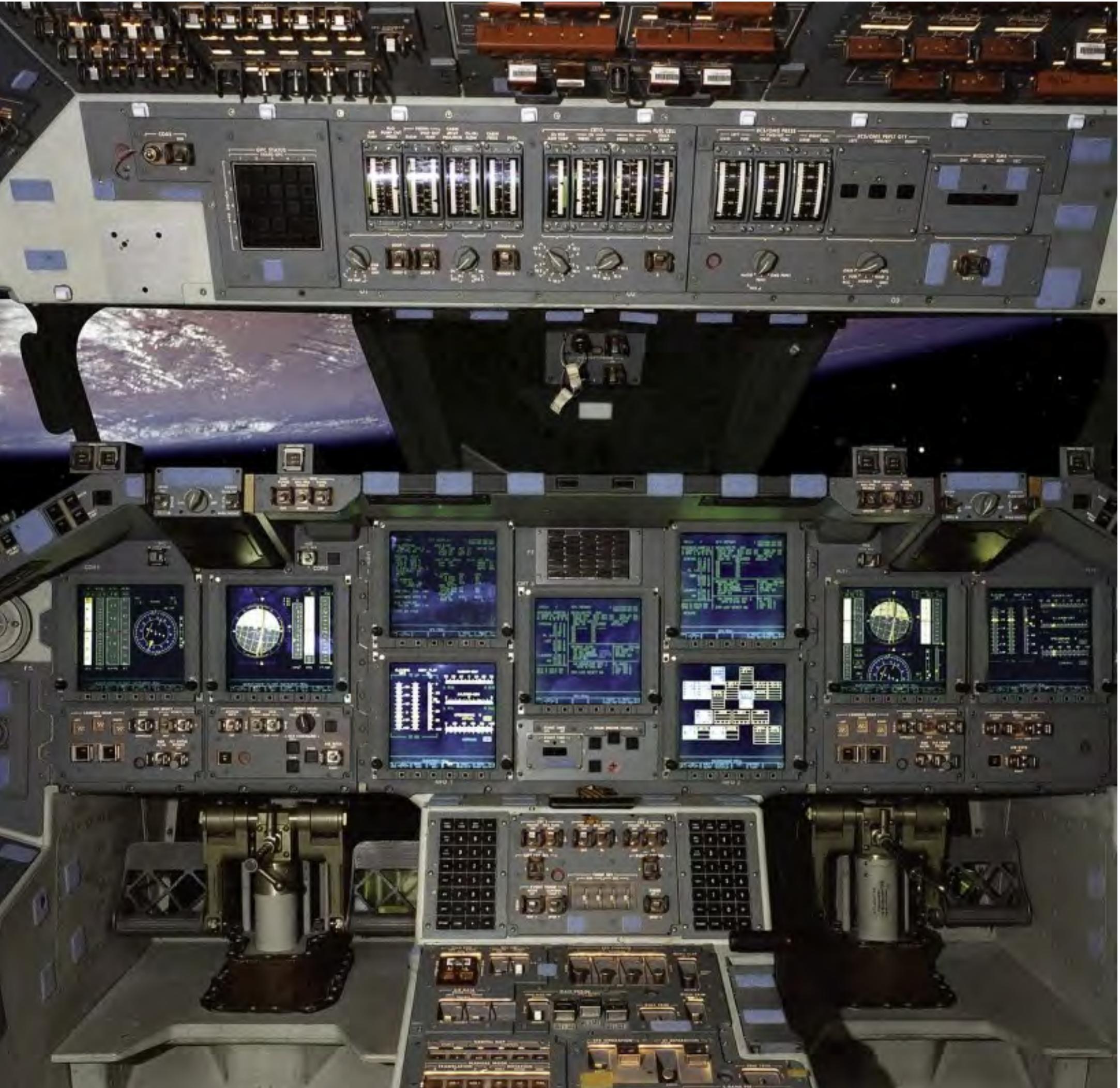
1. Metrics
2. Logging
3. Tracing



Metrics



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



Logging

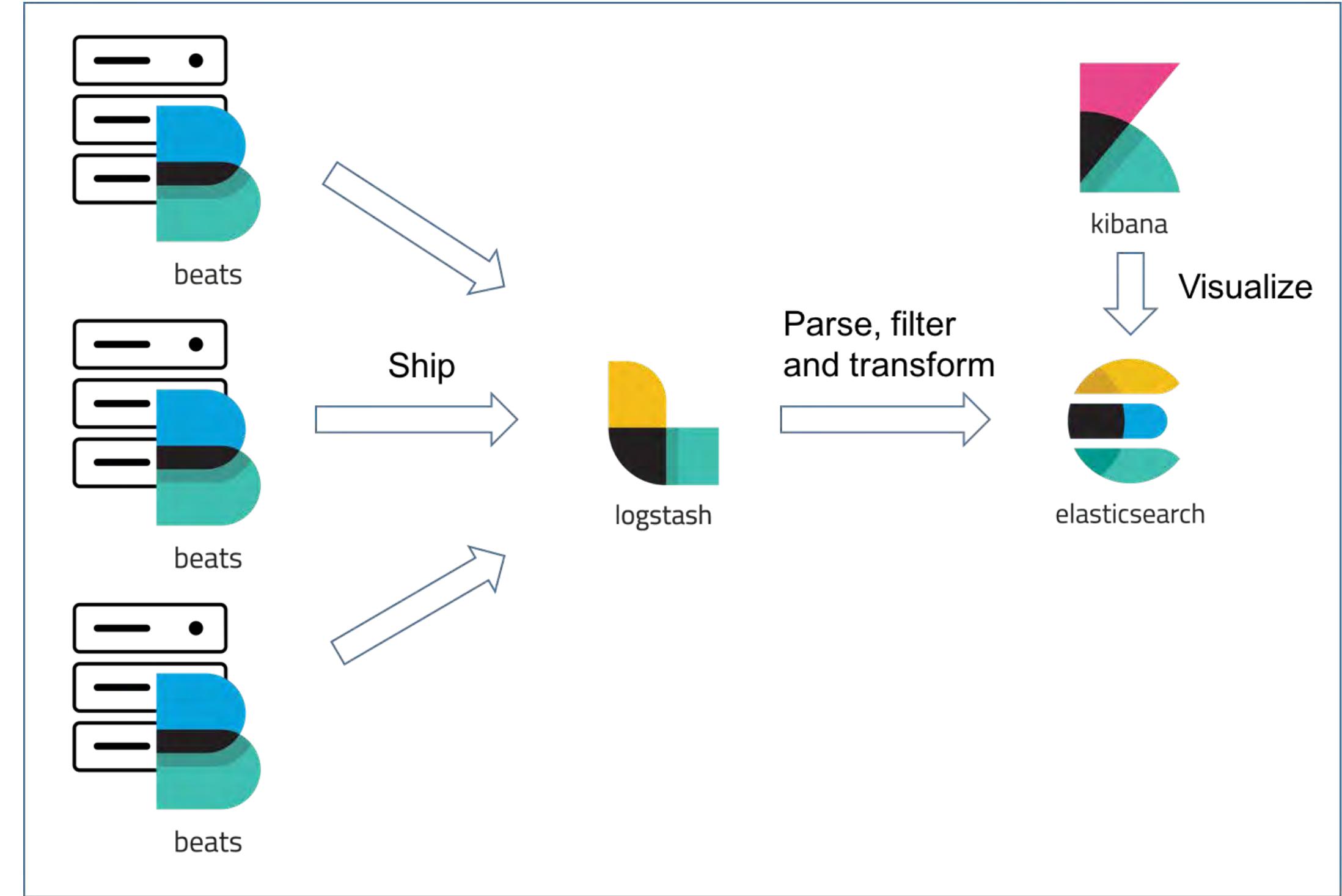
- What to log
 - Auto vs. manual
 - Sensitive data
- Logging format
 - Human readable vs. JSON
- Where to log
 - Console vs. log files
- Logs aggregation FTW



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



DATADOG



fluentd



Grafana loki



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_\(software\)](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)



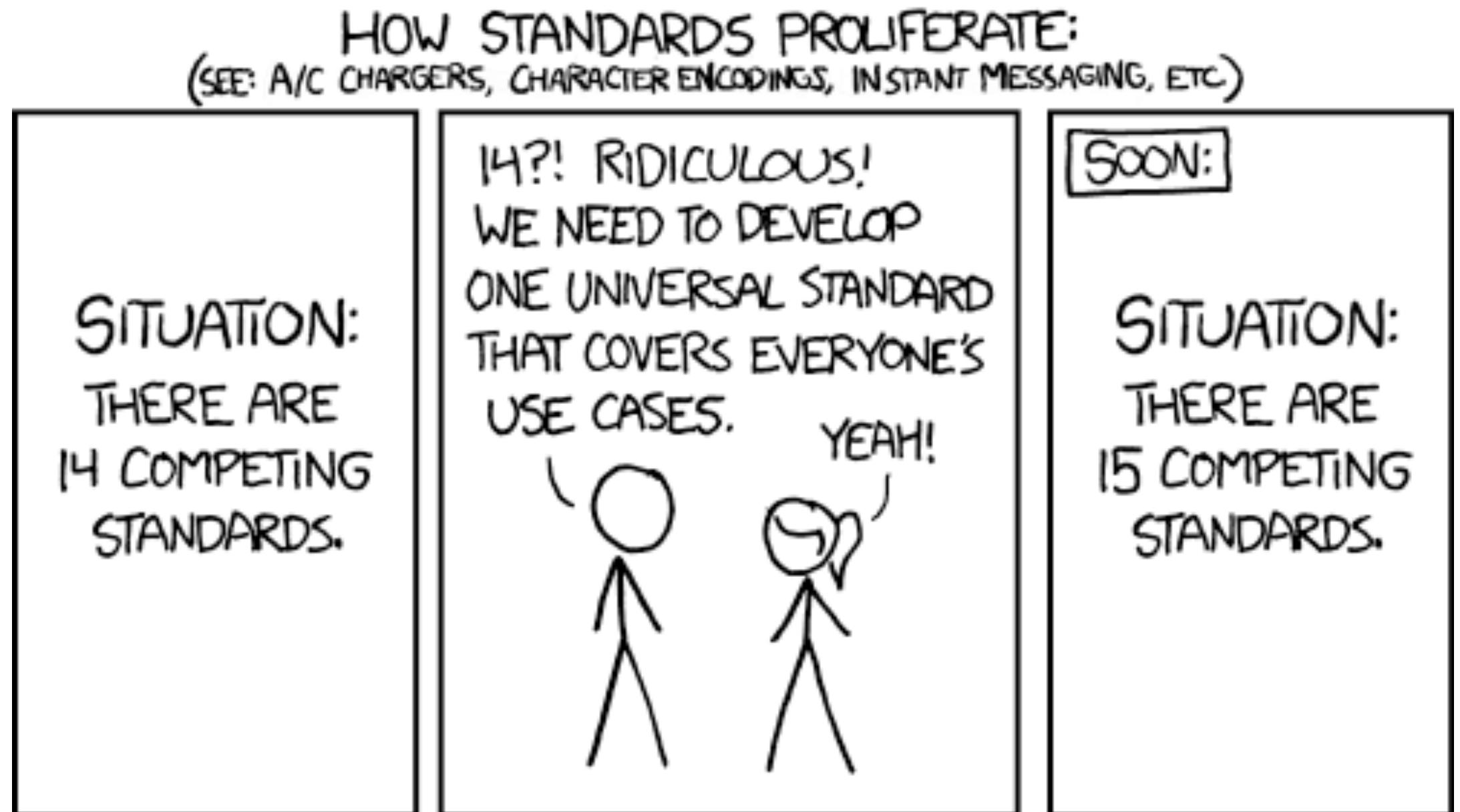
Tracing pioneers



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.”

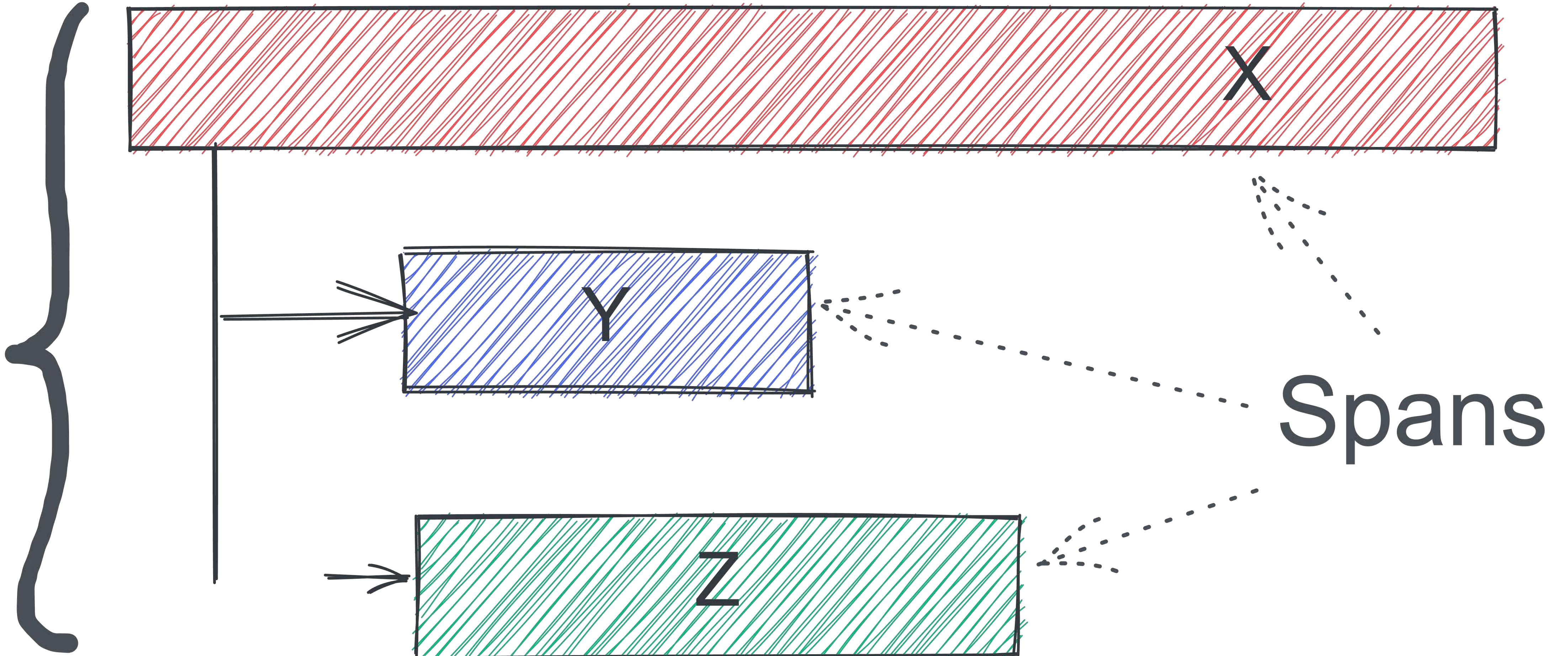
— <https://www.w3.org/TR/trace-context/>



- 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



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.”

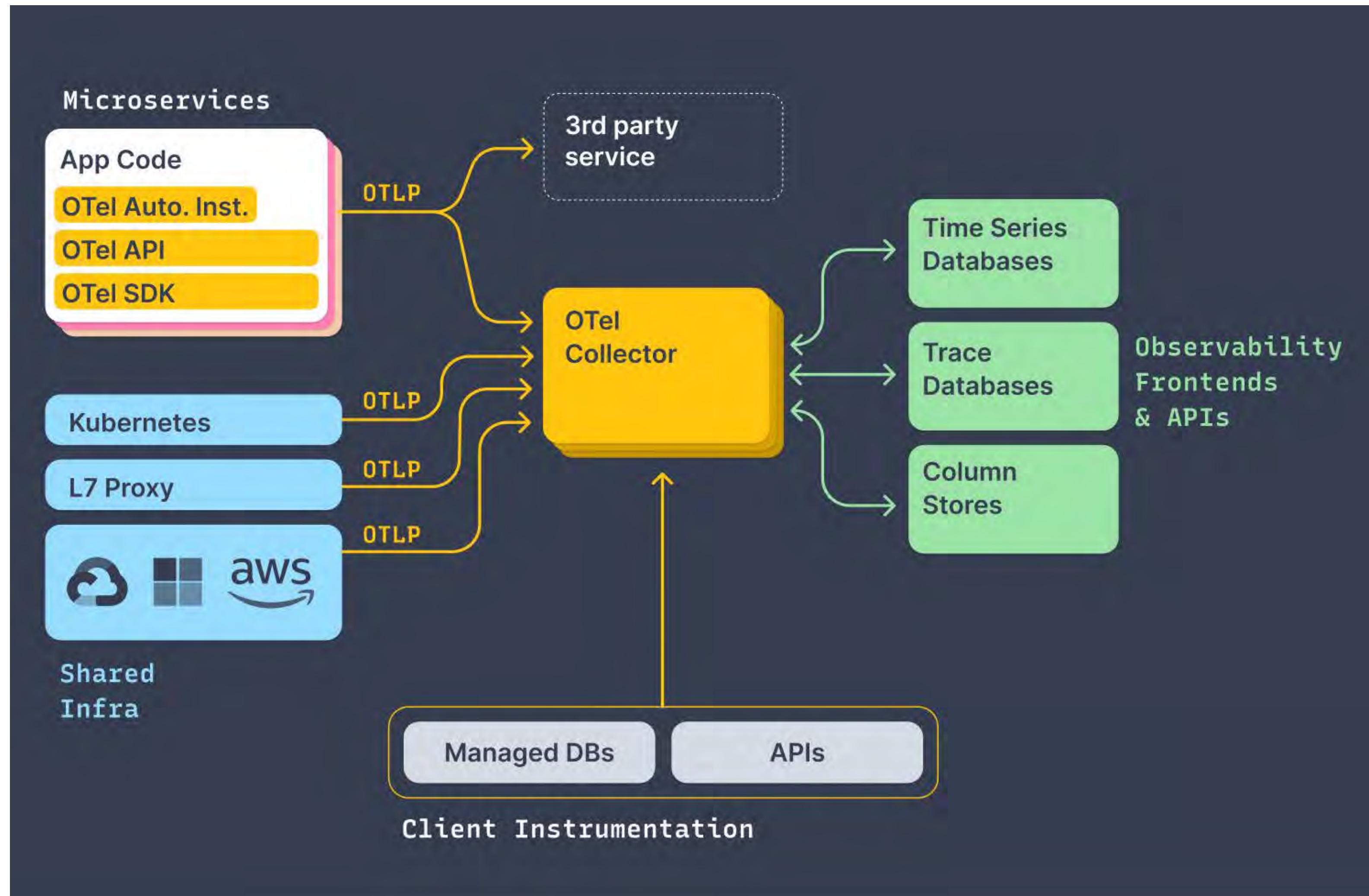


-- <https://opentelemetry.io/>

- 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

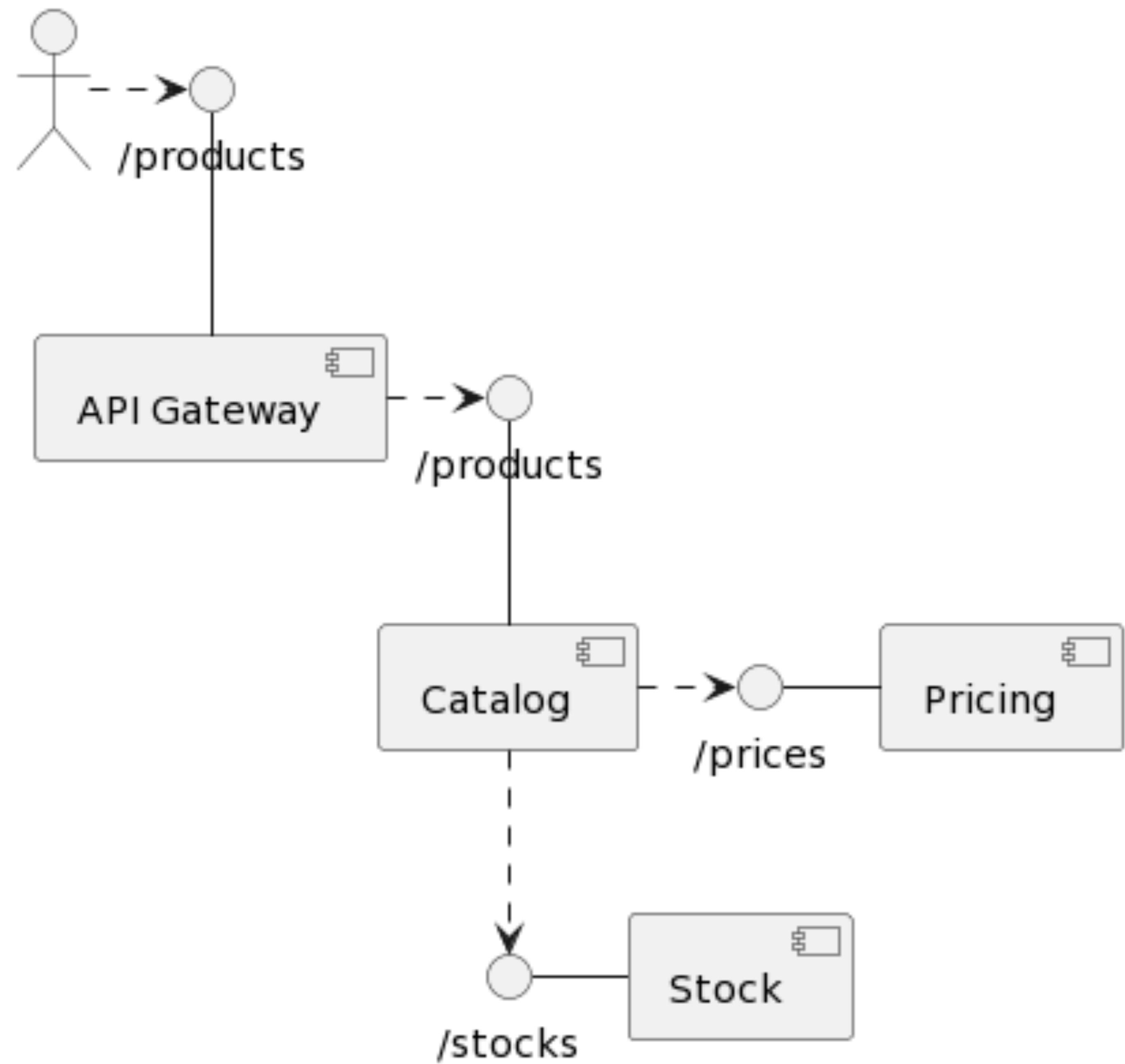


Benefits of auto-instrumentation



- Low-hanging fruit
- No coupling



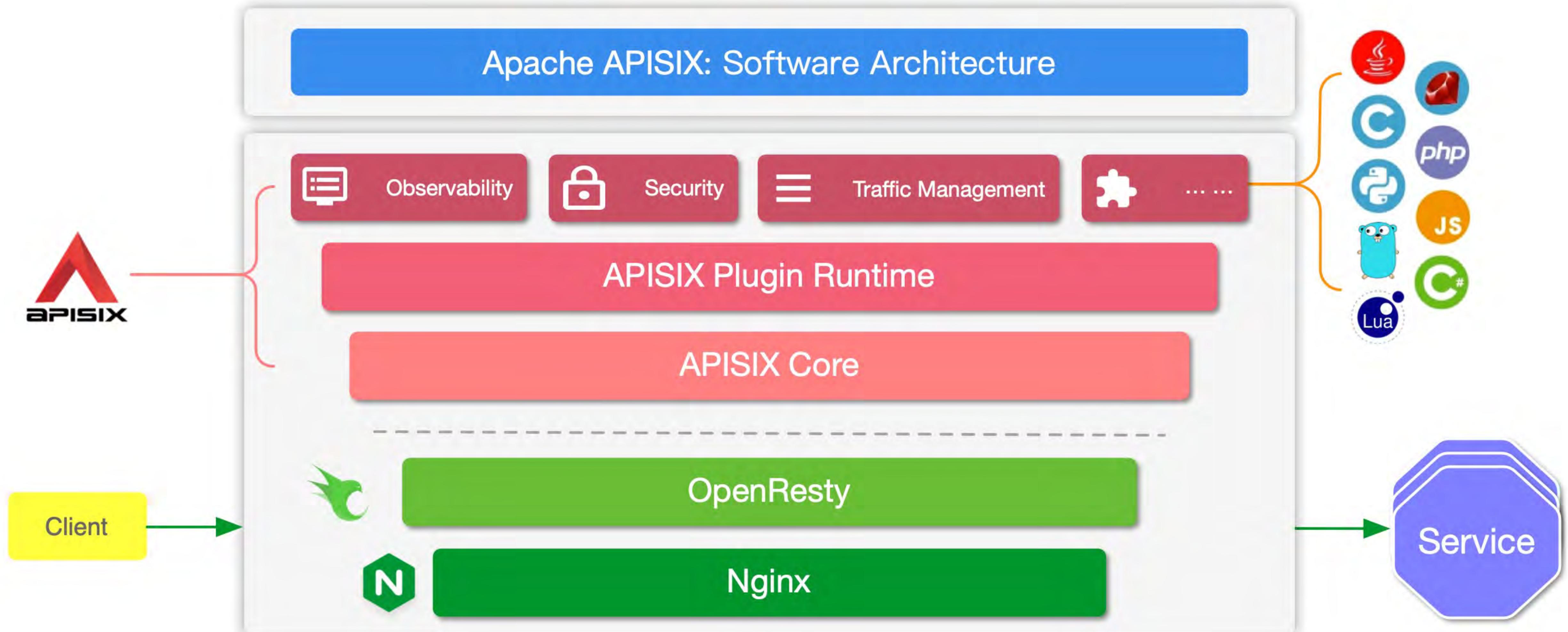


The entrypoint

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



Apache APISIX, an API Gateway the Apache way



General configuration

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



Per-route (or global rule) configuration

```
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



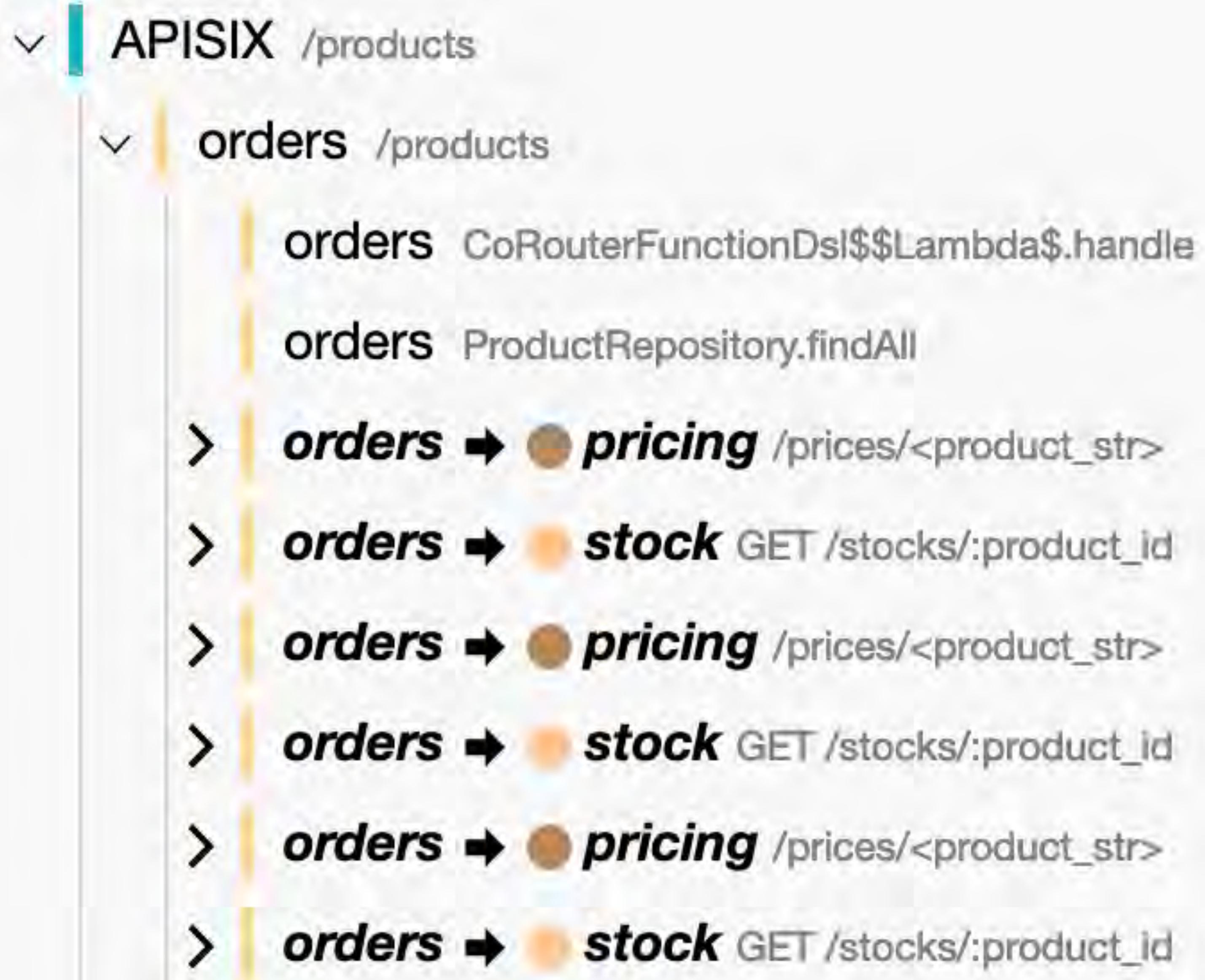
- Via a Java agent:

- -javaagent:otel.jar

- Regardless of:

- The language
 - The framework







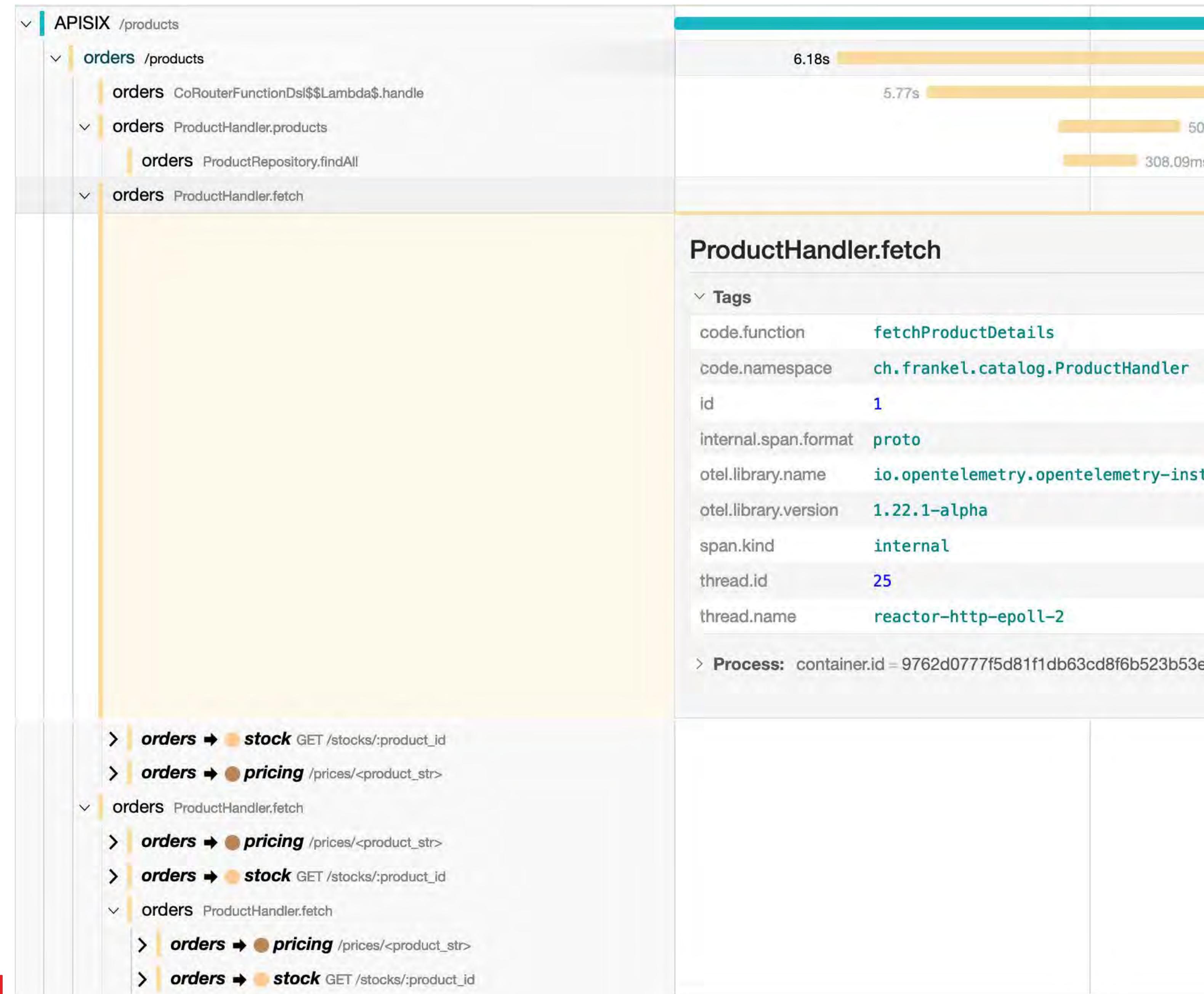
JVM explicit instrumentation

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



Annotations

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



Python auto-instrumentation



- Add the OTEL dependency
- Run with the instrumentation:

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



/prices/<product_str>

Tags

http.flavor	1.1
http.host	pricing:5000
http.method	GET
http.route	/prices/<product_str>
http.scheme	http
http.server_name	0.0.0.0
http.status_code	200
http.target	/prices/1
http.user_agent	ReactorNetty/1.1.1
internal.span.format	proto
net.host.port	5000
net.peer.ip	172.27.0.5
net.peer.port	43238
otel.library.name	opentelemetry.instrumentation.flask
otel.library.version	0.36b0



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

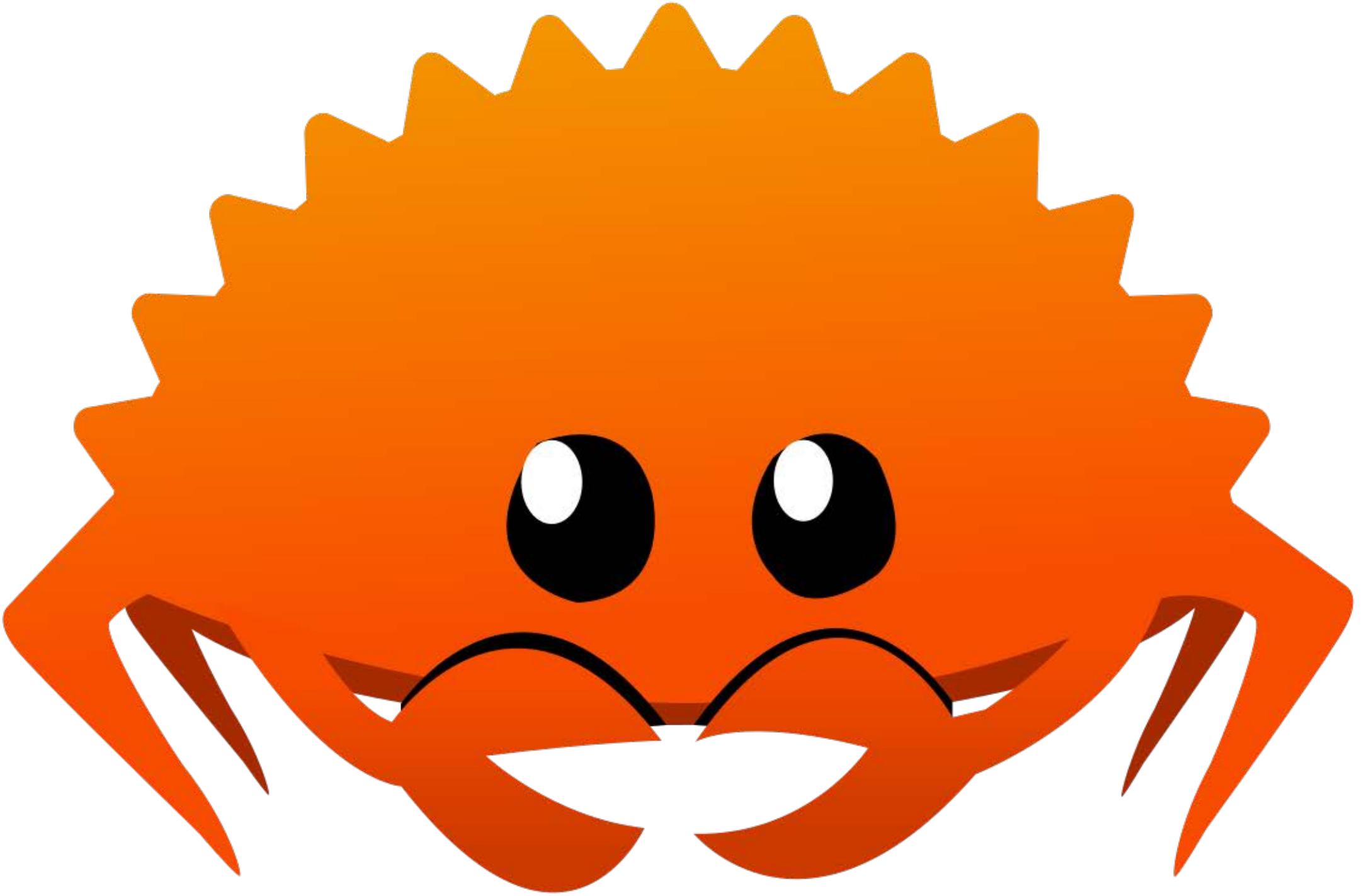
SELECT * FROM PRICE WHERE ID=:id

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 compiles to native:
 - No runtime
 - Needs explicit calls





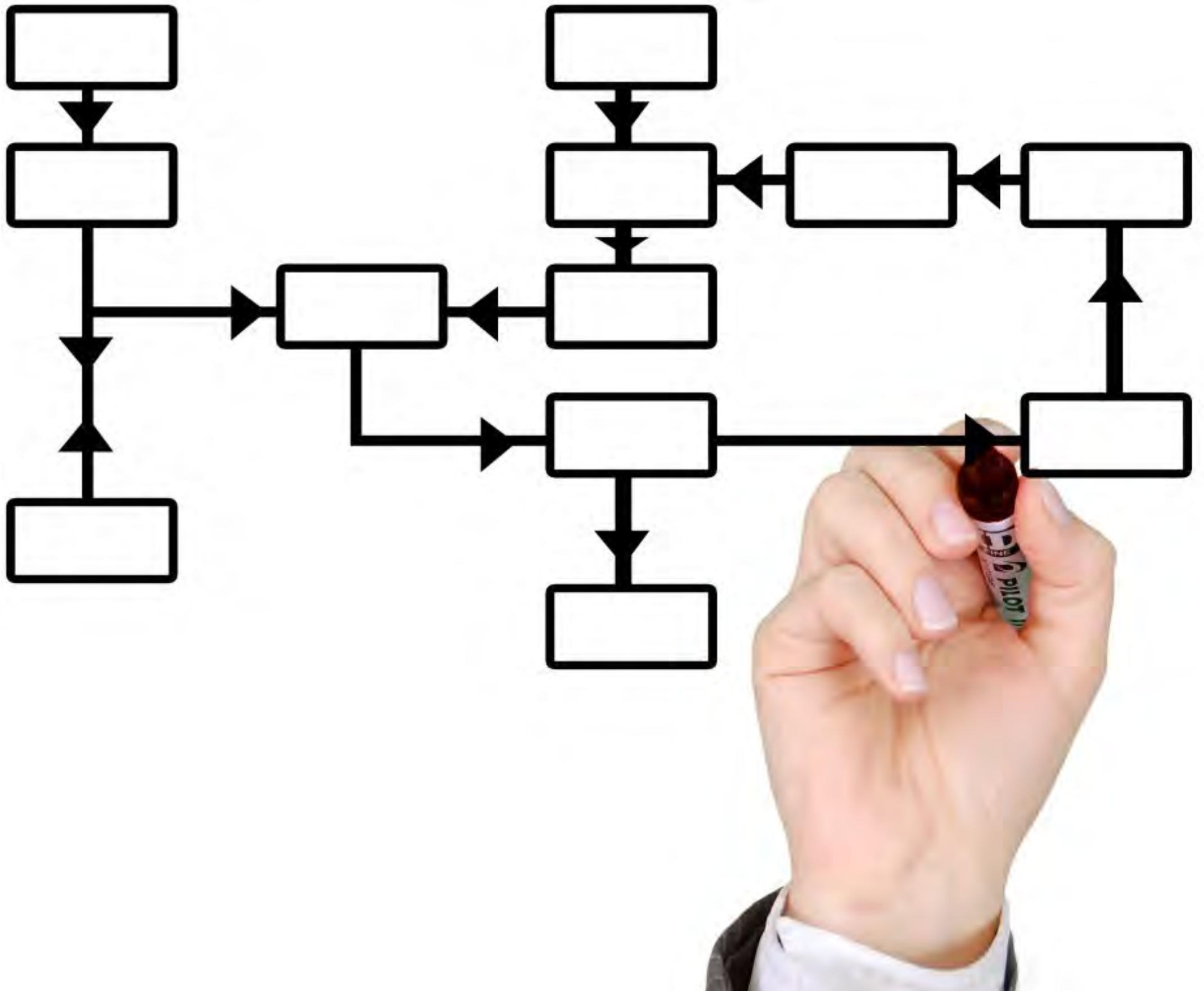
Finding the relevant Cargo dependency

- 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



Thanks for your attention!



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- <https://blog.frankel.ch/end-to-end-tracing-opentelemetry/>
- <https://bit.ly/otel-demo>
- <https://apisix.apache.org/>

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