

# OpenTelemetry Journey

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# Who am I?

- Jinwoong Kim
- Cloud Architect
- Speaker, Translator
- @ddiwoong

## Unknown/Unknown

[https://youtu.be/REWeBzGuzCc?si=Gj4DTQLTTledvv\\_o](https://youtu.be/REWeBzGuzCc?si=Gj4DTQLTTledvv_o)

“우리가 아는 것에는 네 가지가 있습니다.  
첫째, 안다는 것을 알고 있는 것 (Known knowns)  
둘째, 모르고 있다는 것을 아는 것 (Known unknowns)  
셋째, 모르고 있다는 사실조차 모르는 것 (*Unknown unknowns*)  
그리고 또 하나, 안다는 사실을 모르는 것이 있죠. (*Unknown knowns*)  
다시 말해, 안다고 생각하지만 사실은 몰랐던 것입니다.”



# Observability Introduction

A *system* is **observable** if you can determine the *behavior* of the system based on its *outputs*.

# Observability

## Logs - Lines of text

```
hikari-pool-1 - Connection is not available, request timed out after 30000ms
```

## Metrics - Time-orderd set of data

```
hikaricp_connections_timeout_total{pool="HikariPool-1",} 10.0
```

## Tracing - Correlation analysis with Context

```
2022-05-28 18:09:04.165  INFO [service-b,757d0493f099b94b,4e8d66a6aa1c1ed6] 9989 ---  
[nio-8686-exec-3] c.example.msaerrorresponse.BServiceApi : ======b-service=====
```

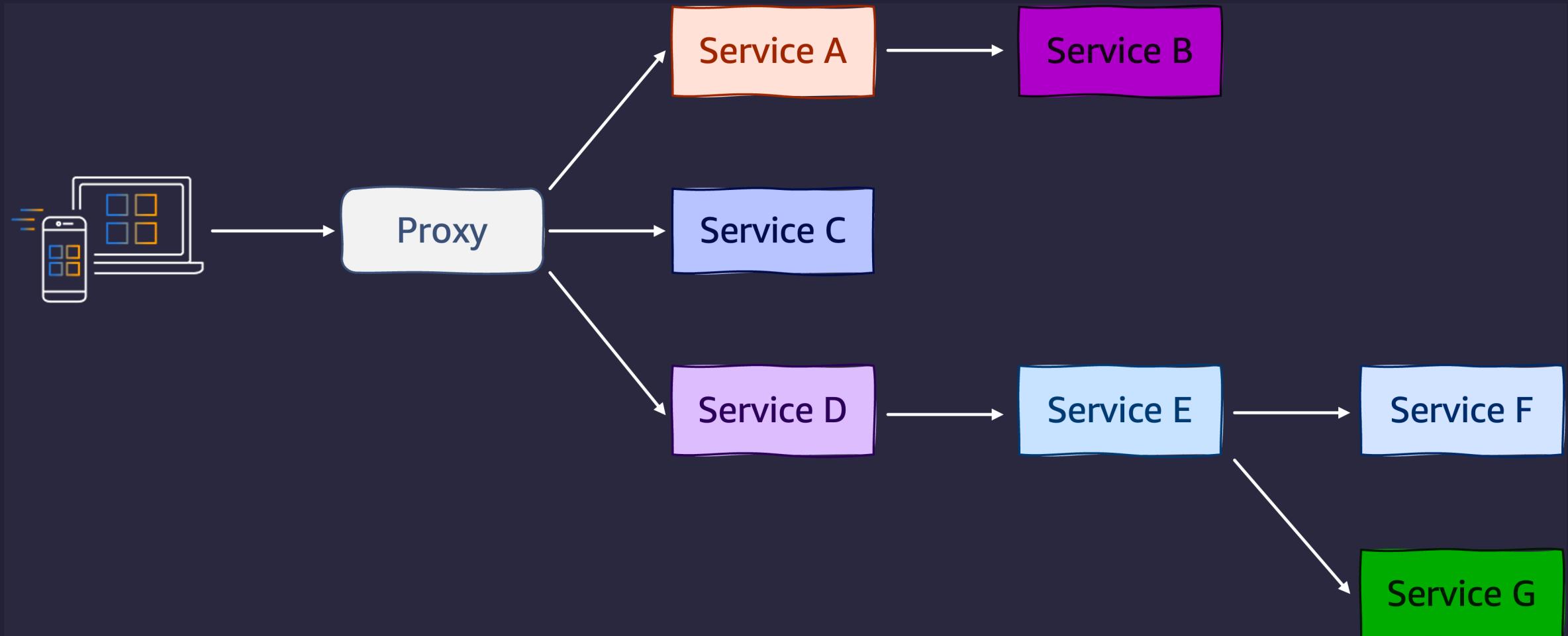
# Distributed Trace

A **telemetry** method that indicates **latency** in specific parts of a system's process:

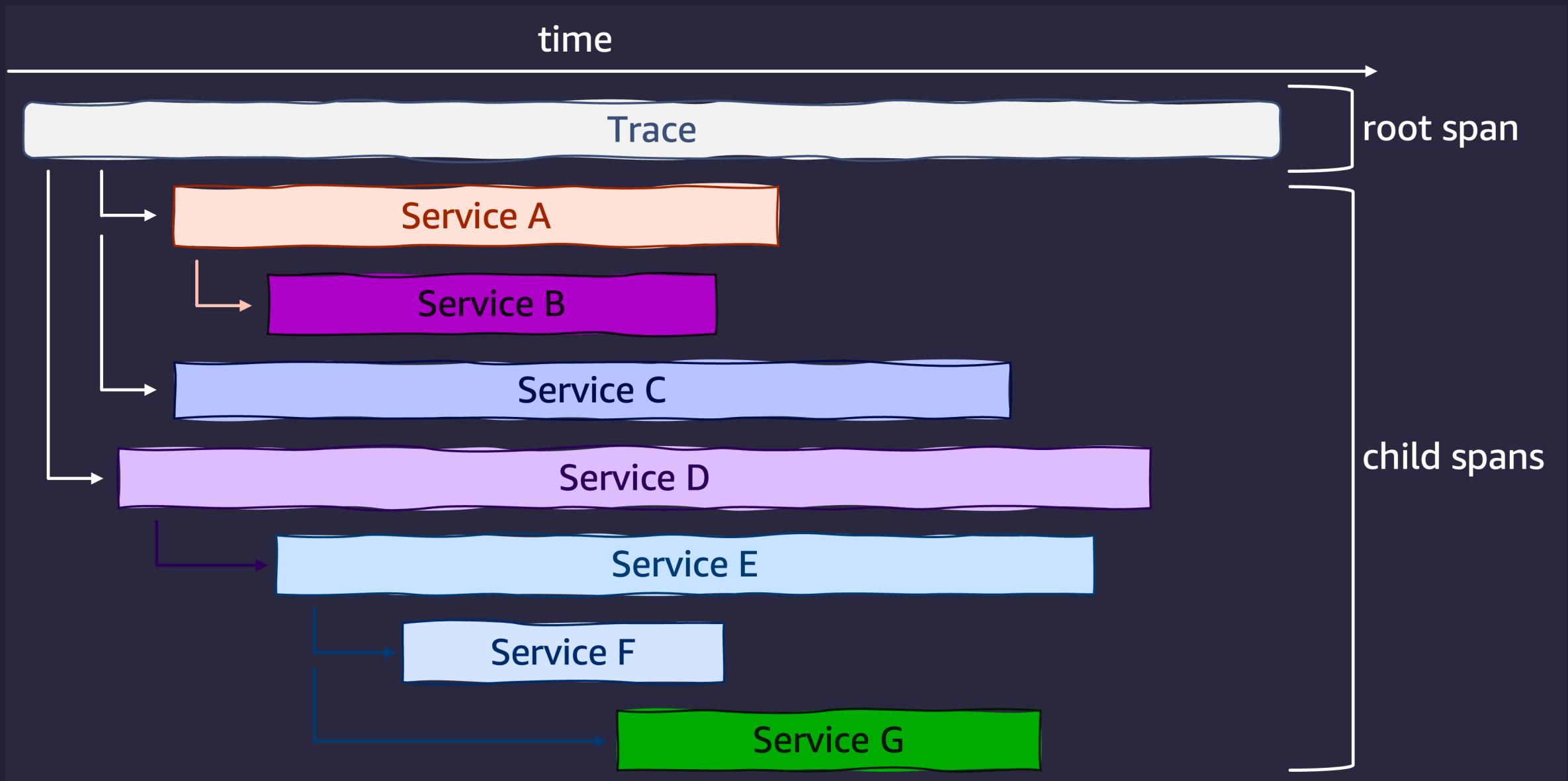
**Records** the path that requests take as they propagate through microservices and serverless architectures.

It is crucial for **observability** because it measures **dependencies** and **relationships** among numerous components in modern architectures like microservices environments, identifying **latency bottlenecks**.

# Trace

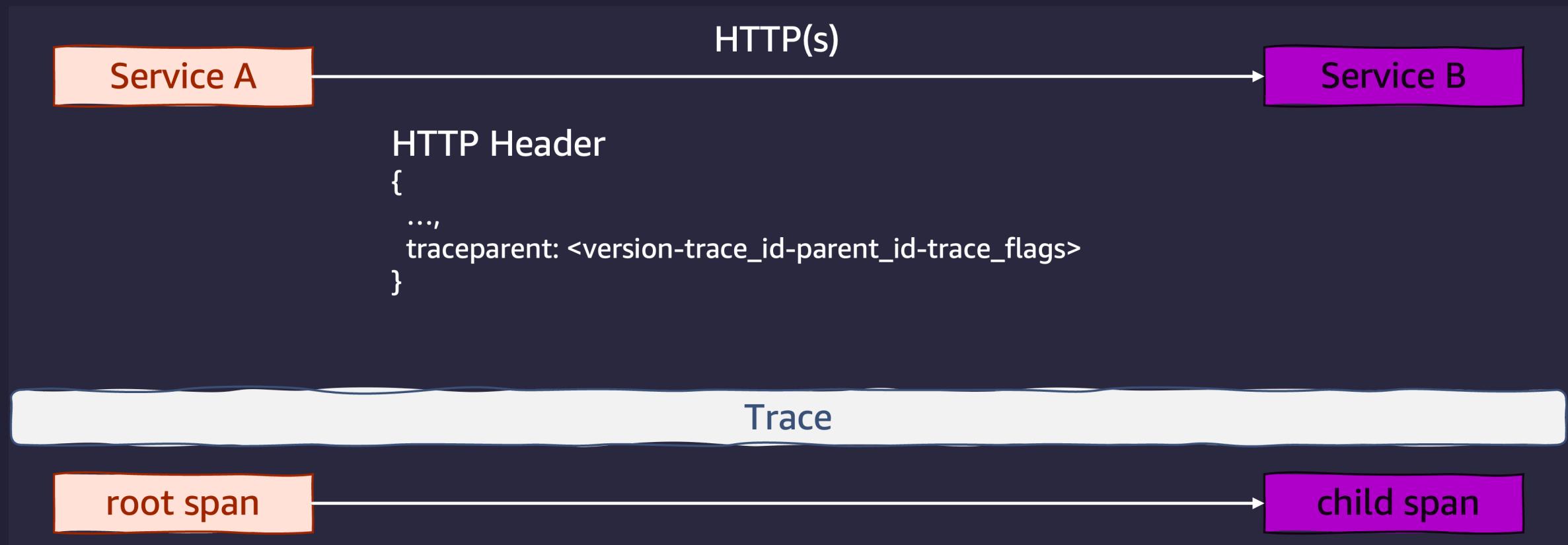


# Trace (Span)

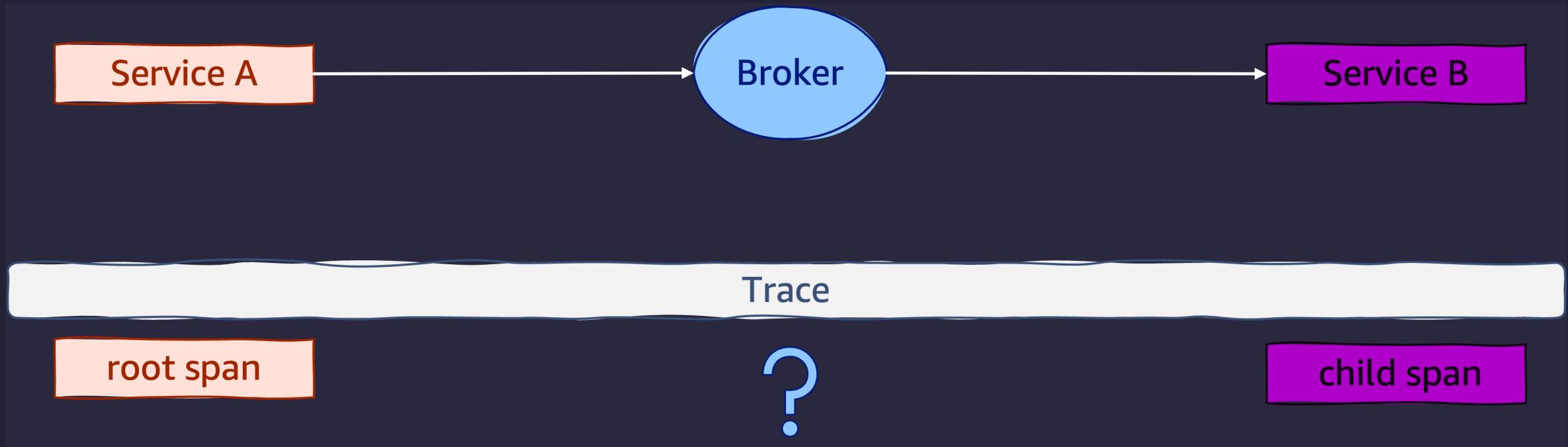


# Trace - context propagation

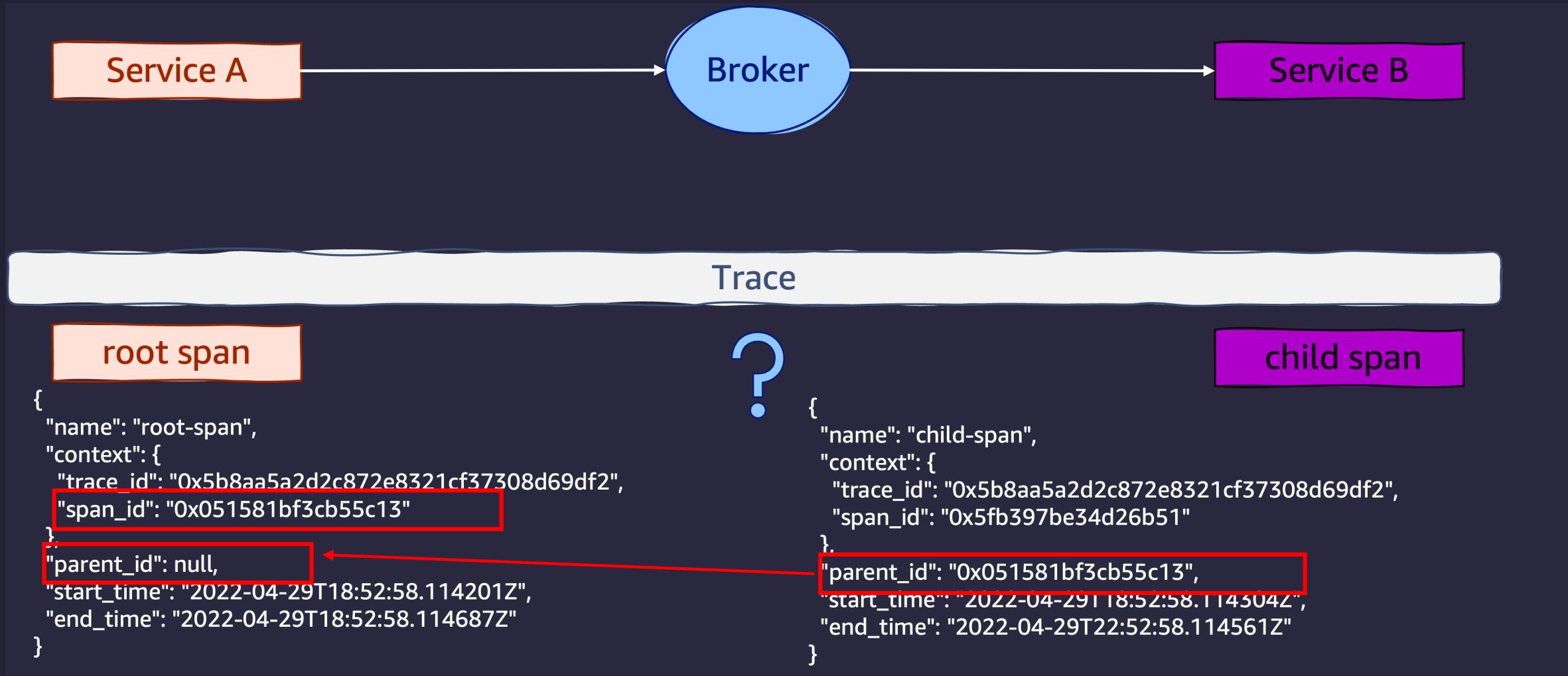
W3C Trace Context :<https://w3c.github.io/trace-context/>



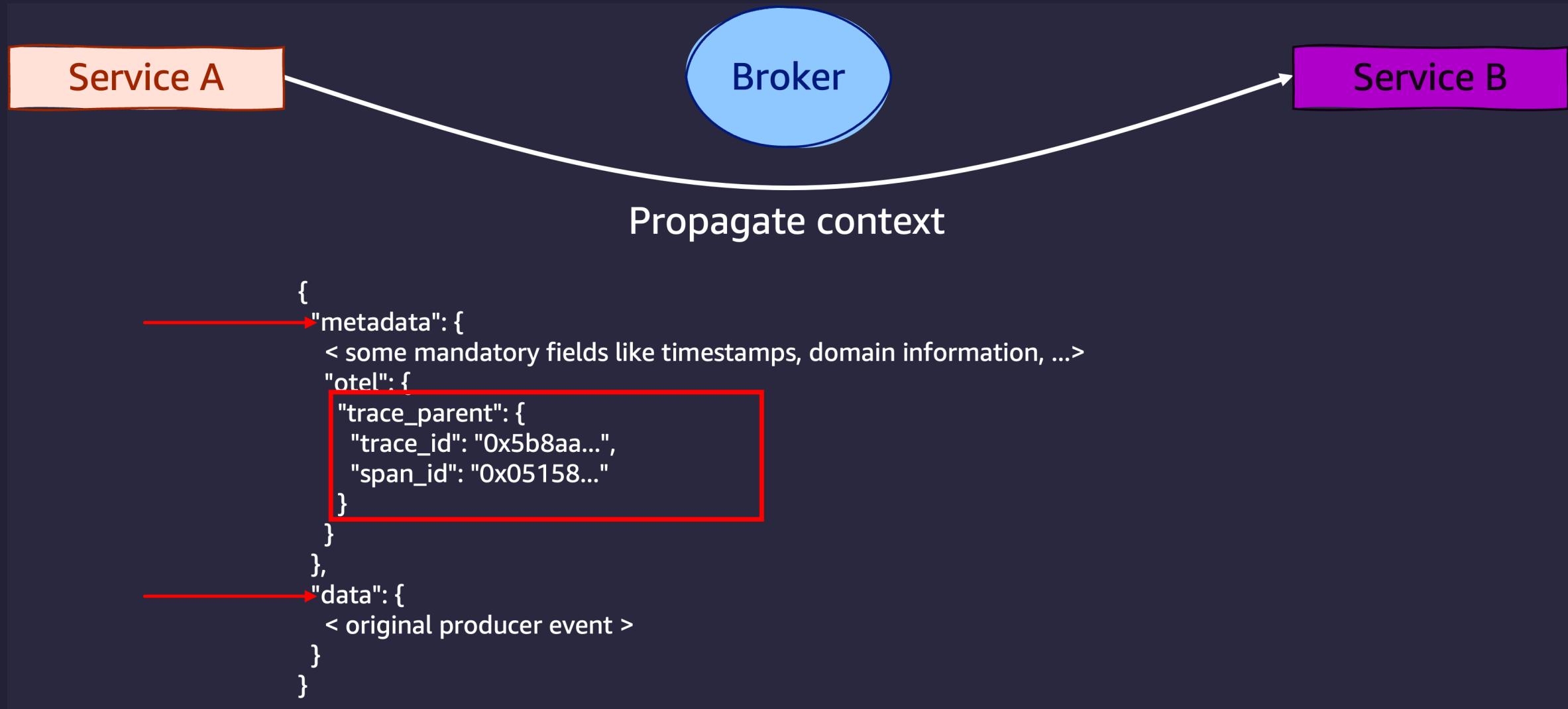
# Trace - context propagation



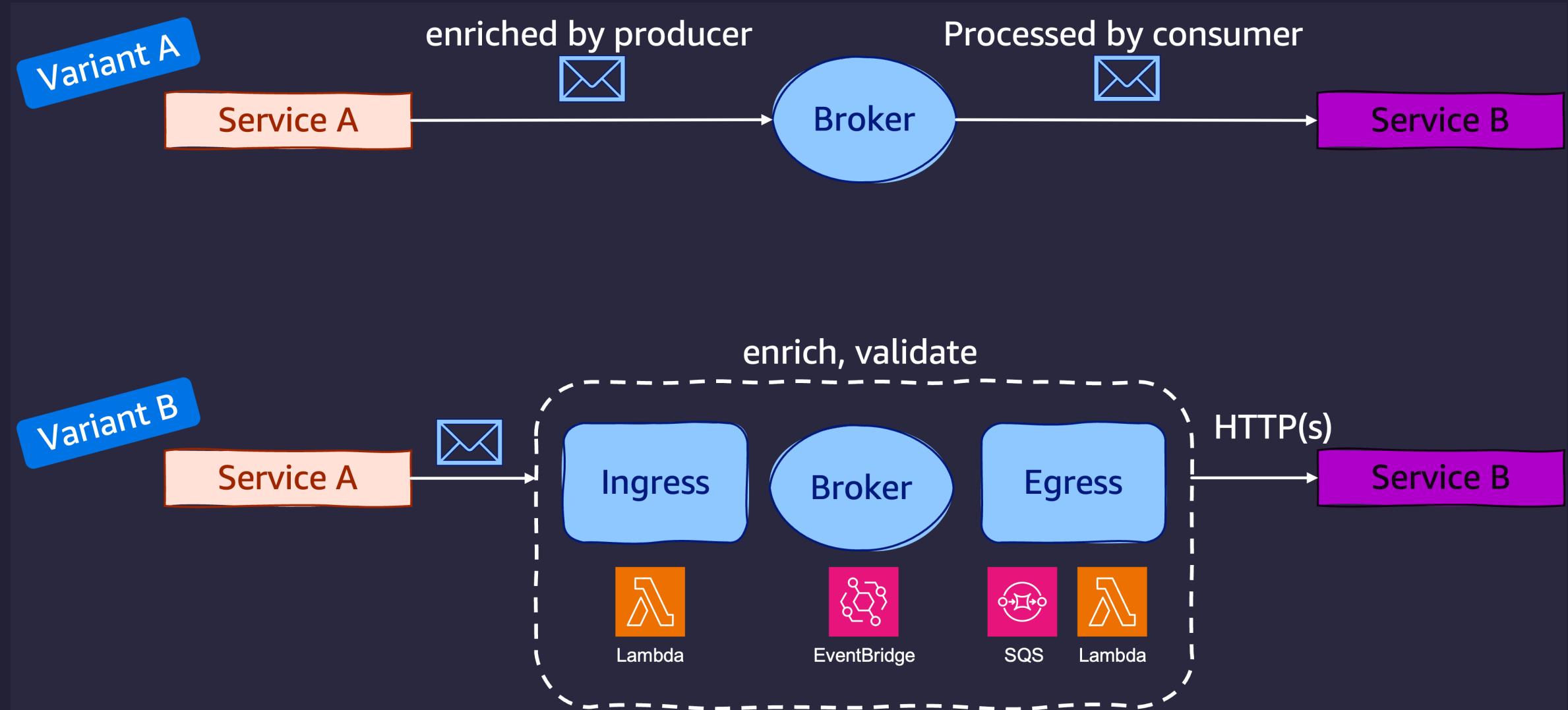
# Trace - context propagation



# Trace - context propagation



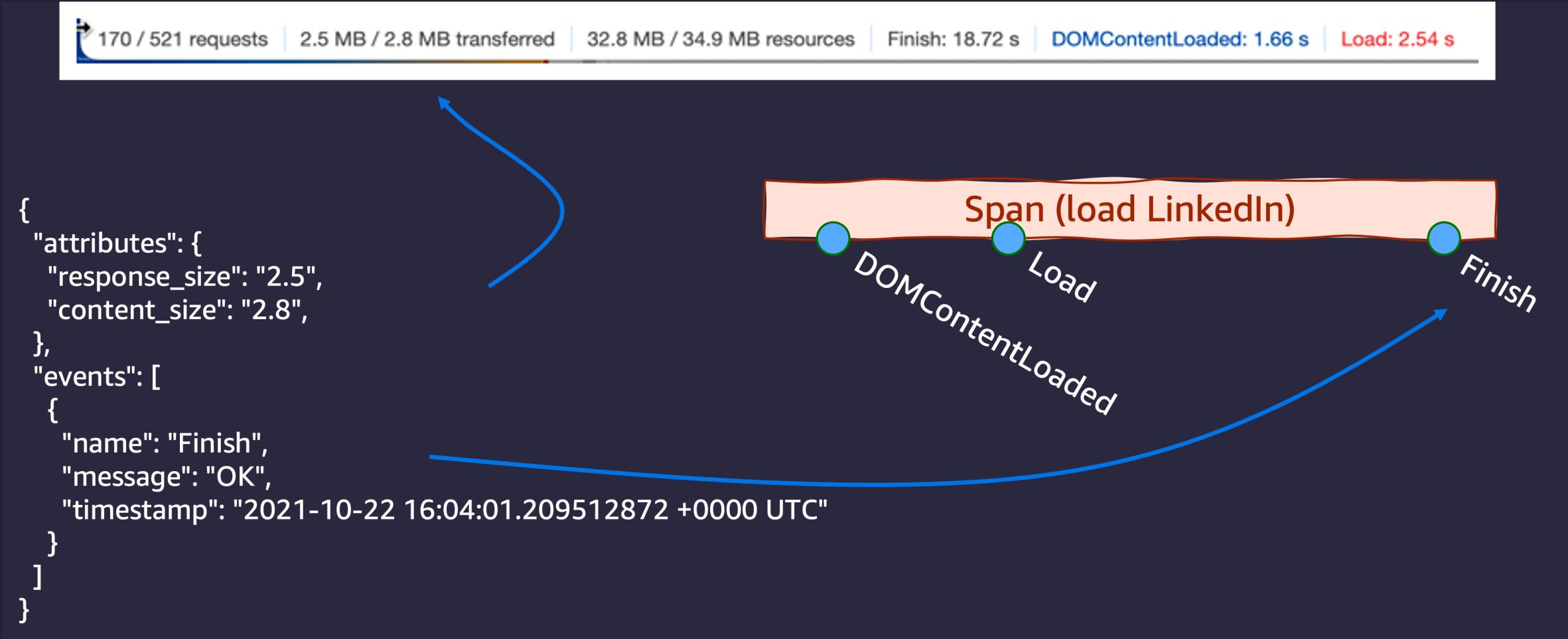
# Trace - context propagation



# Span

```
{  
  "name": "/v1/sys/health",  
  "context": {  
    "trace_id": "7bba9f33312b3dbb8b2c2c62bb7abe2d",  
    "span_id": "086e83747d0e381e"  
  },  
  "parent_id": "",  
  "start_time": "2021-10-22 16:04:01.209458162 +0000 UTC",  
  "end_time": "2021-10-22 16:04:01.209514132 +0000 UTC",  
  "status_code": "STATUS_CODE_OK",  
  "status_message": "",  
  "attributes": {  
    "http.scheme": "http",  
    "http.host": "10.177.2.152:26040",  
  },  
  "events": [  
    {  
      "name": "",  
      "message": "OK",  
      "timestamp": "2021-10-22 16:04:01.209512872 +0000 UTC"  
    }  
  ]  
}
```

# Span

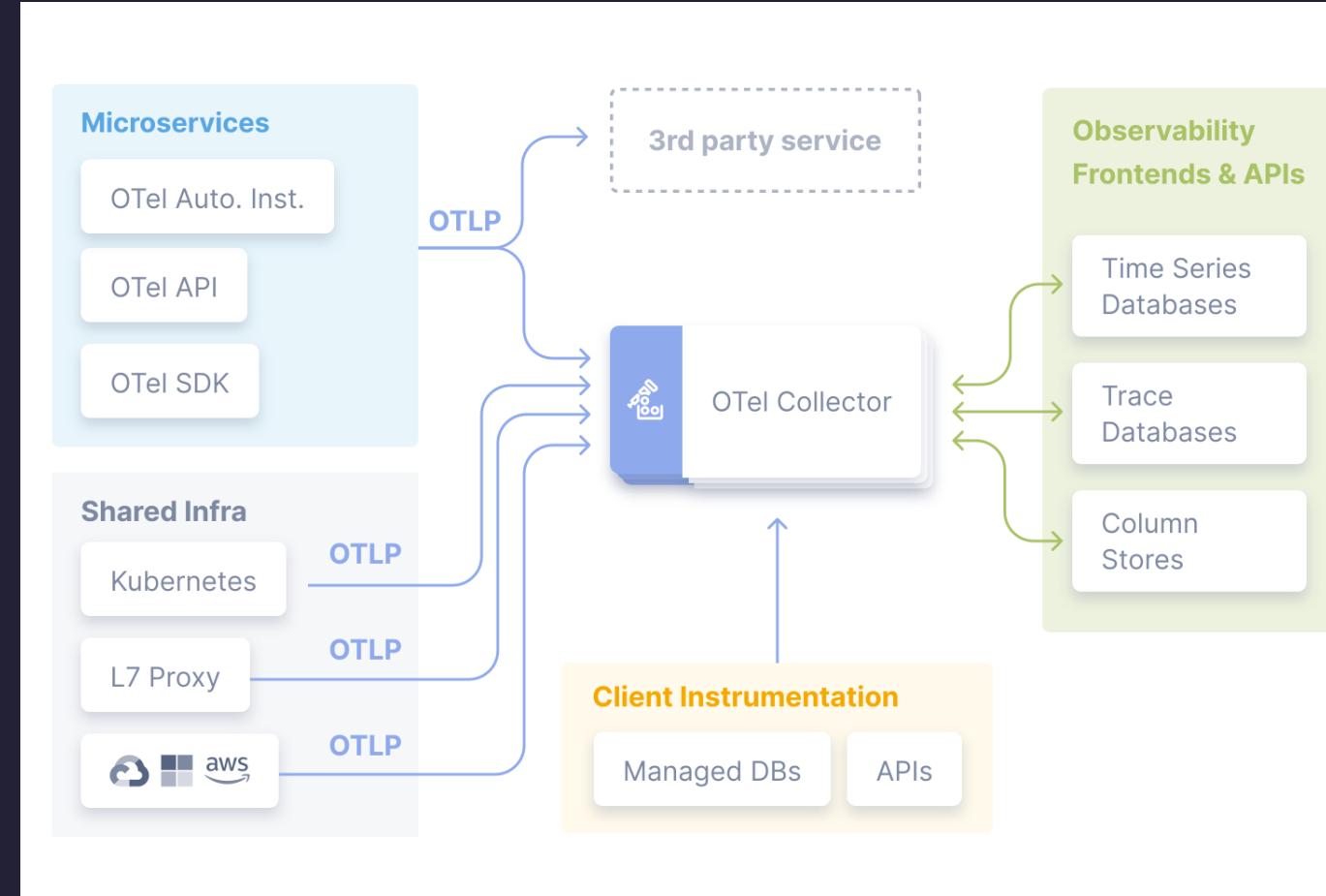


<https://opentelemetry.io/docs/specs/otel/trace/exceptions/>

# Hello, OpenTelemetry

Open source project hosted on CNCF  
Specifications, Implementations for  
instrumentation and transmissions of  
telemetry data (metrics, logs, traces)

1. Cross-language specifications
2. OpenTelemetry Collector (agent)
3. SDKs for each language
4. Auto Instrumentation



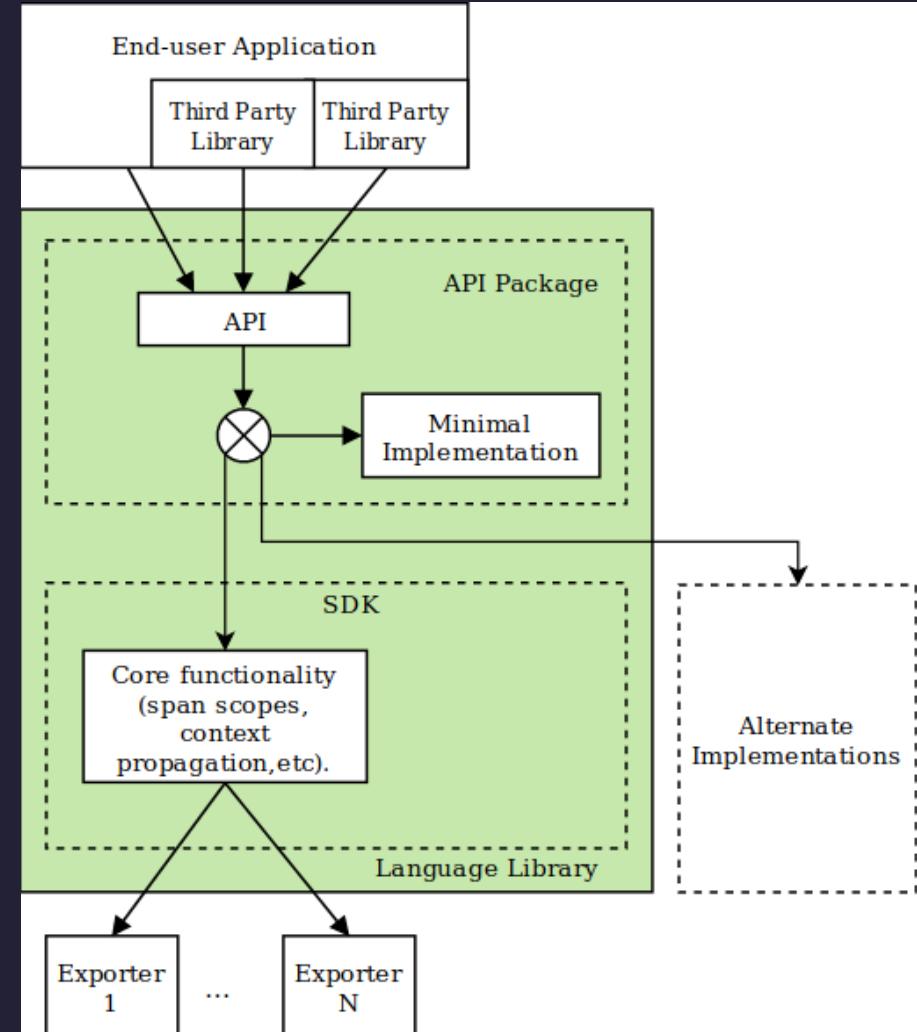
# OpenTelemetry Instrumentation

## 1. Code-based solutions via official APIs and SDKs for most languages

- API defines data types and how to generate telemetry data.
- SDK defines a language-specific implementation of the API, plus configuration, data processing and exporting.

## 2. Zero-code solutions

- Go, .NET, PHP, Python, Java, JavaScript



## Manually Instrumentation (Python)

```
@app.route("/server_request")
def server_request():
    with tracer.start_as_current_span(
        "server_request",
        context=extract(request.headers),
        kind=trace.SpanKind.SERVER,
        attributes=collect_request_attributes(request.environ),
    ):
        print(request.args.get("param"))
    return "served"
```

# Programmatically-instrumented server (Python)

```
instrumentor = FlaskInstrumentor()

app = Flask(__name__)

instrumentor.instrument_app(app)
# instrumentor.instrument_app(app, excluded_urls="/server_request")
@app.route("/server_request")
def server_request():
    print(request.args.get("param"))
    return "served"
```

# Zero-code Instrumentation (Python)

```
pip install opentelemetry-distro opentelemetry-exporter-otlp  
opentelemetry-bootstrap -a install
```

```
opentelemetry-instrument \  
  --traces_exporter console,otlp \  
  --metrics_exporter console \  
  --service_name your-service-name \  
  --exporter_otlp_endpoint 0.0.0.0:4317 \  
  python myapp.py
```

```
@app.route("/server_request")  
def server_request():  
    print(request.args.get("param"))  
    return "served"
```

# OpenTelemetry Registry

OpenTelemetry instrumentation libraries

<https://opentelemetry.io/ecosystem/registry/>

Search **NGINX**

The screenshot shows the OpenTelemetry Registry homepage. At the top, there's a navigation bar with links for Docs, Ecosystem, Status, Community, Blog, English, and a search bar. Below the header, a dark banner features the word "Registry" and a subtitle: "Find libraries, plugins, integrations, and other useful tools for using and extending OpenTelemetry." A callout box highlights that the registry allows users to search for instrumentation libraries, collector components, utilities, and other useful projects in the OpenTelemetry ecosystem. It also provides a link to add a project to the registry.

Below the banner, a search bar displays "Search 838 entries" and "nginx". To the right of the search bar are buttons for "Submit", "Reset", "Language", and "Type".

The main content area contains two search results for "nginx":

- NGINX Instrumentation**  
by [OpenTelemetry Authors](#)  
The NGINX OpenTelemetry module to add OpenTelemetry distributed tracing support to NGINX.  
C++ Language  
Instrumentation Component  
Apache 2.0 License
- NGINX Native OTel Module**  
★ new by [NGINX, Inc.](#)  
The `ngx_otel_module` dynamic module enables NGINX Open Source or NGINX Plus to send telemetry data to an OTEL collector.  
C++ Language  
Instrumentation Component  
Apache-2.0 License

At the bottom of the page, there are links for "Website" and "Repository" for both items.

# OpenTelemetry Protocol (OTLP)

<https://github.com/open-telemetry/opentelemetry-proto/blob/main/docs/specification.md>

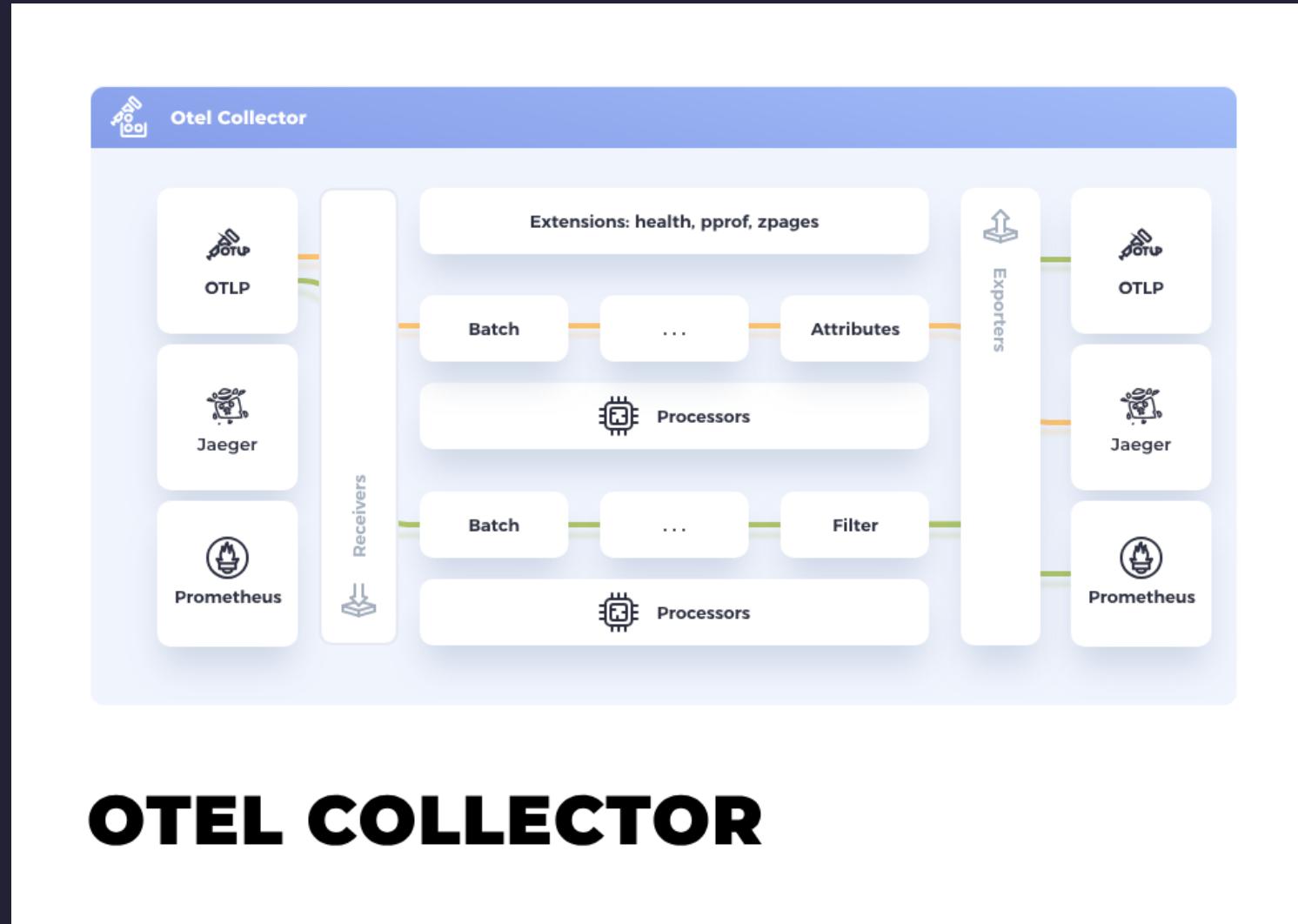
OTLP is implemented over **gRPC** and **HTTP** transports and specifies the Protocol Buffers schema used for payloads.

OTLP is a request/response style protocol where **clients** send requests and the **server** replies with corresponding responses.

All server components must support the following transport compression options: **none**, **gzip**

# OpenTelemetry Collector

<https://opentelemetry.io/docs/collector/configuration>



# OpenTelemetry Collector Receiver

```
receivers:  
  jaeger:  
    protocols:  
      grpc:  
        endpoint: 0.0.0.0:14250  
      thrift_compact:  
      thrift_http:  
  kafka:  
    protocol_version: 2.0.0  
  prometheus:  
    config:  
      scrape_configs:  
        - job_name: otel-collector  
          scrape_interval: 5s  
          static_configs:  
            - targets: [localhost:8888]  
  otlp:  
    protocols:  
      grpc:  
        endpoint: 0.0.0.0:4317  
      http:  
        endpoint: 0.0.0.0:4318
```

# OpenTelemetry Collector Processors

```
processors:  
  attributes:  
    actions:  
      - key: environment  
        value: production  
        action: insert  
      - key: db.statement  
        action: delete  
      - key: email  
        action: hash  
  probabilistic_sampler:  
    hash_seed: 22  
    sampling_percentage: 15  
  memory_limiter:  
    check_interval: 5s  
    limit_mib: 4000  
    spike_limit_mib: 500  
  filter:  
    metrics:  
      include:  
        match_type: regexp  
        metric_names:  
          - prefix/.*  
          - prefix_./*
```

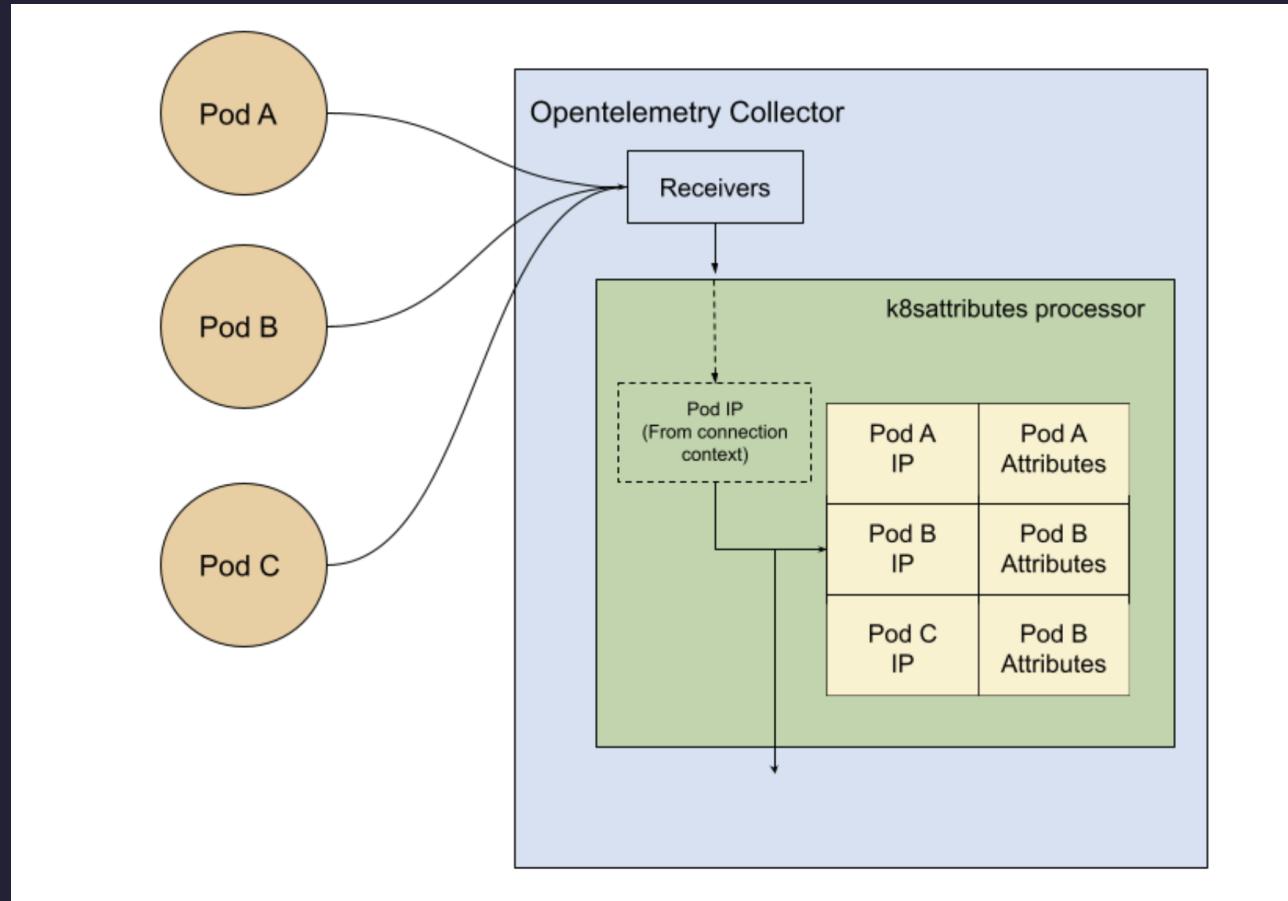
# OpenTelemetry Collector Exporter

```
exporters:  
  file:  
    path: ./filename.json  
  jaeger:  
    endpoint: http://jaeger-all-in-one:14250  
    insecure: true  
  kafka:  
    protocol_version: 2.0.0  
  otlphttp:  
    endpoint: https://otlp.example.com:4318  
  prometheus:  
    endpoint: prometheus:8889  
    namespace: default  
  prometheusremotewrite:  
    endpoint: "http://some.url:9411/api/prom/push"  
  zipkin:  
    endpoint: "http://localhost:9411/api/v2/spans"
```

# Resource Semantic Conventions

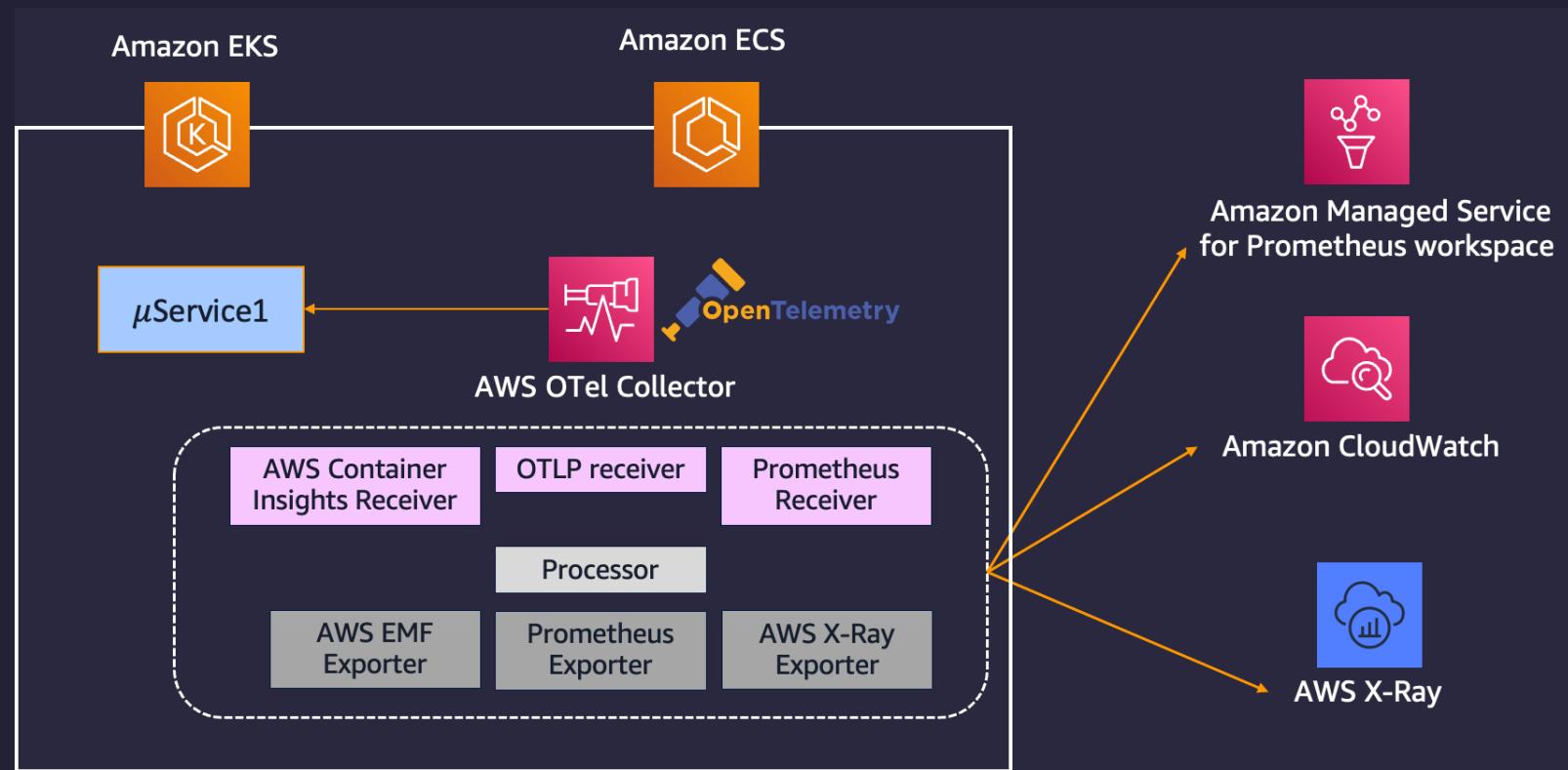
A **Resource** represents the entity producing telemetry as resource attributes.

<https://opentelemetry.io/docs/specs/semconv/>

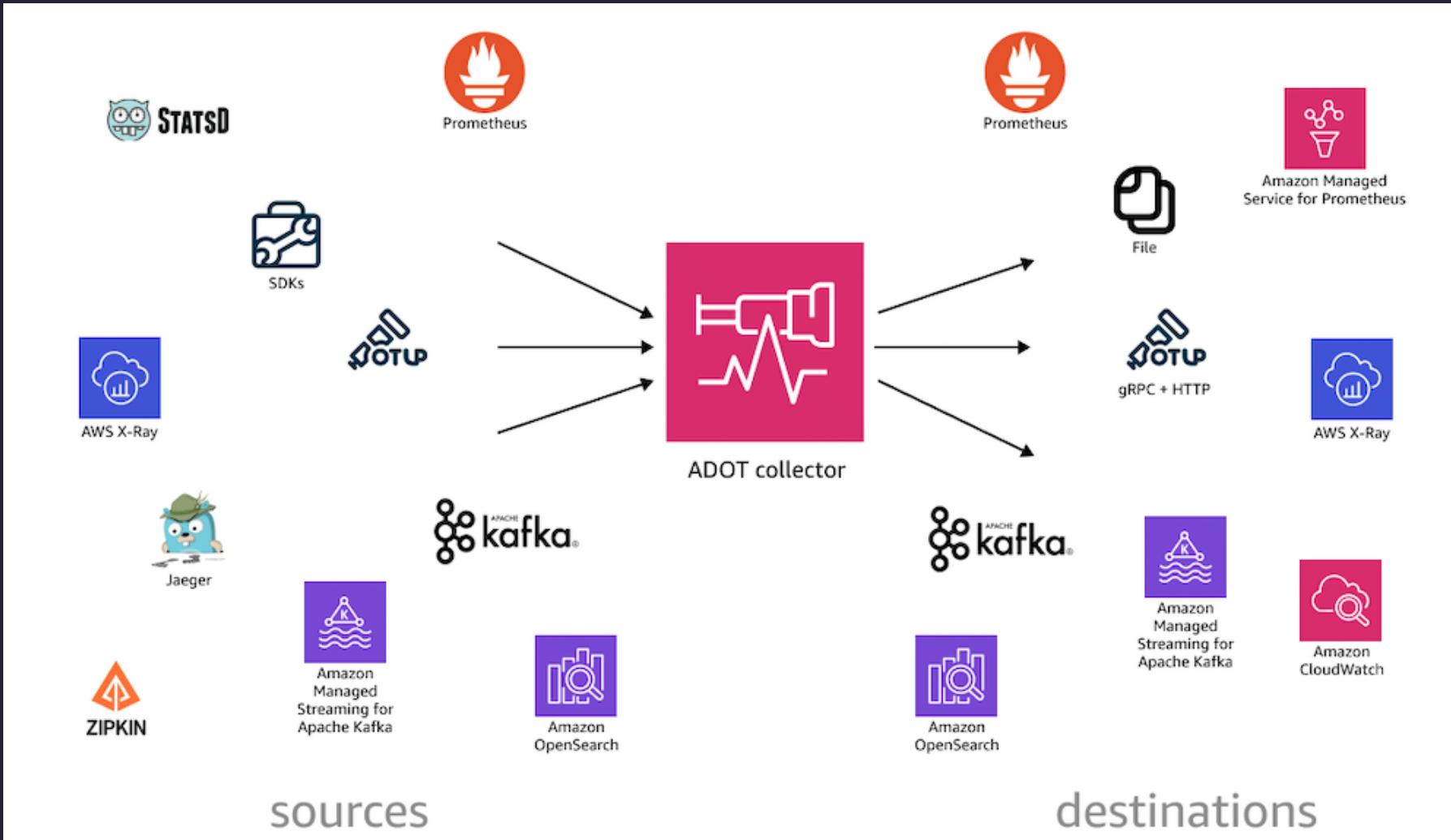


# AWS Distro for OpenTelemetry (ADOT)

- Secure, production ready, and supported by AWS OpenTelemetry distribution
- Extend functionality for ease of use on AWS



# AWS Distro for OpenTelemetry (ADOT)



# OpenTelemetry Ecosystem

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

- OpenTelemetry Demo

- Registry

- Adopters

Organizations that use OpenTelemetry

- Distributions

List of open source OpenTelemetry distributions maintained by third parties.

- Integrations

Libraries, services, and apps with first-party support for OpenTelemetry.

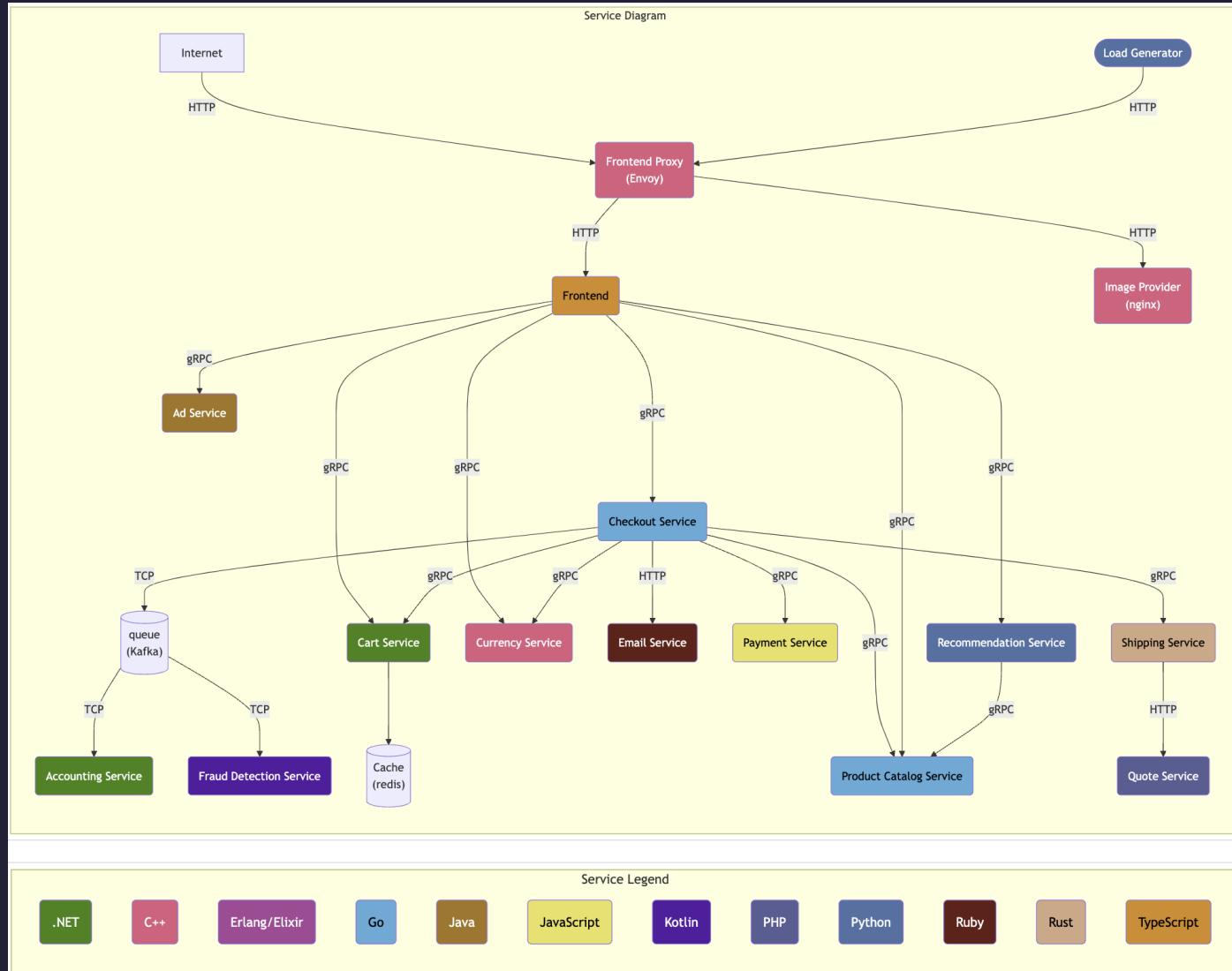
- Vendors

Vendors who natively support OpenTelemetry

# OpenTelemetry Demo

OpenTelemetry Demo is composed of microservices written in different programming languages that talk to each other over gRPC and HTTP; and a load generator which uses Locust to fake user traffic.

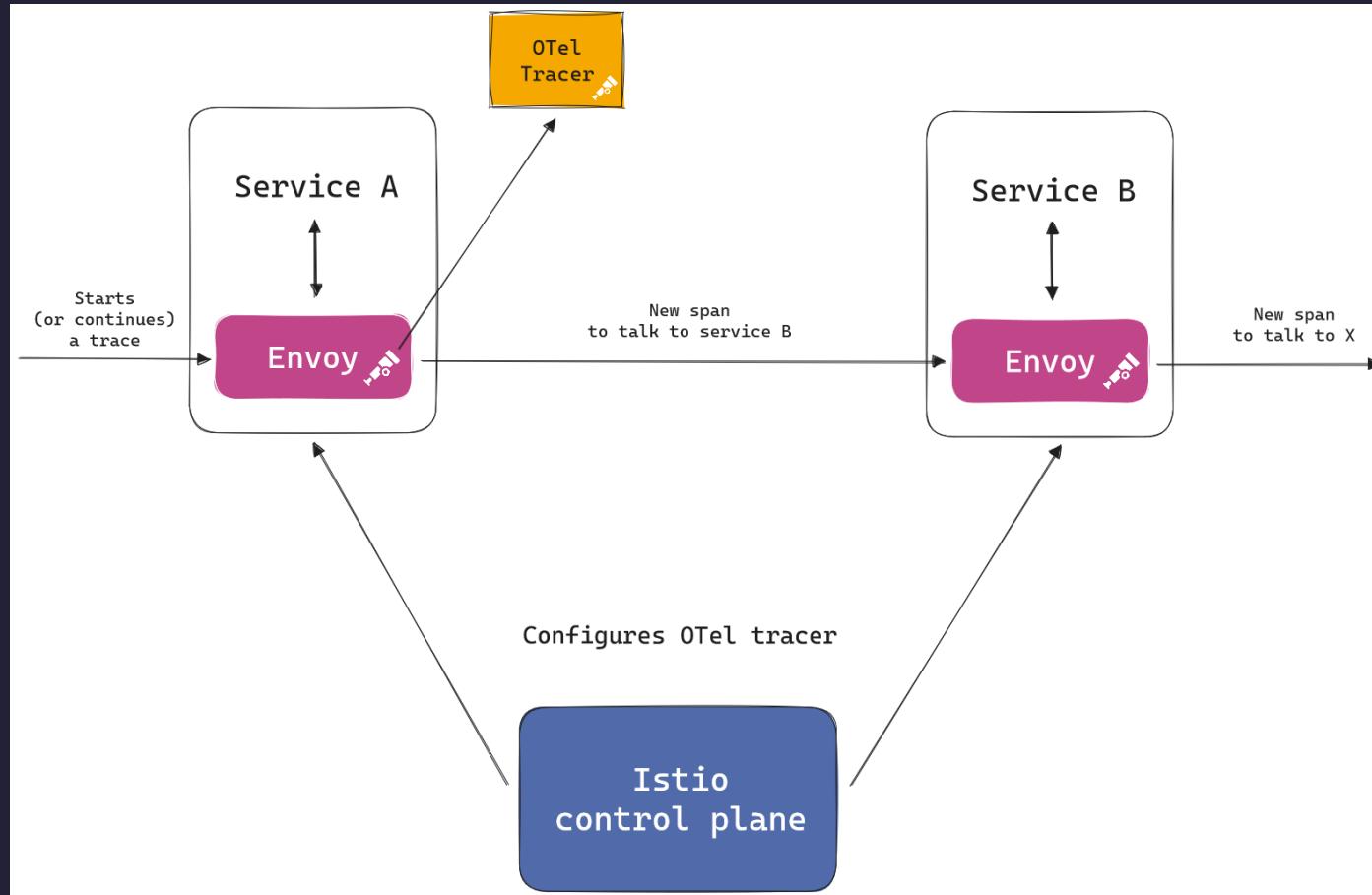
- Web store
- Grafana
- Load Generator
- Jaeger UI



# New Otel Feature

Observability in Envoy and Istio

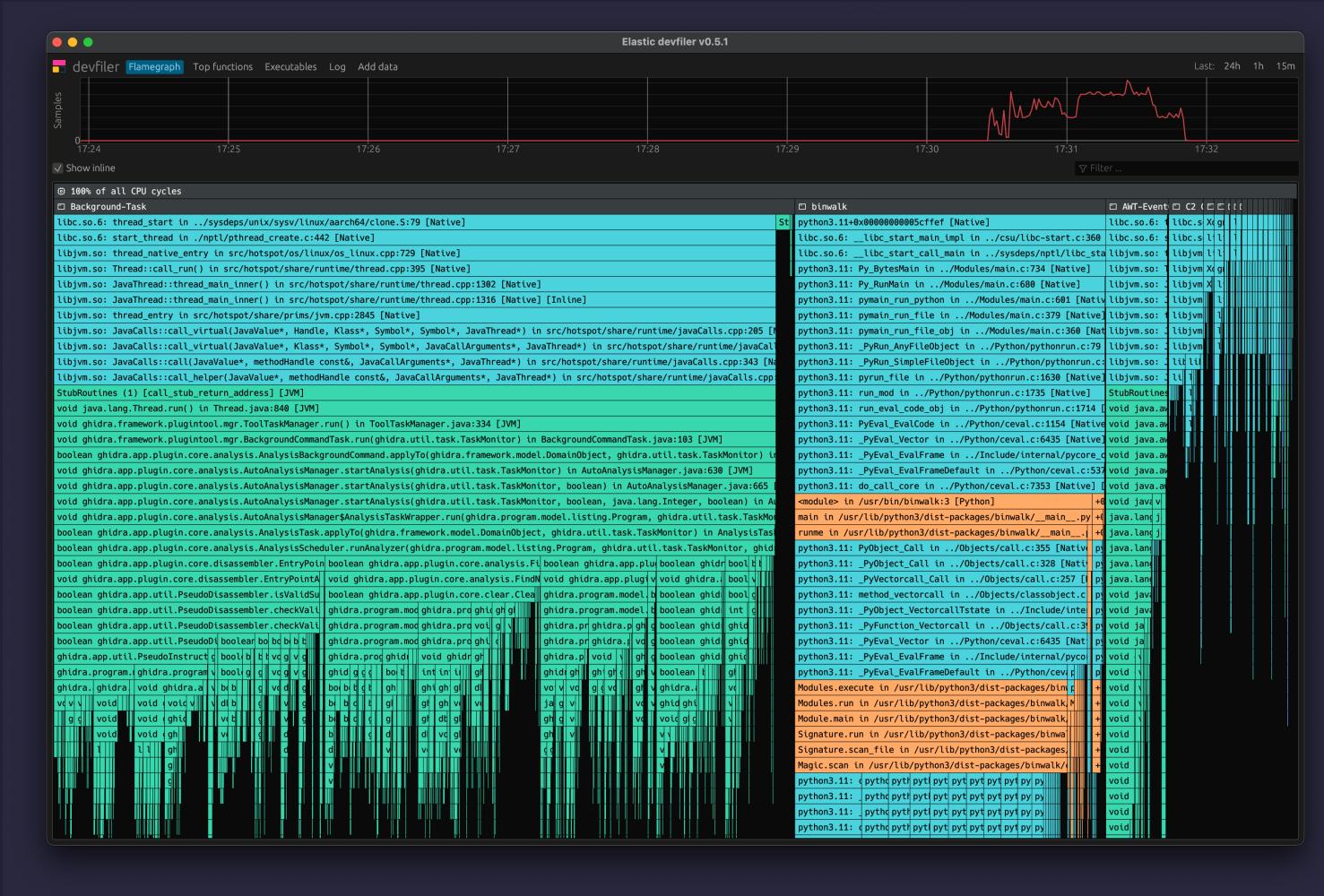
<https://opentelemetry.io/blog/2024/new-otel-features-envoy-istio/>



# New Otel Feature

## Continuous Profiling Agent

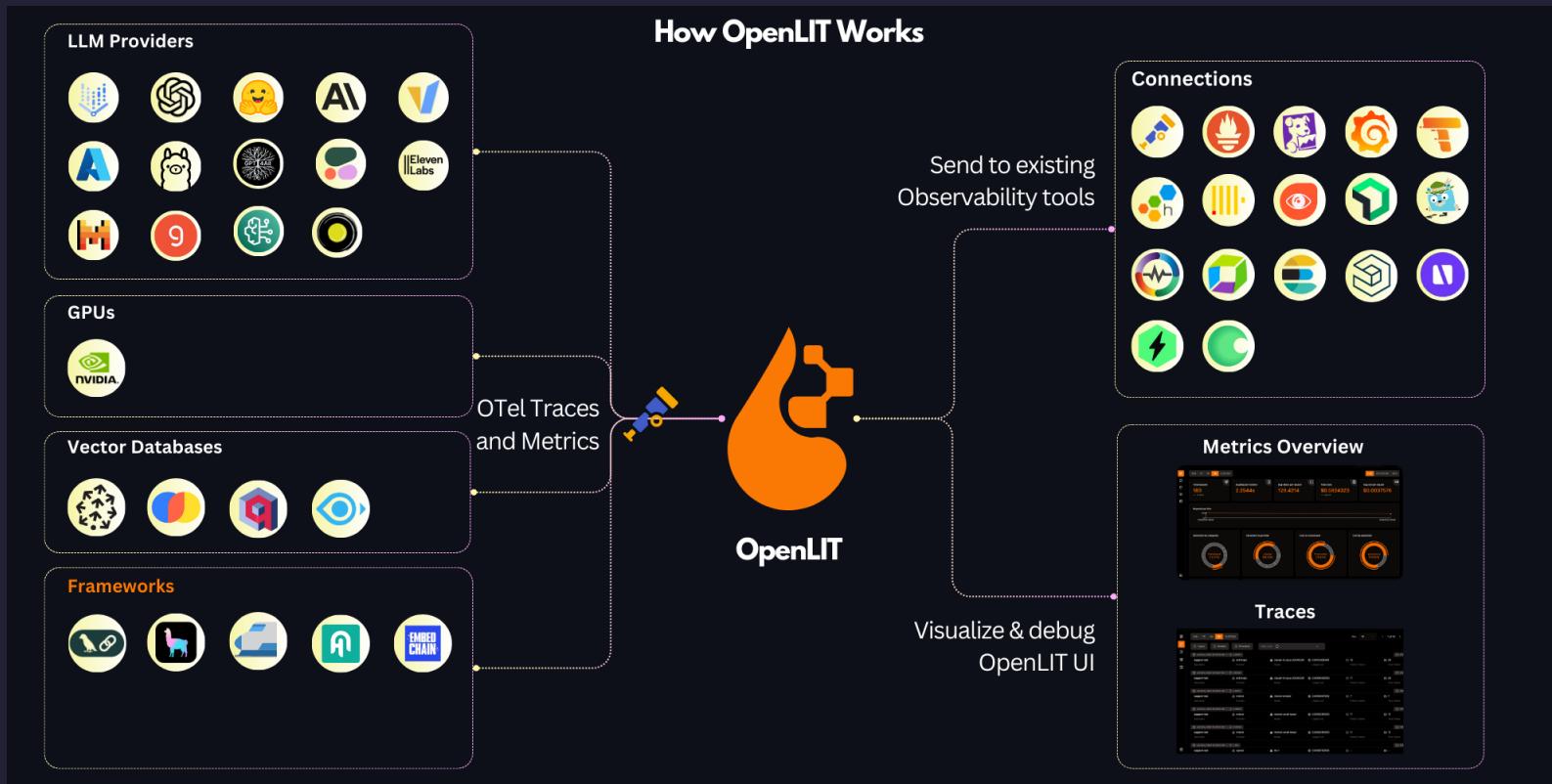
<https://github.com/open-telemetry/opentelemetry-ebpf-profiler>



# New Otel Feature

## LLM Observability

<https://github.com/openlit/openlit>



# References

- <https://opentelemetry.io/docs/>
- <https://w3c.github.io/trace-context/>
- <https://github.com/open-telemetry/opentelemetry-specification>
- <https://opentelemetry.io/docs/specs/semconv/>
- <https://opentelemetry.io/docs/specs/otel/protocol/>
- <https://opentelemetry.io/docs/concepts/sampling/>
- <https://opentelemetry.io/docs/demo/>
- <https://opentelemetry.io/blog/2024/>

# Thank You

@ddiwoong