OpenTelemetry Journey

2024.09

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Who am I?

- Jinwoong Kim
- Cloud Architect @AWS Professional Services
- Speaker, Translator
- @ddiiwoong

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======
```

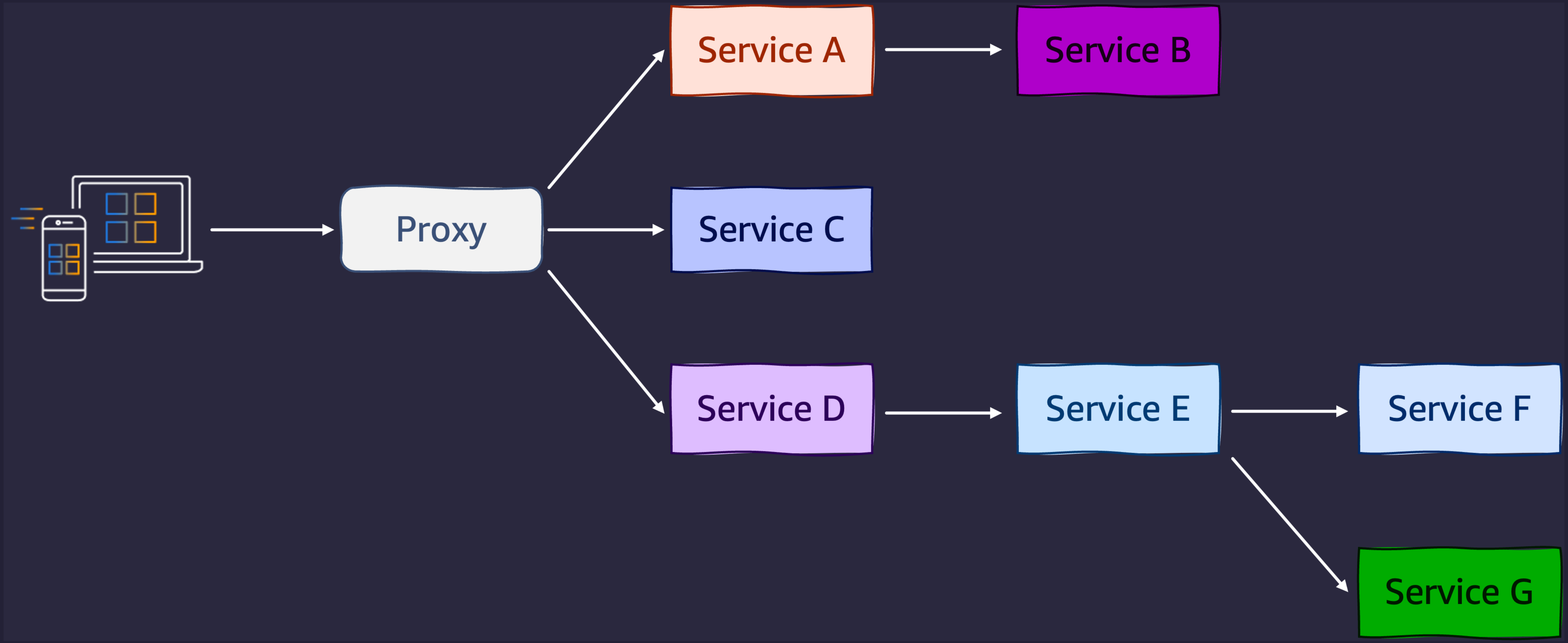
Distributed Trace

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

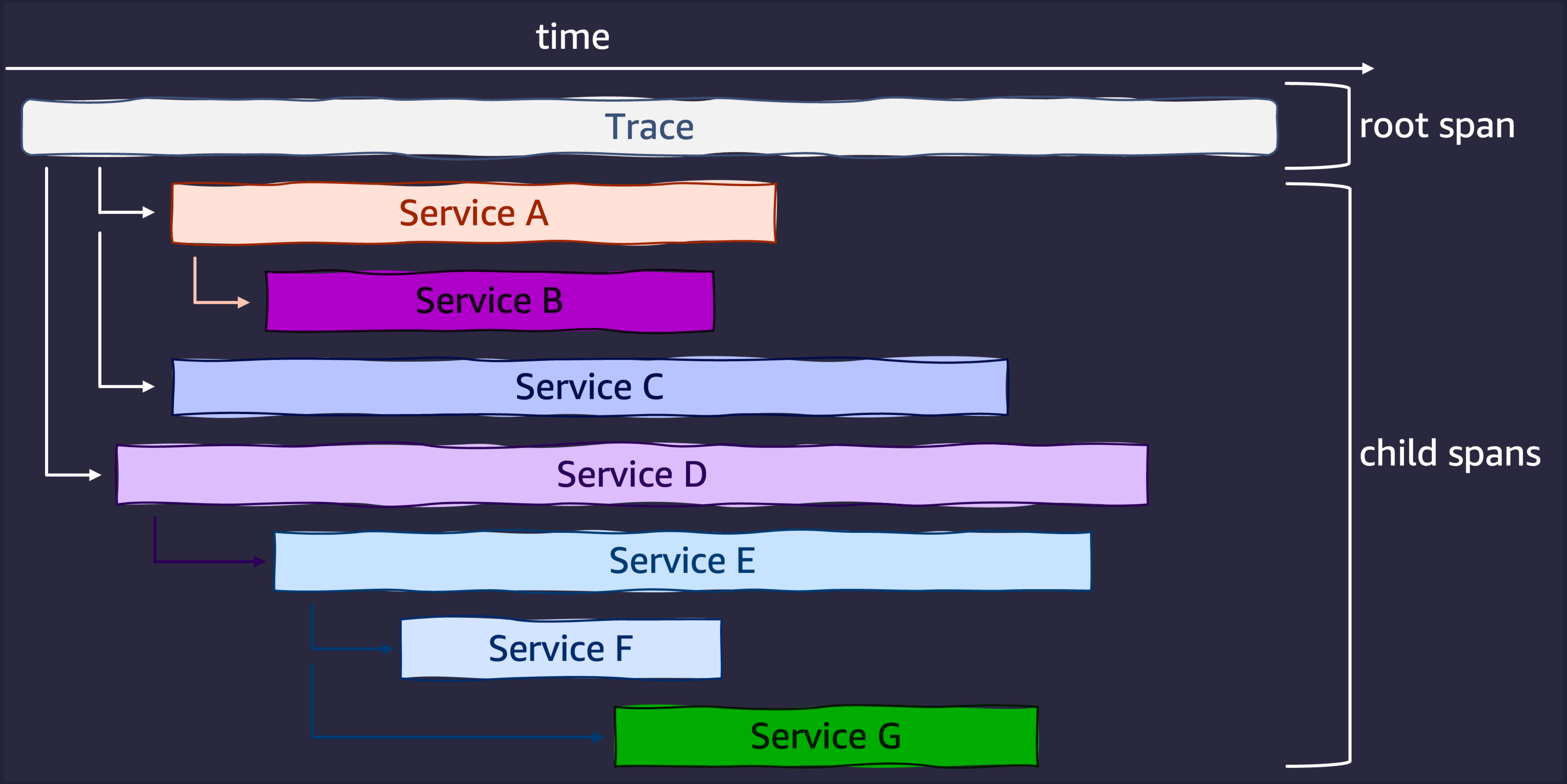
`Records` the path that requests take as they propagate through microservices and serverless architectures.

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

Trace

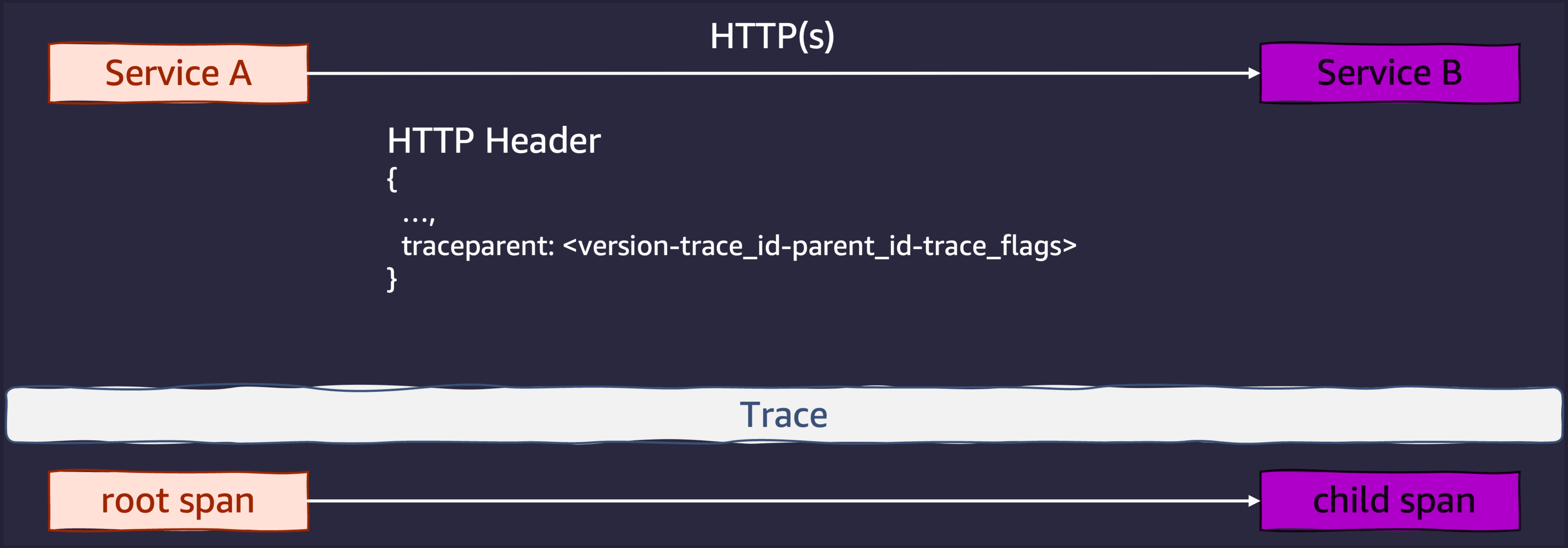

Proxy
Service A
Service B
Service C
Service D
Service E
Service F
Service G

Trace (Span)


time
Trace
root span
Service A
Service B
Service C
Service D
child spans
Service E
Service F
Service G

Trace - context propagation

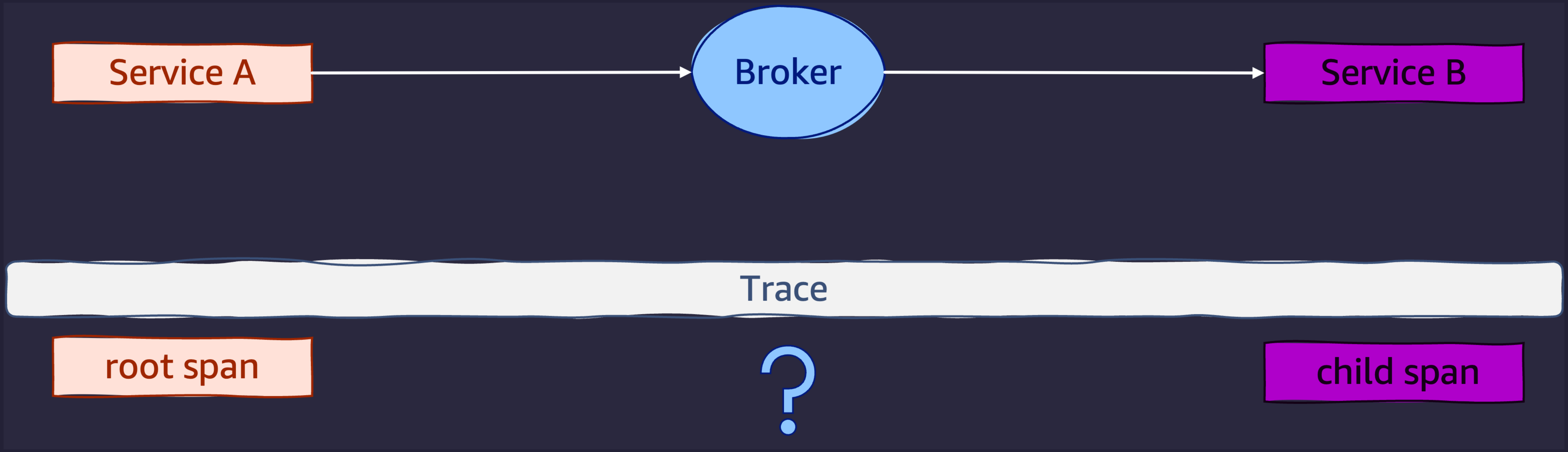
W3C Trace Context :https://w3c.github.io/trace-context/



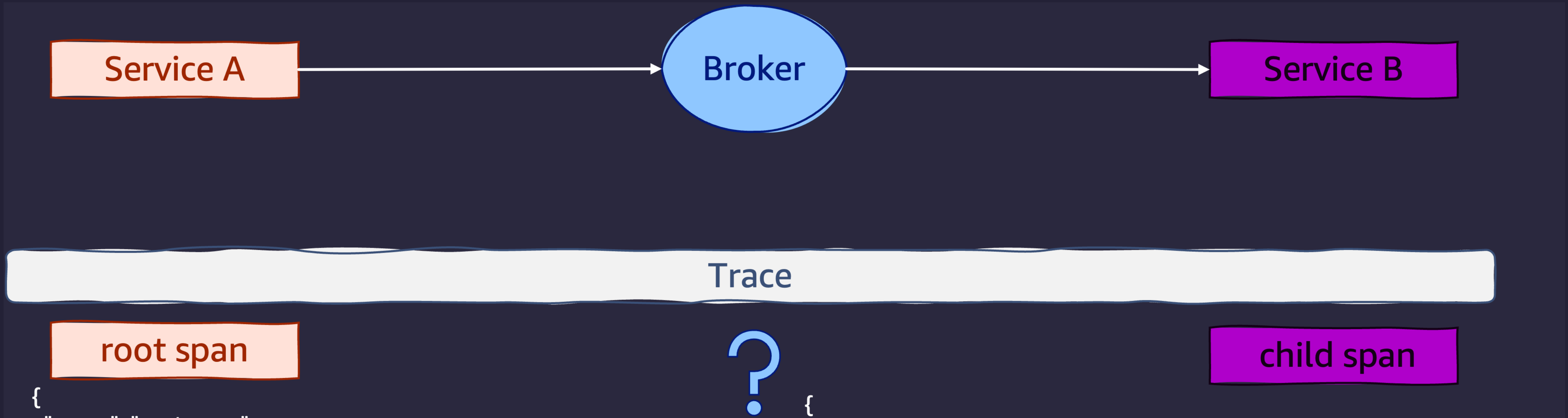
HTTP Header

```
{
  ...,
  traceparent: <version-trace_id-parent_id-trace_flags>
}
```

Trace - context propagation



Trace - context propagation



Service A

Broker

Service B

Trace

root span

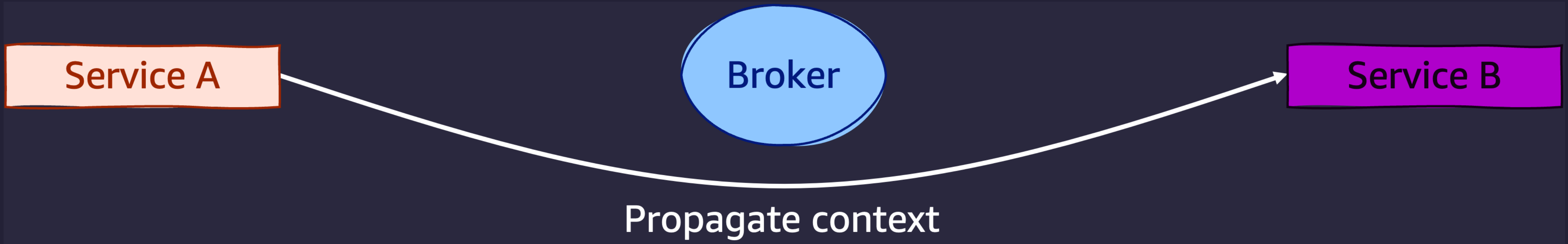
?

child span

```
{
  "name": "root-span",
  "context": {
    "trace_id": "0x5b8aa5a2d2c872e8321cf37308d69df2",
    "span_id": "0x051581bf3cb55c13"
  },
  "parent_id": null,
  "start_time": "2022-04-29T18:52:58.114201Z",
  "end_time": "2022-04-29T18:52:58.114687Z"
}
```

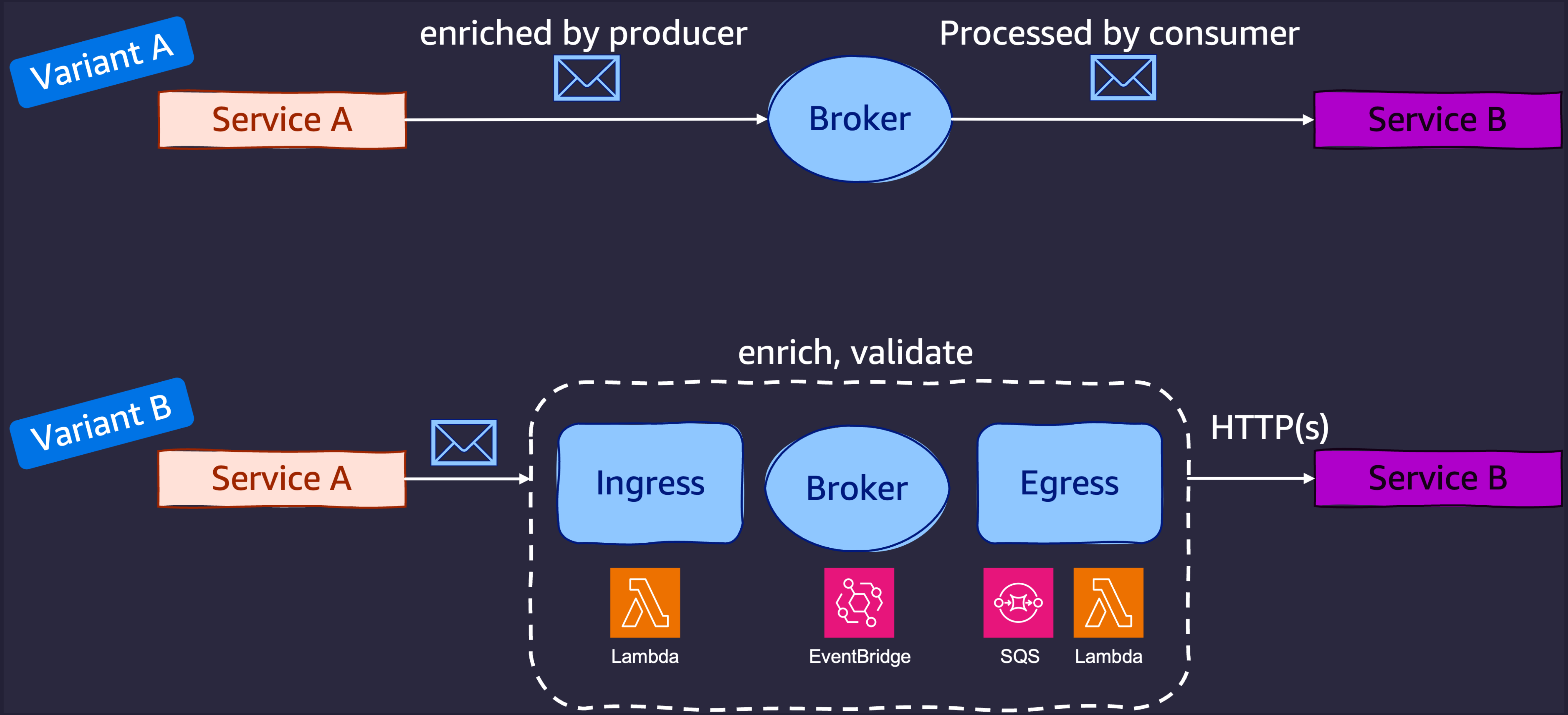
```
{
  "name": "child-span",
  "context": {
    "trace_id": "0x5b8aa5a2d2c872e8321cf37308d69df2",
    "span_id": "0x5fb397be34d26b51"
  },
  "parent_id": "0x051581bf3cb55c13",
  "start_time": "2022-04-29T18:52:58.114304Z",
  "end_time": "2022-04-29T22:52:58.114561Z"
}
```

Trace - context propagation



```
{
  "metadata": {
    < some mandatory fields like timestamps, domain information, ...>
    "otel": {
     "trace_parent": {
       "trace_id": "0x5b8aa...",
       "span_id": "0x05158..."
     }
    }
  },
  "data": {
    < original producer event >
  }
}
```

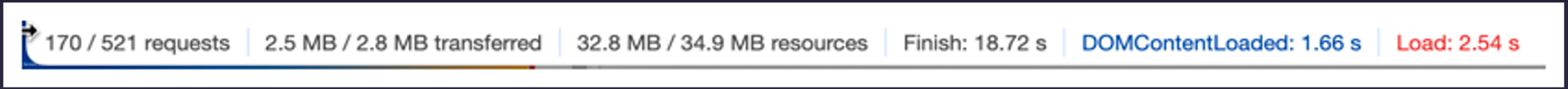
Trace - context propagation



Span

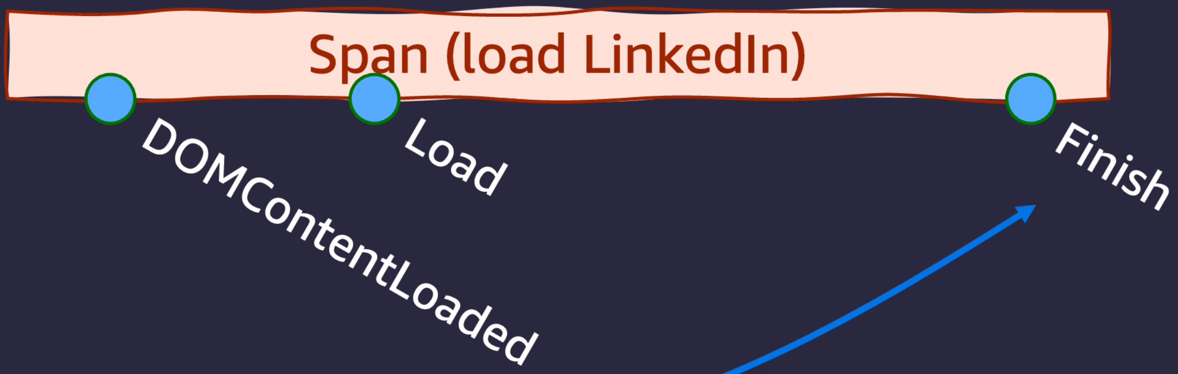
```
{
  "name": "/v1/sys/health",
  "context": {
    "trace_id": "7bba9f33312b3dbb8b2c2c62bb7abe2d",
    "span_id": "086e83747d0e381e"
  },
  "parent_id": "",
  "start_time": "2021-10-22 16:04:01.209458162 +0000 UTC",
  "end_time": "2021-10-22 16:04:01.209514132 +0000 UTC",
  "status_code": "STATUS_CODE_OK",
  "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



170 / 521 requests | 2.5 MB / 2.8 MB transferred | 32.8 MB / 34.9 MB resources | Finish: 18.72 s | DOMContentLoaded: 1.66 s | Load: 2.54 s

```
{
  "attributes": {
    "response_size": "2.5",
    "content_size": "2.8",
  },
  "events": [
    {
      "name": "Finish",
      "message": "OK",
      "timestamp": "2021-10-22 16:04:01.209512872 +0000 UTC"
    }
  ]
}
```

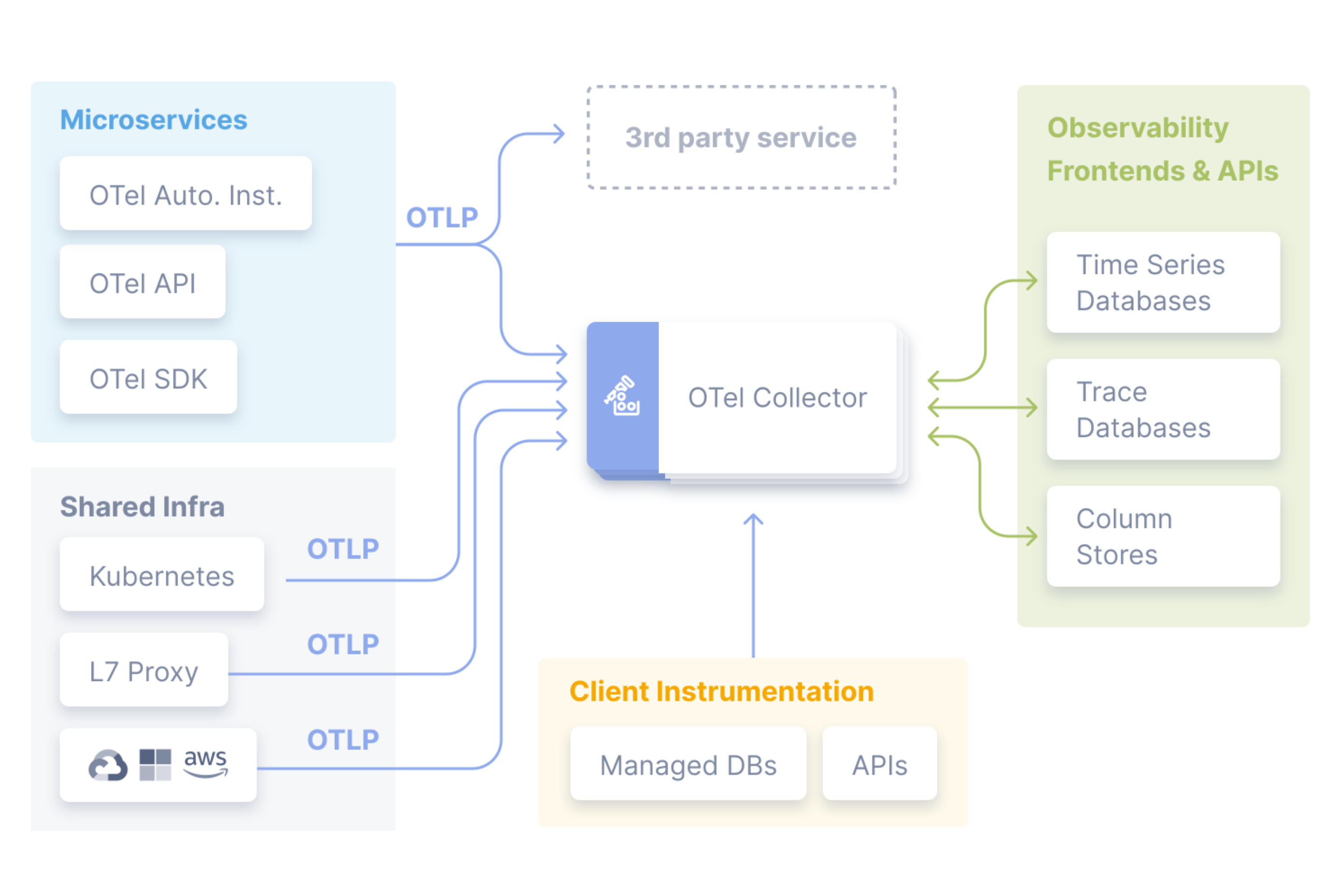


https://opentelemetry.io/docs/specs/otel/trace/exceptions/

Hello, OpenTelemetry

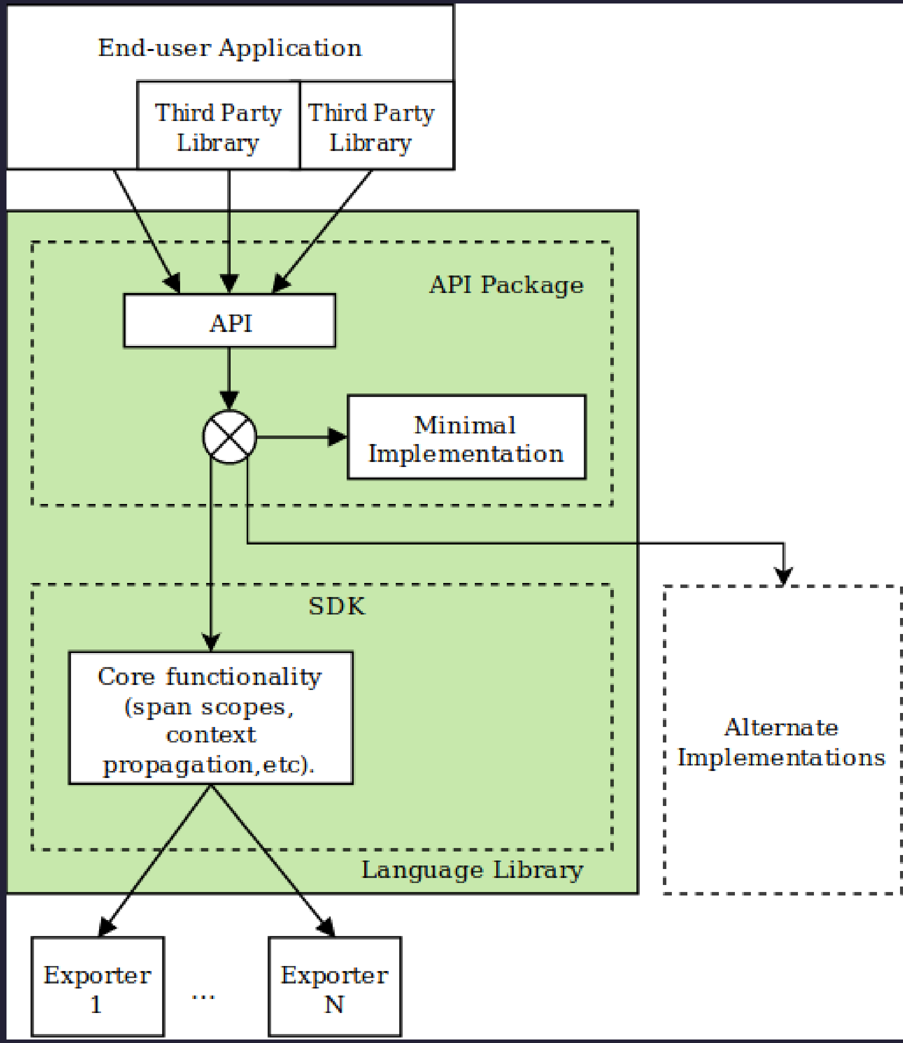
Open source project hosted on CNCF
Specifications, Implementations for instrumentation and transmissions of telemetry data (metrics, logs, traces)

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)

```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)

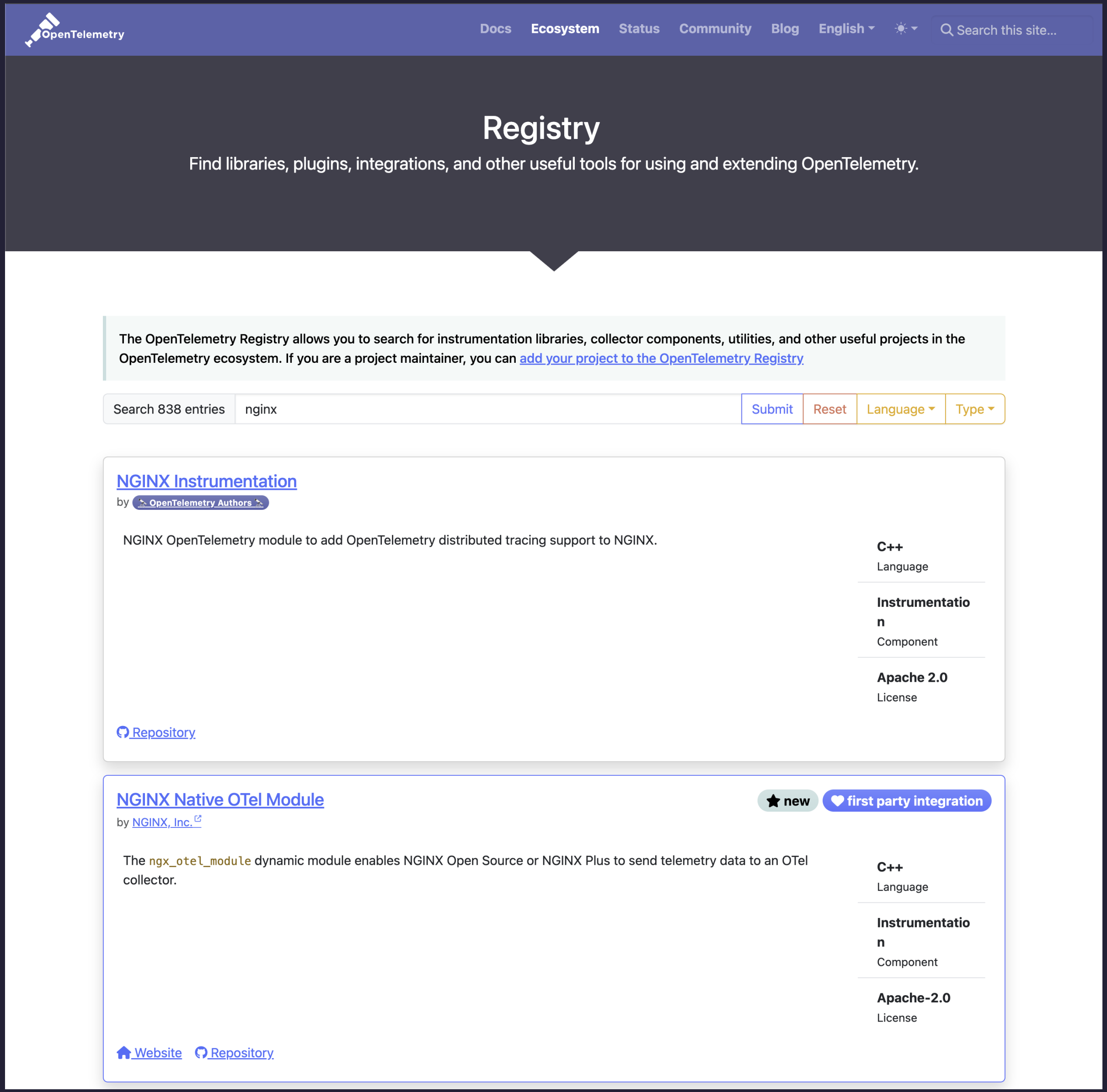
```python
instrumentor = FlaskInstrumentor()

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"
```

OpenTelemetry Registry

OpenTelemetry instrumentation libraries

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

Search `NGINX`



Registry

Find libraries, plugins, integrations, and other useful tools for using and extending OpenTelemetry.

The OpenTelemetry Registry allows you to search for instrumentation libraries, collector components, utilities, and other useful projects in the OpenTelemetry ecosystem. If you are a project maintainer, you can add your project to the OpenTelemetry Registry

Search 838 entries: nginx

NGINX Instrumentation

by OpenTelemetry Authors

NGINX OpenTelemetry module to add OpenTelemetry distributed tracing support to NGINX.

C++ Language

Instrumentation Component

Apache 2.0 License

Repository

NGINX Native OTel Module

new · first party integration

by NGINX, Inc.

The `ngx_otel_module` dynamic module enables NGINX Open Source or NGINX Plus to send telemetry data to an OTel collector.

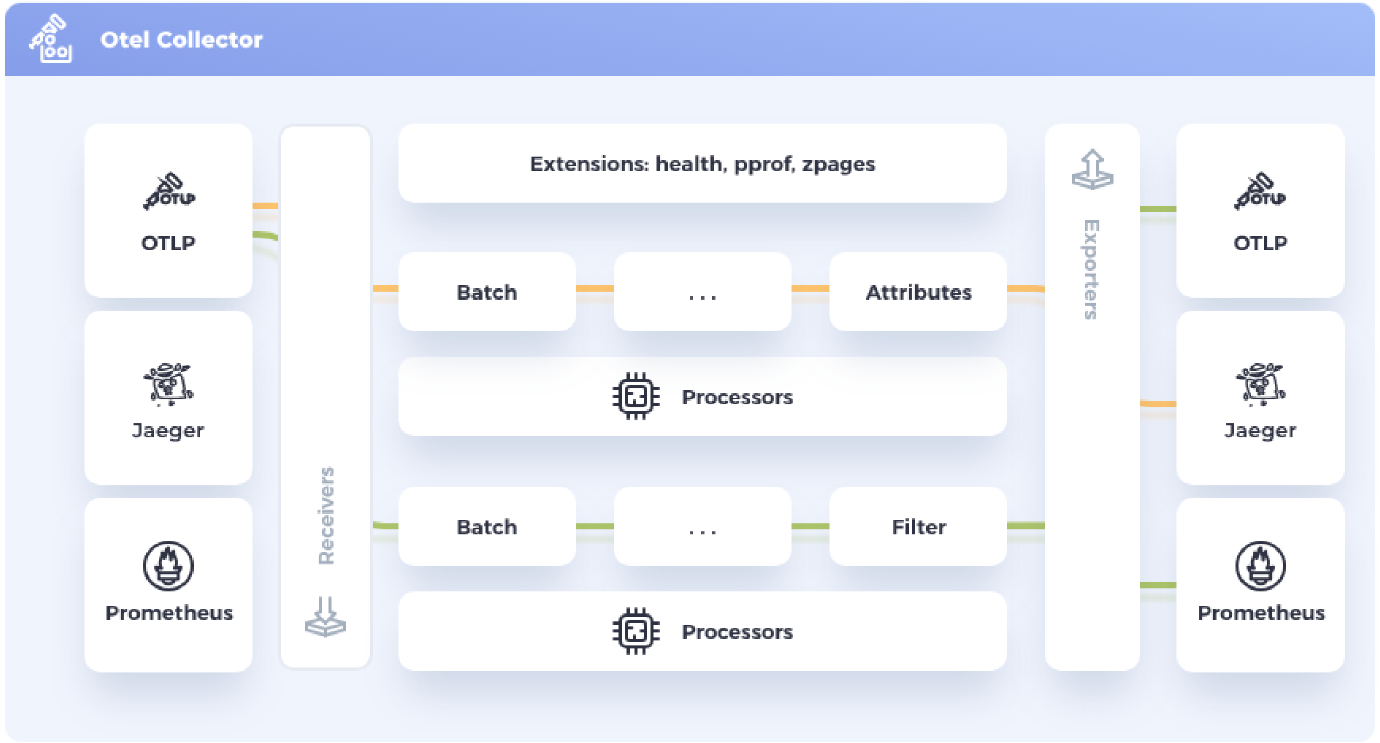
C++ Language

Instrumentation Component

Apache-2.0 License

Website · Repository

OpenTelemetry collector



OTEL COLLECTOR

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.

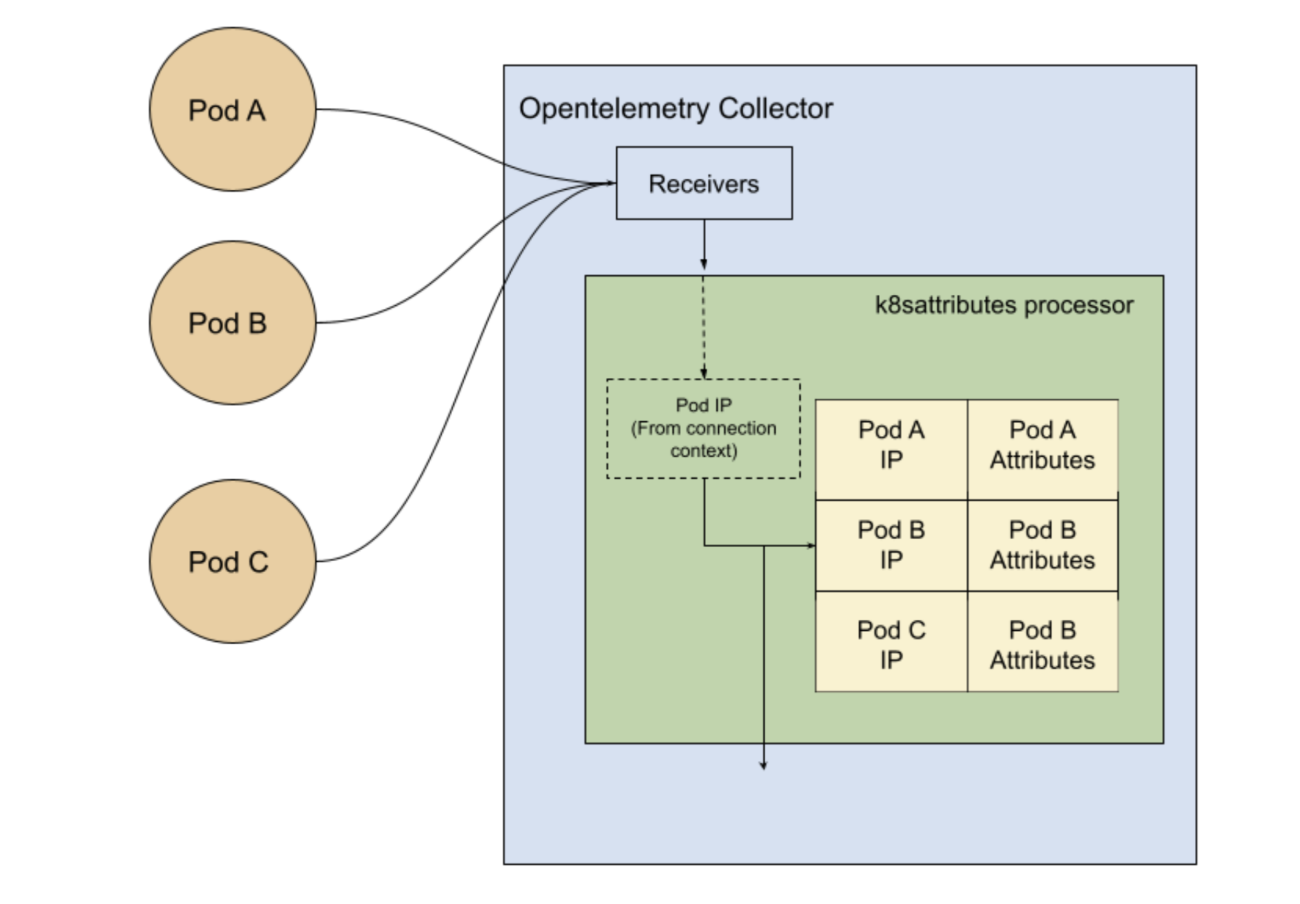
OTLP is a request/response style protocol where `clients` send requests and the `server` replies with corresponding responses.

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

Resource Semantic Conventions

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

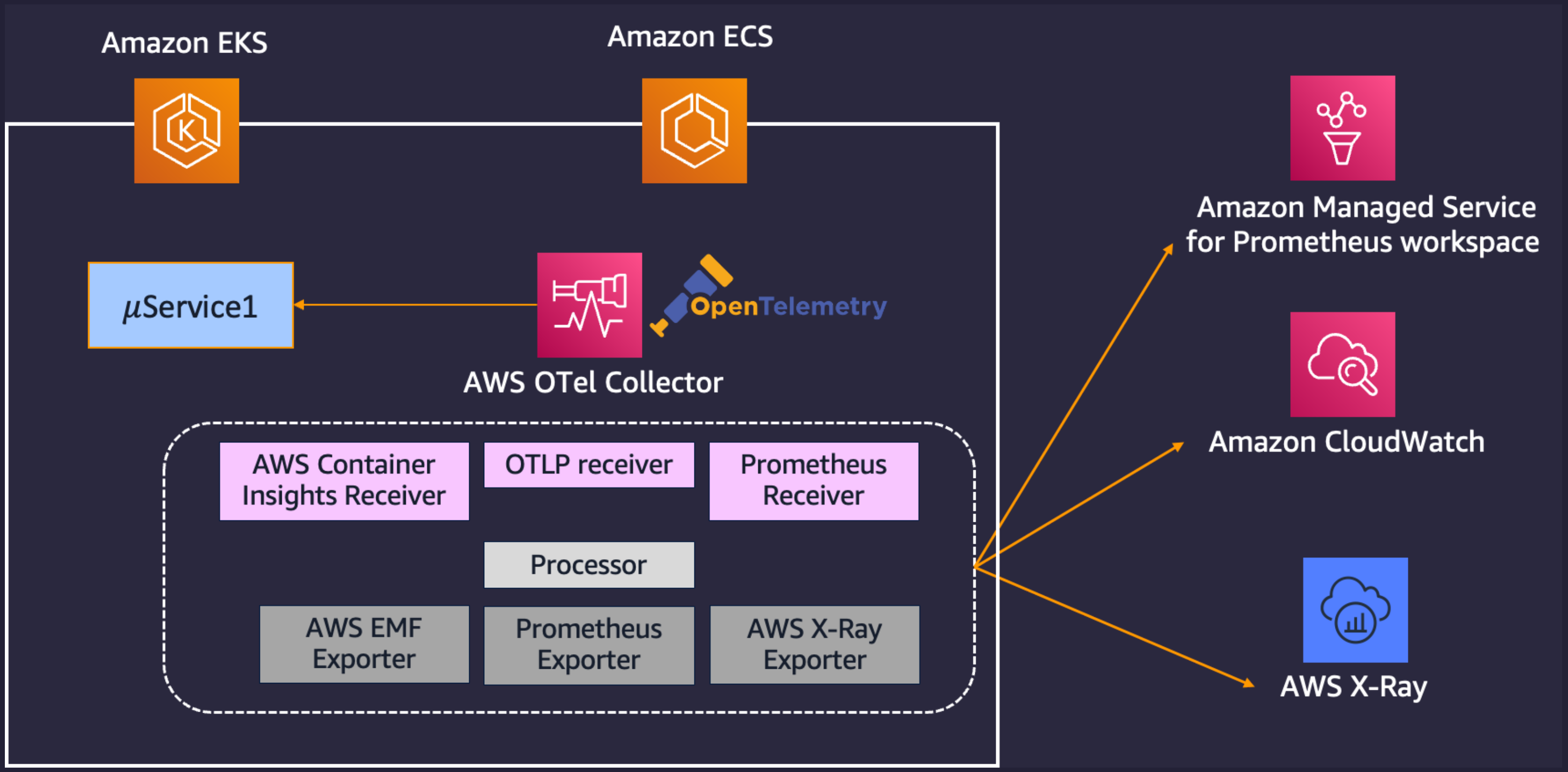
https://opentelemetry.io/docs/specs/semconv/



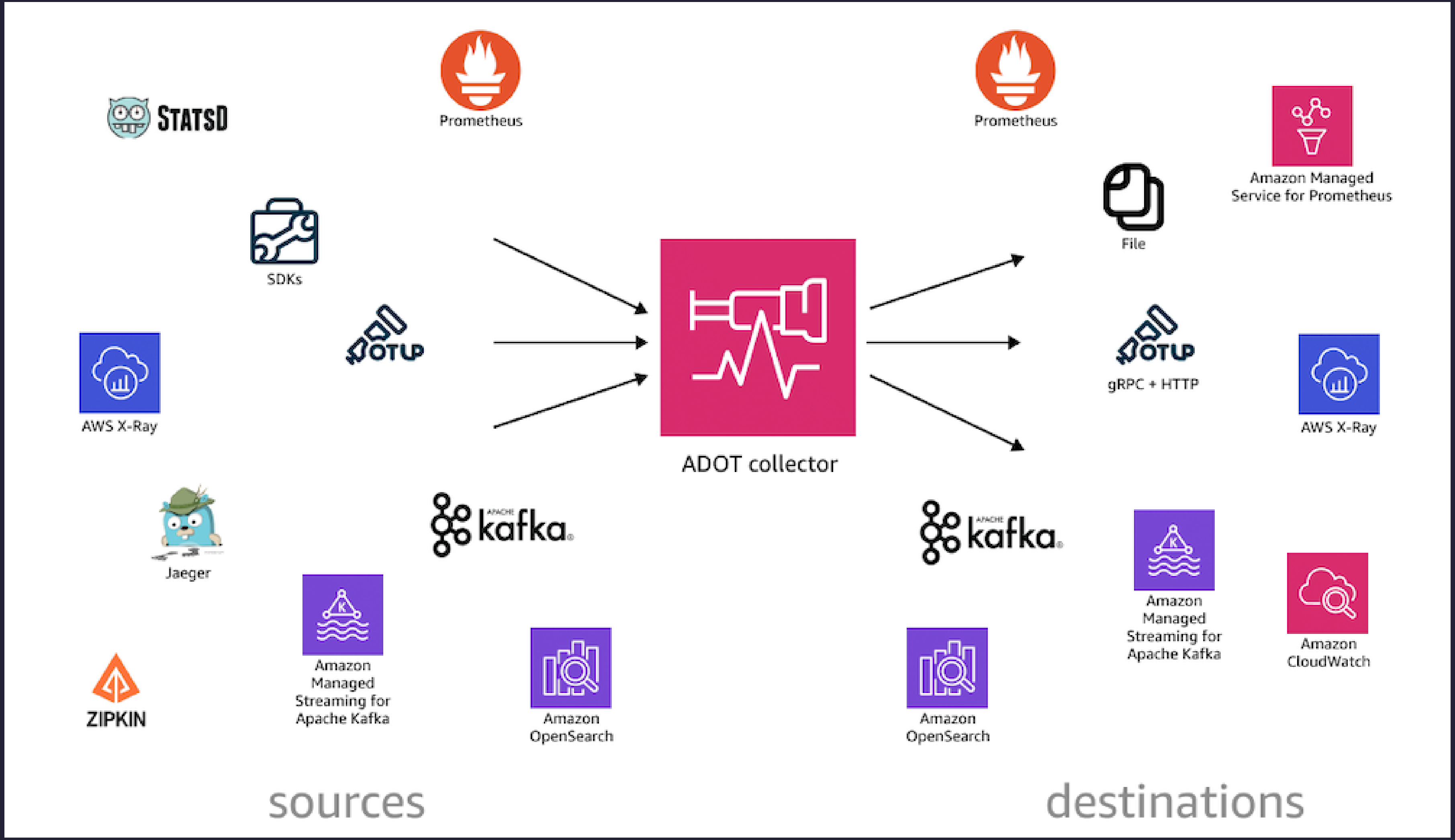
Pod A IP	Pod A Attributes
Pod B IP	Pod B Attributes
Pod C IP	Pod B Attributes

AWS Distro for OpenTelemetry (ADOT)

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



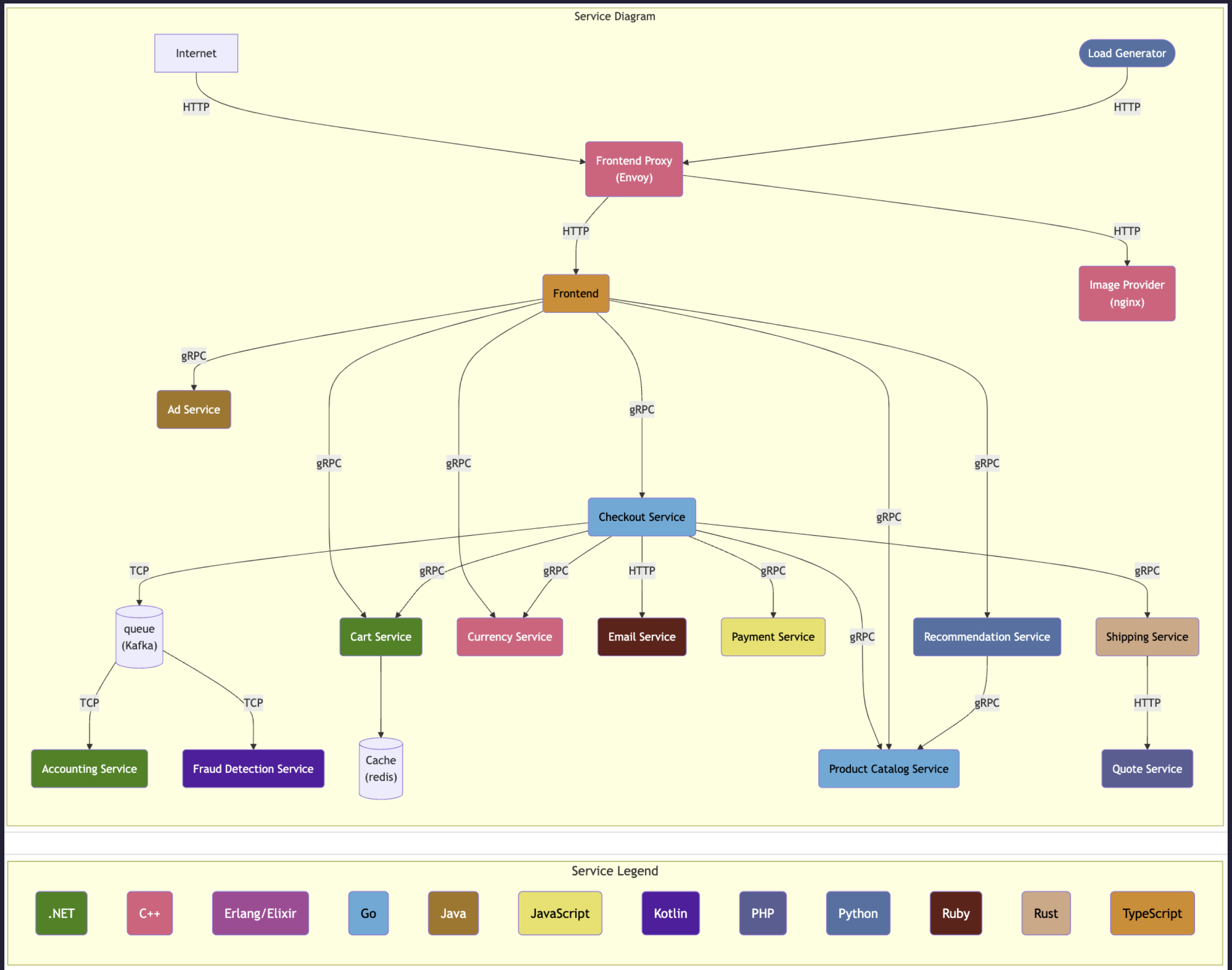
AWS Distro for OpenTelemetry (ADOT)



OpenTelemetry 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

Envoy and Istio

Profiling Agent

LLM Observability

OpenTelemetry Collector Antipatterns

References

- https://opentelemetry.io/docs/
- https://w3c.github.io/trace-context/
- https://w3c.github.io/baggage/
- 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