OpenTelemetry Journey

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Who am I?

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- 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 - 무슨 일이 일어난거야? (Lines of text)

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

Metrics - 어떤 지표가 문제야? (Time-orderd set of data)

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

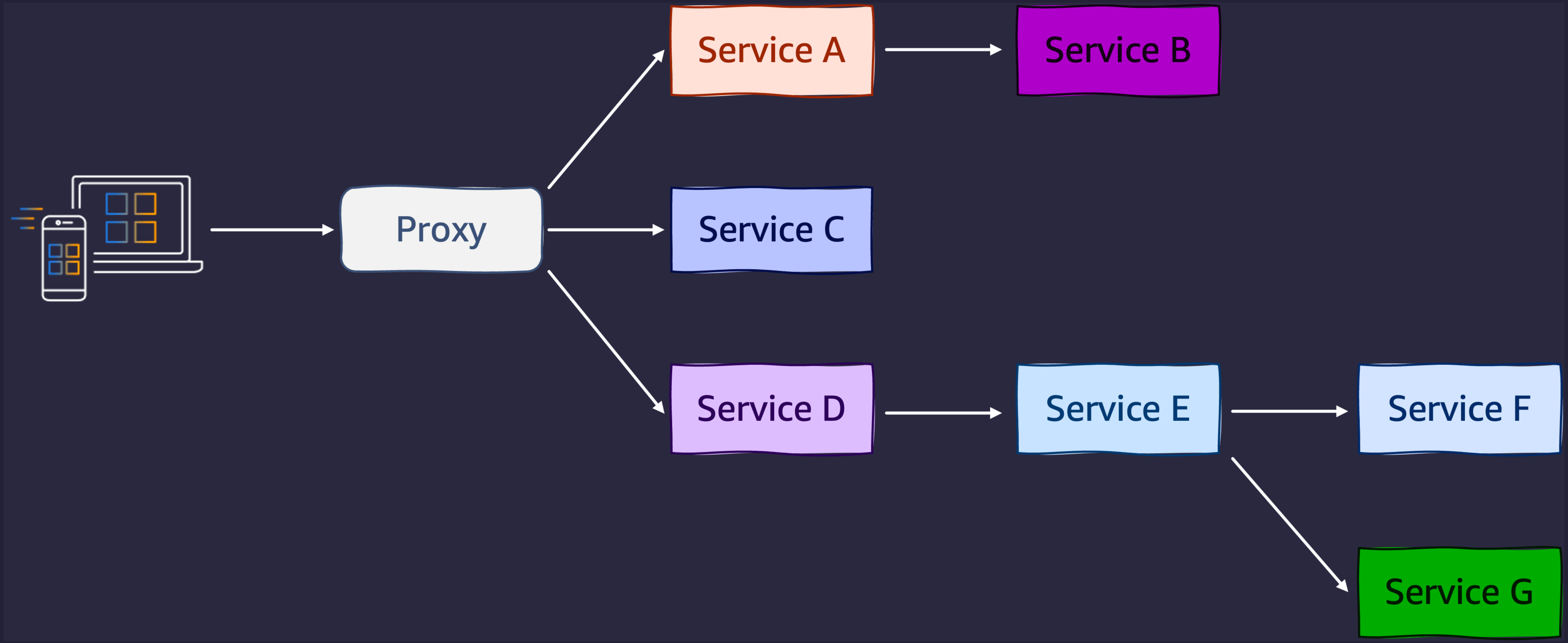
Tracing - 그 일이 왜 일어났지? (Correlation analysis with Context)

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

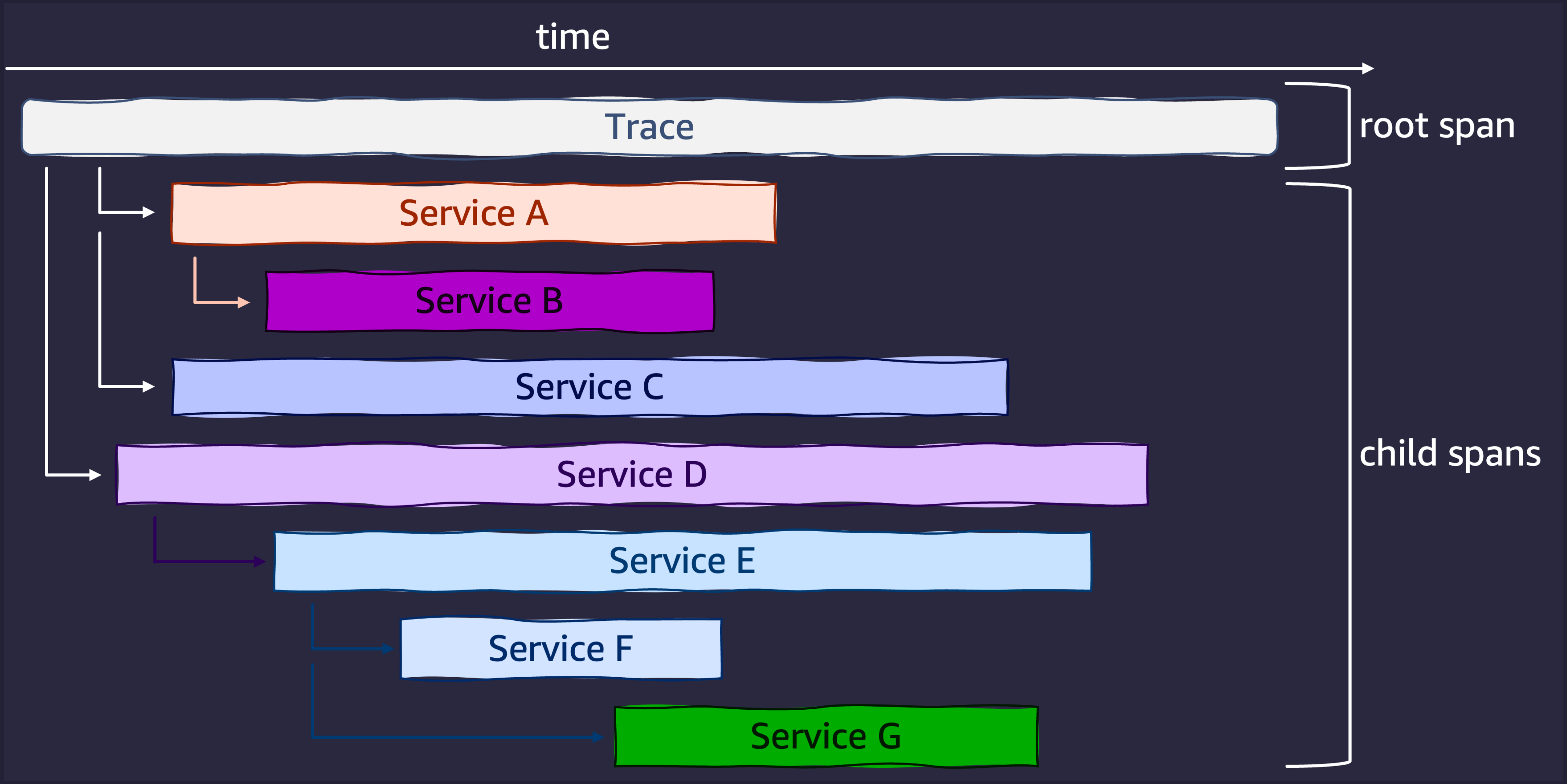
Distributed Trace

- 시스템의 프로세스에서 특정 부분의 지연(latency)을 알려주는 원격 측정(telemetry)방법
- 요청(Requests)이 마이크로서비스 및 서버리스 아키텍처를 통해 전파될때 이동하는 경로를 기록
- 마이크로서비스 환경같은 최신 아키텍처에서 수많은 구성 요소간의 종속성과 관계를 측정하고 지연 병목을 찾아내는 도구이기 때문에 Observability에서 매우 중요

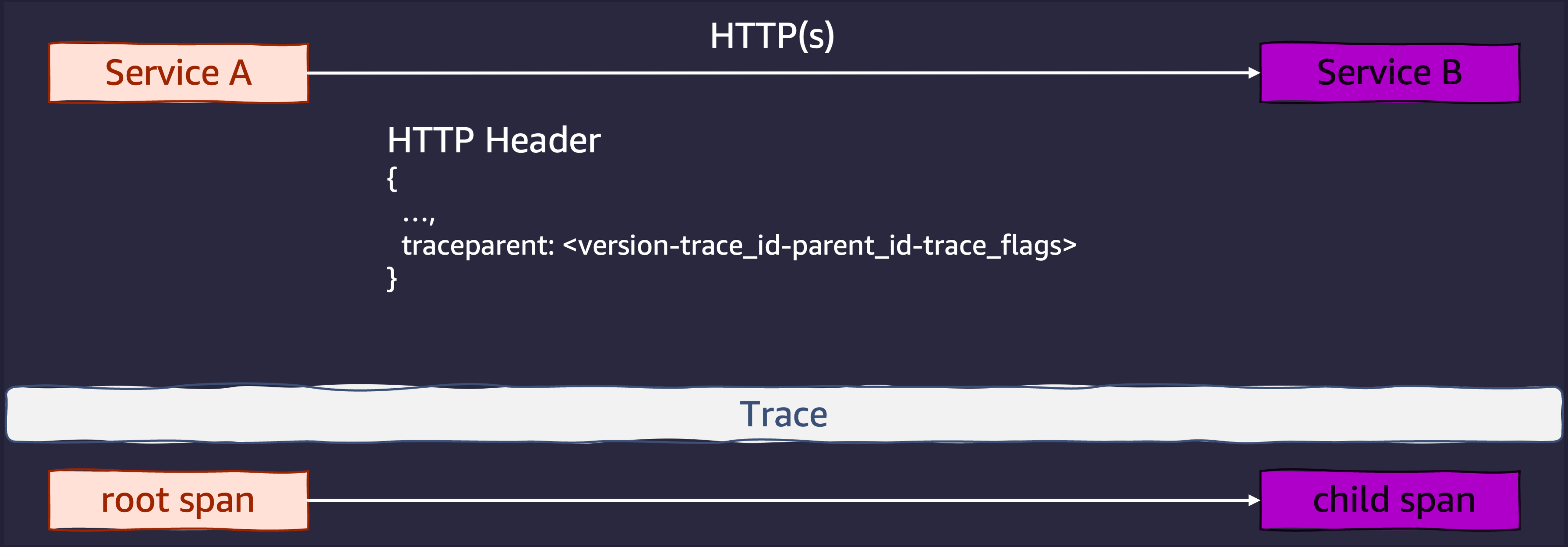
Trace


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

Trace (Span)

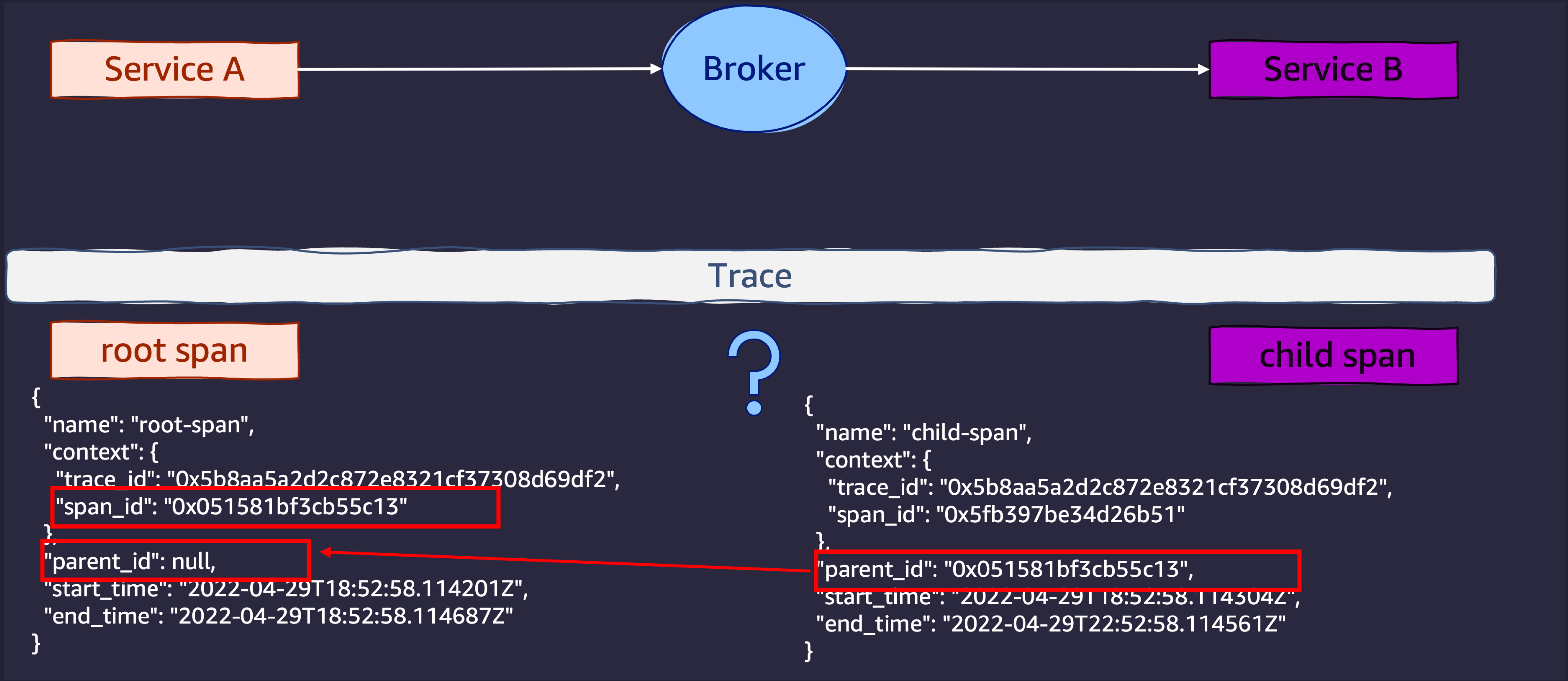

time
Trace
root span
Service A
Service B
Service C
Service D
Service E
Service F
Service G
child spans

Trace - context propagation



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

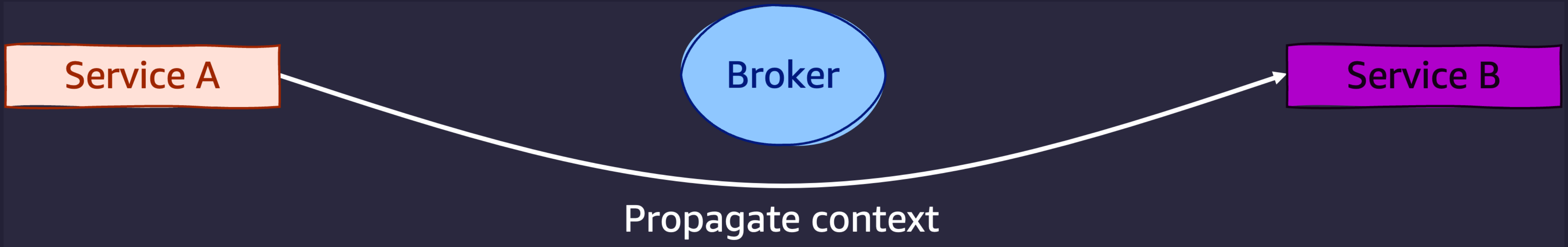
Trace - context propagation



```
{
  "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"
}
```

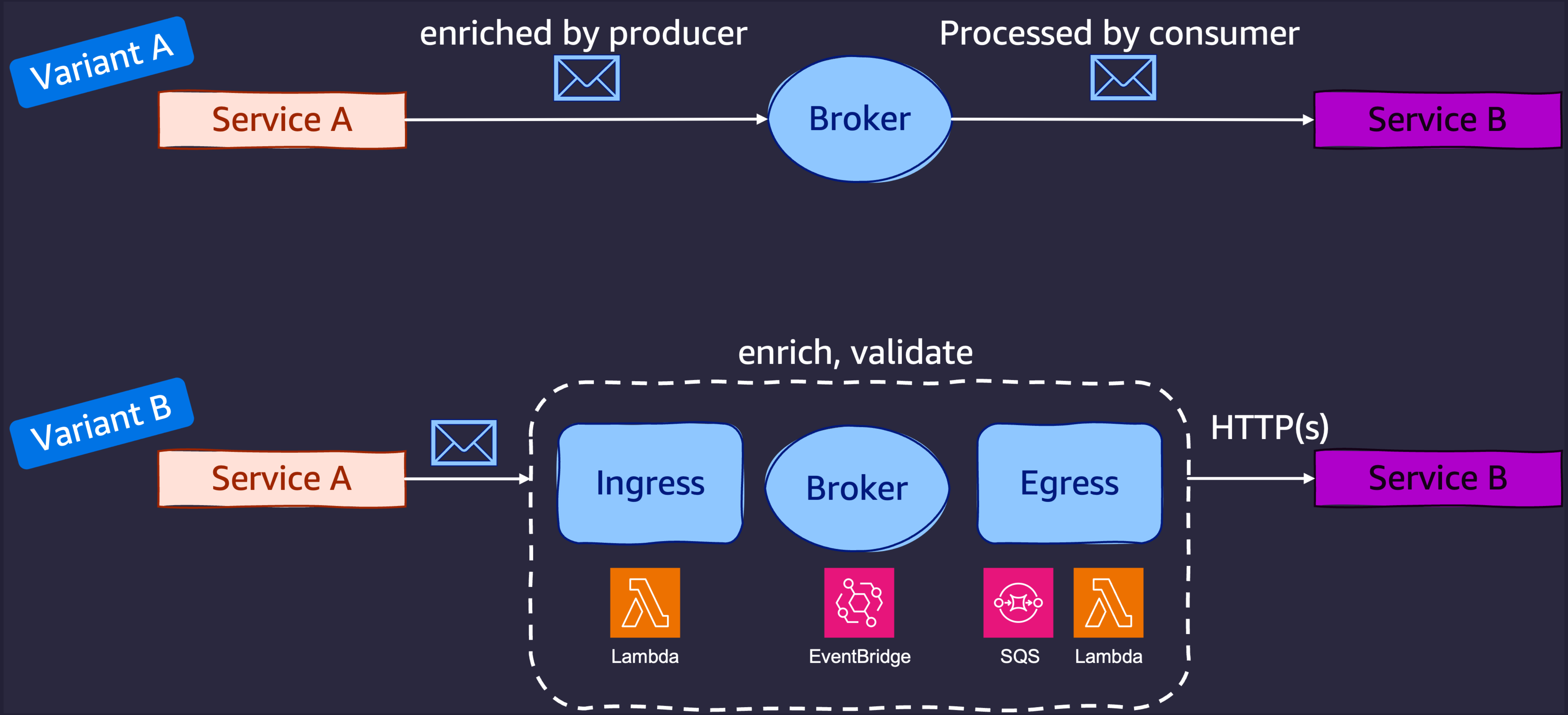
```
{
  "name": "child-span",
  "context": {
    "trace_id": "0x5b8aa5a2d2c872e8321cf37308d69df2",
    "span_id": "0x5fb397be34d26b51"
  },
  "parent_id": "0x051581bf3cb55c13",
  "start_time": "2022-04-29T18:52:58.114304Z",
  "end_time": "2022-04-29T22:52:58.114561Z"
}
```

Trace - context propagation



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

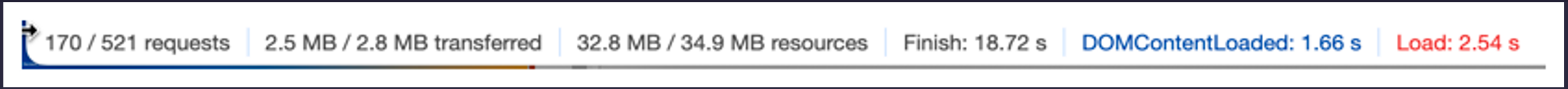
Trace - context propagation



Span

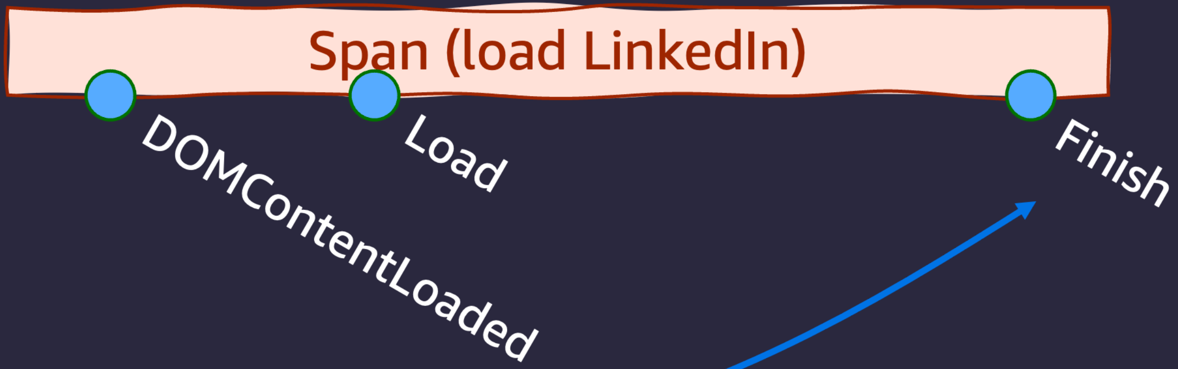
```
{
  "name": "/v1/sys/health",
  "context": {
    "trace_id": "7bba9f33312b3dbb8b2c2c62bb7abe2d",
    "span_id": "086e83747d0e381e"
  },
  "parent_id": "",
  "start_time": "2021-10-22 16:04:01.209458162 +0000 UTC",
  "end_time": "2021-10-22 16:04:01.209514132 +0000 UTC",
  "status_code": "STATUS_CODE_OK",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

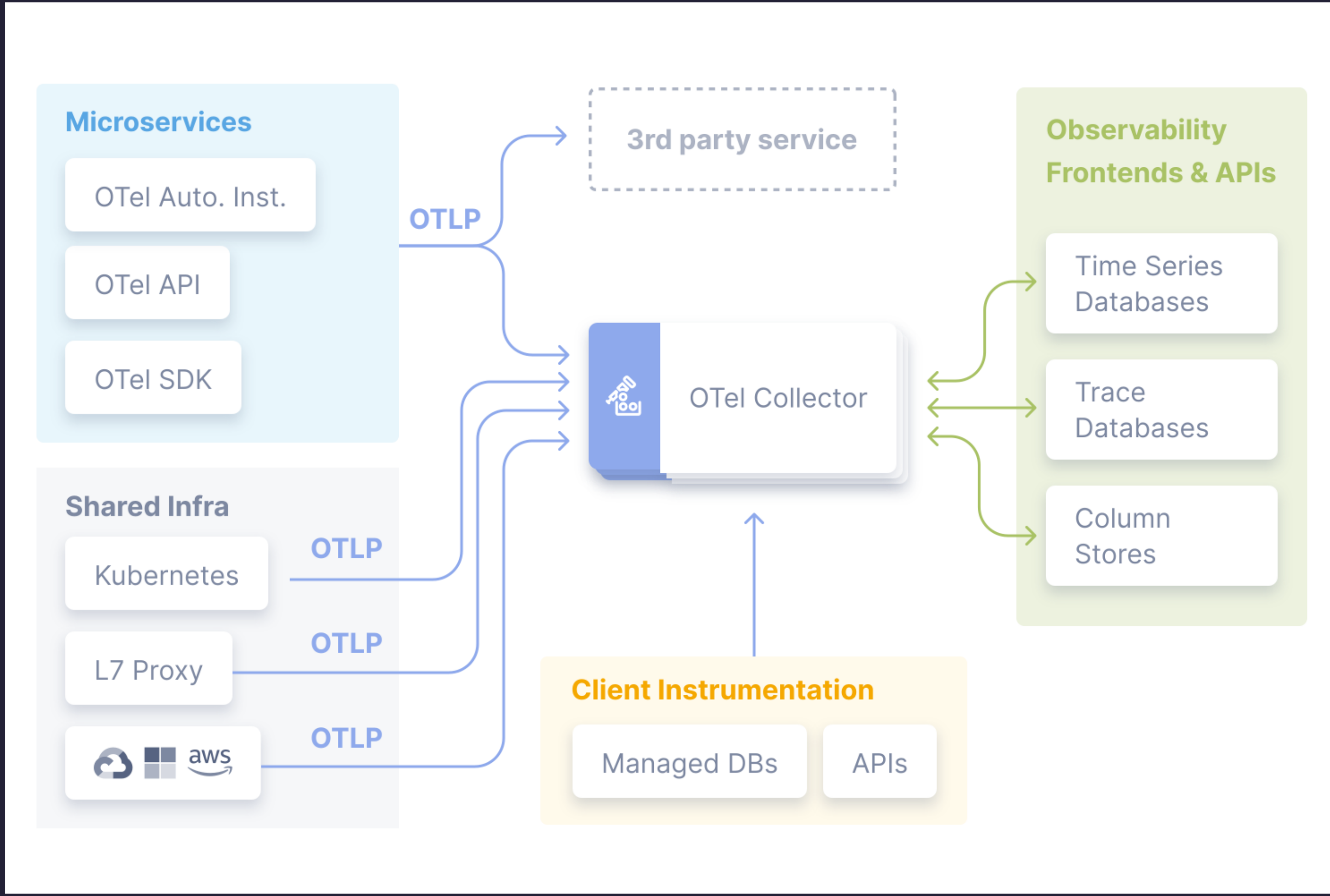
```
{
  "attributes": {
    "response_size": "2.5",
    "content_size": "2.8",
  },
  "events": [
    {
      "name": "Finish",
      "message": "OK",
      "timestamp": "2021-10-22 16:04:01.209512872 +0000 UTC"
    }
  ]
}
```



Hello, OpenTelemetry

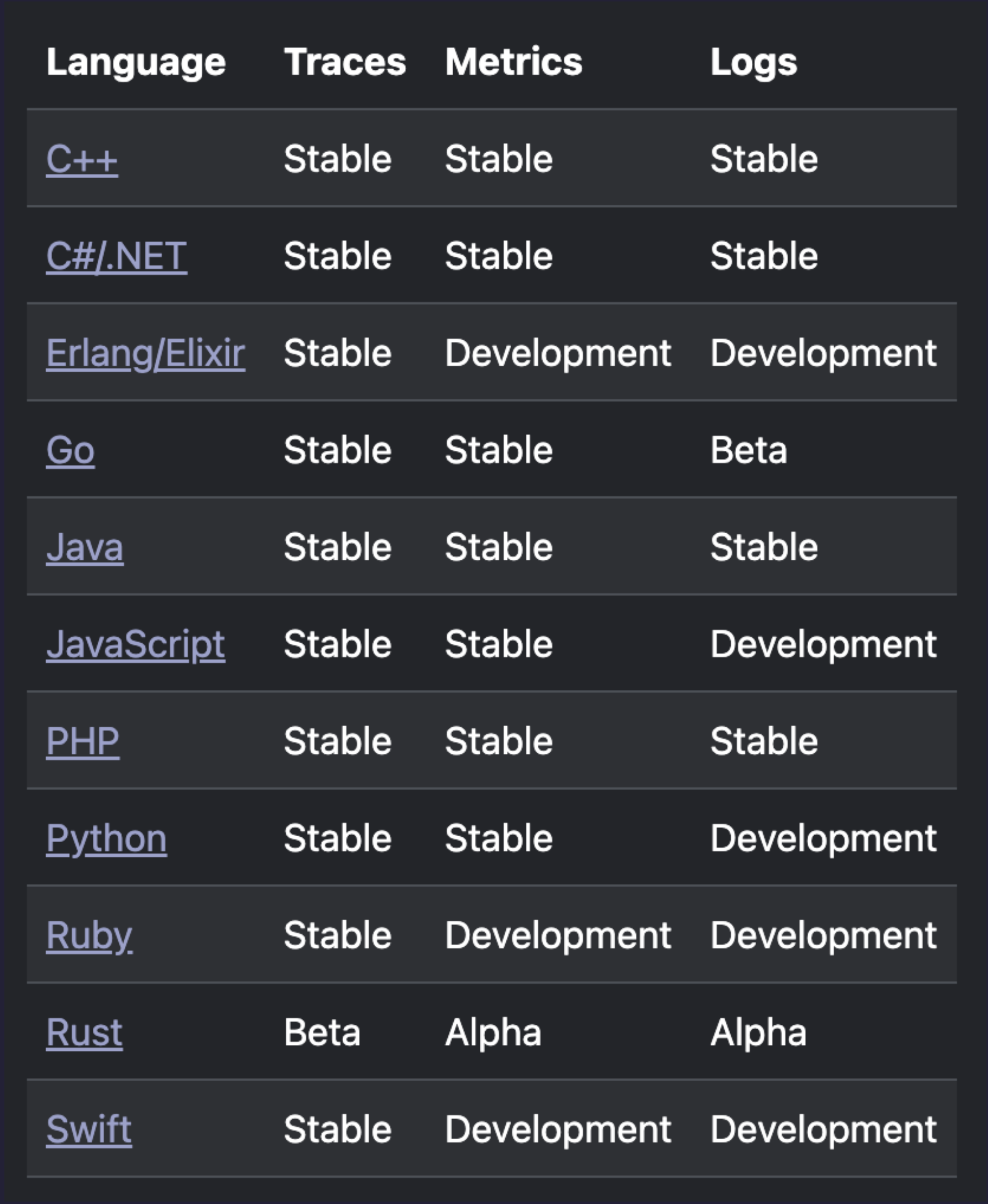
Open source project hosted on CNCF
Specifications, Implementations for instrumentation and transmissions of telemetry data (metrics, logs, traces)

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



Language	Traces	Metrics	Logs
C++	Stable	Stable	Stable
C#/.NET	Stable	Stable	Stable
Erlang/Elixir	Stable	Development	Development
Go	Stable	Stable	Beta
Java	Stable	Stable	Stable
JavaScript	Stable	Stable	Development
PHP	Stable	Stable	Stable
Python	Stable	Stable	Development
Ruby	Stable	Development	Development
Rust	Beta	Alpha	Alpha
Swift	Stable	Development	Development

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)

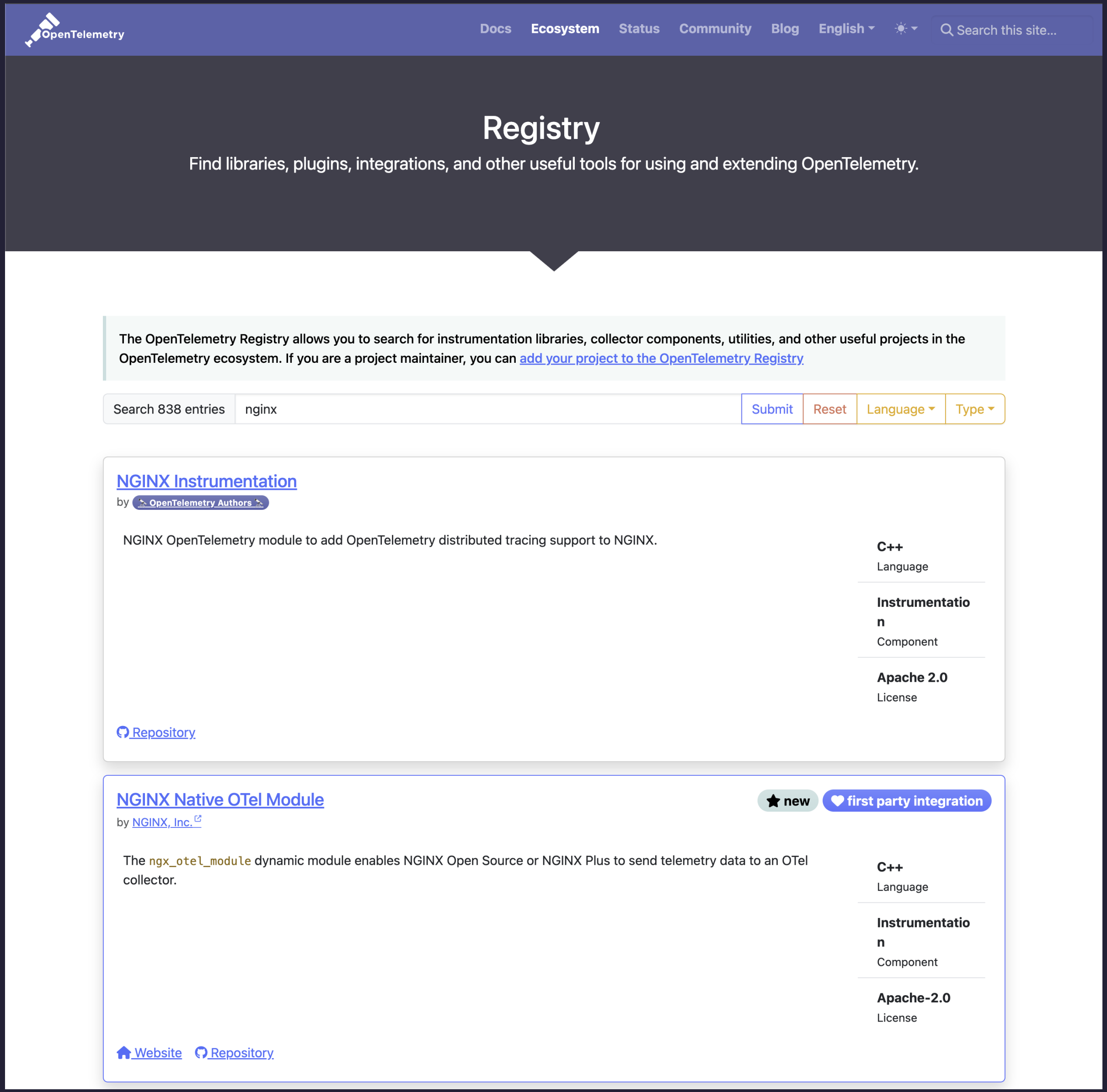
```python
instrumentor = FlaskInstrumentor()

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

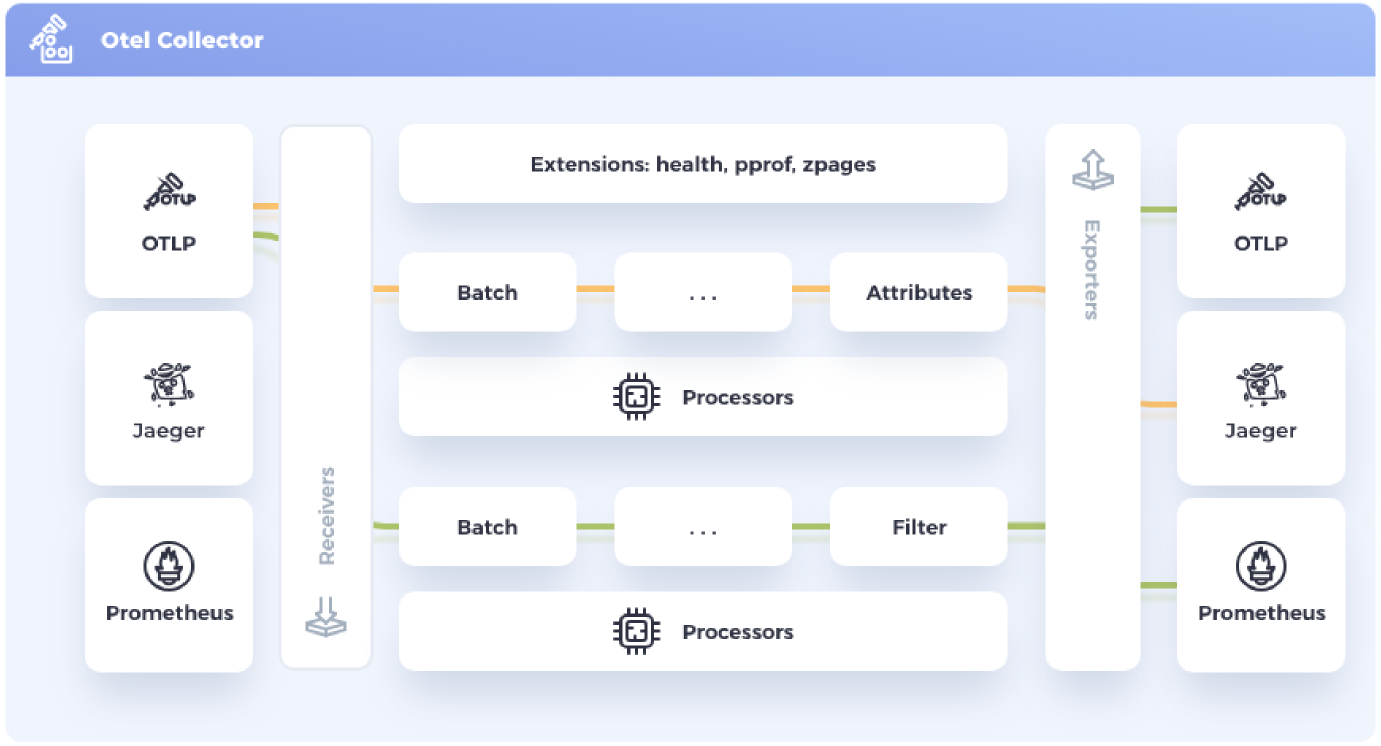
NGINX Native OTel Module — new — first party integration
by NGINX, Inc.

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.

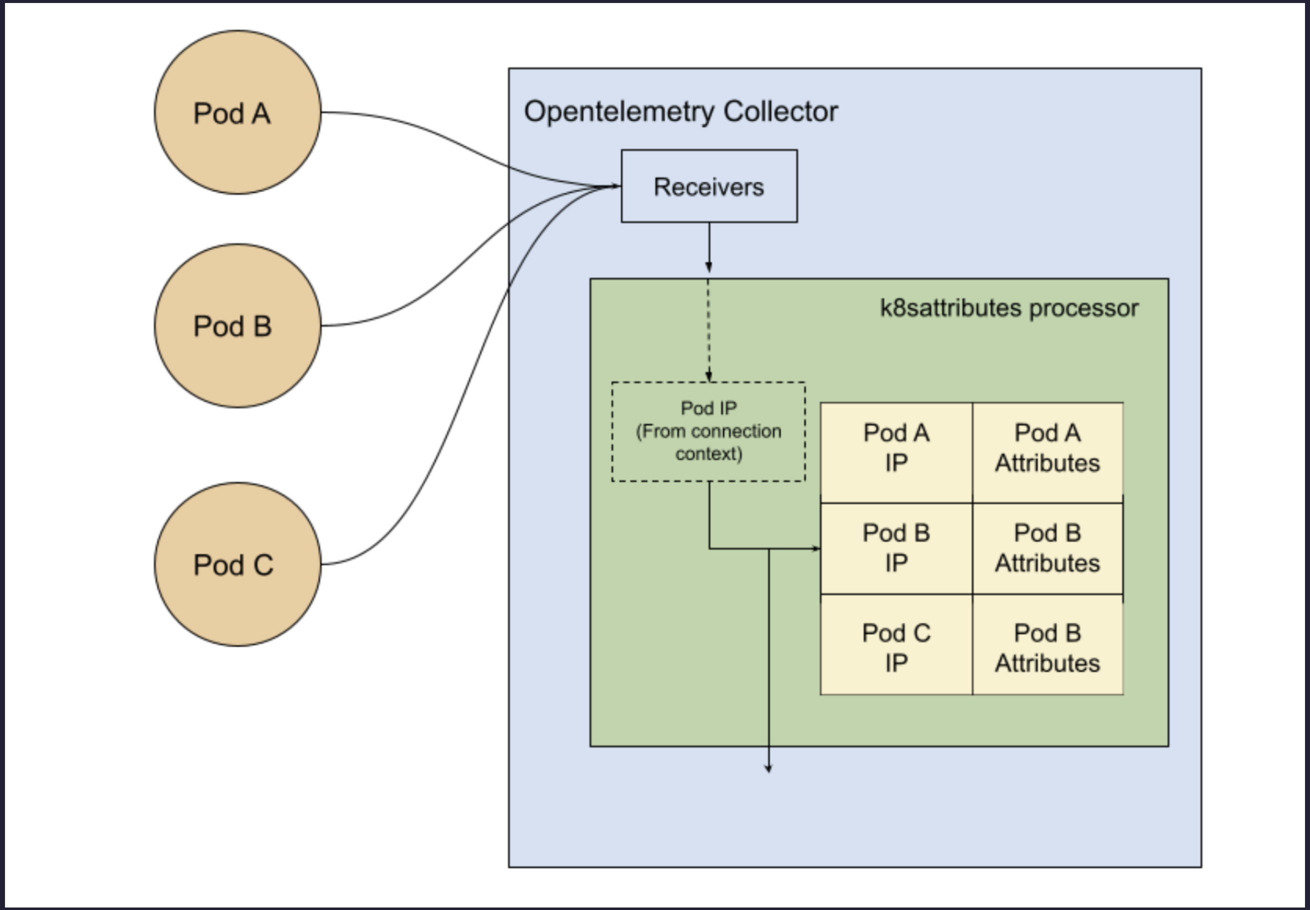
OTLP is a request/response style protocol where `clients` send requests and the `server` replies with corresponding responses.

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

Resource Semantic Conventions

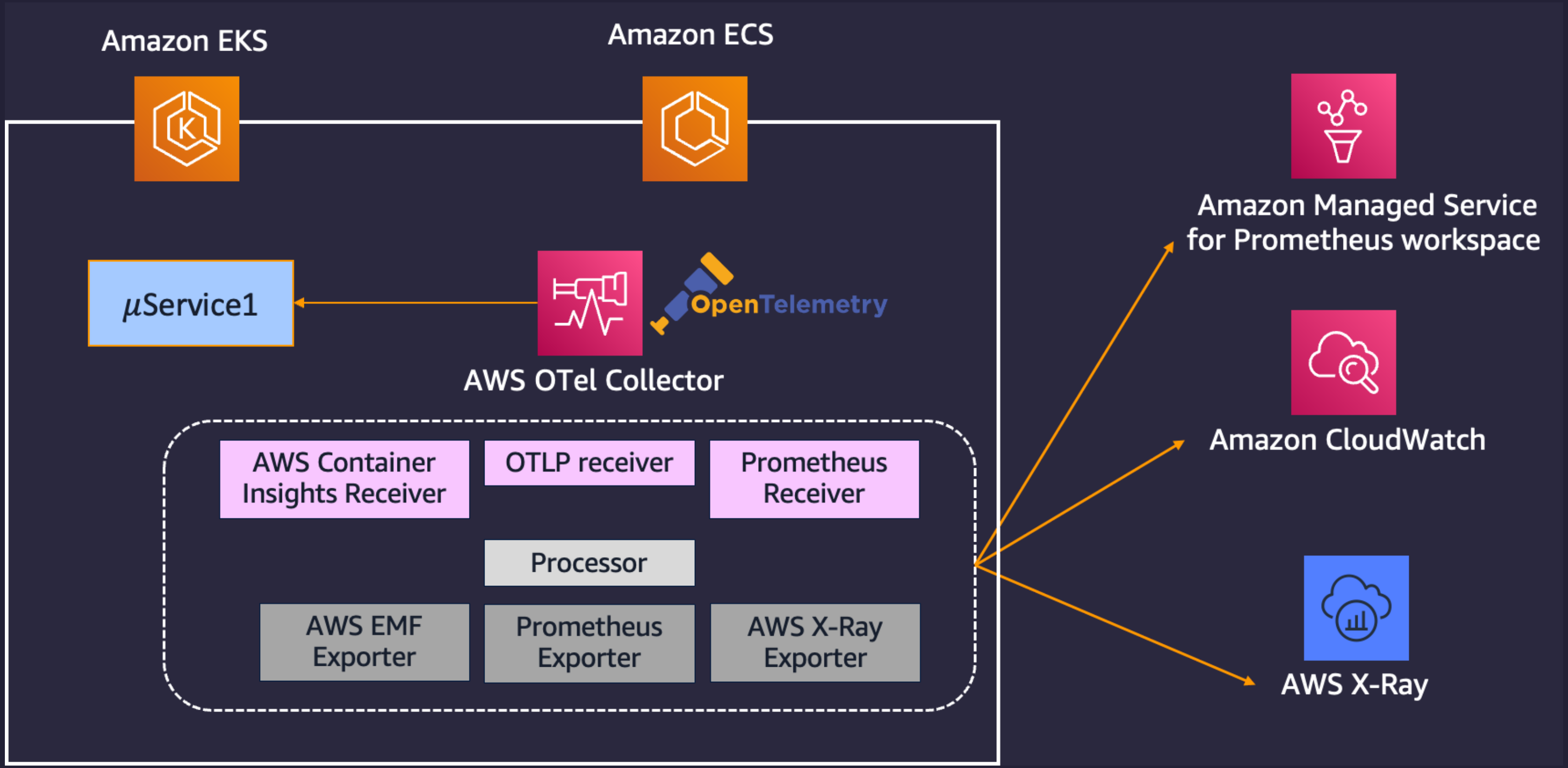
A `Resource` represents the entity producing telemetry as resource attributes.

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

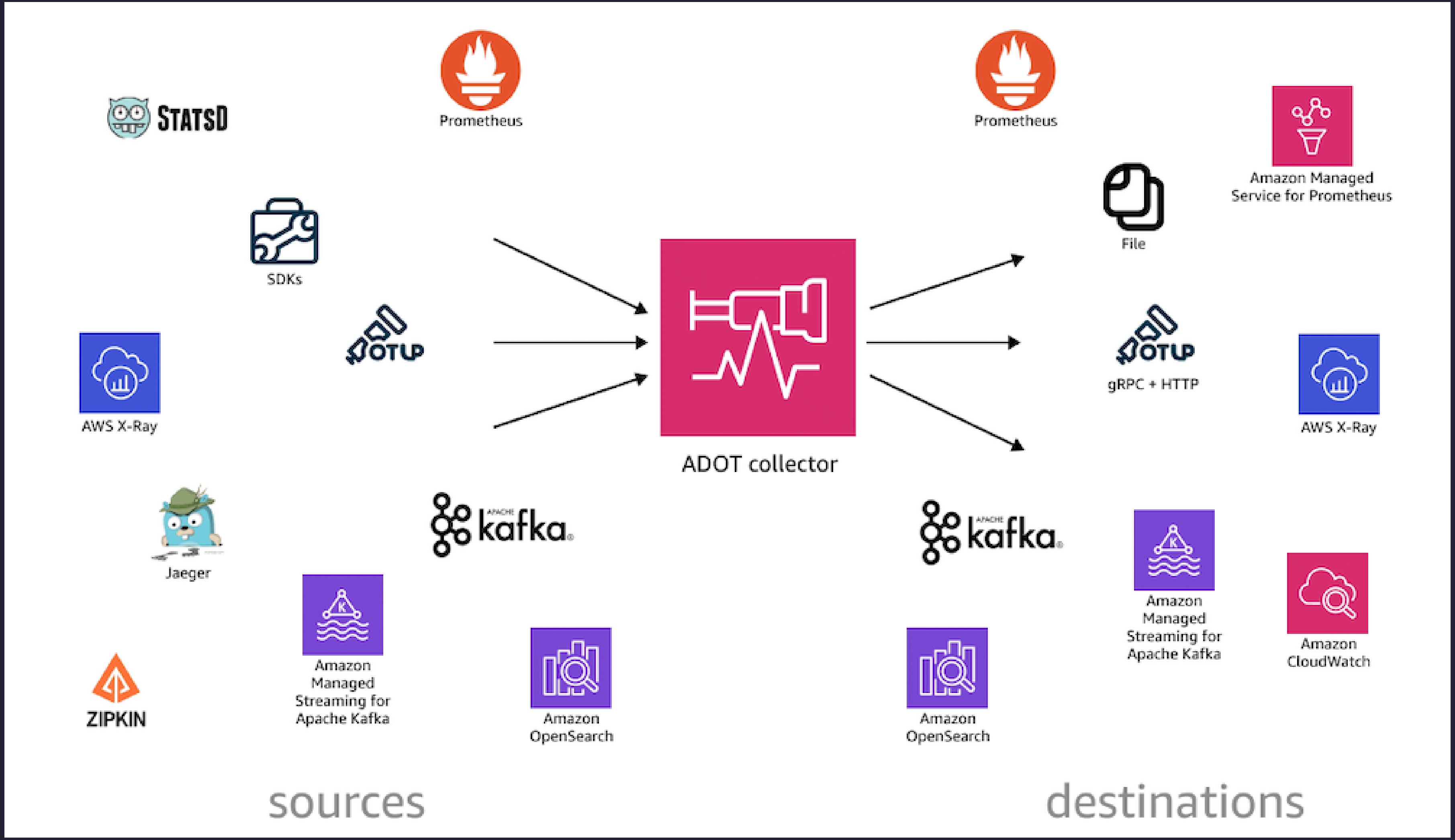


AWS Distro for OpenTelemetry (ADOT)

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



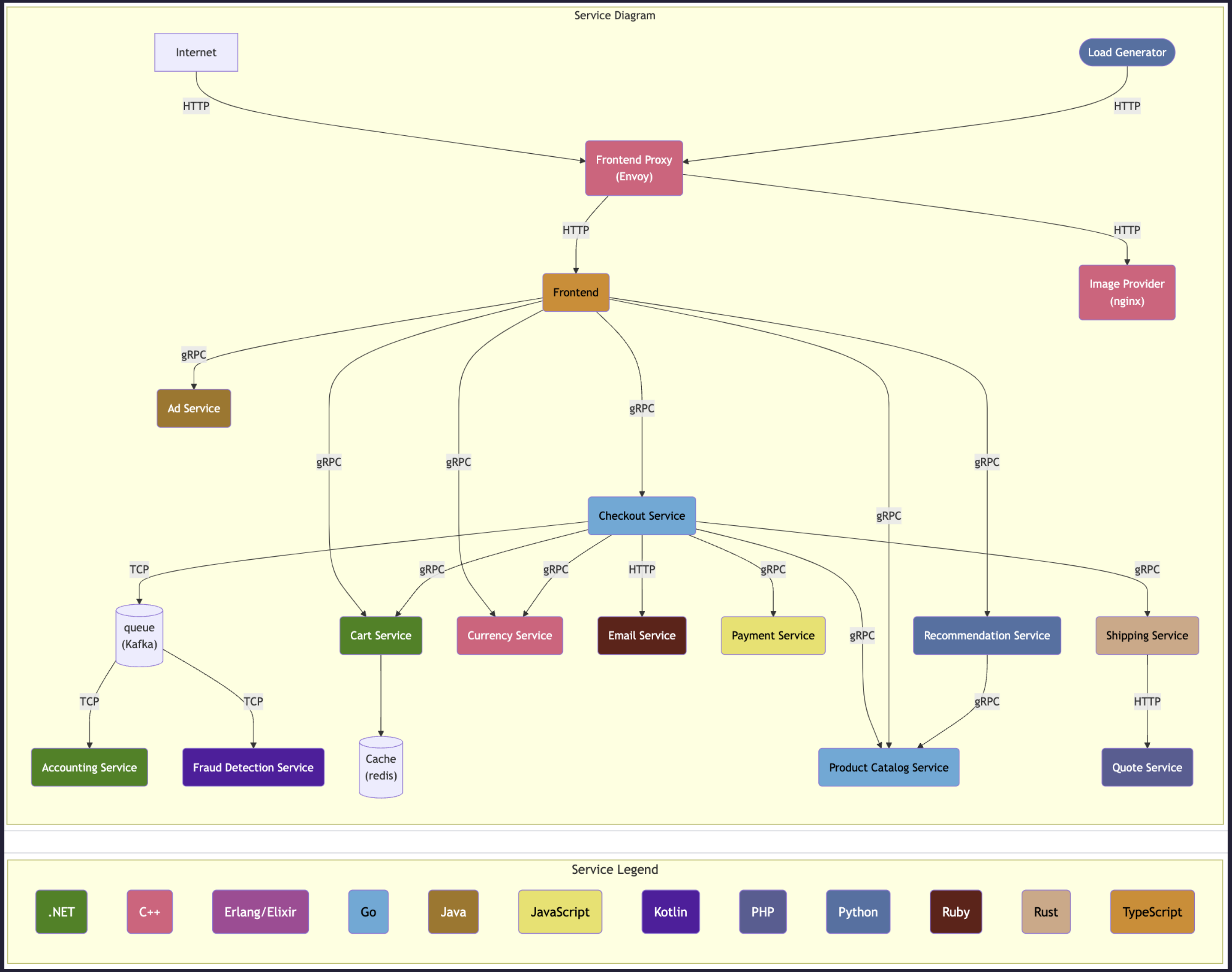
AWS Distro for OpenTelemetry (ADOT)



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