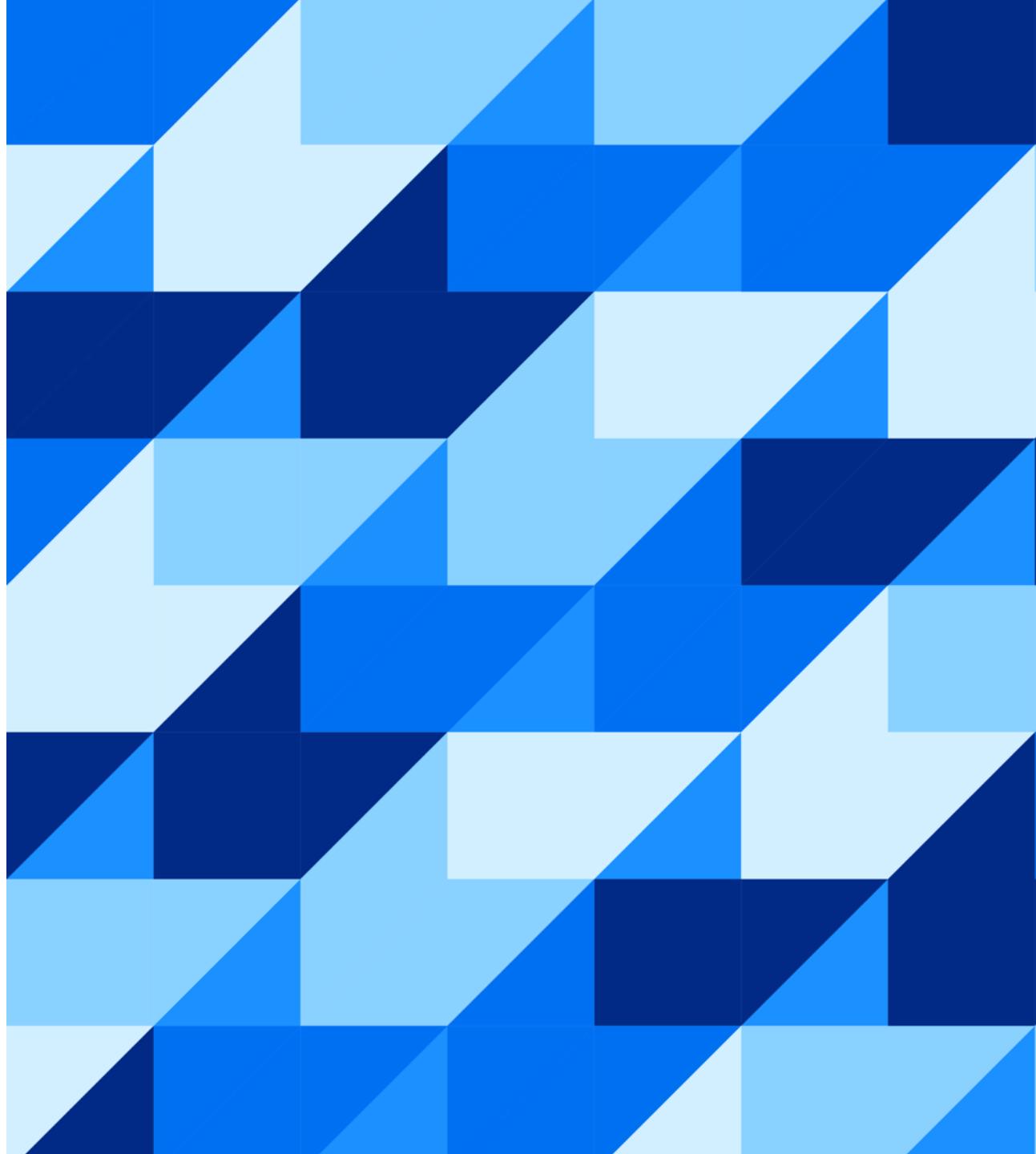




# How SAP analyzes OpenTelemetry signals using Data Prepper

Jannik Brand, SAP  
David Venable, AWS  
May 07, 2024

Public



# About us



**Jannik Brand**  
Software Developer, SAP



**David Venable**  
Senior Software Development Engineer, AWS

# Agenda



Introduction: The Observability Solution SAP Cloud Logging



Motivation to support OpenTelemetry with OpenSearch Data Prepper



Data Prepper - General Overview



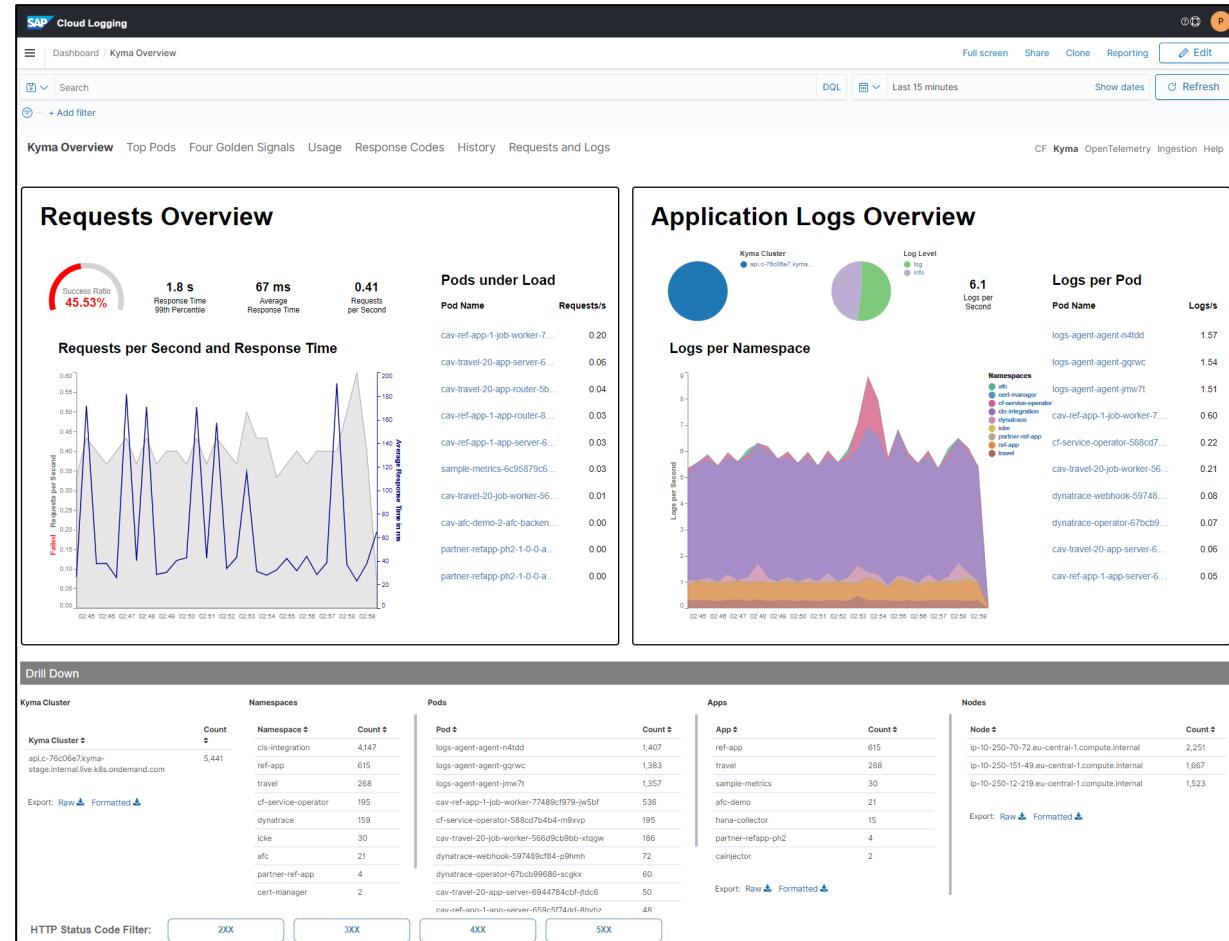
How SAP Cloud Logging utilizes Data Prepper



Collaboration

# The Observability Solution - SAP Cloud Logging

- Store/visualize/analyze application **logs, metrics and traces** from different runtime environments (such as SAP BTP Cloud Foundry, Kyma, Kubernetes)
- Based on **OpenSearch**
- Instance-based service running on **Kubernetes**
- More general information about [SAP Cloud Logging](#) presented in [Keynote](#)
- >7400 internal customer instances
- Generally Available since Dec 2023



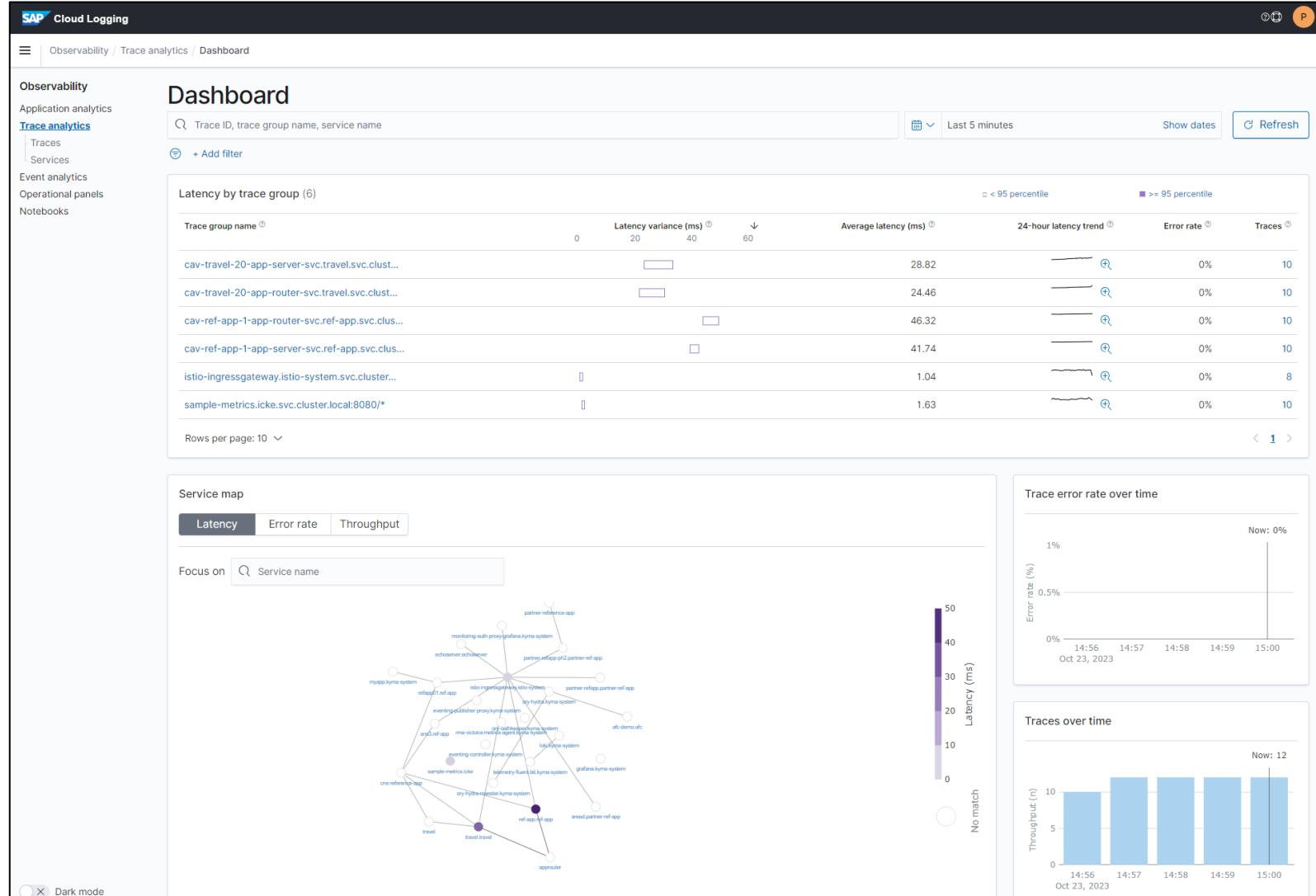
# OpenTelemetry - Motivation

- Collection of APIs, SDKs, tools to instrument/generate/collect and export telemetry data
- SAP Cloud Logging's perspective:
  - Support logs, metrics and traces
  - CNCF standard for Observability
- Customer perspective:
  - Easy code instrumentation
  - Open-source and vendor-neutral



# How Data Prepper comes into play

- Data collector managed by OpenSearch project
  - Supports OTel protocol  
  - OpenSearch requires the OpenTelemetry documents in a specific format
  - Data Prepper maps incoming OTel data into the expected format  
  - => Allows to ingest OTel logs, metrics and traces into OpenSearch



# Data Prepper – General Overview

# Data Prepper in the OpenSearch platform



# Data Prepper Overview

Community-driven, open-source

Distributed trace, log, metric data

Filter, enrich, transform, normalize data

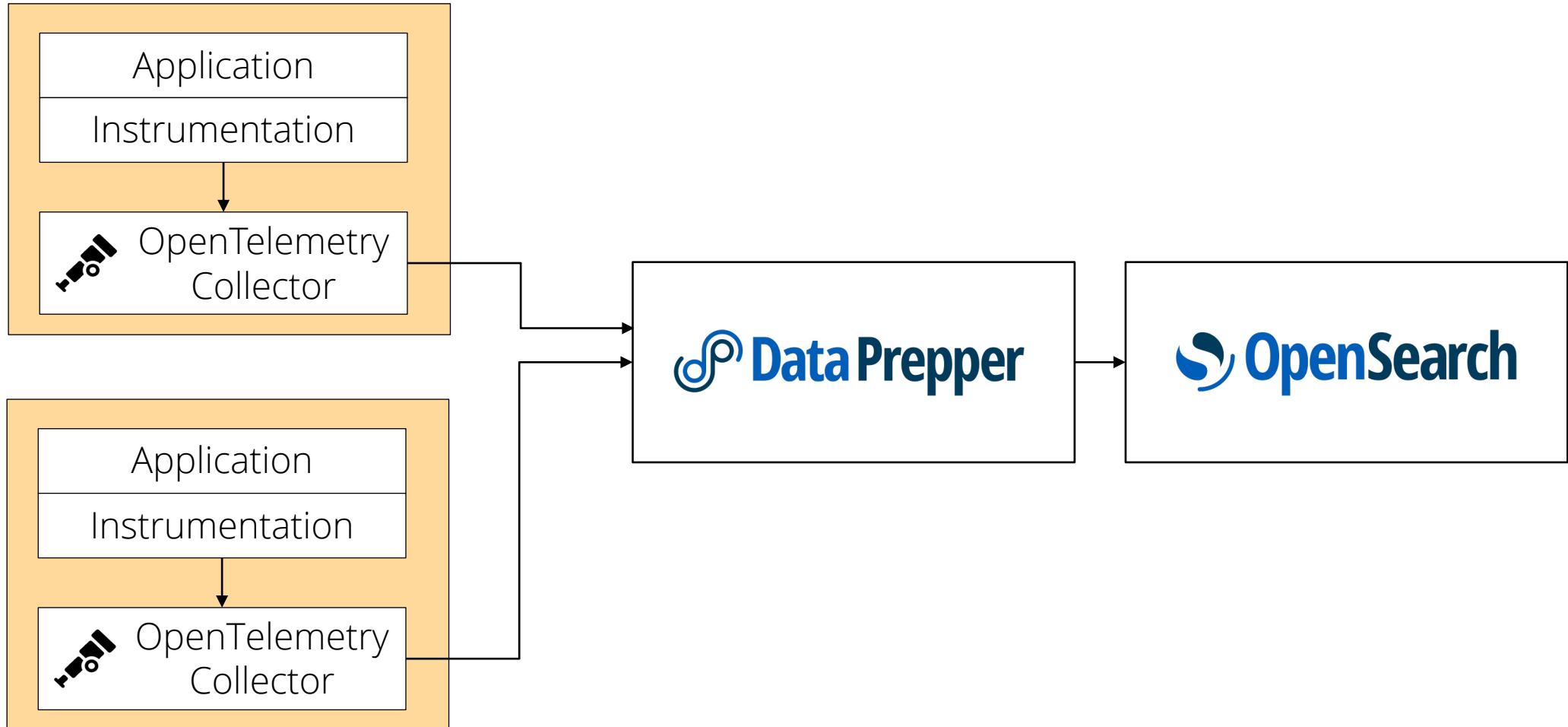
Buffering of data

Stateful processing

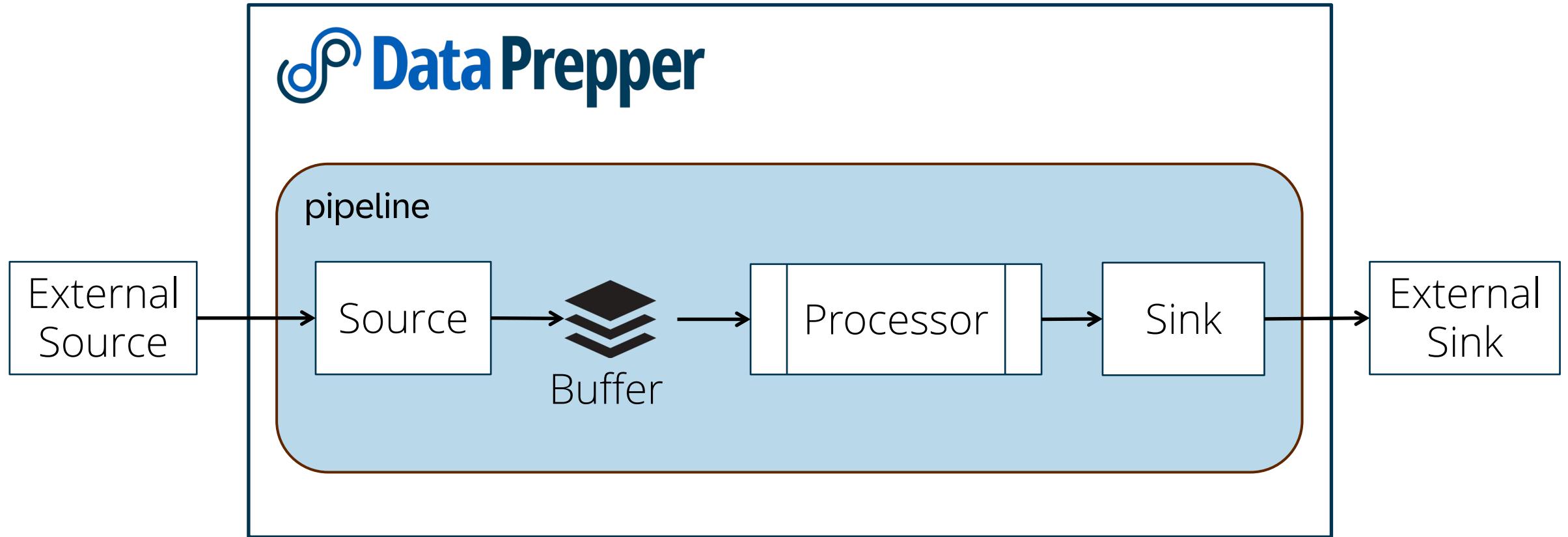
Routing of data



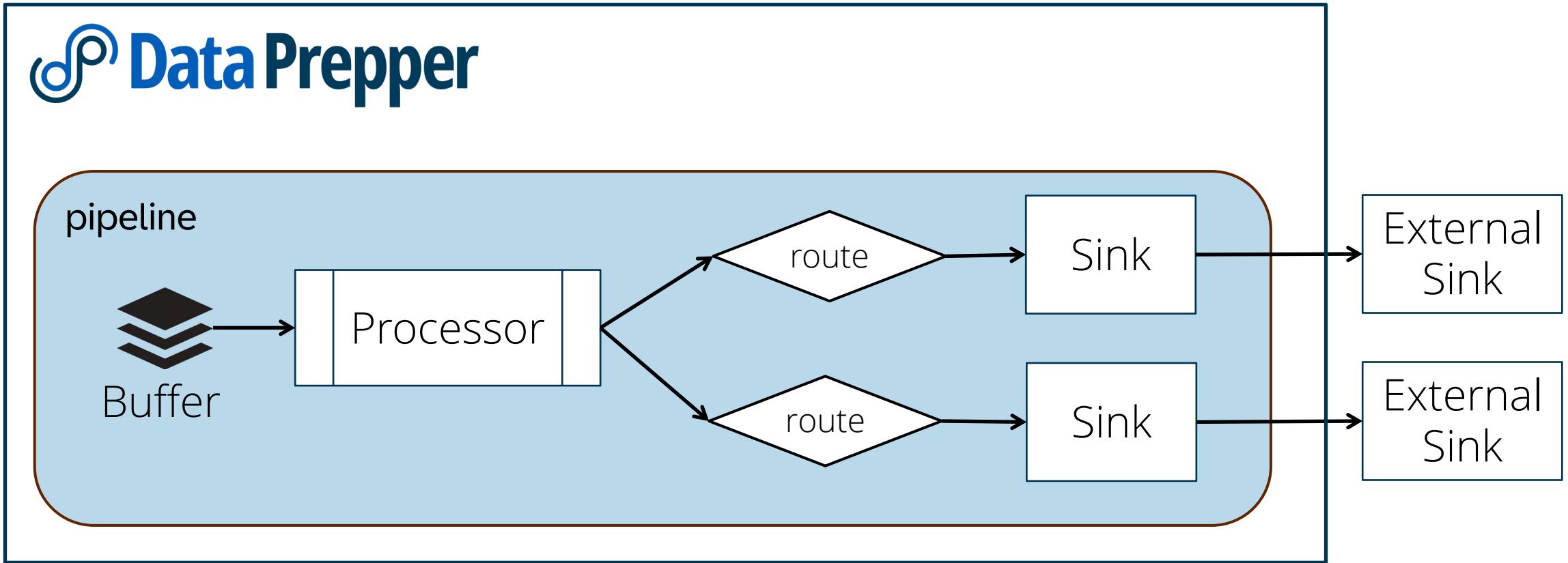
# OpenTelemetry Architecture



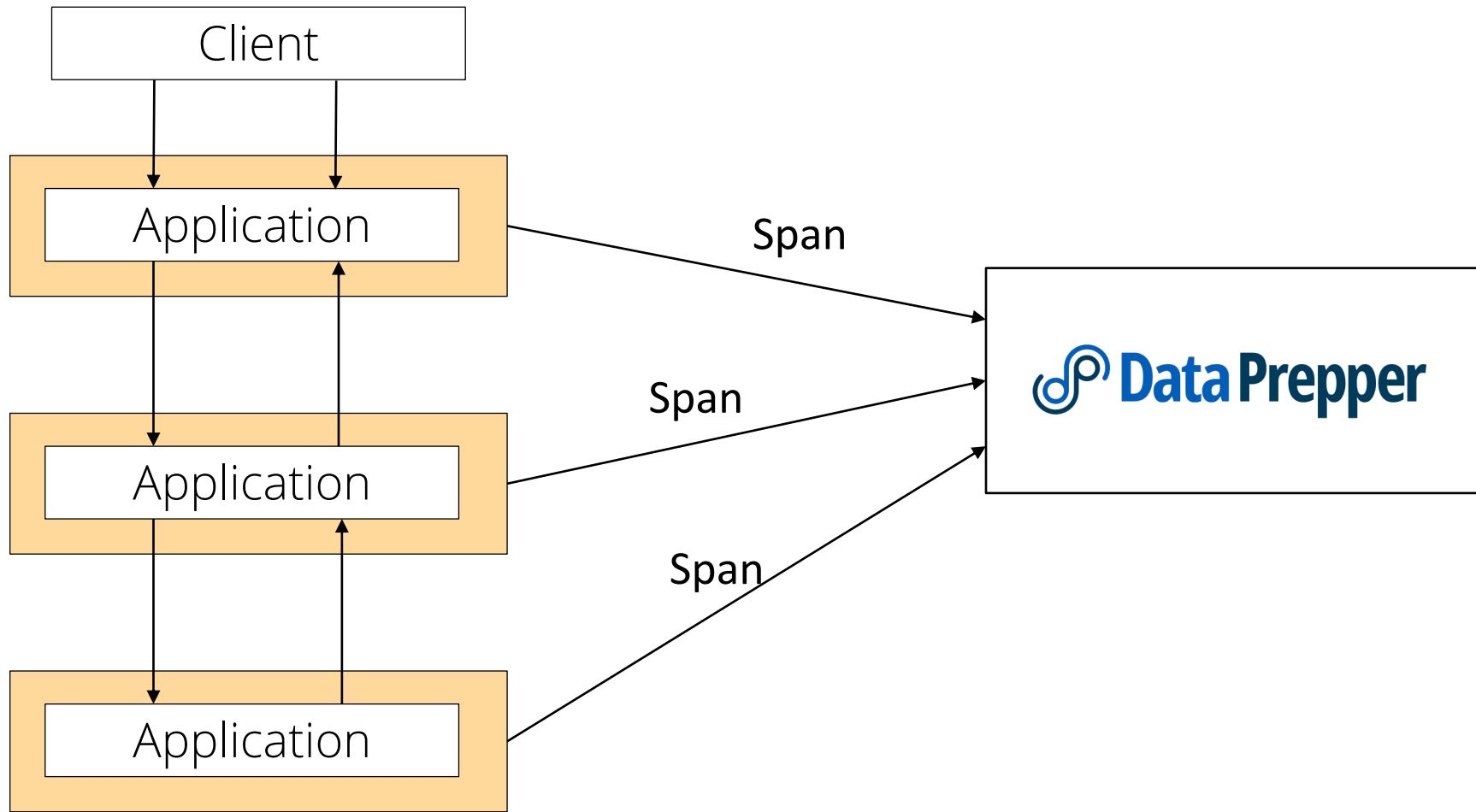
# Pipelines



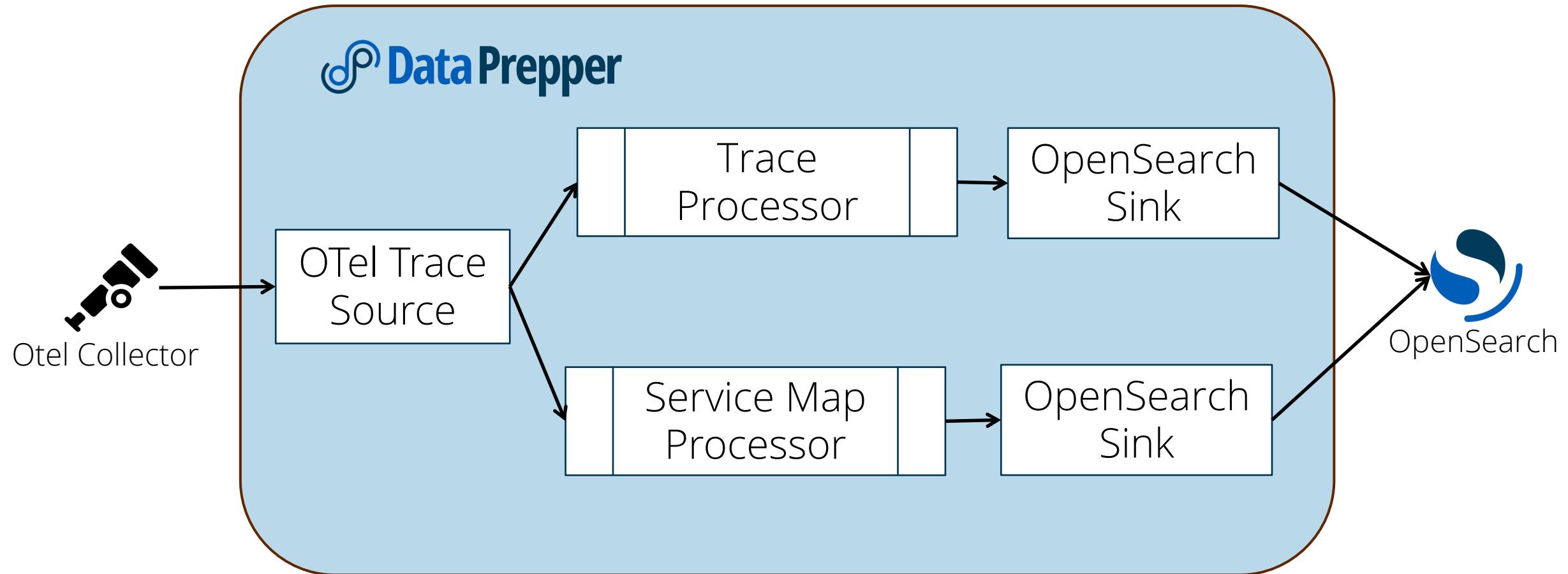
# Pipelines - Routing



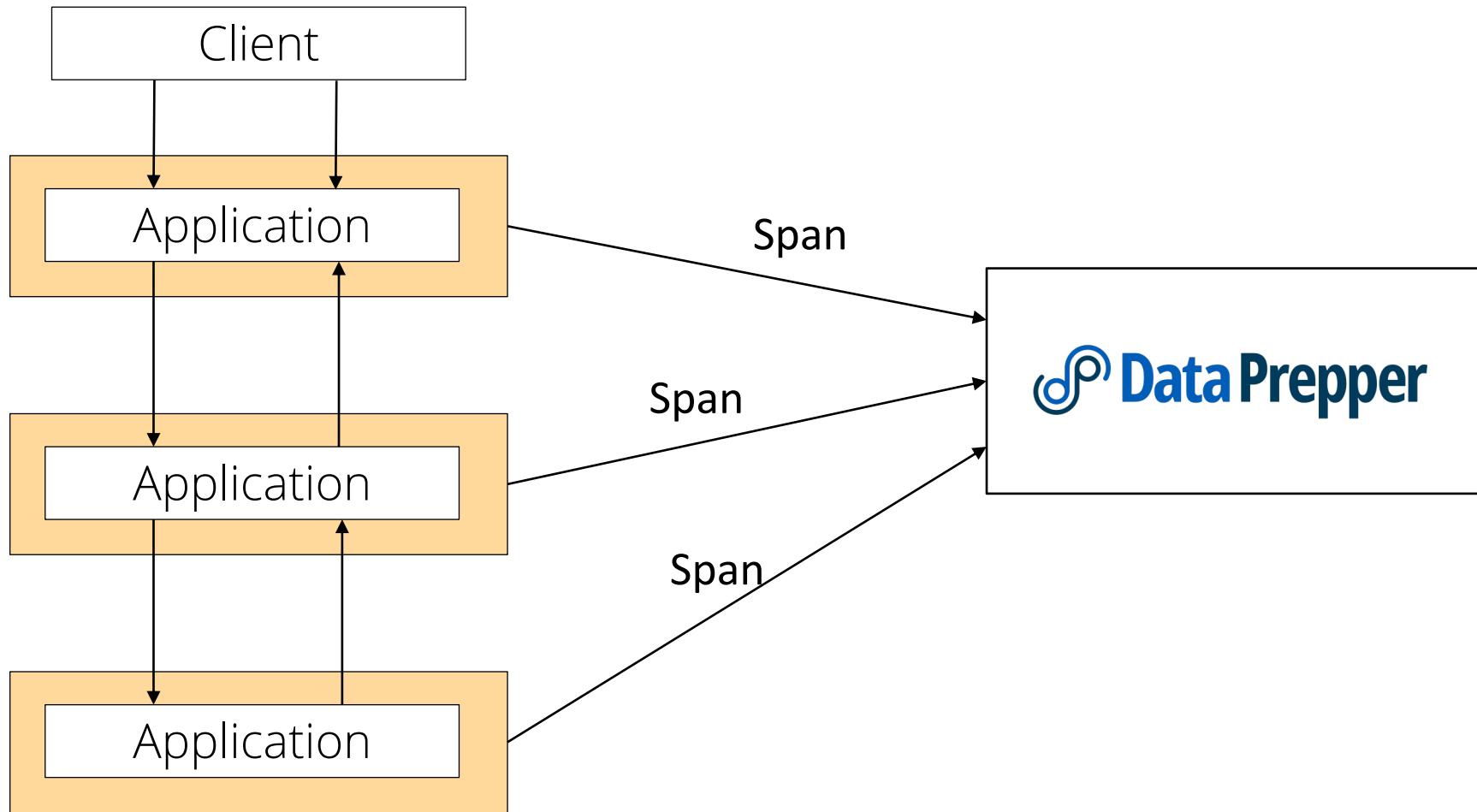
# Trace Analytics



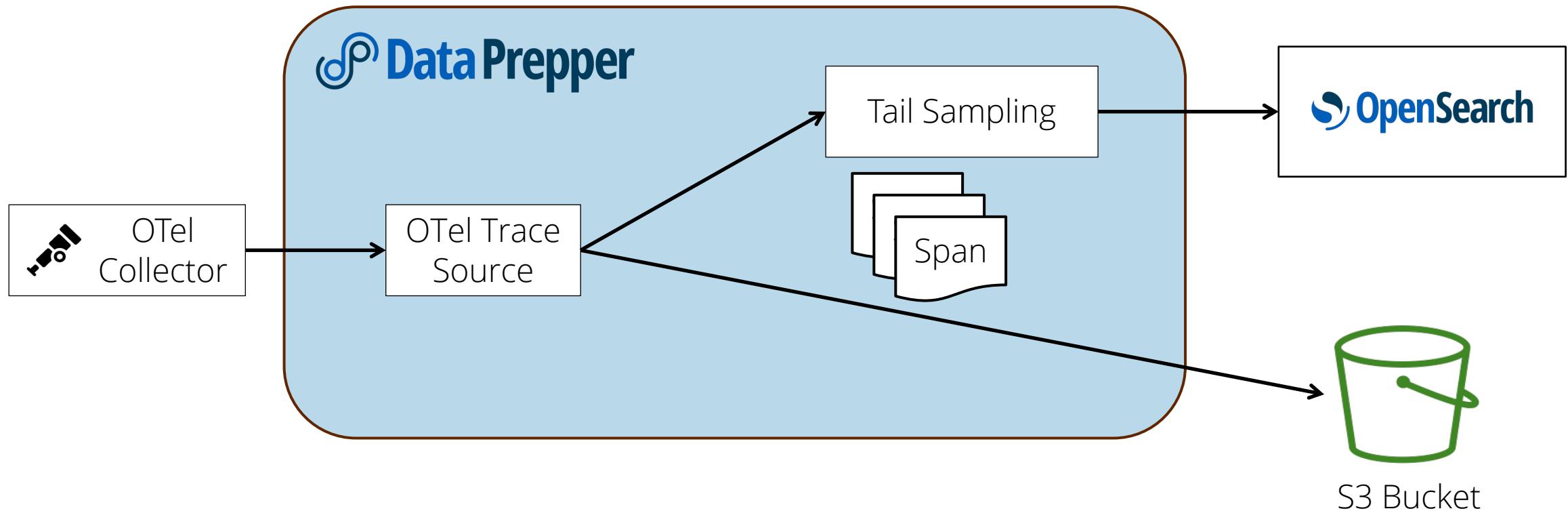
# Trace Analytics - Pipeline



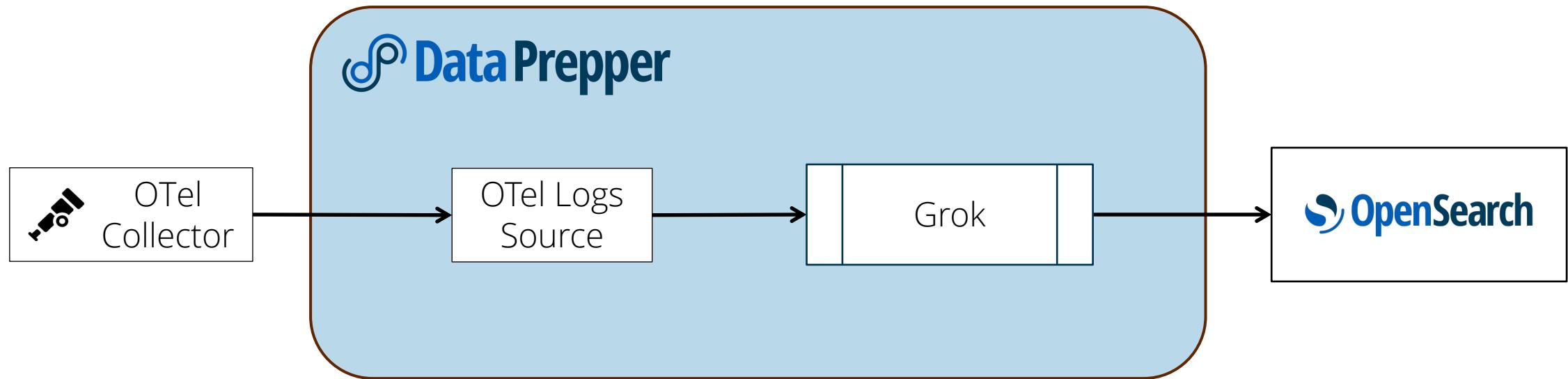
# Trace Analytics – Tail Sampling



# Trace Analytics – Tailing Sampling Pipeline



# Log Analytics –Pipeline

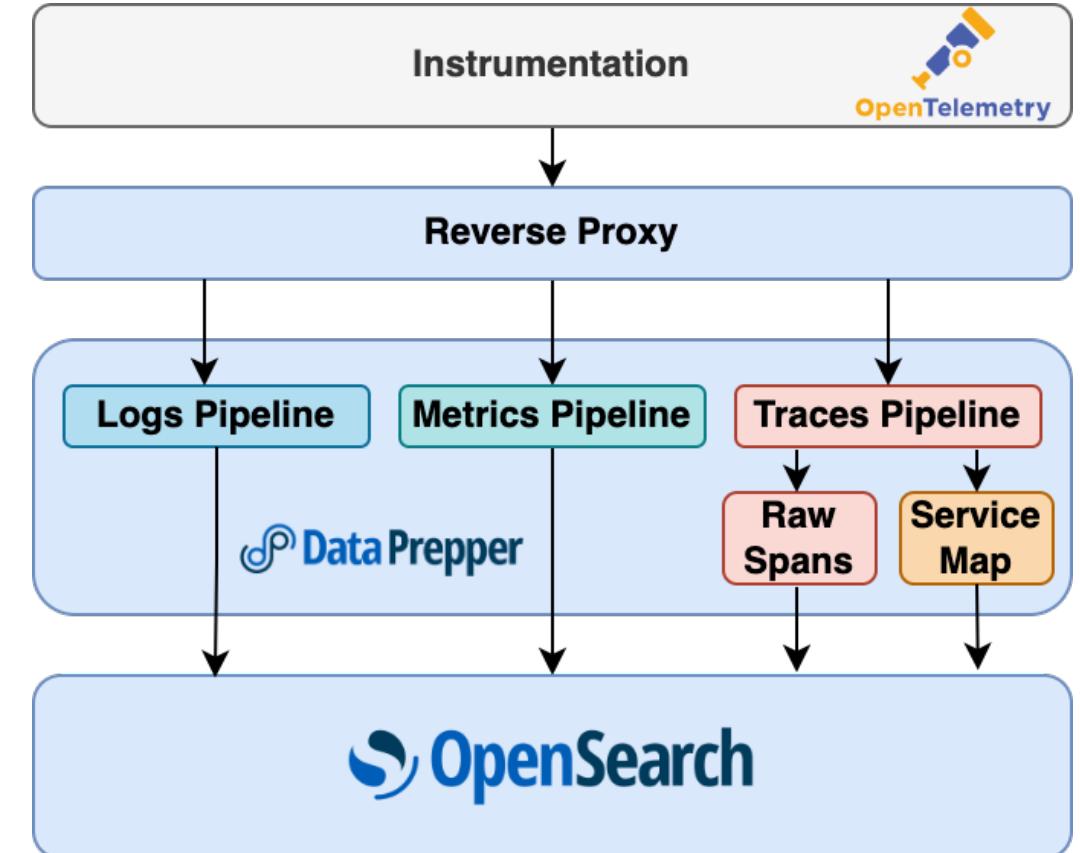


# How SAP Cloud Logging runs Data Prepper in Production



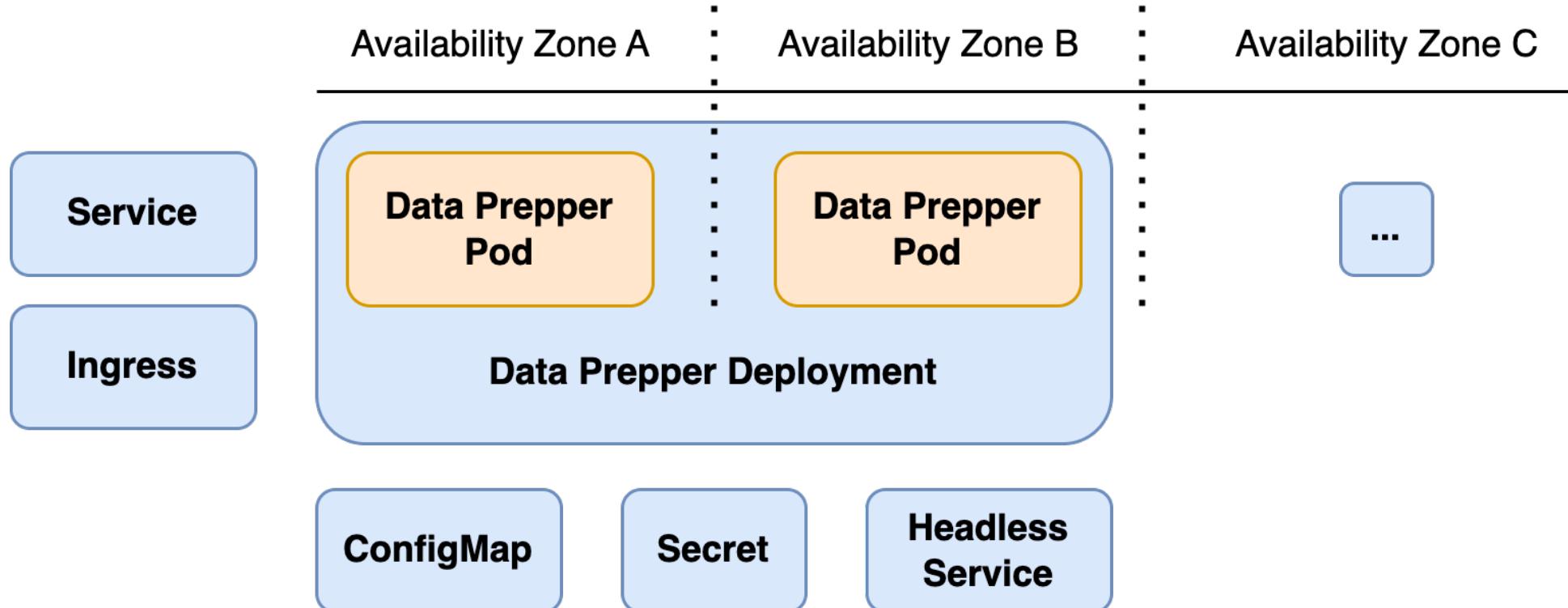
# Component Architecture

- **Sender:** OTel-instrumented applications (or OpenTelemetry Collector)
- **Reverse Proxy**
  - Unified ingestion endpoint (gRPC)
  - Load balancer
  - **Authentication module:** mTLS, certificate rotation
- **Data Prepper:** Pipelines for logs, metrics and traces
- **OpenSearch:** Data Prepper's sink

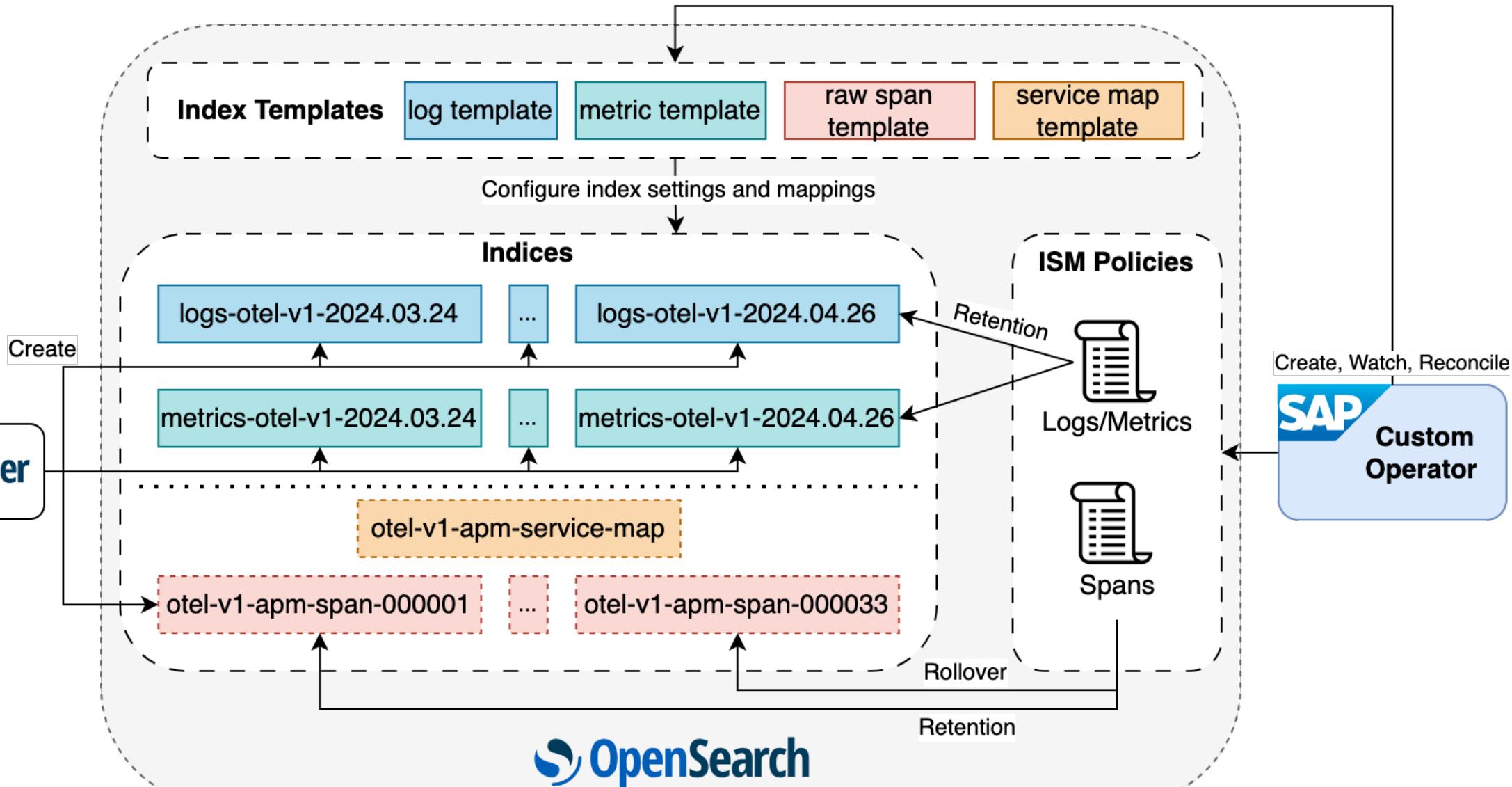


# Running Data Prepper on Kubernetes

- Kubernetes objects for each instance
- Deployed by own Kubernetes operator

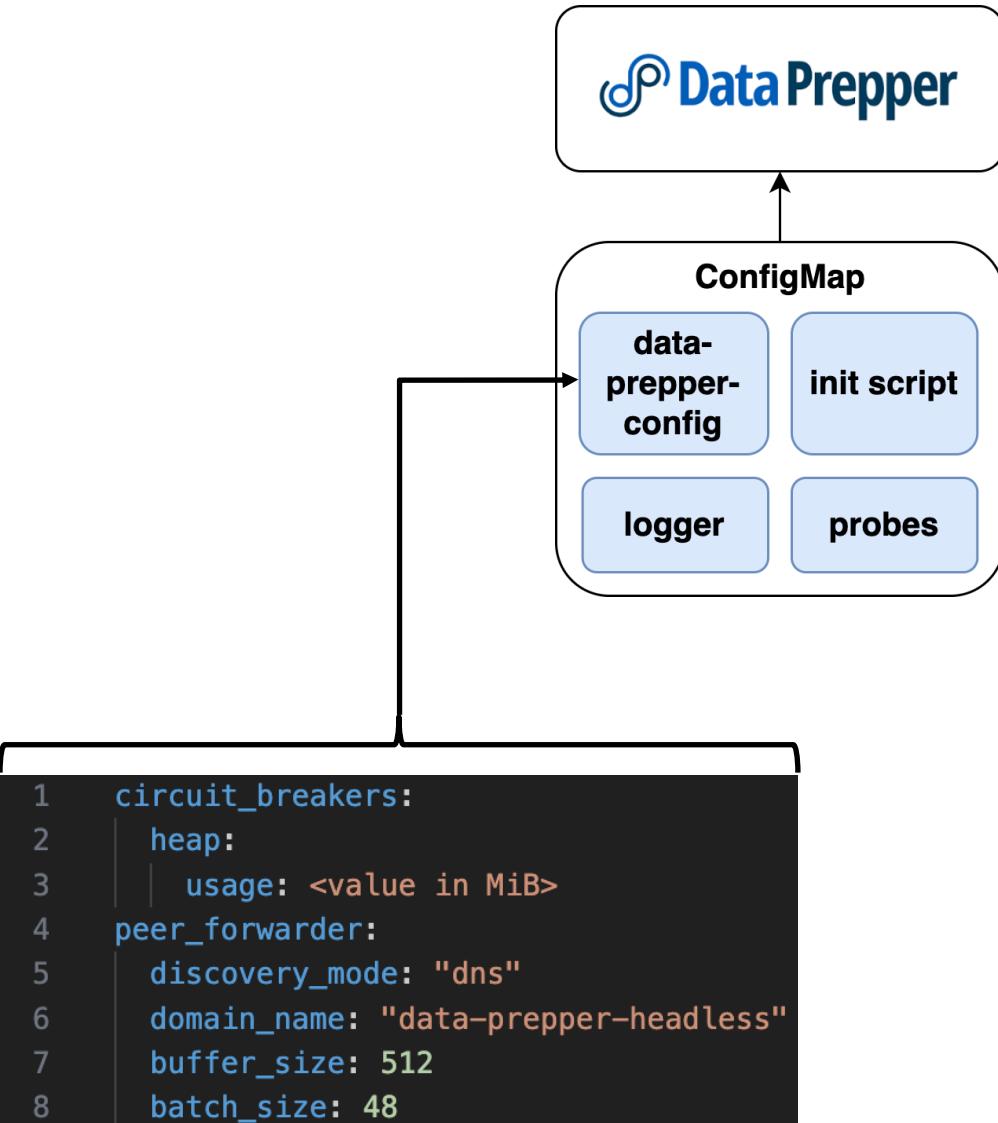


# OpenSearch Objects



# Data Prepper Configuration

- *data-prepper-config.yaml*:
  - Peer forwarder
  - Circuit breakers
- Init script:
  - Wait until OpenSearch & OpenSearch objects are ready
  - Start Data Prepper
- Other:
  - Logger, readiness/liveness probes

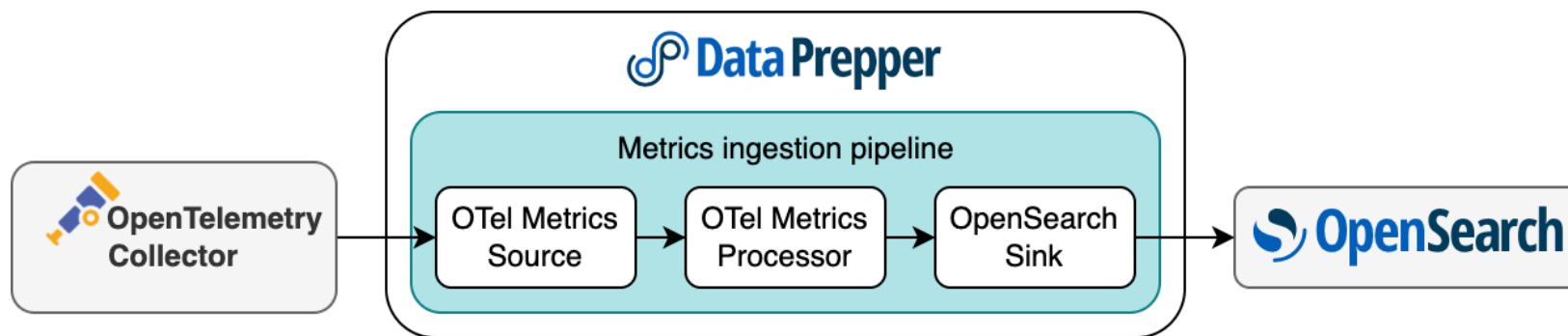


# Metric Ingestion with Data Prepper

Configure workers, buffer\_size, batch\_size  
=> Performance impact

- OpenSearch sink:
  - Basic authentication
  - Daily index created by *Data Prepper*

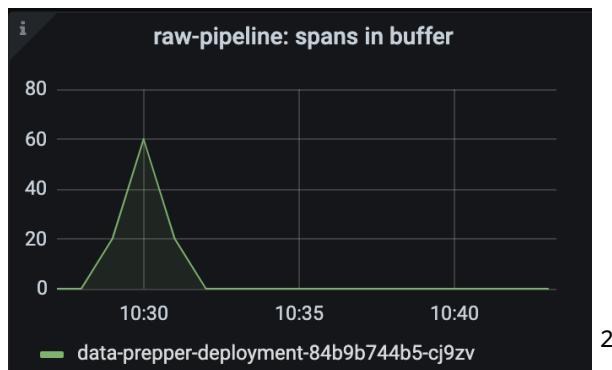
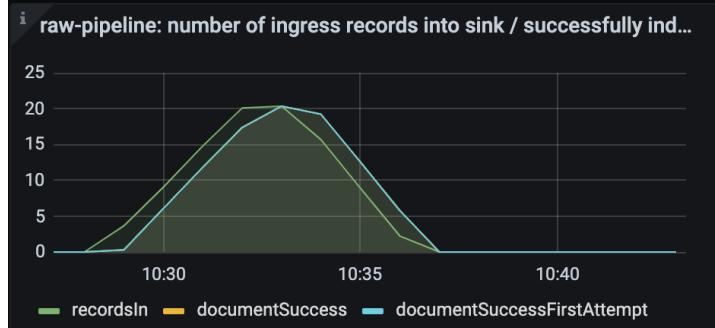
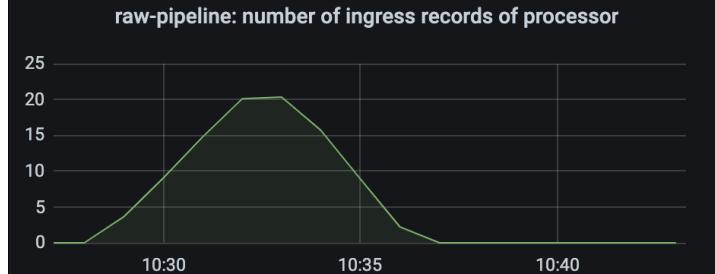
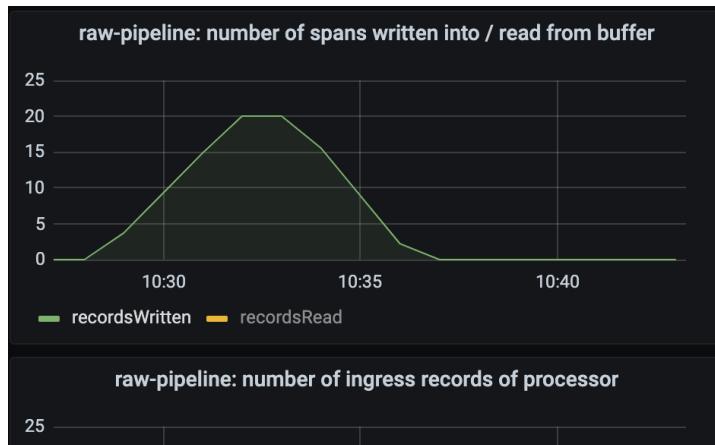
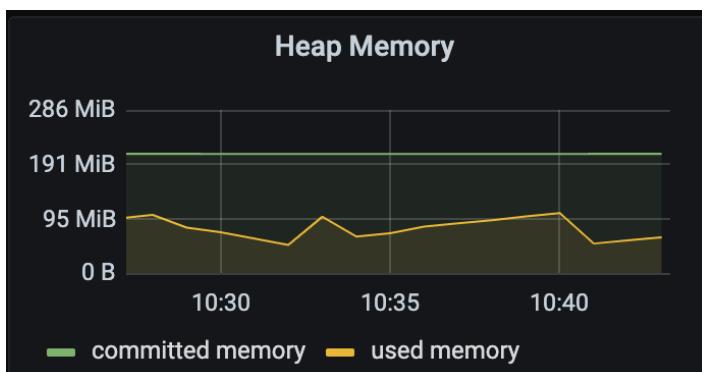
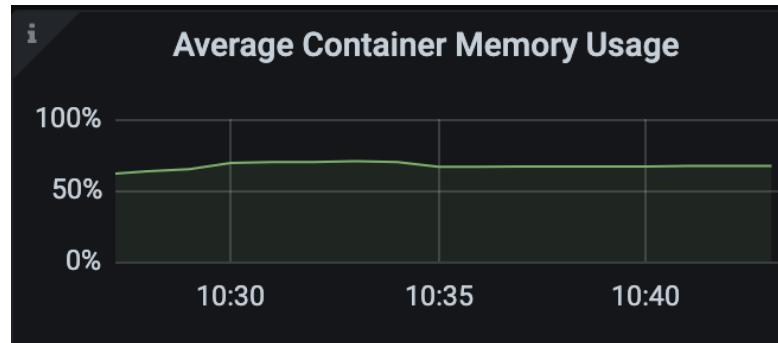
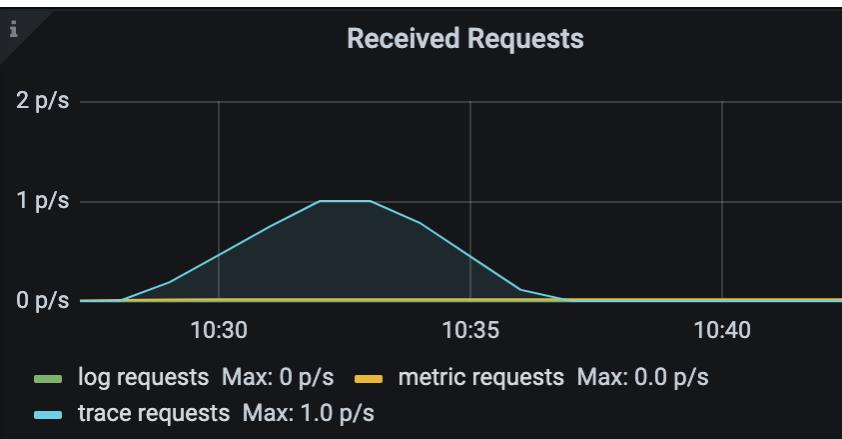
```
1 metrics-pipeline:
2   workers: 4
3   source:
4     otel_metrics_source:
5     buffer:
6       bounded_blocking:
7         buffer_size: 512
8         batch_size: 8
9     processor:
10    - otel_metrics:
11      sink:
12        - opensearch:
13          hosts: [ "https://opensearch-service:9200" ]
14          username: "otelWriter"
15          password: "Password123"
16          index: metrics-otel-v1-%{yyyy.MM.dd}
```



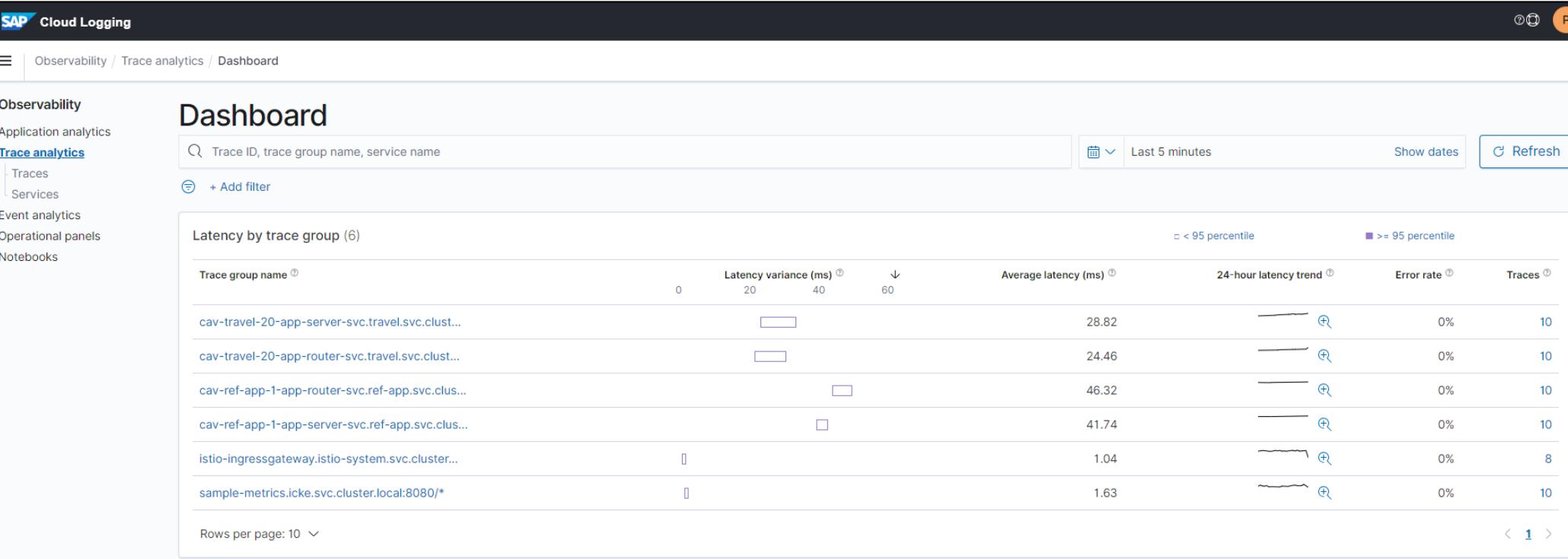
[OpenSearch blog post](#) by  
team member Karsten Schnitter

# Monitoring Data Prepper

- K8s resource consumption
- JVM Heap
- Circuit Breaker & Peer forwarder
- Indexing in OpenSearch
- Every pipeline:
  - Received requests
  - Records in/out of buffer/processor sink
  - Pipeline latency
  - Buffer usage
  - ...



# Trace Analytics Plugin

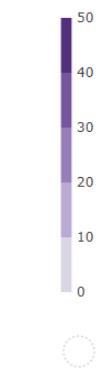
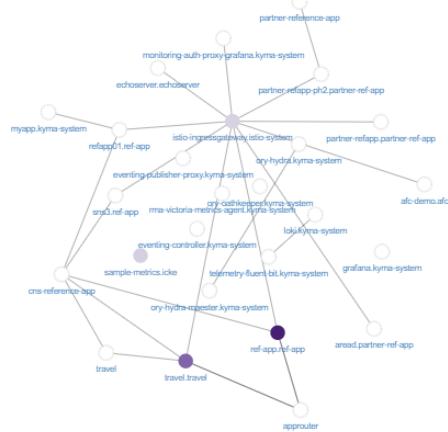


### Service map

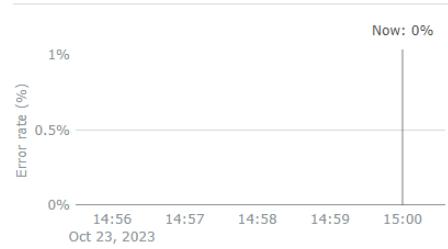
Latency Error rate Throughput

Focus on

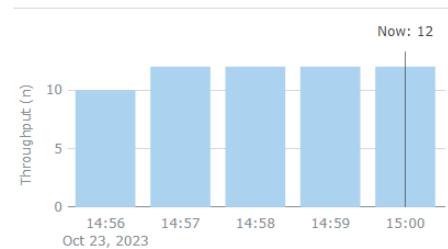
Service name



### Trace error rate over time



### Traces over time



# f3b32b869a4bf2ab70b035c8593c4bd7

## Overview

Trace ID  
f3b32b869a4bf2ab70b035c8593c4bd7 

Latency  
91.41

Errors  
No

Trace group name  
/helloWorld

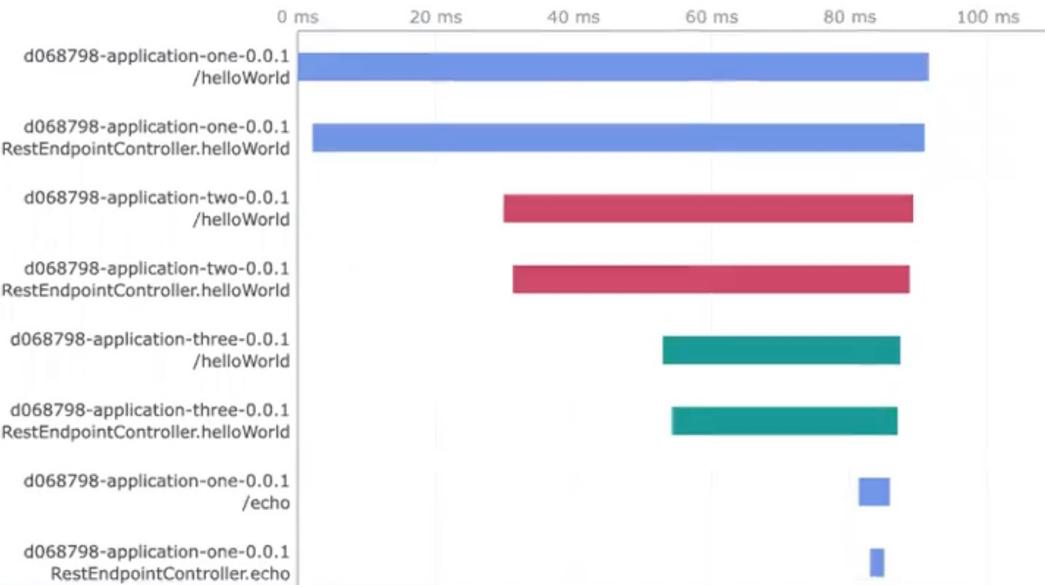
Last updated  
09/20/2022 15:23:11

## Time spent by service



• d068798-application-one-0.0.1	50.35%
• d068798-application-two-0.0.1	31.54%
• d068798-application-three-0.0.1	18.11%

## Spans (8)



Timeline

Span list

# Content

- OTel spans and logs
- OTel metrics explorer

**Server Spans**

1–50 of 1142

Time	serviceName	traceId	name	span.attributes.http@status_code	durationInNanos
> Apr 30, 2024 @ 16:25:28.696000000	incidents-srv	0a12f424c2d63c0b35f109fa921af0ca	POST /	200	24,128,811
> Apr 30, 2024 @ 16:25:26.467000000	incidents-srv	0c7b6cfb6a7c1c6321e2a68f31bafaf4	POST /	200	67,502,497
> Apr 30, 2024 @ 16:24:52.382000000	incidents-srv	bc8d1d892fe6f09cb5da1e4da2221e70	POST /	200	41,271,682
> Apr 30, 2024 @ 16:24:52.042000000	incidents-srv	823cc414de7036fbe7e4817734c45e1a	POST /	200	163,386,293
> Apr 30, 2024 @ 16:24:51.647000000	incidents-srv	661ab1c32b6cc7d6d9fc8d296f73973b	POST /	200	60,774,332

**Logs**

1–50 of 1936

Time	serviceName	traceId	severityText	instrumentationScope.name	body
> Apr 30, 2024 @ 16:23:22.750000000	sflight-srv	6da63dff99205e716355e1eba058 d9b4	INFO	com.sap.cap.sflight.calm.AnalyticsService	Status line of HTTP response: HTTP/1.1 200 OK
> Apr 30, 2024 @ 16:23:22.634000000	sflight-srv	6da63dff99205e716355e1eba058 d9b4	INFO	com.sap.cap.sflight.calm.AnalyticsService	Calling SteamPunk...
> Apr 30, 2024 @ 16:23:22.619000000	sflight-srv	6da63dff99205e716355e1eba058 d9b4	INFO	com.sap.cap.sflight.calm.AnalyticsService	Status line of HTTP response: HTTP/1.1 200 OK
> Apr 30, 2024 @ 16:23:22.506000000	sflight-srv	6da63dff99205e716355e1eba058 d9b4	INFO	com.sap.cap.sflight.calm.AnalyticsService	Calling SteamPunk...
> Apr 30, 2024 @ 16:23:22.491000000	sflight-srv	6da63dff99205e716355e1eba058 d9b4	INFO	com.sap.cap.sflight.calm.AnalyticsService	Status line of HTTP response: HTTP/1.1 200 OK

**Drill Down**

**Total OTel Events by Service Names**

Service Name	Count
sflight-srv	17,741
incidents-srv	1,098
anyname_app	950

**Log Events by Instrumentation Scope**

Instrumentation Scope	Count
com.sap.cap.sflight.calm.AnalyticsService	1,824
com.sap.cap.sflight.processor.CreationHandler	112

**OTel Spans with error status**

Trace ID	Span ID	Status Code
45d5490862bc8e8e690e3c99bdb4babe	0a65536c5af9977c	2
45d5490862bc8e8e690e3c99bdb4babe	830653e9a01c29ec	2
4eb38c6a9e7191f3acbb75d543c91b89	55043db4764fe13b	2
4eb38c6a9e7191f3acbb75d543c91b89	d41df990e60e9d9a	2
008974439d87f251f2bc4adf42ea85b	6f884a743176f408	1
00ad36a4c4933ebfa75b78c6f666272b	97a27b3ed1768152	1

**Details**

**Log Events by TraceId**

traceId: Descending	Count
892430cca5aaec14ff9cf42de140cb0	8
f7c7e5b58e9de6b3fc0e46b6fa9335e8	8
1559e9ce8fef3da36cca0754bc3951a5	7
1b9124ca8a14a8049b51852dcc777818	7
1ea66fa9a5b3f86d4746fe7e1ff70999	7
1fe49bde188a482cc8fb1a5d8cfca79c	7
650e484dec315a526954fec165be4b88	7
92059f078c357885e789a0d852ce6fc9	7
9ed487b9eaf74dcf121182ab708edac8	7

**Log Events by Severity**

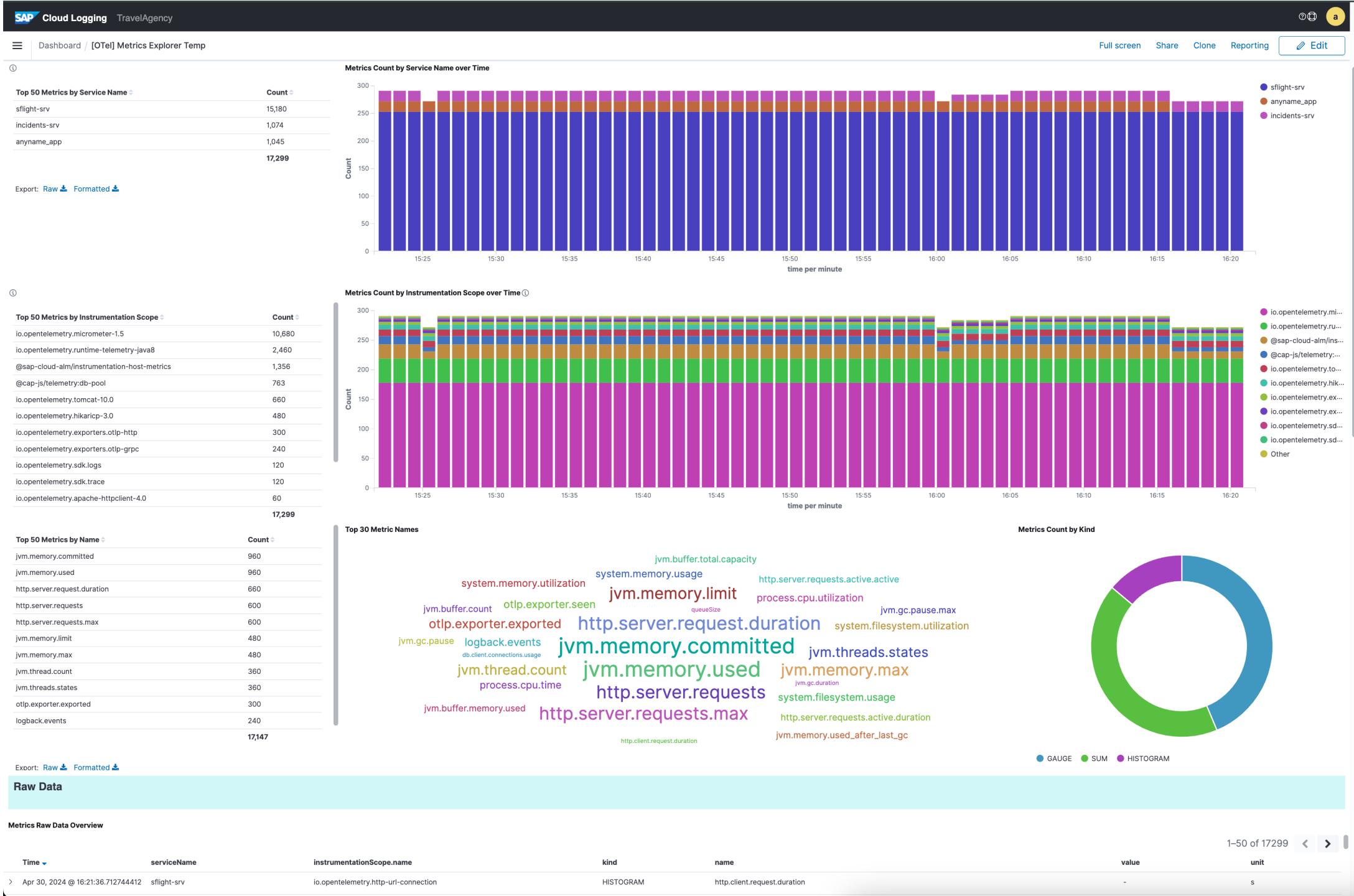
Legend:

- ≥ 1 and < 5
- ≥ 5 and < 8
- ≥ 9 and < 13
- ≥ 13 and < 17
- ≥ 17 and < 20
- ≥ 21 and < 25
- ≥ 0 and < 1

# Content

- OTel spans and logs

- OTel metrics explorer



# Performance: High-Level Insights

## Performance affecting parameters

- Data Prepper resources: CPU limit, memory limit, heap size (2.9GB), replicas
- Data Prepper configuration: circuit\_breakers (95% of heap)  
peer forwarder: buffer\_size, batch\_size
- Pipeline configuration: buffer\_size, batch\_size, worker, delay

## Results

- Ingestion Rates:
  - **Logs: 30000 log records / s**
  - **Metrics: 30000 metric data points / s**
  - **Traces: 5000 trace spans / s**
- Bottleneck: Peer forwarder (traces) / Our OpenSearch capacity (logs, metrics)

# Performance: Challenges & Learnings

- Horizontal scaling for traces
- Stability (in overload scenarios)
  - Prevent container and heap OOM errors ⚡ => Generate back-pressure
  - Container OOM:
    - Finding optimal heap setting (how much space needed for non-heap)
  - Heap OOM:
    - Find optimal buffer sizes
    - Circuit breakers
- Simultaneous ingestion of logs, metrics and traces

# OpenSearch Community & SAP Cloud Logging team



## Data Prepper contributions:

- Issues and PRs
  - E.g.: Support OpenTelemetry logs & metrics; Performance feedback
- Team member Karsten Schnitter [added](#) as a maintainer
- Data Prepper team: Recommendations for performance improvements

## OpenSearch/ElasticSearch: >6 year journey

The screenshot shows four pull requests (PRs) in a GitHub repository, each with a detailed description and commit history.

- [BUG] ISM index rollover actions fail because of missing setting for otel-v1-apm-span-\* indices #3506**
  - Closed** JannikBrand opened this issue on Oct 16, 2023 · 6 comments · Fixed by #3590
  - Describe the bug**

In the Trace Analytics Operator's official index template, the `otel-v1-apm-span-\*` indices are created without the required setting for the ISM rollover actions. This causes them to fail.
  - To Reproduce**
    - Prerequisite is a running Data Prepper instance.
    - Configure Data Prepper to send logs to an OpenSearch Sink.
    - When Data Prepper creates the `otel-v1-apm-span-\*` indices, the ISM rollover actions fail.
  - Signed-off-by:** Jannik Brand [jannik.brand@sap.com](mailto:jannik.brand@sap.com)
  - Description**

This PR updates the default buffer values ( `buffer\_size` , `batch\_size` ) in the documentation. There are new default values due to #1906 (since version 2.0.0). The default `buffer\_size` (previously: 512) and default `batch\_size` (previously: 8) were increased by the factor 25. The new default values are: `buffer\_size` : 12800 and `batch\_size` : 200.
- Update default values in buffer documentation #2233**
  - Merged** divenable merged 1 commit into [opensearch-project:main](#) from [JannikBrand:update-doc-buffer](#) on Feb 4, 2023
  - Conversation 2** Commits 1 Checks 0 Files changed 2
  - JannikBrand commented on Feb 2, 2023 · edited**
  - Signed-off-by:** Jannik Brand [jannik.brand@sap.com](mailto:jannik.brand@sap.com)
  - Description**

This PR updates the default buffer values ( `buffer\_size` , `batch\_size` ) in the documentation. There are new default values due to #1906 (since version 2.0.0). The default `buffer\_size` (previously: 512) and default `batch\_size` (previously: 8) were increased by the factor 25. The new default values are: `buffer\_size` : 12800 and `batch\_size` : 200.
- Support OpenTelemetry Metrics #1154**
  - Merged** divenable merged 21 commits into [opensearch-project:main](#) from [kmssap:feature\\_opentelemetry\\_metrics](#) on Apr 5, 2022
  - Conversation 52** Commits 21 Checks 0 Files changed 49
  - kmssap commented on Mar 8, 2022**
  - Signed-off-by:** Kai M. Sternad [kai.sternad@sap.com](mailto:kai.sternad@sap.com)  
Co-authored-by: Tomas Longo [tomas.longo@sap.com](mailto:tomas.longo@sap.com)  
Co-authored-by: Karsten Schnitter [k.schnitter@sap.com](mailto:k.schnitter@sap.com)
  - Description**

This change introduces support for OpenTelemetry metrics. It adds two plugins, one for receiving Metrics via gRPC and another one for processing and mapping the raw metrics records to JSON records that can be ingested into OpenSearch.
  - Caveats:**

The metrics plugin is structured similarly to the already existing OpenTelemetry tracing plugin and therefore has a number of similarities. Specifically otel-metrics-source basically copies most of otel-trace-source and should ideally be de-duplicated.
  - Also,** in order to be able to use the latest OpenTelemetry protocol changes we upgraded the protocol version from 1.0.1-alpha to 1.7.1-alpha. This may have ramifications for the other otel-related plugins.

# Thank you.

Contact information:

Jannik Brand

jannik.brand@sap.com

David Venable

dlv@amazon.com

## References to our talks at OpenSearch Con Berlin 2024

- Hariharan Gandhi – Part of [Keynote](#)
- David Venable – [Persistent and performant ingestion using Data Prepper](#)
- [This talk](#)

