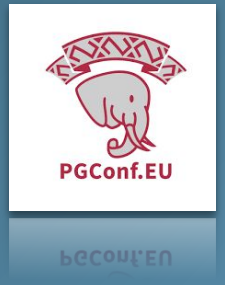

Unified Observability: Monitoring Postgres Anywhere with OpenTelemetry

PG Conf Europe 2025

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Curious One | Full Stack Developer

- Building a **Hybrid Manager** for managing **Postgres** across different deployment platforms
- **Focused** on observability: **collecting** & **visualizing metrics/logs** from Postgres and microservices
- Enabling a **single pane of glass** for **observability** across all deployments

Key Challenges in Monitoring Modern Apps

Modern applications span **hybrid**, **distributed** systems — from **mobile** apps to **cloud** services, containers, and even mainframes.

🚧 Common Challenges:

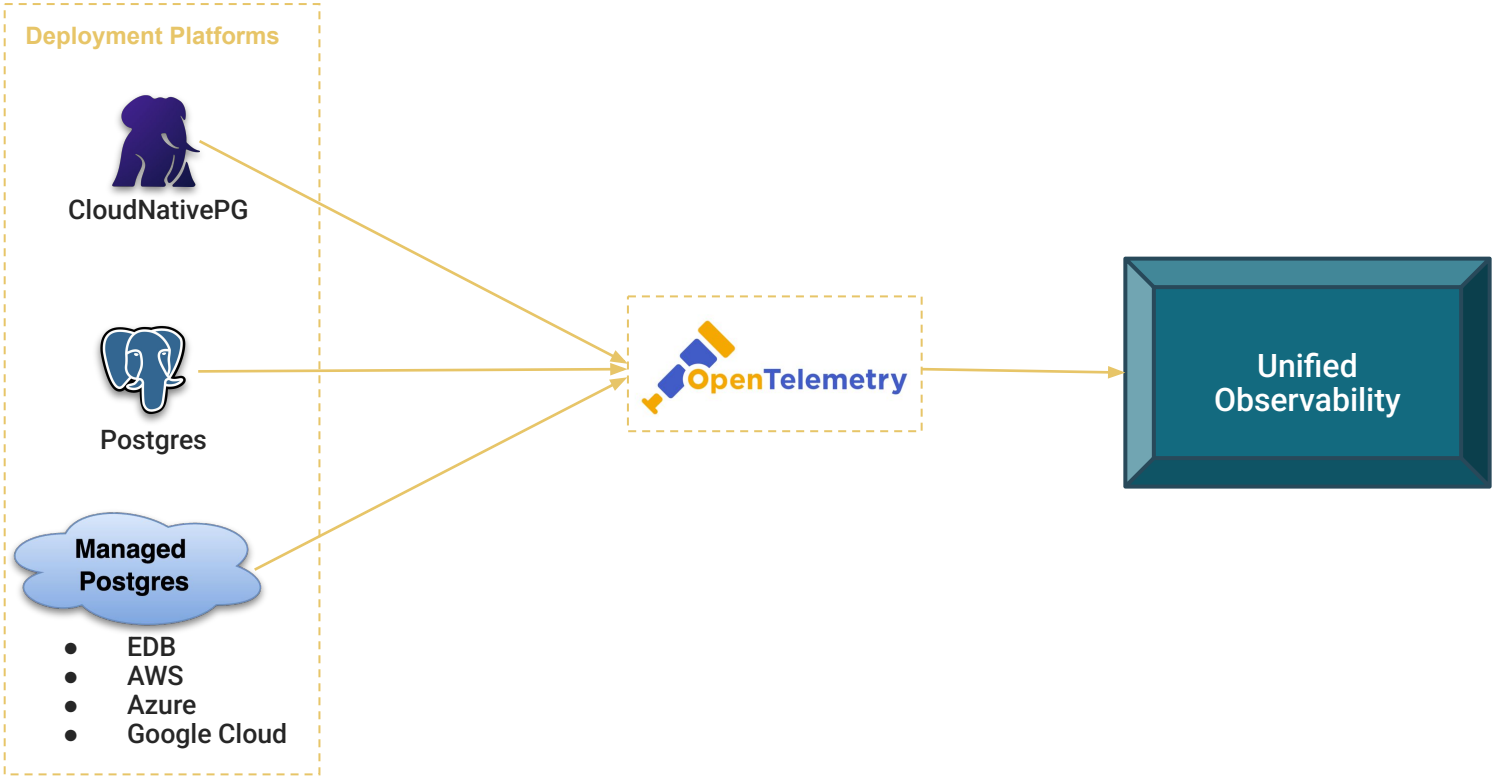
- 🌐 **No More Monoliths** - Applications are **fragmented across platforms** resulting in **lack of end-to-end visibility**
- 🧩 **Multiple Tools** - Most orgs rely on **4–7 disconnected monitoring tools**, making it **complex** to detect and **resolve** issues.
- 🔒 **Separated monitoring data** - Logs, metrics, & traces are collected separately - increasing complexity & **reducing correlations**.

💡 **Solution** - Unified frameworks like **OpenTelemetry** provide a **vendor-neutral**, open standard for collecting all telemetry signals.

Agenda

- Observability
- Monitoring PostgreSQL
- OpenTelemetry
- Monitoring Postgres Anywhere with OpenTelemetry
- Demo

Goal



Observability

Observability

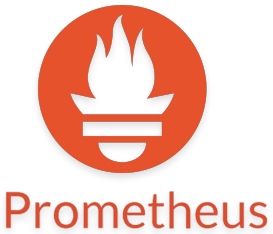
Observability is the ability to understand a system's internal state by examining its external outputs – also known as telemetry data.

This includes three core pillars:

- 📊 **Metrics** – Numerical data that reflects the system's health and performance.
- 📄 **Logs** – Text records that capture events and state changes.
- 🧵 **Traces** – Detailed records of request flows across services.

Making a System Observable

- To achieve observability, a **system must be instrumented** — that means the application code must emit logs, metrics, or traces.
- Once instrumented, this telemetry data is sent to an observability backend, where it can be **analyzed** to gain insights, detect issues, and optimize performance.



Monitoring PostgreSQL

The World's Most Advanced Open Source Relational Database

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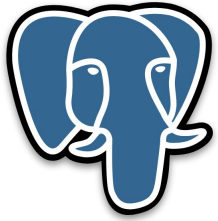
PostgreSQL - Monitoring - Metrics



We can **capture critical metrics** over time to identify trends and perform root cause analysis, for example:

💾 **Resource Usage:** Track CPU, memory, disk I/O, storage usage

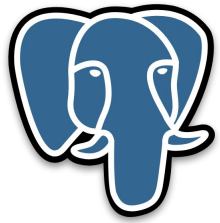
🐢 **Query Performance:** Monitor slow queries, locks, & execution plans

📈 **Connections:** Track active sessions, connection limits, & idle connections

⛑️ **Database Health:** Monitor replication lag, bloat, & vacuum stats

🛑 **Errors:** Keep an eye on failure rates, & warnings

PostgreSQL - Monitoring - Logs



PostgreSQL logs provide a rich source of information to help **monitor** the **database's health, performance, and security.**

🔑 **Some Key Logs to Monitor:**

- **Error Logs:** Capture critical errors and crashes like **deadlock** detected.
- **Warning Logs:** Flag potential issues like **slow queries** or low resources.
- **Connection Logs:** Track connections and **failed login** attempts.
- **Statement Logs:** Record **SQL queries** for **auditing** and troubleshooting.

OpenTelemetry

Open Source Observability Framework

OpenTelemetry (OTel)

OpenTelemetry is an open-source **Observability Framework** &

toolkit for: **Generating** → **Collecting** → **Processing** → **Exporting** telemetry data:

- 📊 Metrics
- 📄 Logs
- 🧵 Traces

⚠️ Important to Note:

OpenTelemetry is not an observability backend – it **does not store** or **visualize** telemetry data.

Instead, it **standardizes and transports** it to the backend of your choice.

OTel - Key Characteristics

✅ **Open Source**

🔧 **Vendor-Neutral & Tool-Agnostic**

🔄 **Pluggable** with multiple backends:

- Open source Tools (e.g., Prometheus, Loki, Jaeger)
- Commercial platforms (e.g., Grafana Cloud, Datadog, New Relic)

🎯 Built for **Easy & Consistent Instrumentation**

Works across:

👩‍💻 Multiple **Programming Language**

🏗️ Any **Infrastructure** - Kubernetes, Bare-metal, VMs

OTel - Data Pipeline

🛠️ Instrumentation

App emits telemetry data:

- 📊 Metrics
- 📄 Logs
- 🧵 Traces

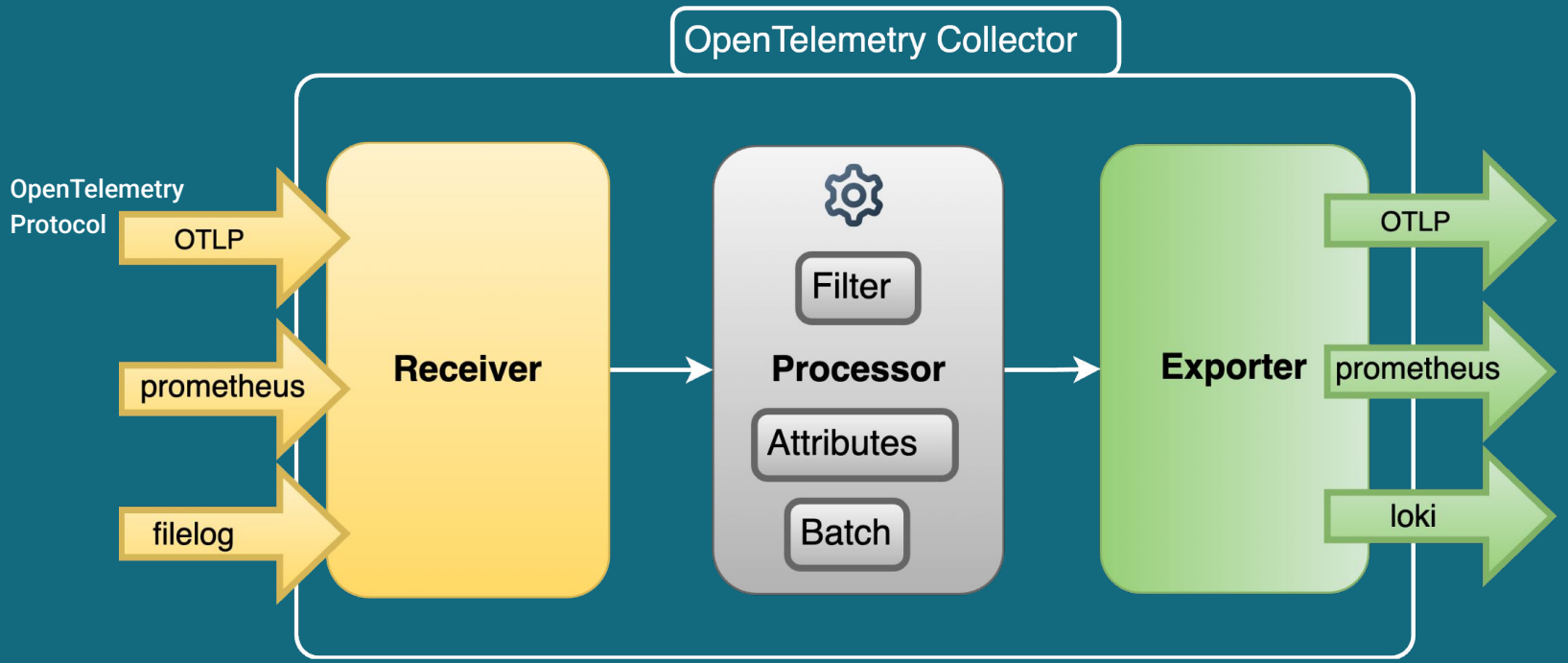
🔀 OTEL Collector

OTel Collector **Receives** → **Processes** → **Exports** telemetry data.

Data can be sent to any preferred **observability backend**:

- 📬 Prometheus, Loki
- ☁️ Datadog, Grafana Cloud, etc.

OTel Collector Design



Monitoring Postgres Anywhere with OpenTelemetry

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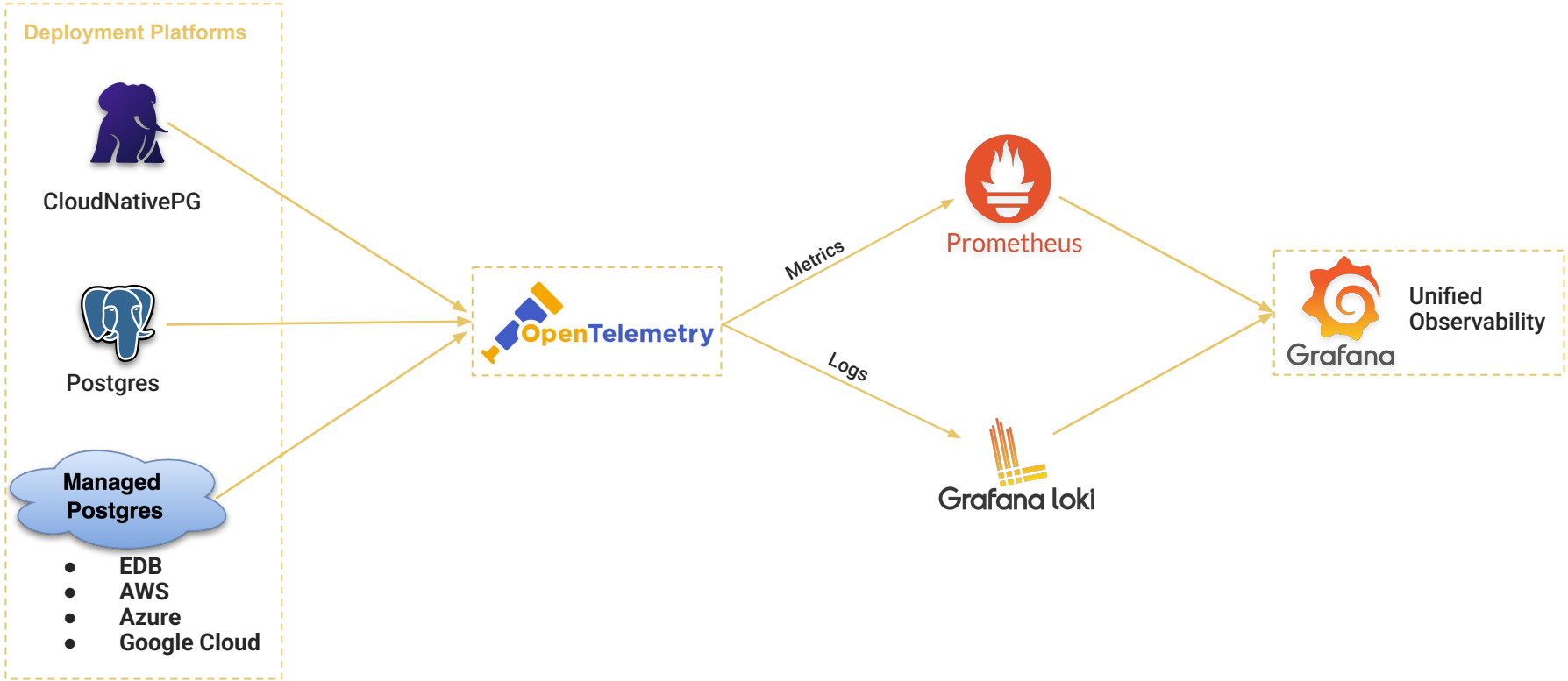
Monitoring Postgres Anywhere with OTeL



CloudNativePG

PostgreSQL Operator for **Kubernetes**

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CloudNativePG

CloudNativePG is a **CNCF Sandbox project** — an **open-source Kubernetes operator** for managing **PostgreSQL** workloads in **Kubernetes**.

🔧 **Kubernetes-Native by Design**

- Defines a **custom k8s resource: Cluster** – represents a PostgreSQL cluster with one primary & optional replicas.
- **Fully declarative** & integrates directly with the Kubernetes API.

🚀 **Full Lifecycle Management**

- Manages deployment, **scaling**, **failover**, and updates.
- Uses native **streaming replication** for **high availability** (primary/standby architecture)
- Does not rely on StatefulSets. Manages its own **PVCs** for storing **PGDATA**.

CloudNativePG - Monitoring

CloudNativePG integrates seamlessly with observability stacks using Prometheus and Kubernetes-native logging.

📊 Metrics Export

- **Exposes native Prometheus metrics**
- Each PostgreSQL instance includes a dedicated exporter
- Predefined metrics included & **Custom queries** can be added **for deeper insights**

📄 Logging

- **Outputs JSON**-formatted logs (including PostgreSQL logs) to stdout
- No disk persistence — improves security and statelessness

OTel - Config - Overview for Postgres

A simple pipeline to collect, process, and export PostgreSQL telemetry:

📥 Receivers

- **hostmetrics** – Gathers system-level metrics
- **postgresql/ sqlquery** – Collects PostgreSQL metrics
- **prometheus** – Scrapes metrics from Prometheus - postgres exporters
- **filelog** – Reads PostgreSQL logs

🧹 Processors

- **attributes** – Adds, updates, deletes custom labels
- **filter** – Keeps only relevant metrics/logs (**save storage cost**)
- **batch** – Batches telemetry data for performance

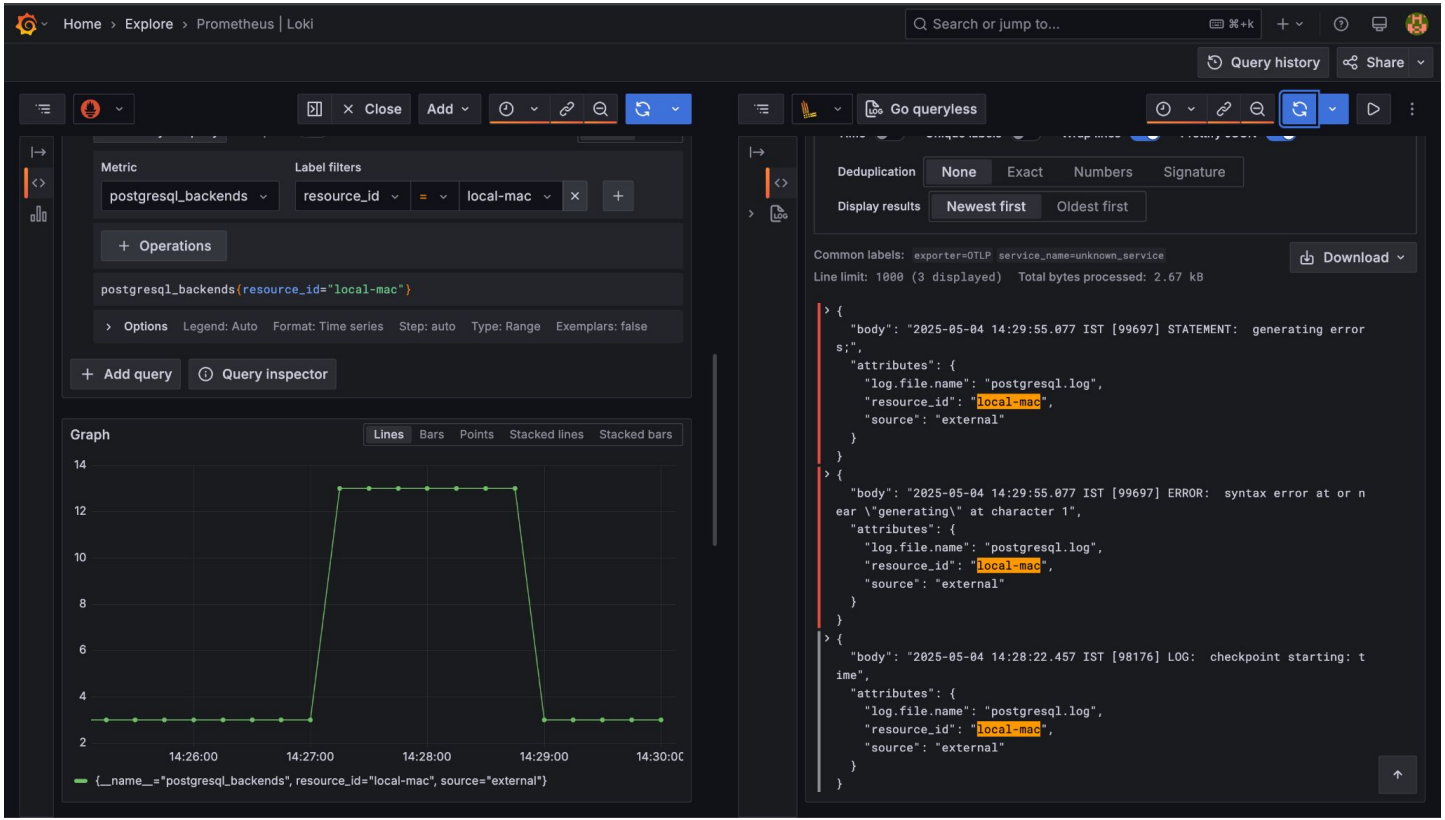
📤 Exporters

- **prometheusremotewrite** – Sends metrics to Prometheus-compatible backends
- **loki** – Streams logs to Grafana Loki
- **otlp** – Exports to any OpenTelemetry-compatible observability backend

OTel - Config - Pipeline Example

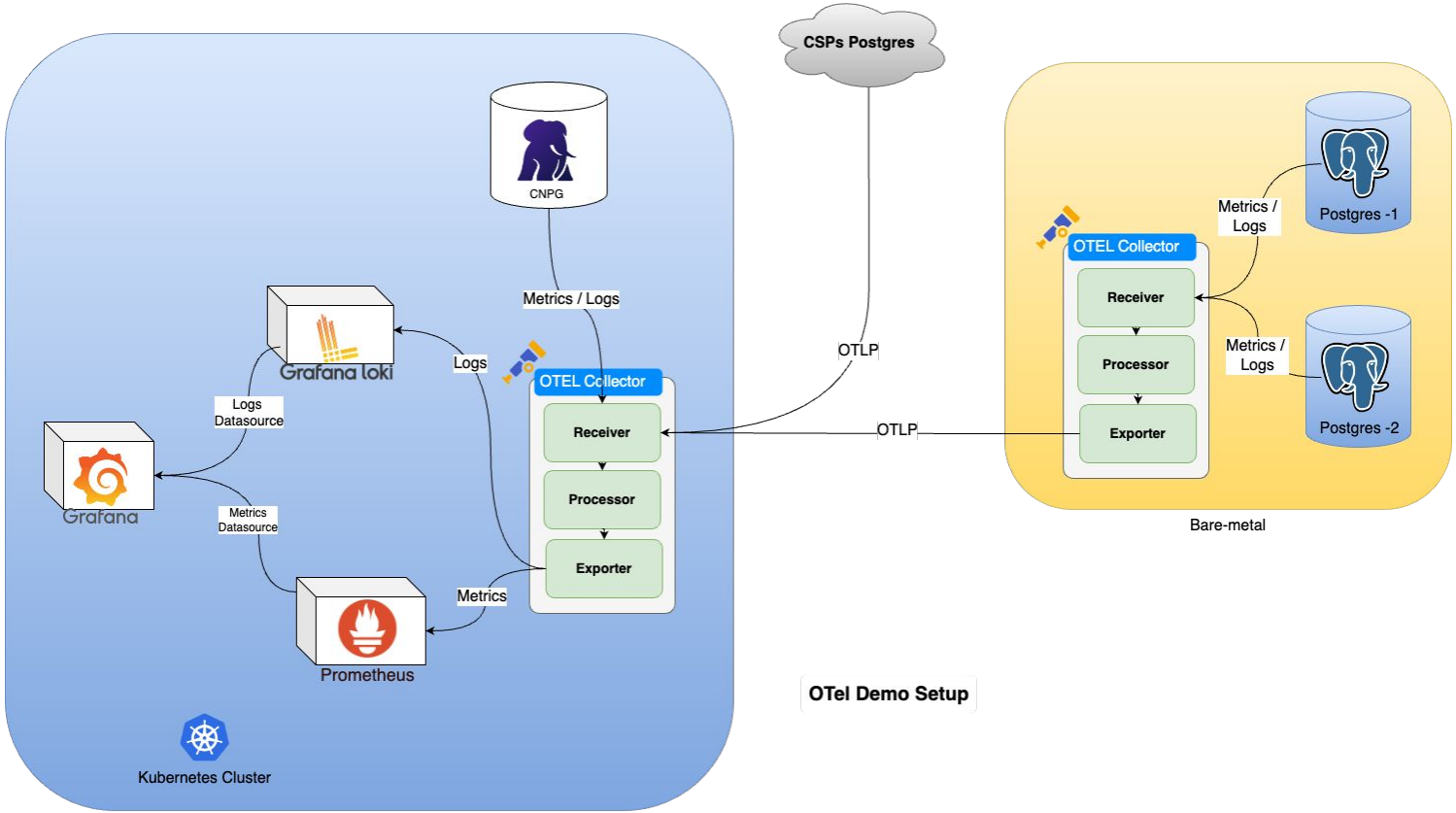
```yaml
service:
  pipelines:
    metrics:
      receivers: [postgresqlreceiver, hostmetricsreceiver, prometheus]
      processors: [attributes, filter, batch]
      exporters: [prometheusremotewrite, oltp]
    logs:
      receivers: [filelogreceiver]
      processors: [filter, batch]
      exporters: [loki, oltp]
```

Unified Observability – Metrics & Logs



DEMO

Demo Setup Overview

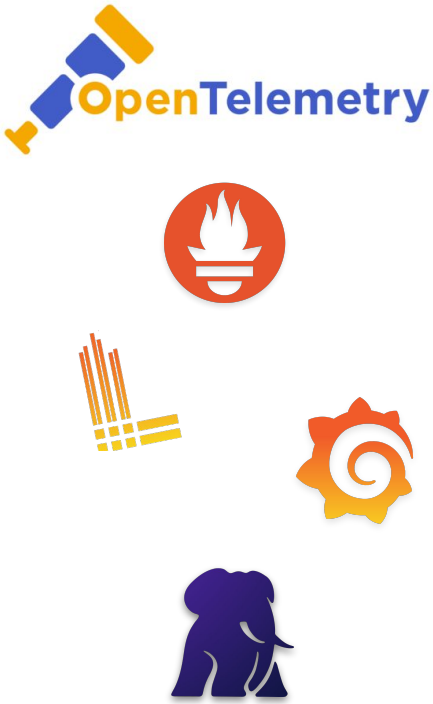


Bonus: Unified Observability + MCP + LLM agents

Category	Query 1	Query 2
Metrics	Is my database latency higher than usual right now?	Did CPU or memory spike before the pod restarted?
Logs	Show me the last ERROR logs from the checkout service.	What were the logs right before the database pod crashed?
Cluster	Which pods are failing or in CrashLoopBackOff state?	Are there any nodes running out of disk space?
Tracing	Show me the trace of the last failed request to the checkout service.	Which microservice is adding the most latency in the payment workflow?
Alerts	Are there any active alerts right now?	Did any pod restart alerts fire recently?

Resources/ Useful Links

- OpenTelemetry (CNCF Incubating Project)
  - OpenTelemetry - Receivers List
  - OpenTelemetry - Processors List
  - OpenTelemetry - Exporter List
- Prometheus (CNCF Graduated Project)
- Loki
- Grafana
- CloudNativePG (CNCF Sandbox Project)
  - CloudNativePG - Monitoring



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Feedback

🤝Let’s connect to talk about:

- Observability
- Postgres
- Kubernetes
- Conversational AI
- Open Source Softwares

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