Mastering Observability with OS Tools

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Who Am I

- **Hi** 👋 I’m Luca Raveri, Software Engineer and AWS Solutions Architect

💻 Backend Development

☁️ Cloud Architectures

🔍 Observability

📌 Venice, Italy

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Do you really know your system?

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Common Scenario

The day after the release...

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What are Monitoring and Observability?

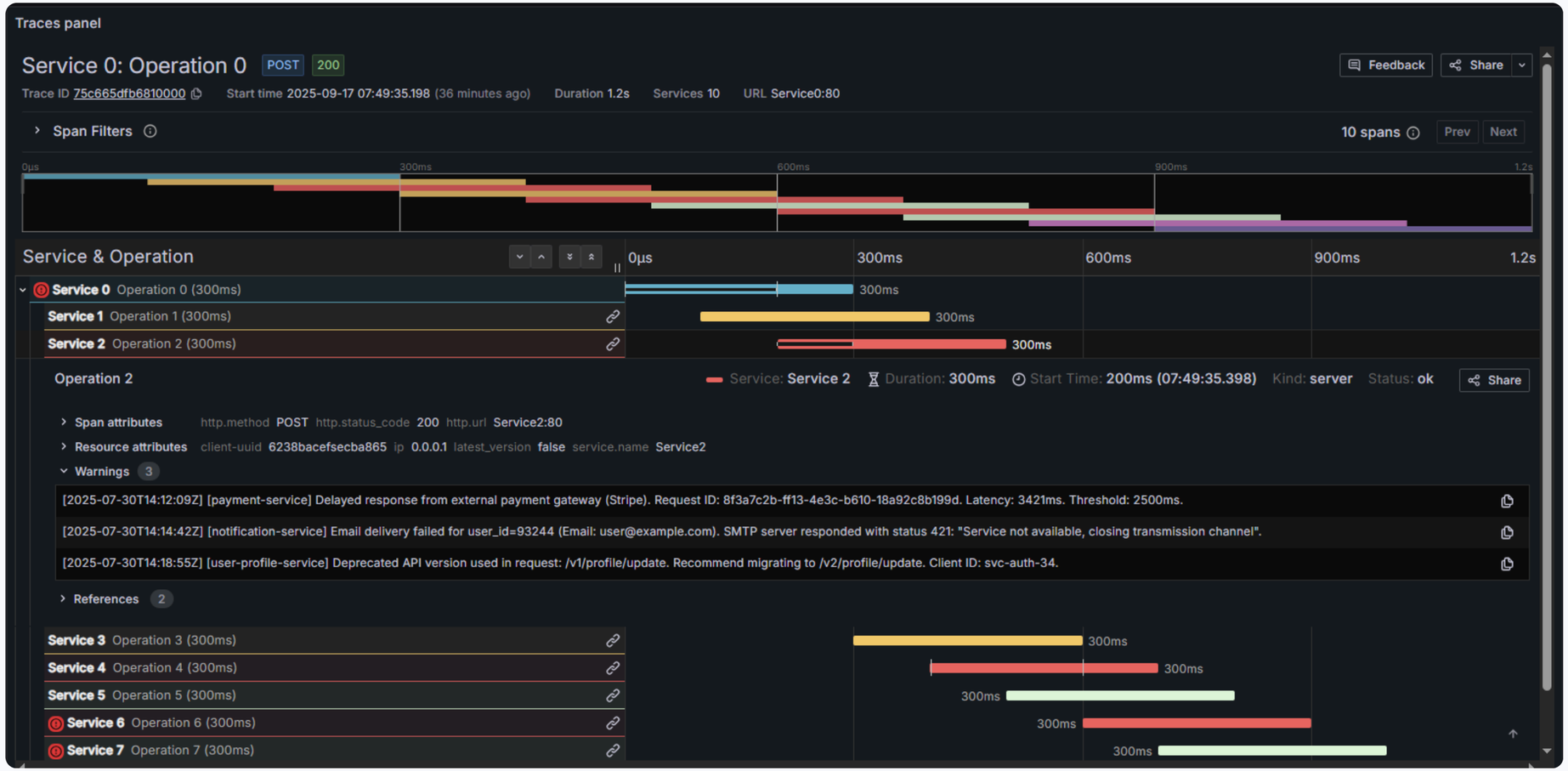
- **Monitoring**: Continuous measurement of a system's health to detect anomalies, performance issues, or downtime → *tells us that something is wrong*

- **Observability**: The ability to understand the internal state of a complex system by examining the data it produces → *tells us why it is wrong*

The Three Pillars Of Observability

- **Metrics**: Numeric measurements over time (e.g. CPU usage)
  → *What is happening*
- **Logs**: Discrete, timestamped records of events → *Why is happening*
- **Traces:** Request flow through the system → *Where is happening*

What is a Trace



https://play.grafana.org

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Key Benefits of Observability

- **Lower MTTD (Mean Time to Detect)**
  Problems are identified quickly, often before users notice.

- **Lower MTTR (Mean Time to Resolve)**
  Root causes are found and fixed faster, reducing downtime and impact

Observability

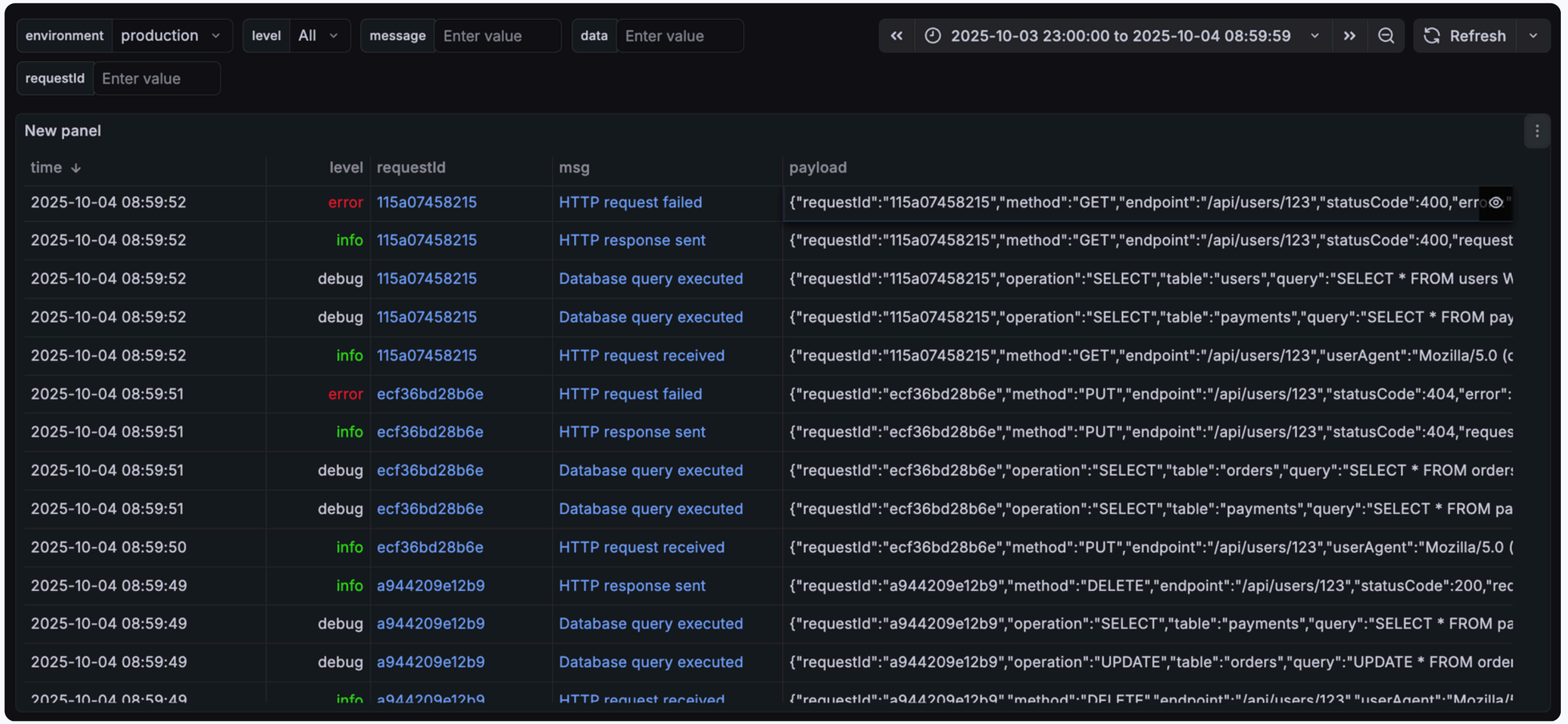
==

Performance

From This...

```
[2025-09-30 19:05:37.130 +0200] INFO: service boot {"service":"grafana-demo","payload":{"requestId":"da34f8bf-0bfa-435e-8198-cfdf016b9de8","service":"orders-api","e
[2025-09-30 19:05:37.370 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"6d3a0a0c-0edb-4e7d-badf-0aa99447f19f","method":"GET","path"
[2025-09-30 19:05:37.418 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"6d3a0a0c-0edb-4e7d-badf-0aa99447f19f","method":"GET","path
[2025-09-30 19:05:37.529 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"2da464f1-2bf9-455b-8efa-60ee5ba10585","sql":"SELECT 1","db":"
[2025-09-30 19:05:37.576 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"152e854c-64a5-43e4-b8fe-f3b45cf97a4a","method":"POST","path
[2025-09-30 19:05:37.696 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"152e854c-64a5-43e4-b8fe-f3b45cf97a4a","sql":"insert into user
[2025-09-30 19:05:37.739 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"152e854c-64a5-43e4-b8fe-f3b45cf97a4a","method":"POST","pat
[2025-09-30 19:05:37.988 +0200] ERROR: rate limit nearing {"service":"grafana-demo","payload":{"requestId":"4be049ab-ca57-417e-94d1-147fab6b1fd7","clientId":"demo-c
[2025-09-30 19:05:38.049 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"ea90cf08-7d69-4e75-89f6-af7e87e96ef2","method":"GET","path"
[2025-09-30 19:05:38.124 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"ea90cf08-7d69-4e75-89f6-af7e87e96ef2","sql":"select id, email
[2025-09-30 19:05:38.163 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"ea90cf08-7d69-4e75-89f6-af7e87e96ef2","method":"GET","path
[2025-09-30 19:05:38.206 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"fb0b4ea8-1050-45a7-ac61-9bad34bc265f","method":"PATCH","pat
[2025-09-30 19:05:38.281 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"fb0b4ea8-1050-45a7-ac61-9bad34bc265f","sql":"update users set
[2025-09-30 19:05:38.316 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"fb0b4ea8-1050-45a7-ac61-9bad34bc265f","method":"PATCH","pa
[2025-09-30 19:05:38.455 +0200] ERROR: unhandled application error {"service":"grafana-demo","payload":{"requestId":"d4d9fafa-b284-416f-baba-2a1dfbb6f85b","method":
[2025-09-30 19:05:38.562 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"d4d9fafa-b284-416f-baba-2a1dfbb6f85b","sql":"select id from u
[2025-09-30 19:05:38.600 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"d4d9fafa-b284-416f-baba-2a1dfbb6f85b","method":"GET","path
[2025-09-30 19:05:38.692 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"cbca0ba1-cae2-4555-a516-62bb5329a166","method":"GET","path"
[2025-09-30 19:05:38.756 +0200] DEBUG: cache get {"service":"grafana-demo","payload":{"requestId":"cbca0ba1-cae2-4555-a516-62bb5329a166","key":"order:5012","backend
[2025-09-30 19:05:38.781 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"cbca0ba1-cae2-4555-a516-62bb5329a166","method":"GET","path
[2025-09-30 19:05:38.905 +0200] ERROR: slow query detected {"service":"grafana-demo","payload":{"requestId":"25012bdd-1a6a-45e2-9d32-6f1b6c803e32","sql":"select * f
[2025-09-30 19:05:39.090 +0200] INFO: incoming request {"service":"grafana-demo","payload":{"requestId":"e1fef4d3-beec-4480-a0ca-9fb6782213fe","method":"DELETE","pa
[2025-09-30 19:05:39.131 +0200] INFO: request completed {"service":"grafana-demo","payload":{"requestId":"e1fef4d3-beec-4480-a0ca-9fb6782213fe","method":"DELETE","p
[2025-09-30 19:05:39.241 +0200] ERROR: payment gateway timeout {"service":"grafana-demo","payload":{"requestId":"12ceeb00-0a86-4ea0-bce0-99efade0a625","method":"POS
[2025-09-30 19:05:39.413 +0200] DEBUG: sql execution {"service":"grafana-demo","payload":{"requestId":"12ceeb00-0a86-4ea0-bce0-99efade0a625","sql":"insert into paym
```

...to This!



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Demo Time!

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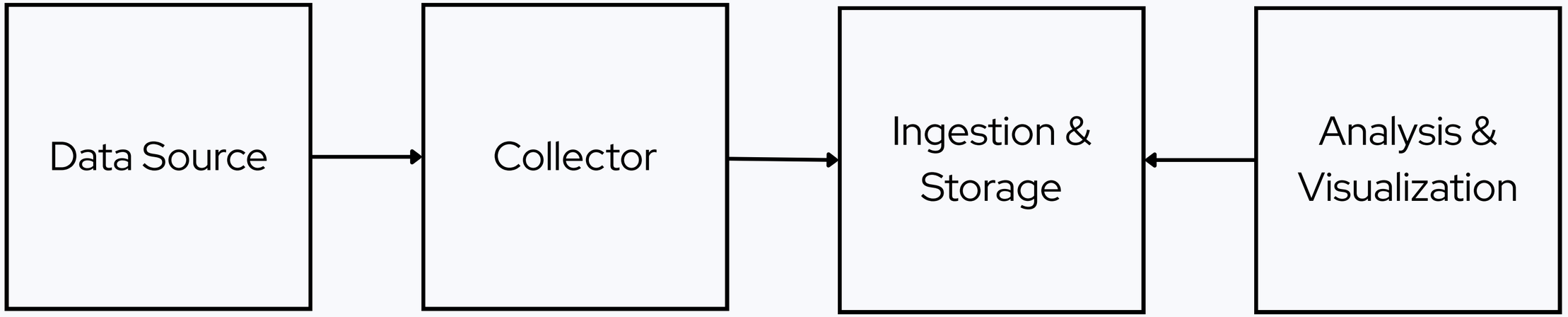
Let’s Build an Observability System



LGTM Stack

Loki

Database
for logs

Grafana

Visualization
tool

Tempo

Database
for traces

Mimir

Database
for metrics

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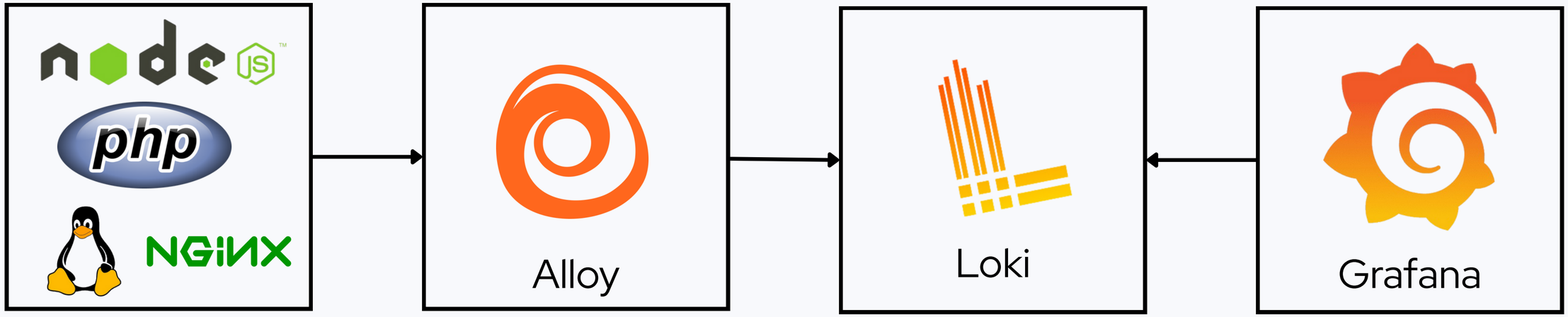
Let’s build an Observability System



Let’s Start Logging

- Use a logger instead of native functions
- Apply log levels and timestamps
- Format logs (JSON)
- Never log secrets and PII
- Set retention policies (e.g., logrotate)

Logging Strategies

- Log system inputs and outputs
- Centralize logging in a single layer
- Use UUIDs to correlate related logs
- More logs means more insight, but higher overhead

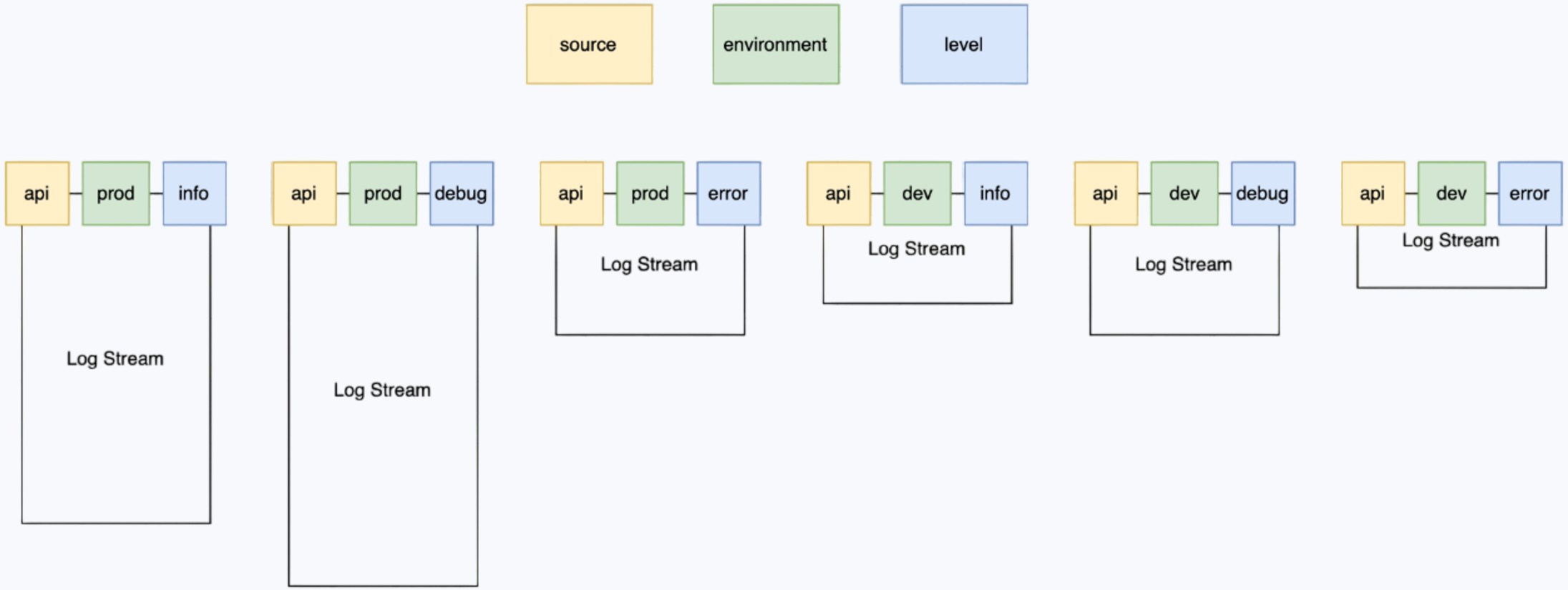
```
console.log(`Customer ${customerName} purchased ${itemsPurchased} items`);
```

```
logger.info('Customer purchase', {
  customerId: customer.id,
  customerName: customer.name,
  itemsPurchased: customer.itemsPurchased,
  totalAmount: customer.totalAmount,
});
```

What is Loki

“Loki is a horizontally scalable, highly available, multi-tenant log aggregation system inspired by Prometheus. It is designed to be very cost effective and easy to operate. It does not index the contents of the logs, but rather a set of labels for each log stream.”

How Loki Works



"...It does not index the contents of the logs, but rather a set of labels for each log stream.""

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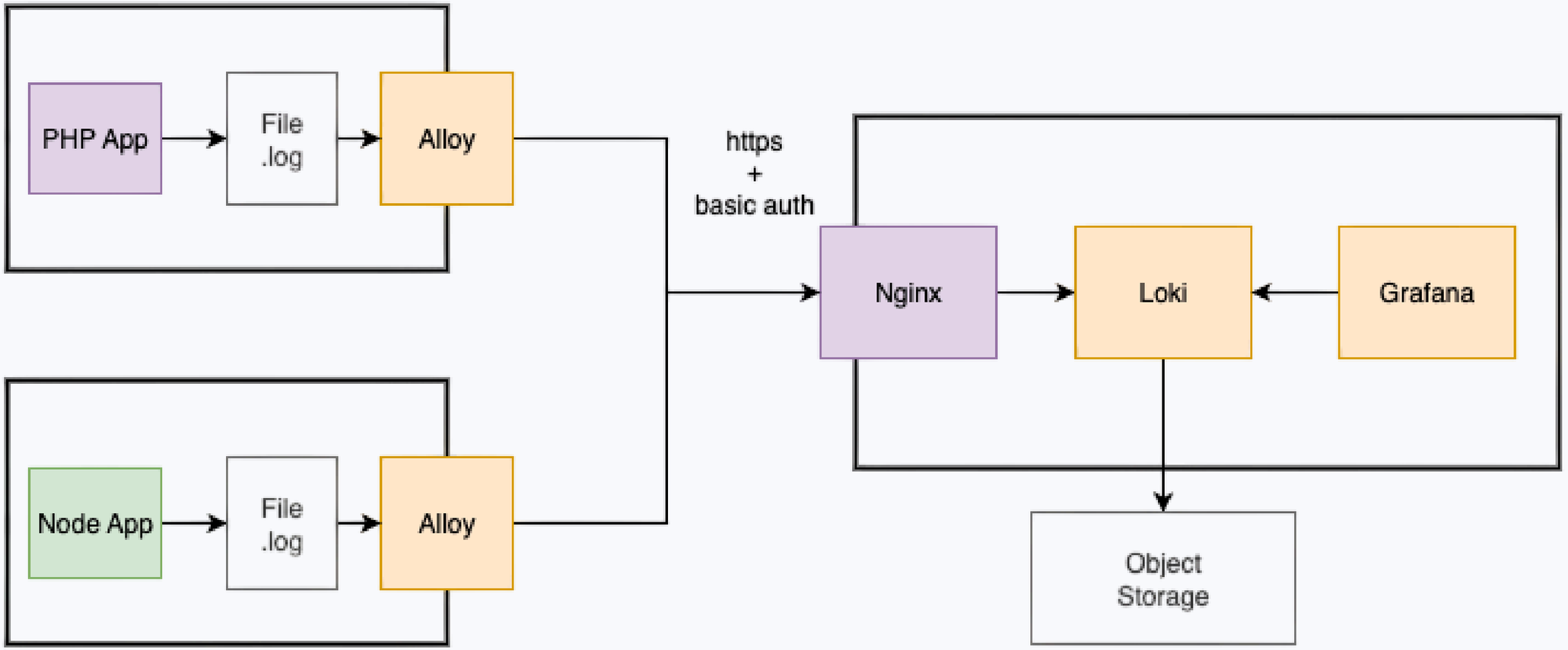
How to Send Logs to Loki

Grafana Alloy is a collector that automatically reads your log files and pushes them to Loki. It can:

- Apply **static labels** to all logs from a file
- Extract **dynamic labels** from log content
- Perform **transformations** on log data

Hosting Loki



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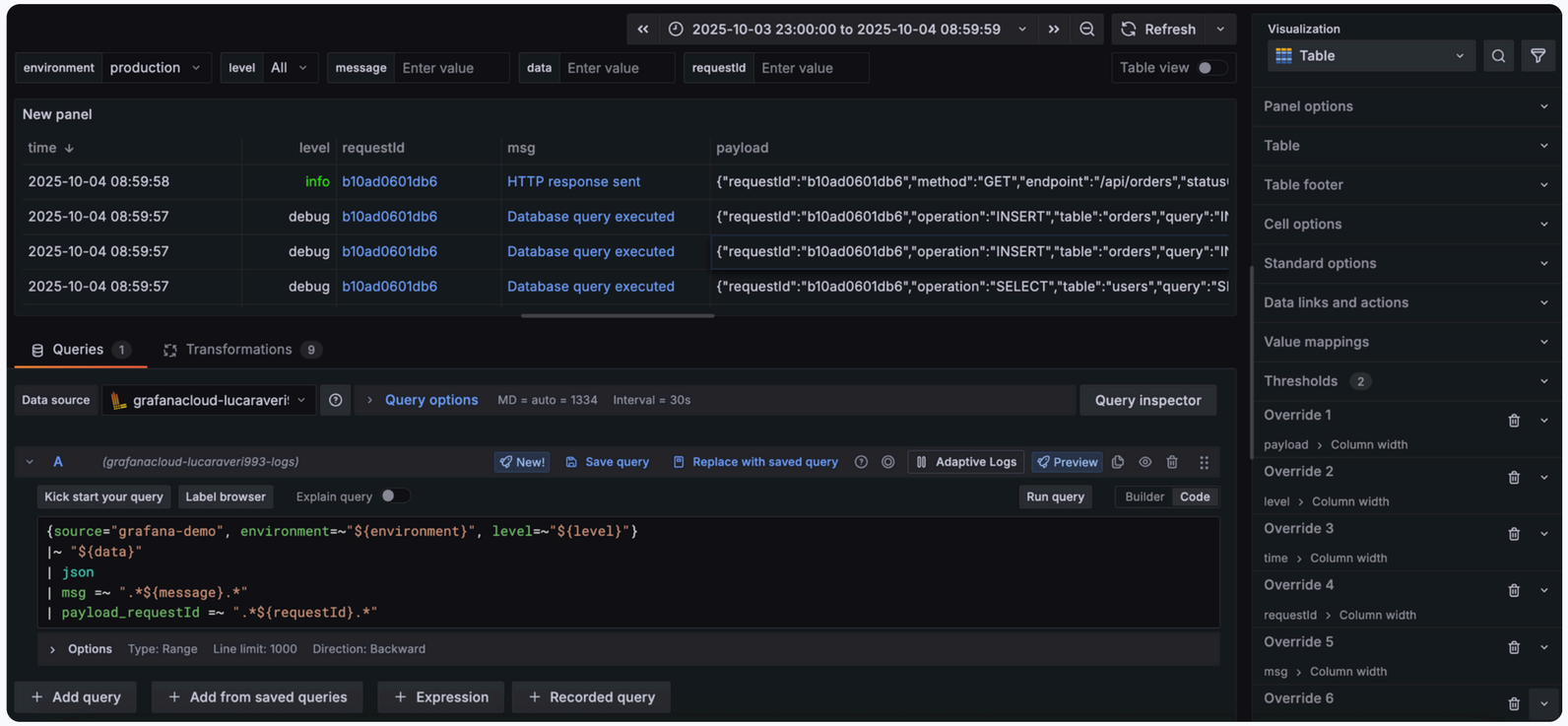
How to Query Logs

```
{source="grafana-demo", environment=~"${environment}", level=~"${level}"}
|~ "${data}"
| json
| msg =~ ".*${message}.*"
| payload_requestId =~ ".*${requestId}.*"
```

```
{job="apache_error_log", environment=~"${environment}", source=~"${source}"}
|~ "${data}"
| regexp "\\[(?P<timestamp>[^\\]]+)\\].*\\[php7:(?P<level>[^\\]]+)\\].*PHP (?P<type>[^:]+): (?P<message>.*?) in (?
P<file>[A-Z]:\\\\[^\"]+?)(?::(?P<line>\\d+)| on line (?P<line_alt>\\d+))"
| line_format "{{ printf `{\"timestamp\":\"%s\", \"level\":\"%s\", \"type\":\"%s\", \"message\":\"%s\",
\"file\":\"%s\", \"line\":\"%s\"}` .timestamp .level .type .message .file (or .line .line_alt) }}"
| message =~ ".*${message}.*"
| file =~ ".*${file}.*"
| message != ""
```

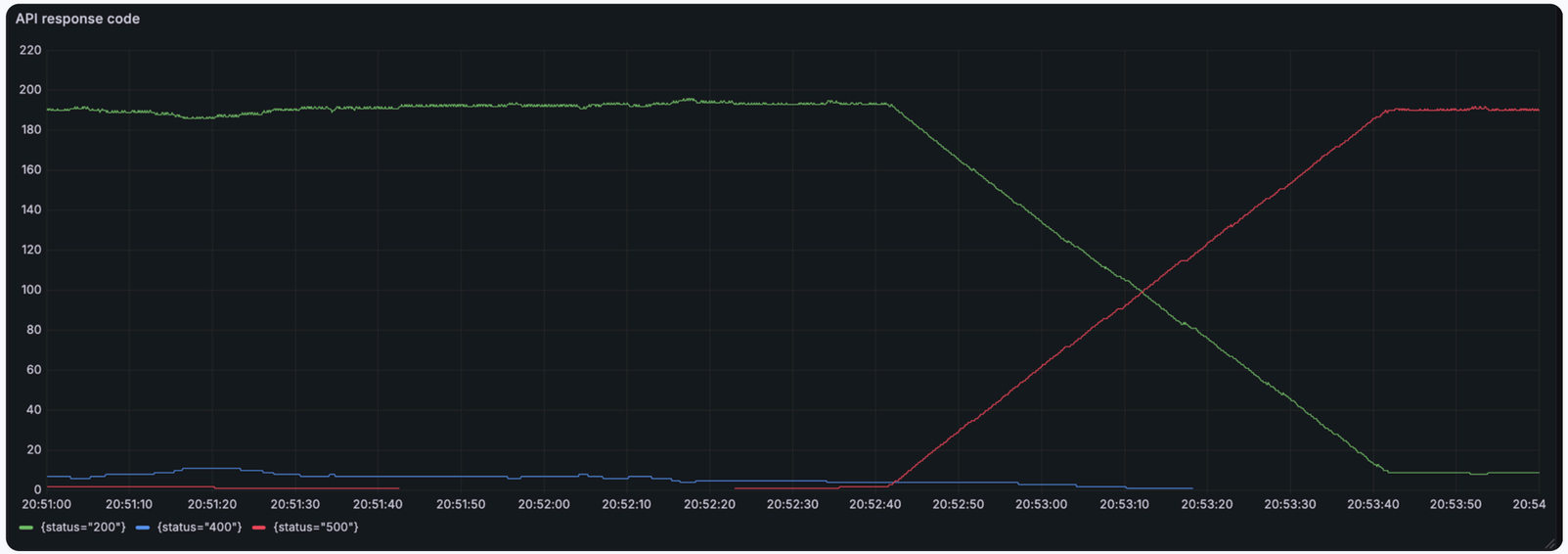
How to Visualize Logs

1. Write the query
2. Apply transformations
3. Create variables
4. Add overrides



Alerting Strategies

- Single error detection → trigger on critical errors
- Error rate spikes (RED method) → alert on sudden increase in errors



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Results

- Strong team adoption and enthusiasm.
- Significantly improved **MTTD** and reduced **MTTR** from 2 days to 2 hours, enhancing service quality.
- Handled 1 GB/day with 2-week retention (14 GB total), running smoothly on a €6/month instance.

Thank you!

Questions?

Demo Repository