Observability 200: Logging with OpenTelemetry

Getting Started

The advent of OpenTelemetry has forever changed how we capture observability signals. While OTel initially focused on delivering traces and metrics, support for collection of logs is now stable and gaining adoption, particularly in Kubernetes environments.

In this lab, we will explore several models for using OpenTelemetry to collect and parse logs.

Lab Architecture

In this lab, we will be working with an exemplary stock trading system, comprised of several services and their dependencies running in Kubernetes. We are using the OpenTelemetry Operator to automatically instrument all of our services.

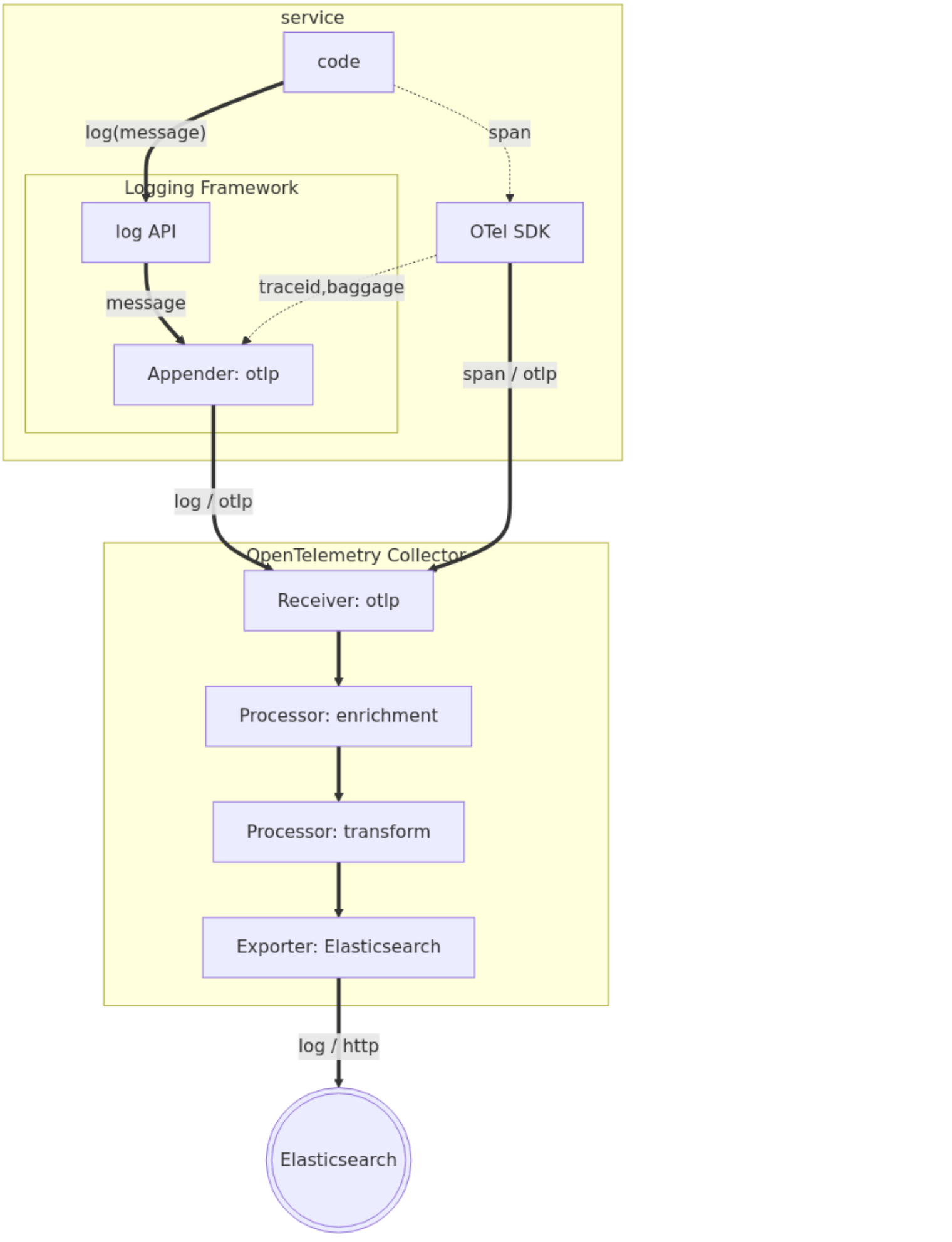
Our trading system is comprised of:

- `proxy`: a nginx reverse proxy which proxies requests from the outside into the trading system
- `trader`: a python application that trades stocks on orders from customers
- `router`: a node.js application that routes committed trade records
- `recorder-java`: a Java application that records trades to a PostgreSQL database

Finally, we have `monkey`, a python application we use for testing our system that makes periodic, automated trade requests on behalf of fictional customers. `monkey` routes its requests through `proxy`.

OpenTelemetry Logging with OTLP

In this model, we will be sending logs directly from a service to an OpenTelemetry Collector over the network using the OTLP protocol. This is the default mechanism most OpenTelemetry SDKs use for exporting logs from a service.


service
code
log(message)
span
Logging Framework
log API
OTel SDK
traceid,baggage
message
Appender: otlp
span / otlp
log / otlp
OpenTelemetry Collector
Receiver: otlp
Processor: enrichment
Processor: transform
Exporter: Elasticsearch
log / http
Elasticsearch

Looking at the diagram:

1) a service leverages an existing logging framework (e.g., logback in Java) to generate log statements
2) on service startup, the OTel SDK injects a new Appender module into the logging framework. This module formats the log metadata to appropriate OTel semantic conventions (e.g., log.level), adds appropriate contextual metadata (e.g., trace.id), and outputs the log lines via OTLP (typically buffered) to a configured OTel Collector
3) an OTel Collector (typically, but not necessarily) on the same node as the service receives the log lines via the `otlp` receiver
4) the Collector enriches the log line with additional metadata and optionally parses or otherwise transforms the message
5) the Collector then outputs the logs downstream (either directly to Elasticsearch, or more typically through a gateway Collector, and then to Elasticsearch)

Assumptions

While this model is relatively simple to implement, it assumes several things:

1) The service can be instrumented with OpenTelemetry (either through runtime zero-configuration instrumentation, or through explicit instrumentation). This essentially rules out use of this method for most opaque, third-party applications and services.
2) Your OTel pipelines are robust enough to forgo file-based logging. Traditional logging relied on services writing to files and agents reading or "tailing" those log files. File-based logging inherently adds a semi-reliable, FIFO, disk-based queue between services and the Collector. If there is a downstream failure in the telemetry pipeline (e.g., a failure in the Collector or downstream of the Collector) or back-pressure from Elasticsearch, the file will serve as a temporary, reasonably robust buffer. Notably, this concern can be mitigated with Collector-based disk queues and/or the use of a Kafka-like queue somewhere in-between the first Collector and Elasticsearch.

Advantages

There are, of course, many advantages to using OTLP as a logging protocol where possible:

1) you don't have to deal with file rotation or disk overflow due to logs
2) there is less io overhead (no file operations) on the node
3) the Collector need not be local to the node running the applications (though you would typically want a Collector per node for other reasons)

Additionally, exporting logs from a service using the OTel SDK offers the following general benefits:

1) logs are automatically formatted with OTel Semantic Conventions
2) key/values applied to log statements are automatically emitted as attributes
3) traceid and spanid are automatically added when appropriate
4) contextual metadata (e.g., service.name) are automatically emitted as attributes
5) custom metadata in baggage can be automatically applied as attributes to each log line

All of the above leads to logs with rich context and metadata with little to no additional work. It is worth noting that the Collector now supports a disk-based buffer between the receivers and the exporters.

Configuration

Most of the languages supported by OpenTelemetry are automatically instrumented for logging via OTLP by default. In the case of Java, for example, the OTel SDK, when in zero-code instrumentation, will automatically attach an OTLP appender to either Logback or Log4j.

In this example, we are leveraging the OpenTelemetry Operator for Kubernetes to automatically inject the OTel SDK into our services, including the `recorder-java` service. Our `recorder-java` service is using Logback as a logging framework with a slf4j facade.

Checking the Source

Let's have a look at the configuration of our `recorder-java` service.

1. Open the button label="recorder-java Source" tab
2. Navigate to `src/main/resources/logback.xml`

3. Note that no appenders are specified in the Logback configuration (they are automatically injected by the OTel SDK on startup)

   [!NOTE] It is possible to leave a console appender in your Logback configuration such that you can still view the logs locally (with `kubectl logs` or by tailing the log file itself). In this case, you would want to be sure you are explicitly excluding this log file from also being scrapped by your OTel Collector to avoid duplicative log input into Elasticsearch. We will show a straightforward way of doing this in a future challenge.

Correlation

One major advantage of using OTLP for logging is the ability to very easily append the active `trace.id` and `span.id` if the log is emitted during an active APM span.

1. Open the button label="Elasticsearch" tab
2. Click `Applications` > `Service Inventory` in the left-hand navigation pane
3. Click on the `recorder-java` service
4. Click on the `Transactions` tab
5. Click on the `POST /record` tab
6. Scroll down to `Trace sample`
7. Click on the `Logs` tab
8. Click on the right scroll arrow next to `Trace sample` to find a sample with a complete set of logs (you should see logs from `trader`, `postgresql`, and `recorder-java`)

These are all the logs associated with this particular trace sample.

Attributes via Structured Logging

Let's say that we think we might have a problem with the Garbage Collector in our Java Virtual Machine (JVM) running too often, possibly affecting database performance. As a developer, you might think to sample the amount of time spent in GC and then report that in a log file.

Say we wanted to graph GC time by region to see if perhaps the issue is localized. To do that, we need GC time as a metric value. While we could just encode it into the log message as text and parse it out, that's unnecessary with modern structured logging APIs and OpenTelemetry.

OTLP logging allows us to easily add attributes to our log lines by using key/value mechanisms present in your existing logging API. In this case, we can use the `addKeyValue()` API exposed by our logging facade, slf4j.

1. Open the button label="recorder-java Source" tab
2. Navigate to `src/main/java/com/example/recorder/TradeRecorder.java`
3. Find the following line:

```
log.atInfo().log("trade committed for " + trade.customerId);
```

and change it to:

```
log.atInfo().addKeyValue(Main.ATTRIBUTE_PREFIX + ".gc_time", utilities.getGarbageCollectorDeltaTime()).log("trade committed for " + trade.cus
```

   [!NOTE] It is generally considered best practice to prepend any custom attributes with a prefix scoped to your enterprise, like `com.example`

Now let's recompile and redeploy our `recorder-java` service.

1. Open the button label="Terminal" tab
2. Execute the following:

```
./builddeploy.sh -s recorder-java
```

Now let's see what our logs look like in Elasticsearch.

1. Open the button label="Elasticsearch" tab
2. Click `Discover` in the left-hand navigation pane
3. Execute the following query:

```
FROM logs-*
| WHERE service.name == "recorder-java" and message LIKE "*trade committed*"
| WHERE attributes.com.example.gc_time IS NOT NULL
```

4. Open the first log record by clicking on the double arrow icon under `Actions`

5. Click on the `Attributes` tab

Note the added attribute `attributes.com.example.gc_time`!

> [!NOTE] if `attributes.com.example.gc_time` is not yet present, refresh the view in Discover until there are valid results

Now let's graph `gc_time` to answer our question.

Execute the following query:

```
FROM logs-*
| WHERE service.name == "recorder-java"
| WHERE attributes.com.example.gc_time IS NOT NULL
| STATS count = MAX(attributes.com.example.gc_time) BY attributes.com.example.region, BUCKET(@timestamp, 1 minute)
```

Indeed, it looks like only the `recorder-java` service deployed to the `NA` region is exhibiting this problem.

Attributes via Baggage

Note that the log record has other custom attributes like `attributes.com.example.customer_id`. We didn't add that in our logging statement in `recorder-java`. How did it get there?

1. Open the button label="Elasticsearch" tab
2. Click `Applications` > `Service Inventory` in the left-hand navigation pane
3. Click on the `Service Map` tab
4. Click on the `trader` service
5. Click on `Service Details`
6. Click on the `Transactions` tab
7. Scroll down and click on the `POST /trade/request` transaction under `Transactions`
8. Scroll down to the waterfall graph under `Trace sample`
9. Click on the first span `POST /trade/request` to open the flyout

Note that `attributes.com.example.customer_id` exists in this span too!

1. Close the `Transaction details` flyout
2. Click on the `Logs` tab under `Trace sample`
3. Click on the log line that looks like `trade committed for <customer.id>` from the `recorder-java` service

Note that `attributes.com.example.customer_id` exists here too!

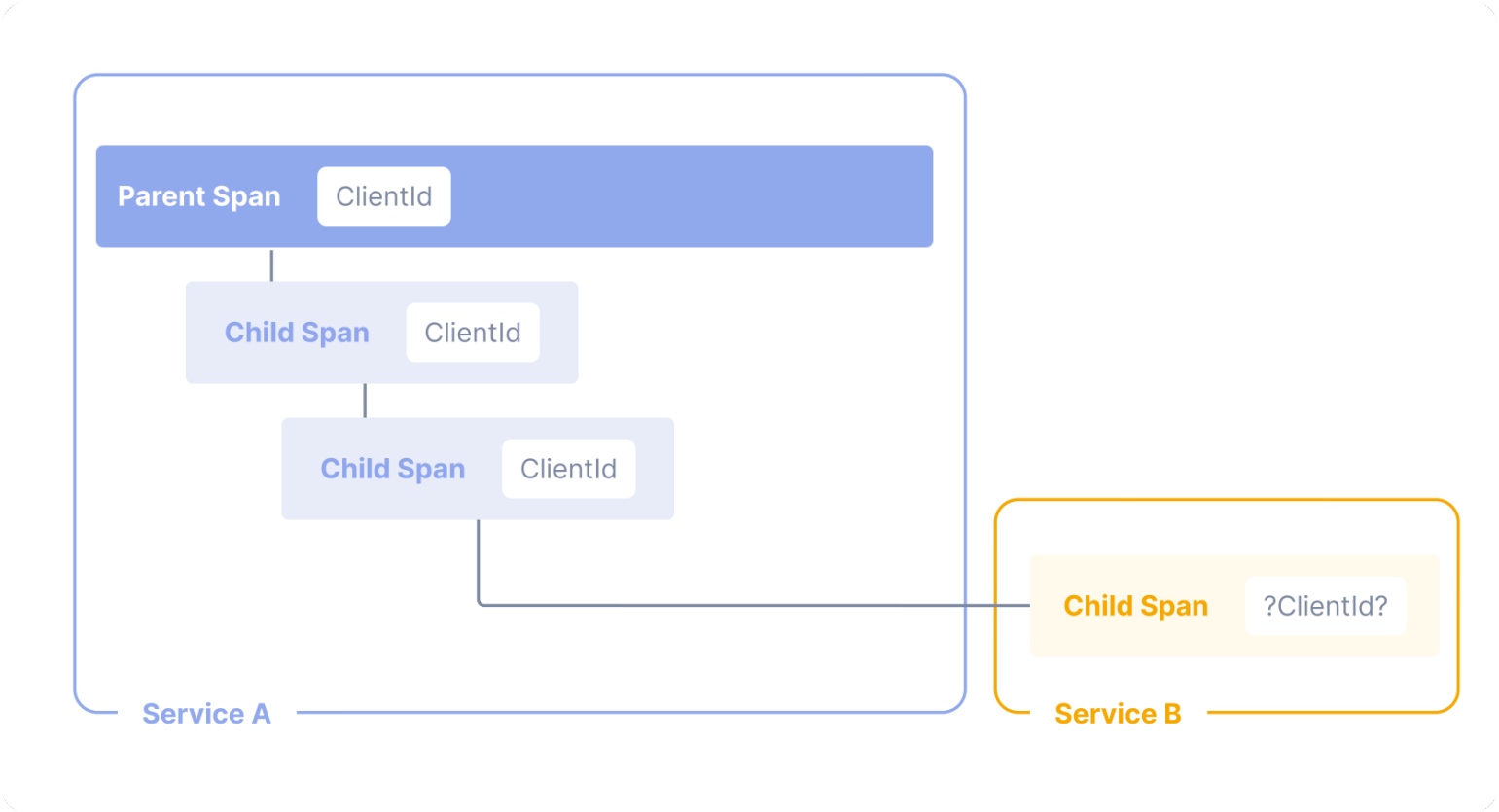
This is a great example of the power of using OpenTelemetry Baggage. Baggage lets us inject attributes early on in our distributed service mesh and then automatically distribute and apply them downstream to every span and log message emitted in context!

Imagine how easy this will make the life of your SREs and analysts to easily search across all of your observability signals using the inputs they are accustomed to: namely, `customer_id`, for example.

Let's look at the code which initially stuck `customer_id` into OTel baggage:

1. Open the button label="Trader Source" tab
2. Navigate to `app.py`
3. Look for calls to `set_attribute_and_baggage()` inside the `decode_common_args()` function

Here, we are pushing attributes into OTel Baggage. OTel is propagating that baggage with every call to a distributed surface. The baggage follows the context of a given span through all dependent services. Within a given service, we can leverage BaggageProcessor extensions to automatically apply metadata in baggage as attributes to the active span (including logs).



Let's add an additional attribute in our trader service.

1. Find the following line in the `decode_common_args()` function:

```
    subscription = params.get('subscription', None)
```

2. Add the following to push `subscription` into baggage:

```
    if subscription is not None:
        set_attribute_and_baggage(f"{ATTRIBUTE_PREFIX}.subscription", subscription)
```

Now let's recompile and redeploy our `trader` service.

1. Open the button label="Terminal" tab
2. Execute the following:

```
./builddeploy.sh -s trader
```

And now let's check our work in Elasticsearch:

1. Open the button label="Elasticsearch" tab
2. Click `Discover` in the left-hand navigation pane
3. Execute the following query:

```
FROM logs-*
| WHERE service.name == "recorder-java" and message LIKE "*trade committed*"
| WHERE attributes.com.example.subscription IS NOT NULL
```

4. Open the first log record by clicking on the double arrow icon under `Actions`
5. Click on the `Attributes` tab

Note the added attribute `attributes.com.example.subscription` in the `recorder-java` logs, automatically passed along via OTel Baggage from where they inserted by `trader`.

> [!NOTE] if `attributes.com.example.subscription` is not yet present as an attribute, refresh the view in Discover until there are valid results

Note that Baggage is also automatically applied to every child span:

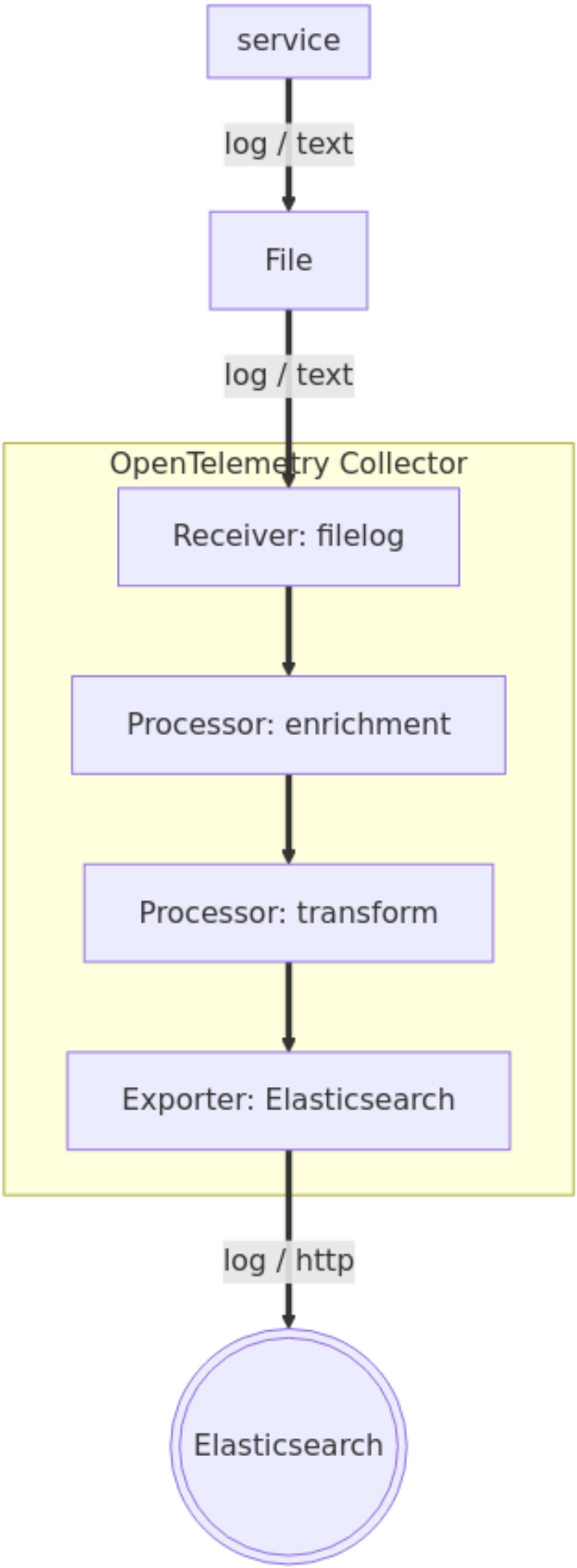
1. Open the button label="Elasticsearch" tab
2. Click `Applications` > `Service Inventory` in the left-hand navigation pane
3. Click on the `Service Map` tab
4. Click on the `trader` service
5. Click on `Service Details`

6. Click on the `Transactions` tab
7. Scroll down and click on the `POST /trade/request` transaction under `Transactions`
8. Scroll down to the waterfall graph under `Trace sample`
9. Click on the `INSERT trades.trades` database span recorded by the `recorder-java` service
10. Note the presence of the `subscription` attribute! ___

OpenTelemetry Logging with the Filelog Receiver

There are many reasons why use of OTLP-based logging may be impractical. Chief among them is accommodating services which cannot be instrumented with OpenTelemetry (e.g., third-party services). These services simply write their logs to disk directly, or more commonly to stdout, which is then written to disk by the Kubernetes or Docker logging provider, for example.

To accommodate such services, we can use the filelog receiver in the OTel Collector. In many regards, the `filelog` receiver is the OTel equivalent of Elastic's filebeat (often running as a module inside Elastic Agent).


service
log / text
File
log / text
OpenTelemetry Collector
Receiver: filelog
Processor: enrichment
Processor: transform
Exporter: Elasticsearch
log / http
Elasticsearch

Getting our bearings

In this example, we will be working with a service which outputs logs to stdout in a custom JSON format.

Let's first examine the raw JSON logs as they are currently being received by Elasticsearch: 1. Open the button label="Elasticsearch" tab 2. Execute the following query:

```
FROM logs-*
| WHERE service.name == "router"
```

3. Open the first log record by clicking on the double arrow icon under `Actions`
4. Click on the `Log overview` tab

Note that the body of the message is not particularly useable: * it has a "burned-in" JSON format * it contains both the message ("0") and associated metadata ("_meta") * the log level as presented by Elasticsearch will always be `INFO` regardless of the actual log level

Checking the Source

Now let's validate that these logs are indeed being emitted to stdout and written to disk:

1. Open the button label="Terminal" tab
2. Execute the following to get a list of the active Kubernetes pods that comprise our trading system:

```
kubectl -n trading get pods
```

3. Find the active `router-...` pod in the list
4. Get stdout logs from the active `router` pod:

```
kubectl -n trading logs <router-...>
```

(replace ... with the pod instance id)

Note that the logs are being written to stdout and are being captured by the Kubernetes logging provider. Let's validate that Kubernetes is writing this log stream to disk:

1. Open the button label="Terminal" tab
2. Get all log files associated with pods

```
cd /var/log/pods/
ls
```

3. Get logs for current instant of the `router` pod

```
cd trading_router*
ls
cd router
ls
```

4. Look at the router container logs

```
cat 0.log
```

Yup! Clearly these logs are being written to disk.

Parsing JSON logs

Many custom applications log to a JSON format to provide some structure to the log line. To fully appreciate this benefit in a logging backend, however, you need to parse that JSON (embedded in the log line) and extract fields of interest.

While you could do this with Elasticsearch using Streams (as we will see in the future challenge), with OpenTelemetry, this can also be done at the edge in the Collector using OTTL.

OTTL Playground

Crafting OTTL in a vacuum is tricky: the feedback loop of crafting OTTL, deploying it to the collector, validating it has the correct syntax, and validating it does what you expect can be long and painful.

Fortunately, there is a better way! Elastic has made available the OTTL Playground: a tool to interactively refine your OTTL before putting it in production.

1. Open the button label="OTTL Playground" tab
2. Paste into the `OTLP Payload` pane an example from our JSON formatted `router` logs:

```
{
  "resourceLogs": [
    {
      "resource": {},
      "scopeLogs": [
        {
          "scope": {},
          "logRecords": [
            {
              "timeUnixNano": "1544712660300000000",
              "observedTimeUnixNano": "1544712660300000000",
              "severityNumber": 10,
              "severityText": "Information",
              "traceId": "5b8efff798038103d269b633813fc60c",
              "spanId": "eee19b7ec3c1b174",
              "body": {
                "stringValue": "{\"0\": \"routing request to http://recorder-java:9003\",  \"_meta\": {    \"runtime\": \"Nodejs\",    \"runt
              }
            }
          ]
        }
      ]
    }
  ]
}
```

3. Paste into the `Configuration` pane the following:

```
          log_statements:
            - context: log
              conditions:
                - body != nil and Substring(body, 0, 2) == "{\""
              statements:
                - set(cache, ParseJSON(body))
                - flatten(cache, "")
                - merge_maps(attributes, cache, "upsert")
```

Those initial set of log statements: 1. check if the message body is JSON formatted 2. if so, parses the body as json, flattens the key names (to prevent nesting), and merges all extracted keys to `attributes`

Click on the `Run >` button. In the `Result` pane, you can see the diff of what this OTTL would do, and it *kind of* matches what we expect.

It is far from ideal: * it does not conform to OTel semantic conventions (e.g., `_meta.logLevelName`, `_meta.date`) * the message body is stored as an attribute with key `0`

Let's clean that up with OTTL!

1. Paste the following into the `Configuration` pane:

```
          log_statements:
            - context: log
              conditions:
                - body != nil and Substring(body, 0, 2) == "{\""
              statements:
                - set(cache, ParseJSON(body))
                - flatten(cache, "")
                - merge_maps(attributes, cache, "upsert")

                - set(time, Time(attributes["_meta.date"], "%Y-%m-%dT%H:%M:%SZ"))
                - set(severity_text, attributes["_meta.logLevelName"])
                - set(severity_number, Int(attributes["_meta.logLevelId"]))
                - delete_matching_keys(attributes, "_meta\\..*")

                - set(body, attributes["0"])
                - delete_key(attributes, "0")
```

2. Click on the `Run >` button

Ah, that looks much better! Here, we are: * converting the date from a string to an epoch timestamp and copying it into the proper semantic convention (semcon) field * copy the log level into the proper semcon fields * deleting the remaining `_meta.*` fields * copying the body from `attributes.0` to the proper semcon field * deleting the now defunct `attributes.0`

This looks great. Let's put this configuration into production!

Putting It Into Production

1. Open the button label="Collector Config" tab
2. Open the file `values.yaml`
3. Find the following block under `collectors/daemon/config/processors`:

```
      # REPLACE THIS BLOCK WITH WORKSHOP CONTENT
      transform/parse_json_body:
          error_mode: ignore
```

4. Replace it with the OTTL we developed above:

```
      transform/parse_json_body:
          error_mode: ignore
          log_statements:
            - context: log
              conditions:
                - body != nil and Substring(body, 0, 2) == "{\""
              statements:
                - set(cache, ParseJSON(body))
                - flatten(cache, "")
                - merge_maps(attributes, cache, "upsert")

                - set(time, Time(attributes["_meta.date"], "%Y-%m-%dT%H:%M:%SZ"))
                - set(severity_text, attributes["_meta.logLevelName"])
                - set(severity_number, Int(attributes["_meta.logLevelId"]))
                - delete_matching_keys(attributes, "_meta\\..*")

                - set(body, attributes["0"])
                - delete_key(attributes, "0")
```

Now let's redeploy the OTel Operator with our updated config:

1. Open the button label="Terminal" tab
2. Execute the following:

```
cd /workspace/workshop
helm upgrade --install opentelemetry-kube-stack open-telemetry/opentelemetry-kube-stack --force \
  --namespace opentelemetry-operator-system \
  --values 'collector/values.yaml' \
  --version '0.10.5'
```

This will redeploy the OTelOperator, which in turn will restart the daemonset Collectors with their new config. We can check when the new configuration has taken affect by looking at the status of the daemonset Collectors.

1. Open the button label="Terminal" tab
2. Execute the following:

```
kubectl -n opentelemetry-operator-system get pods
```

When you see that the replacement daemonset Collectors have been up for at least 30 seconds, let's check the logs coming into Elastic:

1. Open the button label="Elasticsearch" tab
2. Click `Discover` in the left-hand navigation pane
3. Execute the following query:

```
FROM logs-*
| WHERE service.name == "router"
| WHERE message LIKE "routing request*"
```

4. Open the first log record by clicking on the double arrow icon under `Actions`
5. Click on the `Log overview` tab

   [!NOTE] you may have to refresh the ES|QL query several times before results are present

Yes! Note that cleanly parsed JSON logs: * the message body is now just the message * the log level and timestamp are set correctly

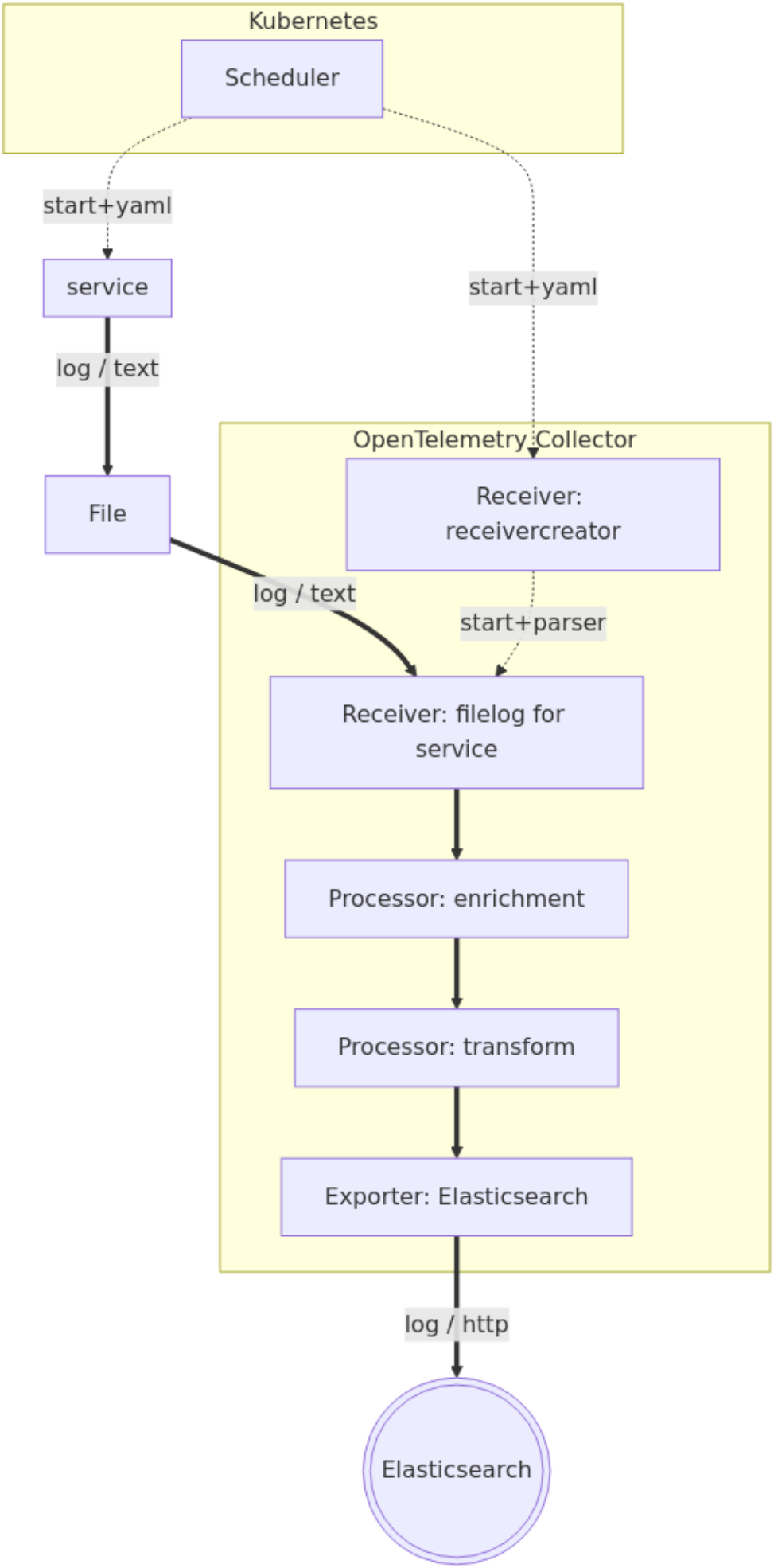
Nice and clean JSON logs in Elastic: perfect.

Well almost. You'll note that we had to modify the configuration of the Collector in the daemonset; the same Collector which handles logs from all of our services. Imagine we have multiple services, each which outputs a unique JSON schema. In that case, we would have to introduce routing in our Collector pipelines in order to selectively apply the right OTTL for a given log source... What if there was a way that the services themselves could specify their configuration?

OpenTelemetry Logging on Kubernetes with Receiver Creator

Modifying the Collector config to parse specific logs feels awkward. Ideally, we could push bespoke parsing configurations to the deployment of the app or service itself. Realistically, it is the service which is in the best position to know the nuances of its custom logging pattern.

Fortunately, on Kubernetes, just such an option exists: the Receiver Creator can be used to dynamically instantiate `file` receivers with a custom configuration driven by the deployment yaml of each service.


Kubernetes
Scheduler
start+yaml
service
log / text
File
start+yaml
OpenTelemetry Collector
Receiver:
receivercreator
log / text
start+parser
Receiver: filelog for
service
Processor: enrichment
Processor: transform
Exporter: Elasticsearch
log / http
Elasticsearch

Getting our bearings

Let's have a look at our postgresql logs. These are being generated by postgresql, writing to stdout, captured by the Kubernetes log provider, and written to disk.

1. Open the button label="Elasticsearch" tab
2. Click `Discover` in the left-hand navigation pane
3. Execute the following query:

```
FROM logs-*
| WHERE service.name == "postgresql"
```

4. Open the first log record by clicking on the double arrow icon under `Actions`
5. Click on the `Log overview` tab

Note the presence of a `traceparent` field burned into some of the log lines. Recall that these logs are generated from postgresql directly. Postgresql at present is not OpenTelemetry enabled, and thus has no native provisions for accepting a `traceparent` via distributed tracing and appending it to log lines. How did this line get there?

SQL Commentor is a library that can be used by Java applications making SQL calls (here, `recorder-java`). SQL Commentor will look for an active OpenTelemetry trace and append the appropriate `traceparent` header as a comment to the SQL query. Most SQL databases (including postgresql) will output the comment as part of the audit log!

Configuring the Receiver Creator

We've already modified the OpenTelemetry Collector Config to accommodate the Receiver Creator. Let's have a look at the modified configuration:

1. Open the button label="Collector Config" tab
2. Open the `values.patch` file

Configuring the Service

Now we need to modify our `postgresql.yaml` to include our parsing directives.

1. Open the button label="postgresql Config" tab
2. Open the file `postgres.yaml`
3. Find the following lines under `spec/template/metadata/annotations`:

```
    annotations:
      io.opentelemetry.discovery.logs/enabled: "true"
      # WORKSHOP CONTENT GOES HERE
```

4. Replace it with the following:

```
    annotations:
      io.opentelemetry.discovery.logs/enabled: "true"
      io.opentelemetry.discovery.logs/config: |
        operators:
        - type: container
        - type: regex_parser
          on_error: send_quiet
          parse_from: body
          regex: '^(?P<timestamp_field>\d{4}-\d{2}-\d{2}\s\d{2}:\d{2}:\d{2}.\d{3}\s[A-z]+)\s\[\d+\]\s(?P<severity_field>[A-Z]+):\s*(?<msg_
          timestamp:
            parse_from: attributes.timestamp_field
            on_error: send_quiet
            layout_type: strptime
            layout: '%Y-%m-%d %H:%M:%S.%L %Z'
          trace:
            trace_id:
              parse_from: attributes.trace_id
              on_error: send_quiet
            span_id:
              parse_from: attributes.span_id
              on_error: send_quiet
            trace_flags:
              parse_from: attributes.trace_flags
              on_error: send_quiet
          severity:
            parse_from: attributes.severity_field
            on_error: send_quiet
```

```
            mapping:
              warn:
                - WARNING
                - NOTICE
              error:
                - ERROR
              info:
                - LOG
                - INFO
                - STATEMENT
              debug1:
                - DEBUG1
              debug2:
                - DEBUG2
              debug3:
                - DEBUG3
              debug4:
                - DEBUG4
              debug5:
                - DEBUG5
              fatal:
                - FATAL
                - PANIC
        - type: move
          on_error: send_quiet
          from: attributes.msg_field
          to: body
        - type: remove
          on_error: send_quiet
          field: attributes.timestamp_field
        - type: remove
          on_error: send_quiet
          field: attributes.severity_field
        - type: remove
          on_error: send_quiet
          field: attributes.trace_id
        - type: remove
          on_error: send_quiet
          field: attributes.span_id
        - type: remove
          on_error: send_quiet
          field: attributes.trace_flags
```

This configuration applies a regex to parse postgresql audit lines. As you can see: * it extracts and appropriately sets the timestamp * it extracts and appropriately sets the log level * it extracts and appropriately sets the `trace.id` and `span.id`

> [!NOTE] You'll note that Receiver Creator unfortunately uses a different language than OTTL. This is largely because the Receiver Creator does its processing within the receiver itself. Currently, only Processors speak OTTL; manipulation of signals in the receivers is limited to the similar, but of course different, `operators` lingua.

Now apply the modified `postgres.yaml` Kubernetes deployment yaml: 1. Open the button label="Terminal" tab 2. Execute the following:

```
./deploy.sh -s postgresql
./deploy.sh -s recorder-java
```

This will redeploy `postgresql` with the modified deployment yaml.

We can check that by describing the pod. 1. Open the button label="Terminal" tab 2. Execute the following

```
kubectl -n trading describe pod postgresql
```

Note the `Annotations` as expected.

And let's check that the daemonset Collector received the directive to create a new receiver for `postgresql`: 1. Open the button label="Terminal" tab 2. Execute the following to get a list of the active Kubernetes pods that comprise our trading system:

```
kubectl -n opentelemetry-operator-system get pods
```

3. Find the active `opentelemetry-kube-stack-daemon-collector...` pod in the list
4. Get stdout logs from the active `opentelemetry-kube-stack-daemon-collector` pod:

```
kubectl -n opentelemetry-operator-system logs <opentelemetry-kube-stack-daemon-collector-...> | grep "starting receiver"
```

(replace ... with the pod instance id)

And find the `starting receiver` message which shows `postgresql` starting up and being configured.

Verifying our Changes

Let's check to see if our logs are being parsed as expected. 1. Open the button label="Elasticsearch" tab 2. Click `Discover` in the left-hand navigation pane 3. Execute the following query:

```
FROM logs-*
| WHERE service.name == "postgresql"
| WHERE trace.id IS NOT NULL
```

4. Open the first log record by clicking on the double arrow icon under `Actions`
5. Click on the `Log overview` tab

   [!NOTE] you may have to refresh the ES|QL query several times before results are present

Indeed, you'll note that the timestamp, log level, and `trace.id` are now being set as expected and stripped from the message body.

We can also check to see how our `postgresql` logs magically integrate into our distributed trace logs: 1. Open the button label="Elasticsearch" tab 2. Click `Applications` > `Service Inventory` in the left-hand navigation pane 3. Click on the `Service Map` tab 4. Click on the `trader` service 5. Click on `Service Details` 6. Click on the `Transactions` tab 7. Scroll down and click on the `POST /trade/request` transaction under `Transactions` 8. Scroll down to the waterfall graph under `Trace sample` 9. Click on the `Logs` tab 10. Click on the `execute <unnamed>: ...` log line emitted by the `postgresql` service 11. Click on the `Table` tab 12. Search for the attribute `trace.id`

Correlated SQL audit logs with our trace logs! Amazing!
