Observing Kubernetes with OpenTelemetry

Jessica Kerr, @jessitron@hachyderm.io



Observability

Telemetry

Instrumentation

Propagation

Distributed Tracing

trace ID

span

duration

parent span

attributes

waterfall

semantic conventions

pipeline

telemetry backend

OpenTelemetry

OTLP

automatic instrumentation

traceparent

libraries

OTel Operator

Instrumentation

OTel Collector

SDK

receiver

API

processor

exporter



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chart

template

image

chart repository

image repository

Daemonset

sidecar

Node

cluster

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Observability

Kubernetes

a story of software maturity

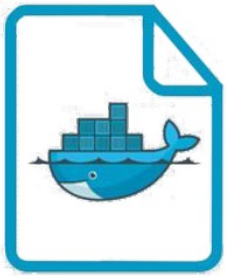
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a story of software maturity

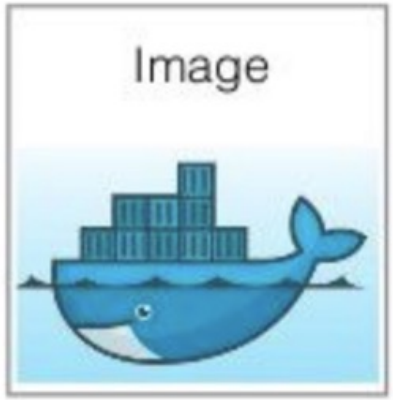


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Dockerfile

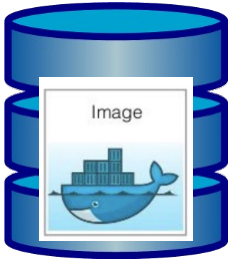


Docker builds your app into a container image

Push the image up to the image repository

Put the repository, image name, and tag into

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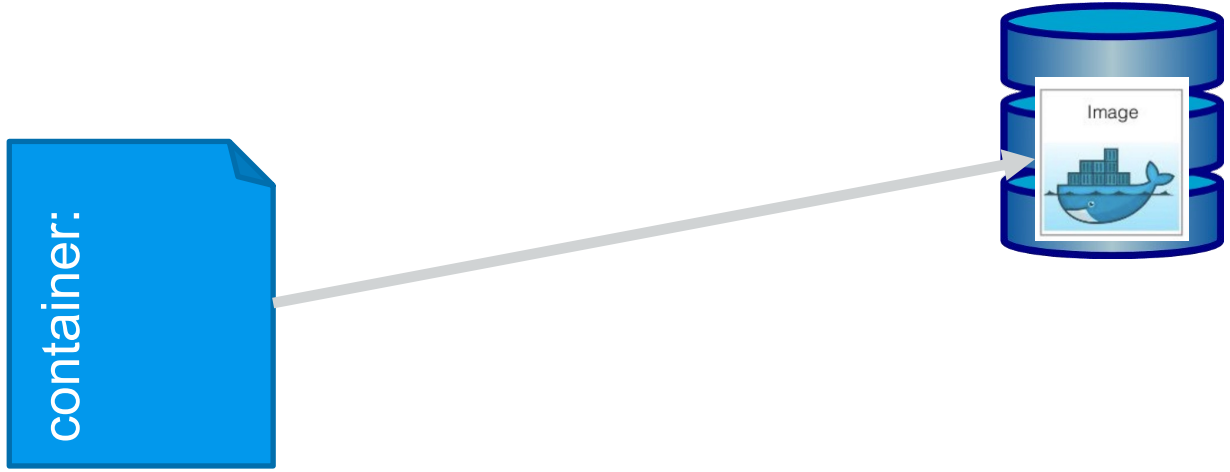


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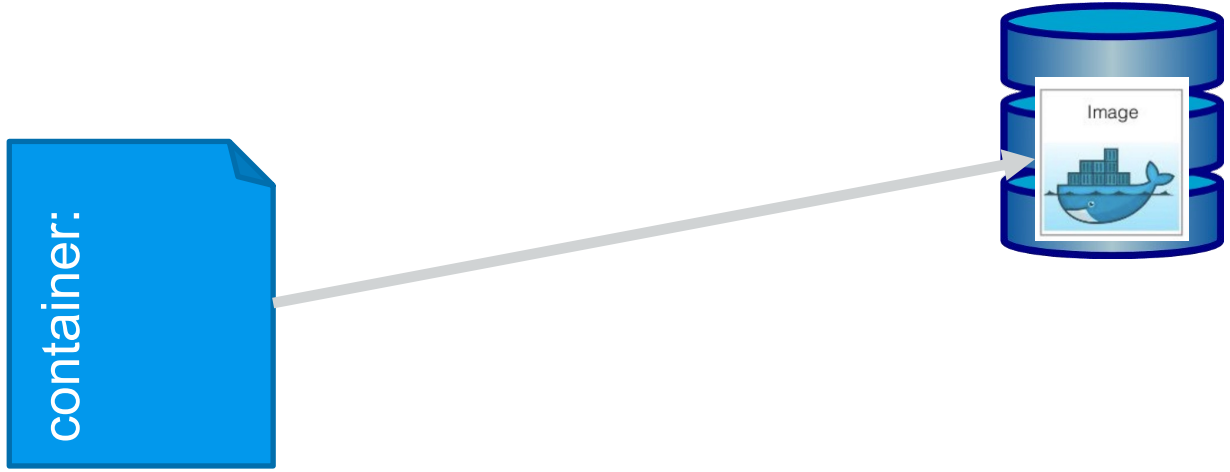
Docker builds your app into a container image

Push the image up to the image repository

Put the repository, image name, and tag into the container definition

And now we're into the YAML!

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Push the image up to the image repository

Put the repository, image name, and tag into the container definition

And now we're into the YAML.

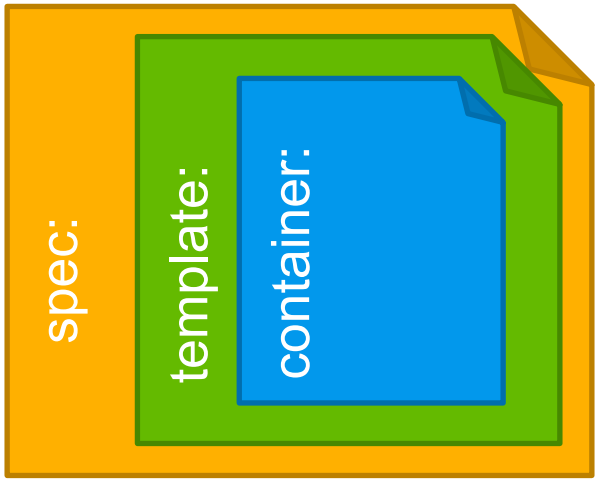
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The container YAML goes inside the pod YAML.

The pod YAML goes inside the ReplicaSet.

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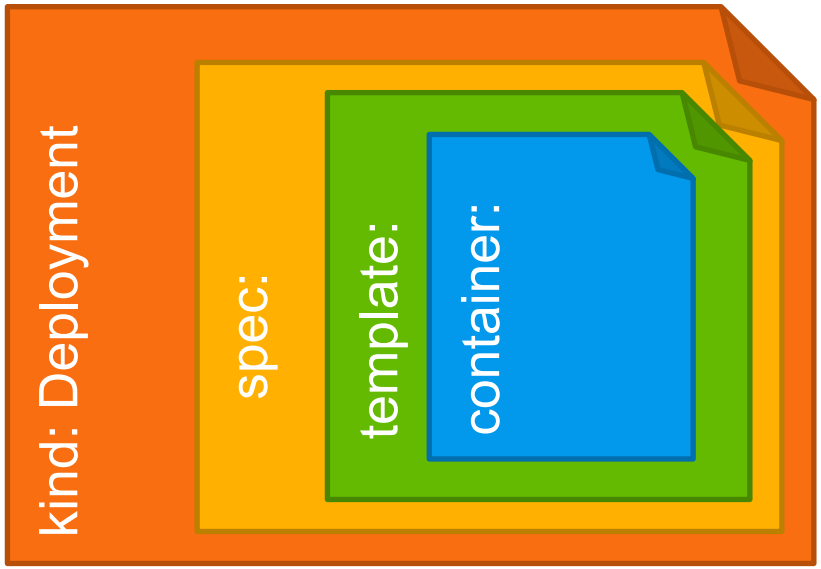


The container YAML goes inside the pod YAML.

The pod YAML goes inside the ReplicaSet.

The replicaSet goes inside the deployment

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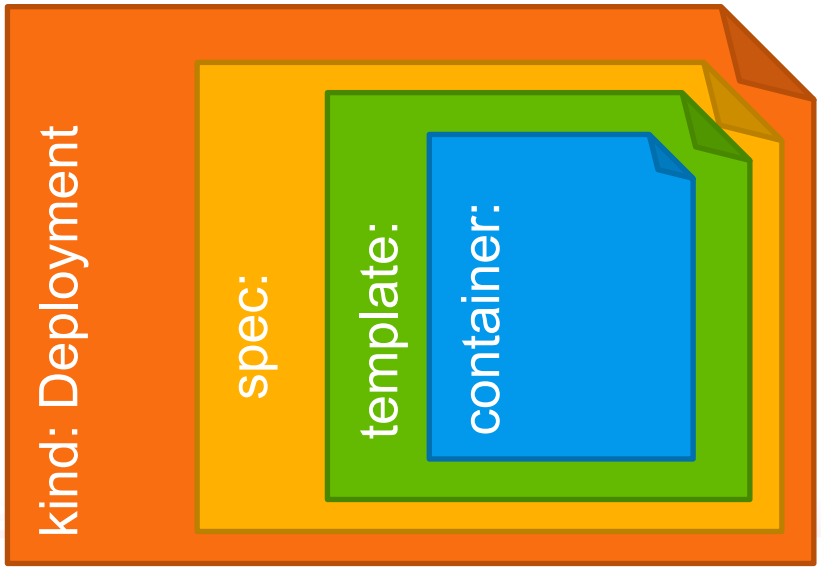
The container YAML goes inside the pod YAML.

The pod YAML goes inside the ReplicaSet.

The replicaSet goes inside the deployment YAML.

Now we can kubectl apply. (but don't).

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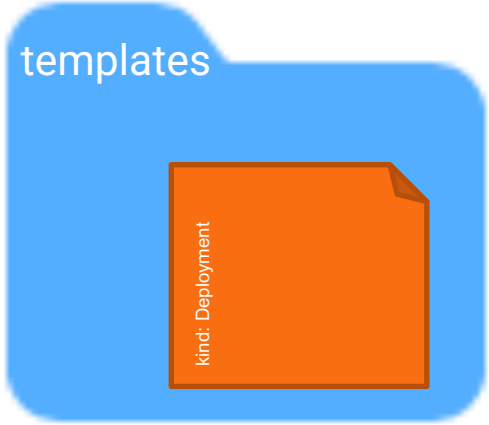


The pod YAML goes inside the ReplicaSet.

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Now we can kubectl apply. (but don't).

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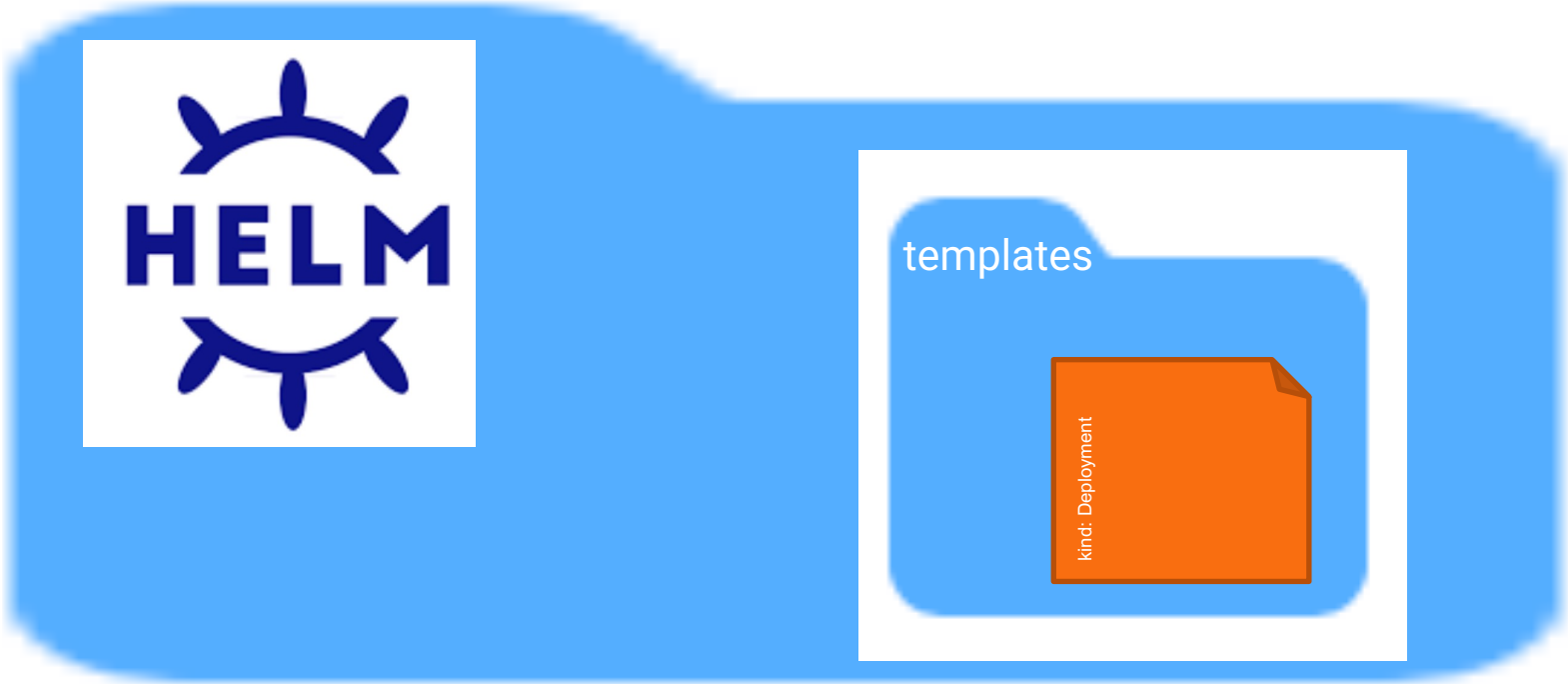


The deployment YAML goes into a Helm template

The Helm template goes inside a Helm chart

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Push the Helm chart up to the chart repository

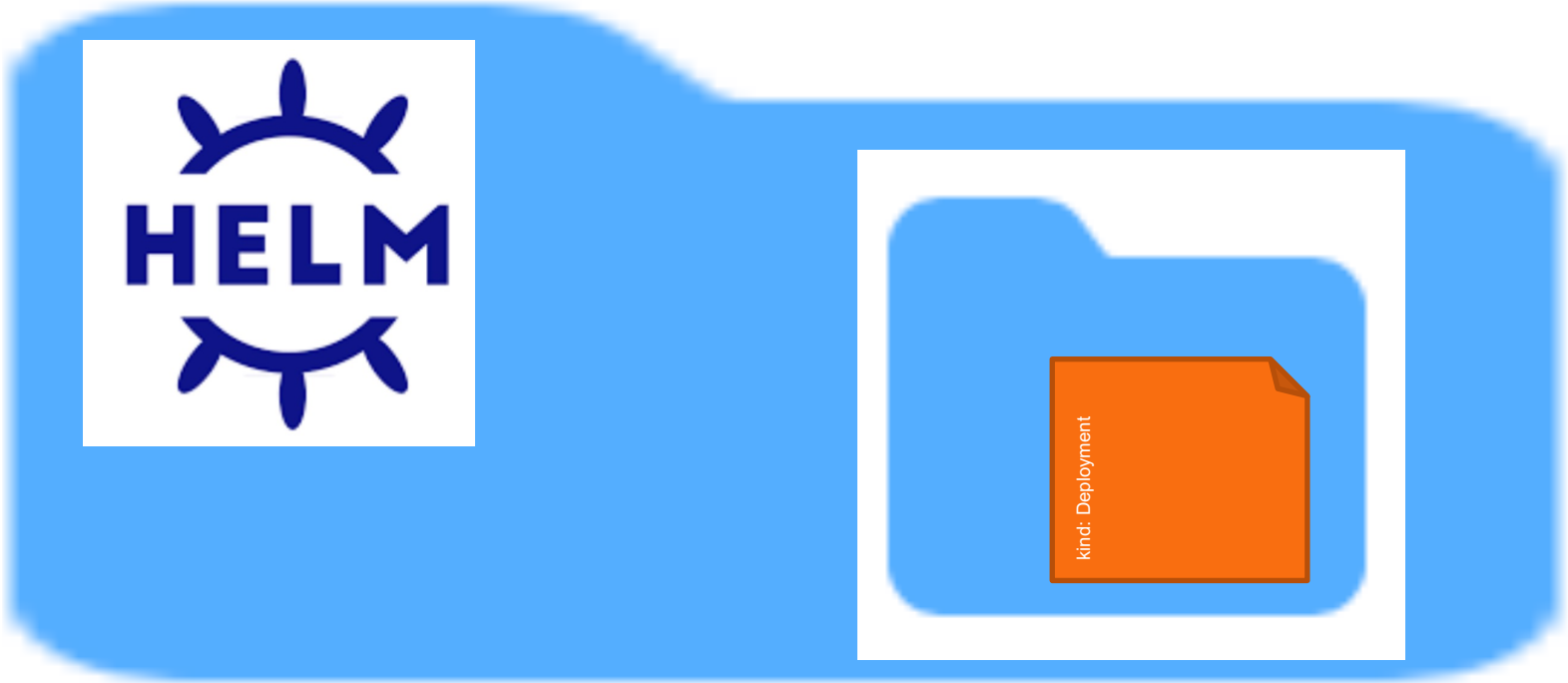


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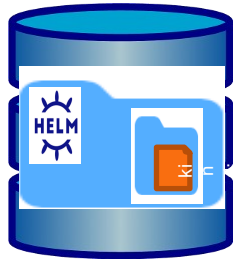


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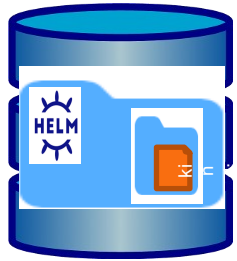
The deployment YAML goes into a Helm template

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Push the Helm chart up to the chart repository

Now we can helm install. (but no)

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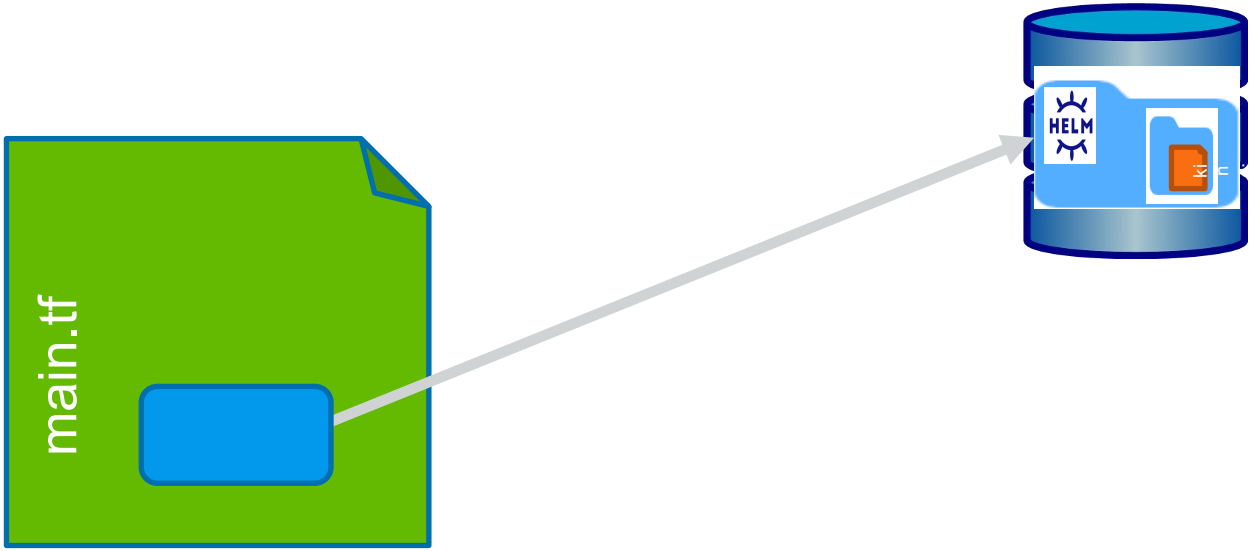
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The Helm release goes inside the terraform.

The terraform provider adds the Helm resource.

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The Helm release goes inside the terraform.

The terraform provider adds the Helm resource.

The terraform goes goes into my git repository.

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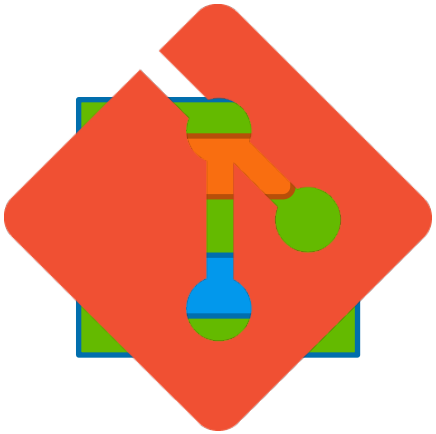


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The Helm release goes inside the terraform.

The terraform provider adds the Helm resource.

The terraform goes goes into my git repository.

And now I can finally save it!

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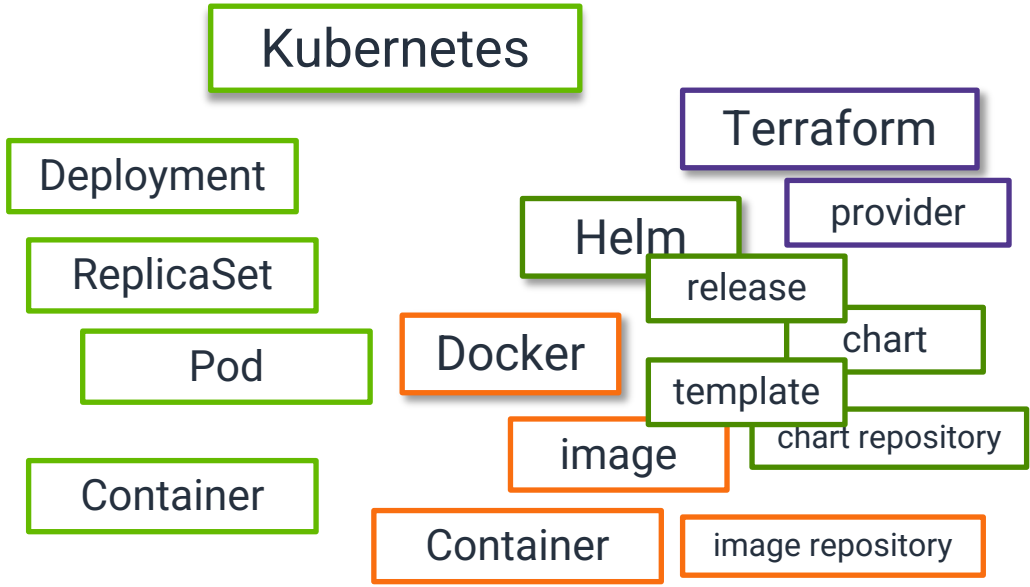
The Helm release goes inside the terraform.

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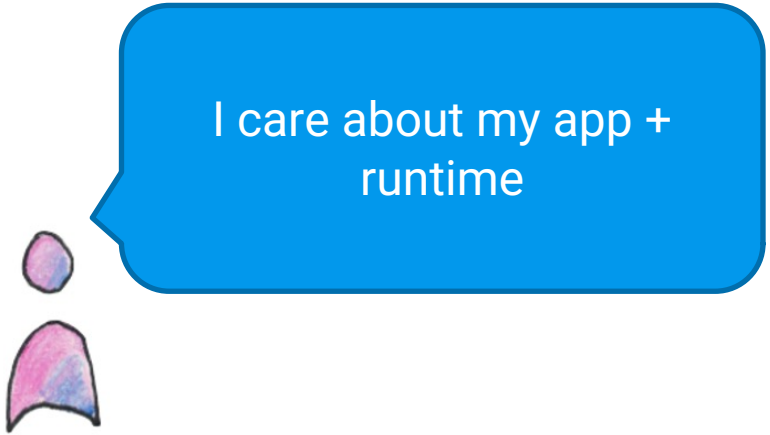
The terraform goes goes into my git repository.

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Kubernetes

Deployment

ReplicaSet

Pod

Container

Terraform

provider

Helm

release

chart

Docker

template

chart repository

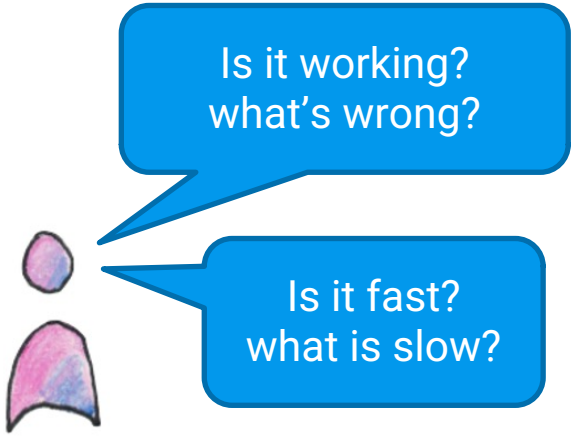
image

Container

image repository

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Observability



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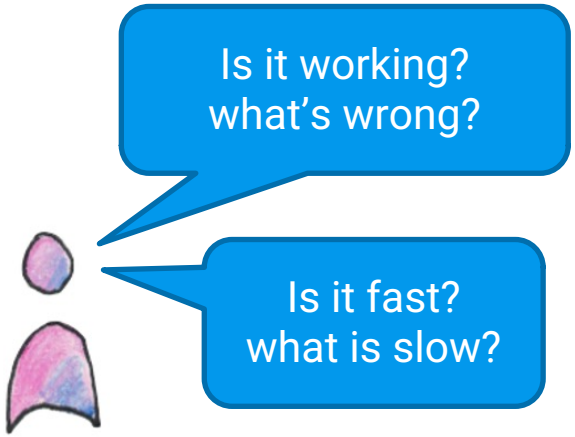
chart repository

image

Container

image repository

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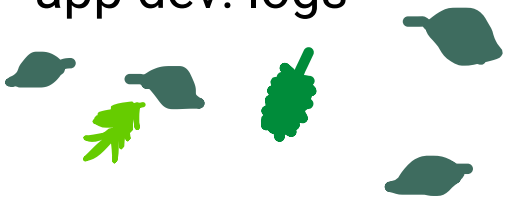




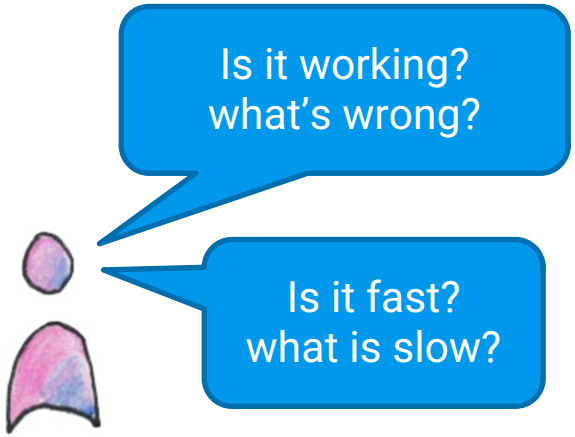
ops: metrics



app dev: logs



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app dev*ops*: observability

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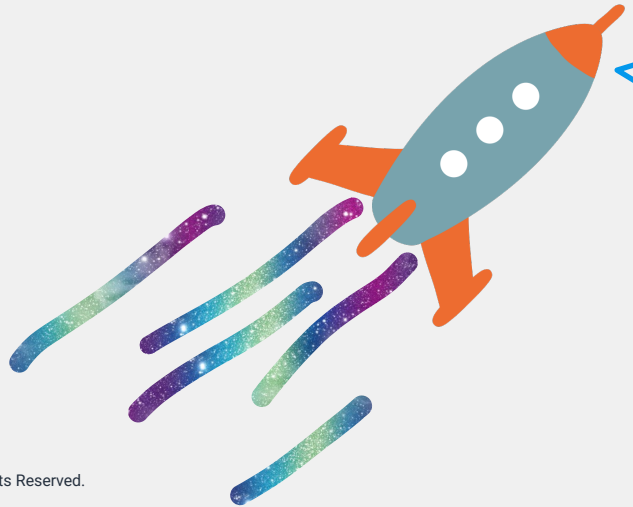
Observability

We can see what’s happening inside our system, because it tells us.

Definition

Telemetry

data emitted to reveal inner state



I’m going 500kph, 20km up
Air pressure 200mb, wind 30m/s E
Desired course is 0.3 degrees east
Adjusting left rocket to 30% power

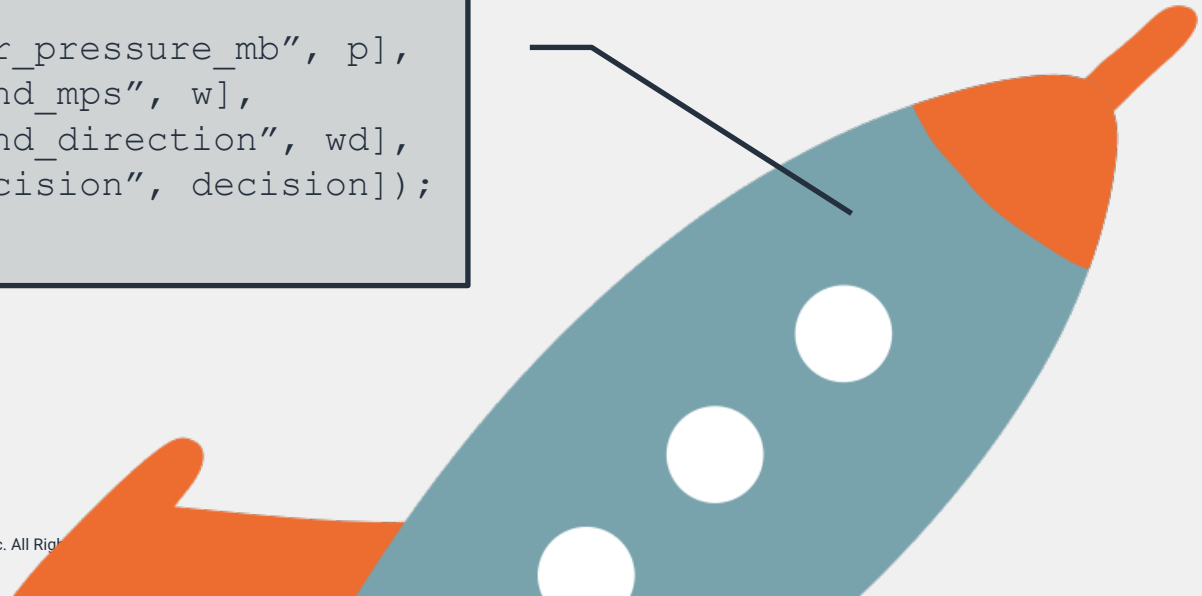
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Definition

Instrumentation

code that emits telemetry

```
report(["air_pressure_mb", p],
       ["wind_mps", w],
       ["wind_direction", wd],
       ["decision", decision]);
```



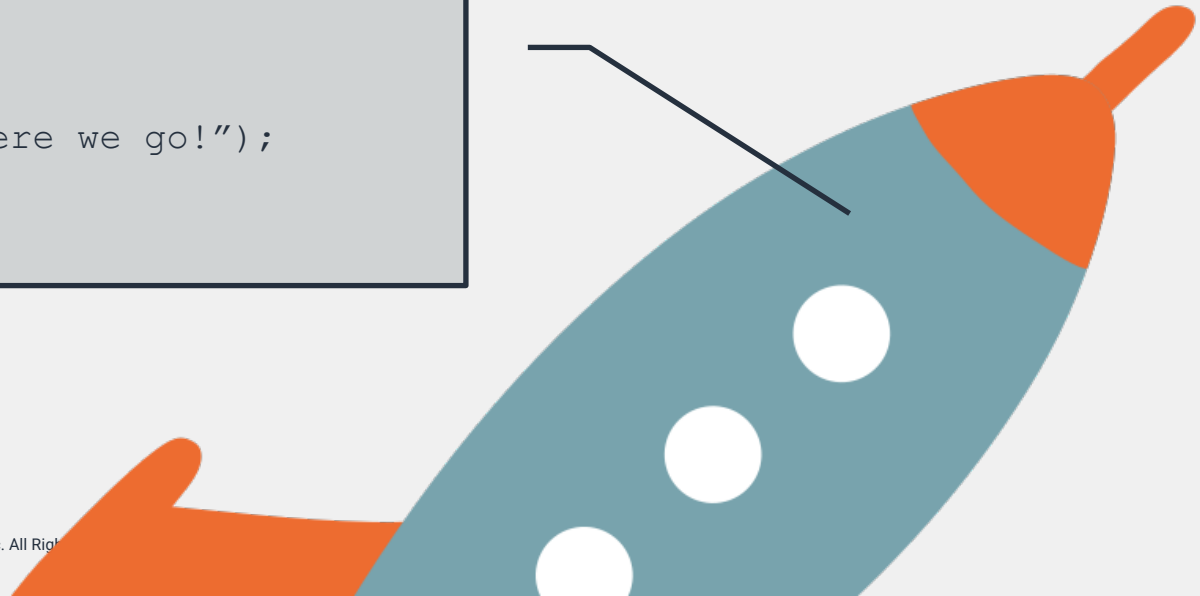
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Definition

Instrumentation

code that emits telemetry

```
log.info("Here we go!");
```

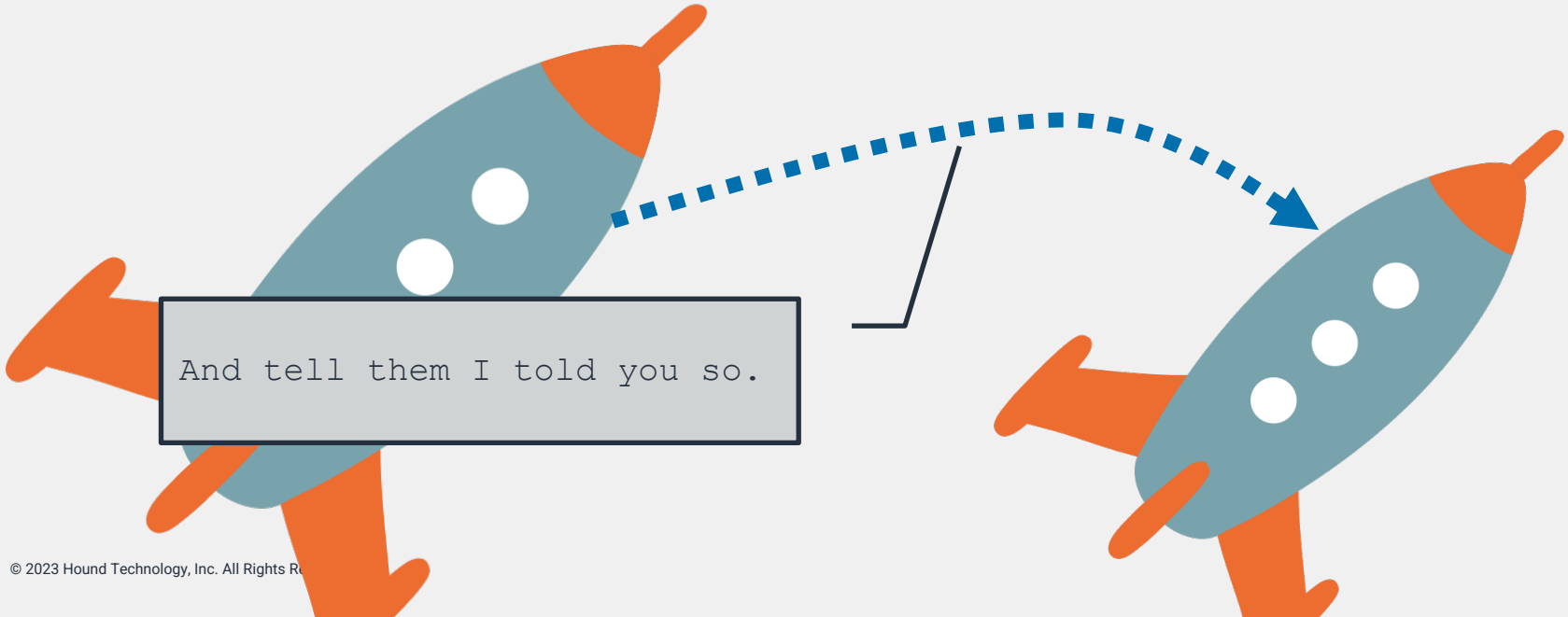


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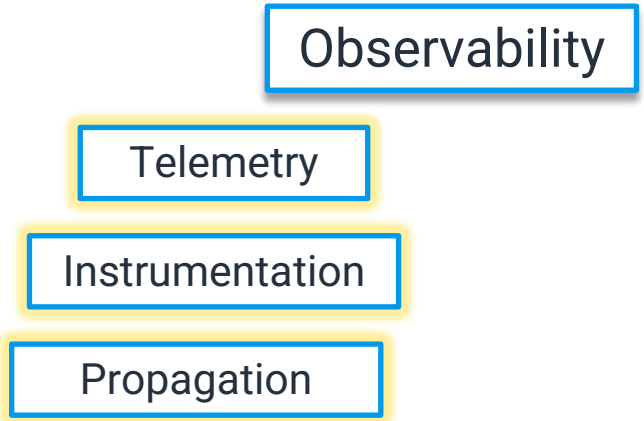
Definition

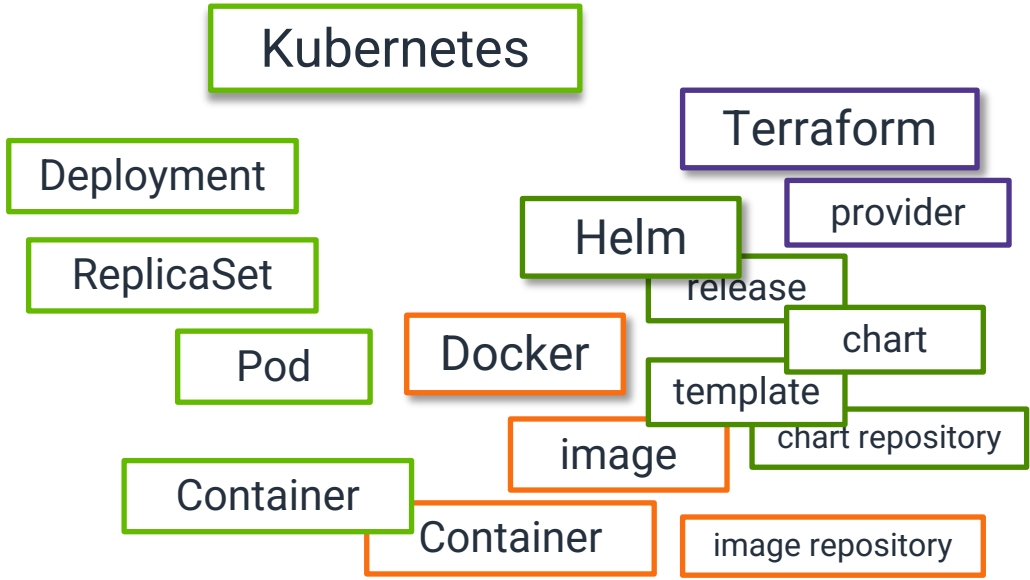
Propagation

pass the data needed to link events up

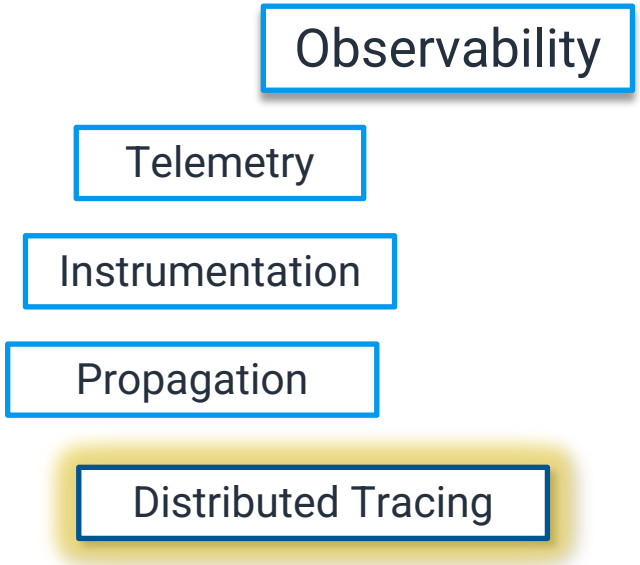


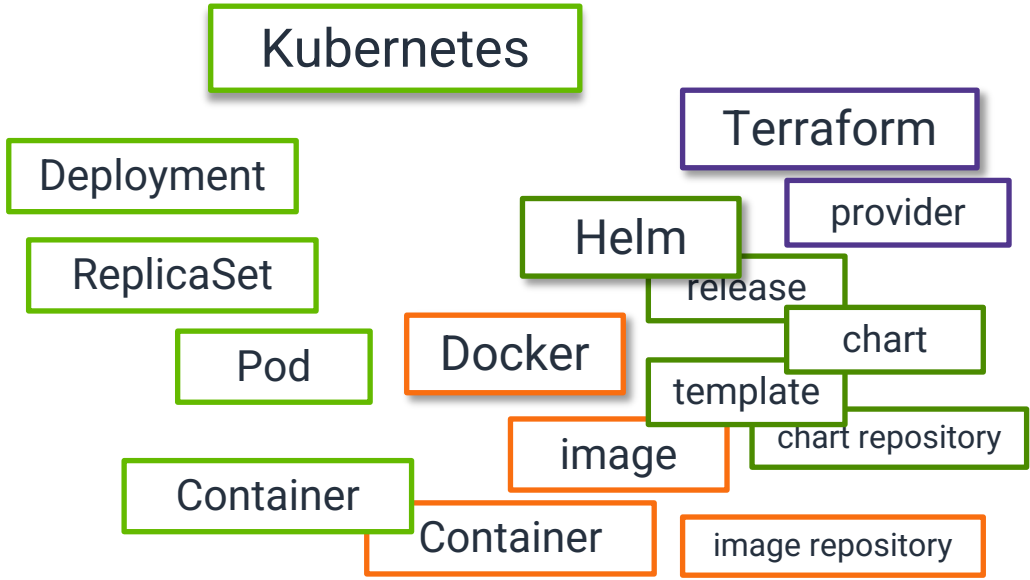
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Received: POST

checking out

calling /cart

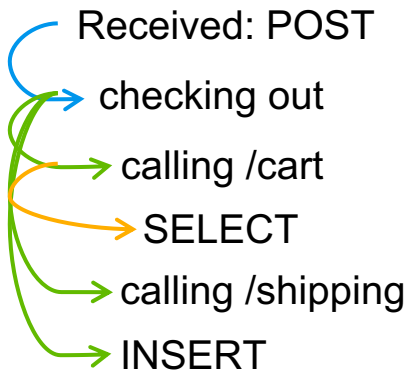
SELECT

calling /shipping

INSERT



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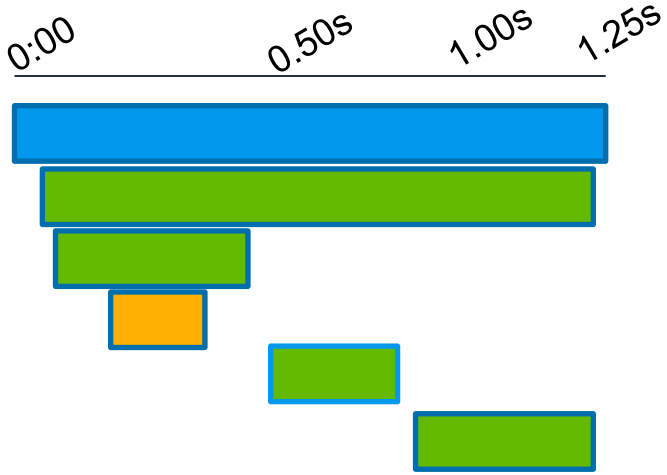


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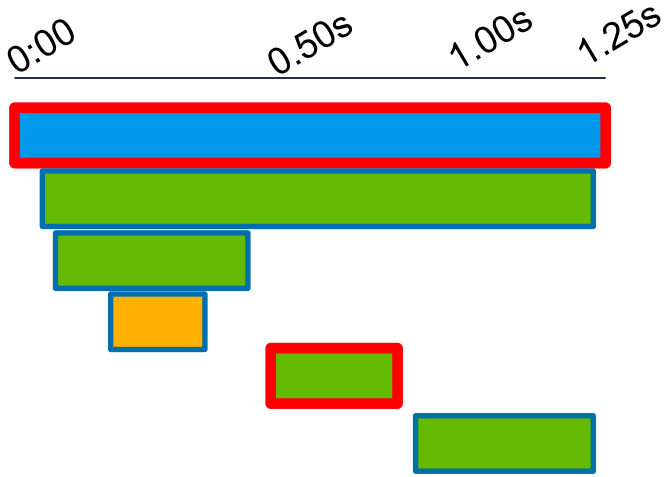
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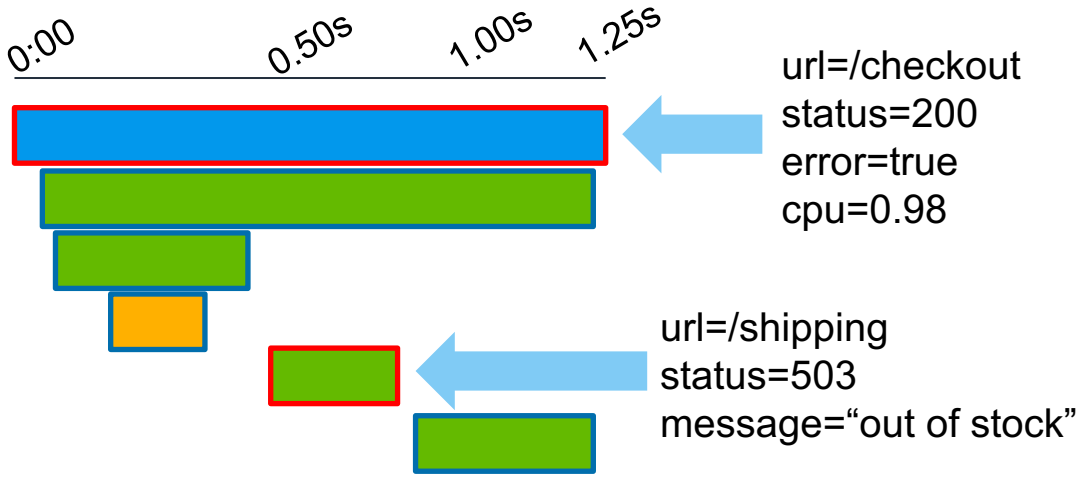
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Received: POST	gateway
checking out	checkout
calling /cart	checkout
SELECT	cart
calling /shipping	checkout
INSERT	checkout



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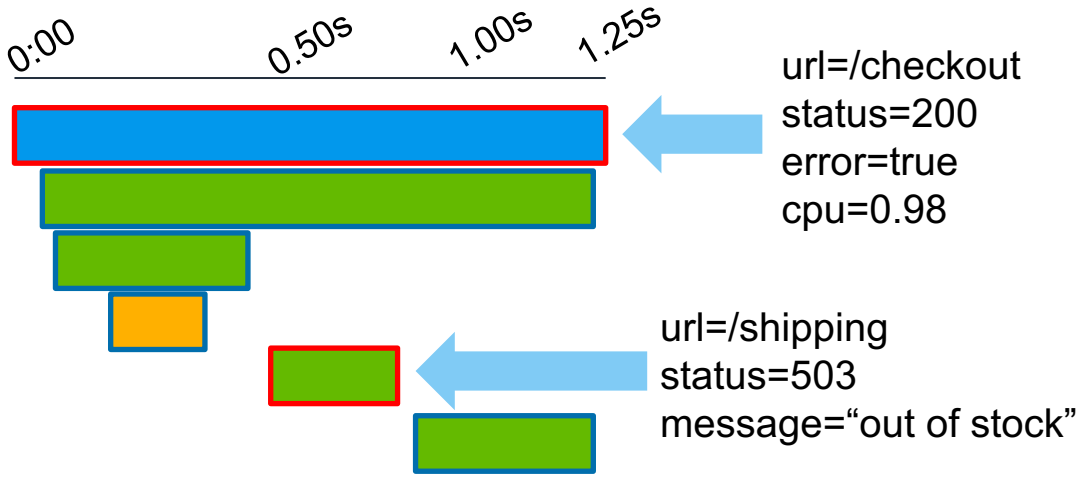
Received: POST	gateway
checking out	checkout
calling /cart	checkout
SELECT	cart
calling /shipping	checkout
INSERT	checkout



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Trace ID: 0acdf4850ffed 14:25:03

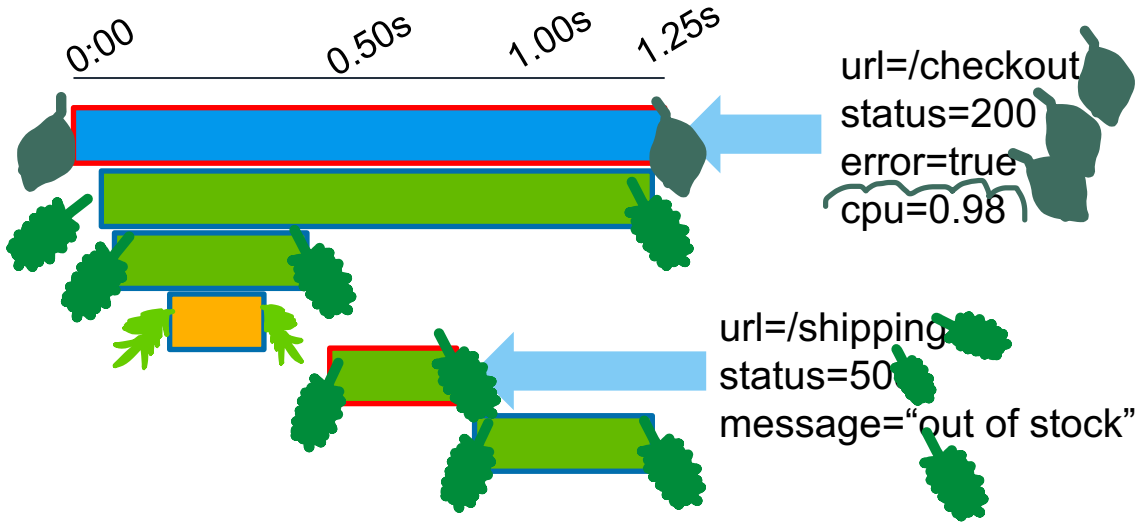
Received: POST	gateway
checking out	checkout
calling /cart	checkout
SELECT	cart
calling /shipping	checkout
INSERT	checkout



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Trace ID: 0acdf4850ffed 14:25:03

Received: POST	gateway
checking out	checkout
calling /cart	checkout
SELECT	cart
calling /shipping	checkout
INSERT	checkout



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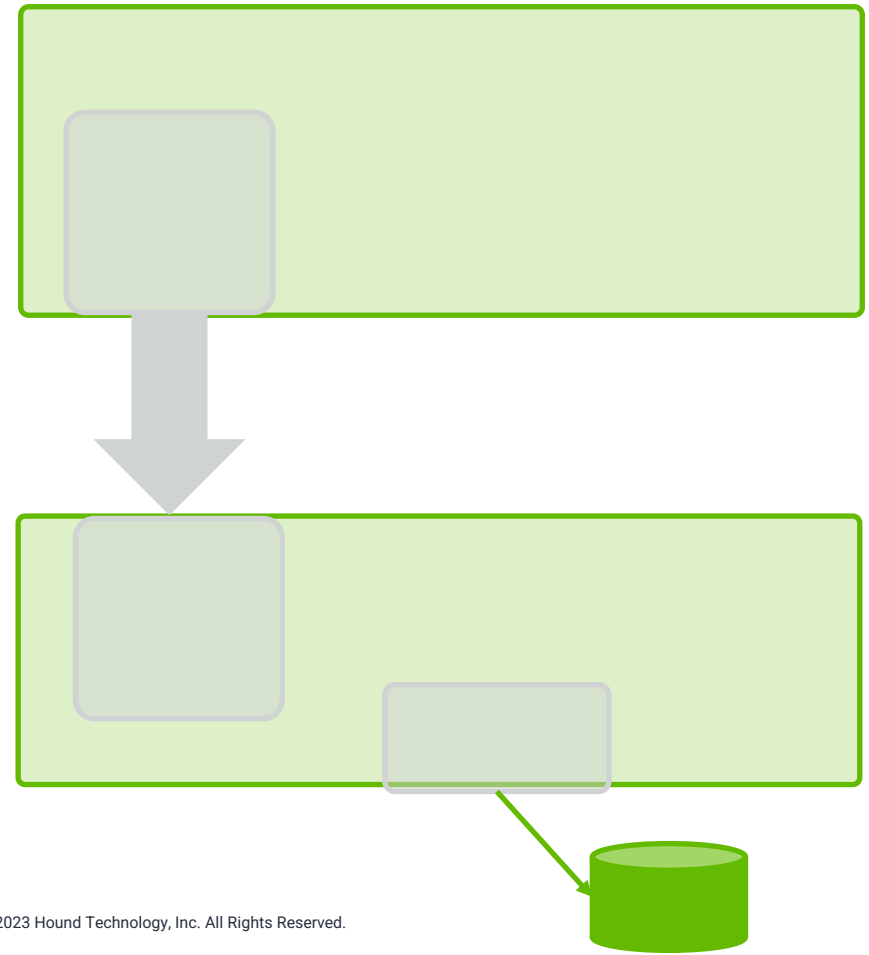
image

chart repository

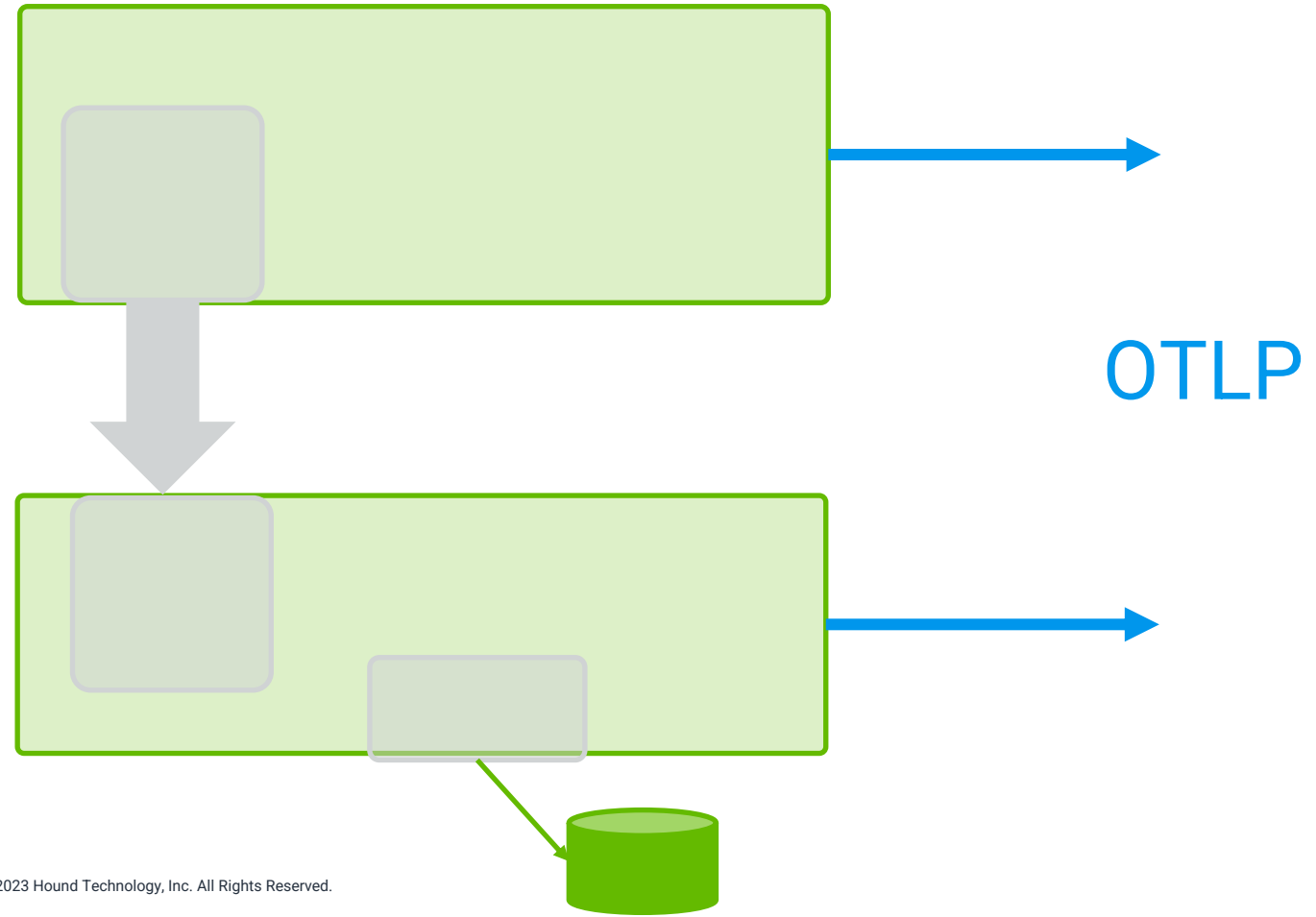
image repository



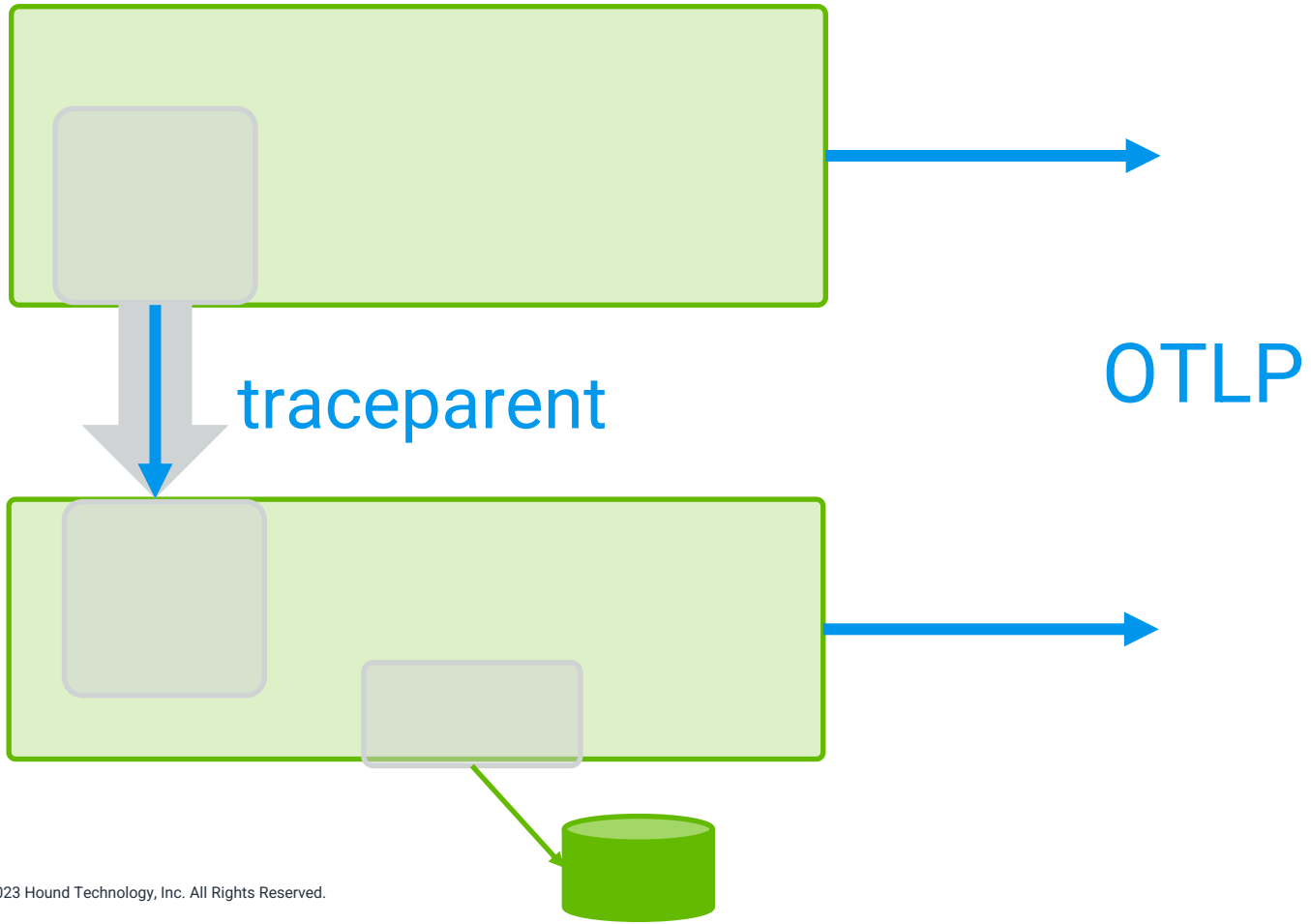
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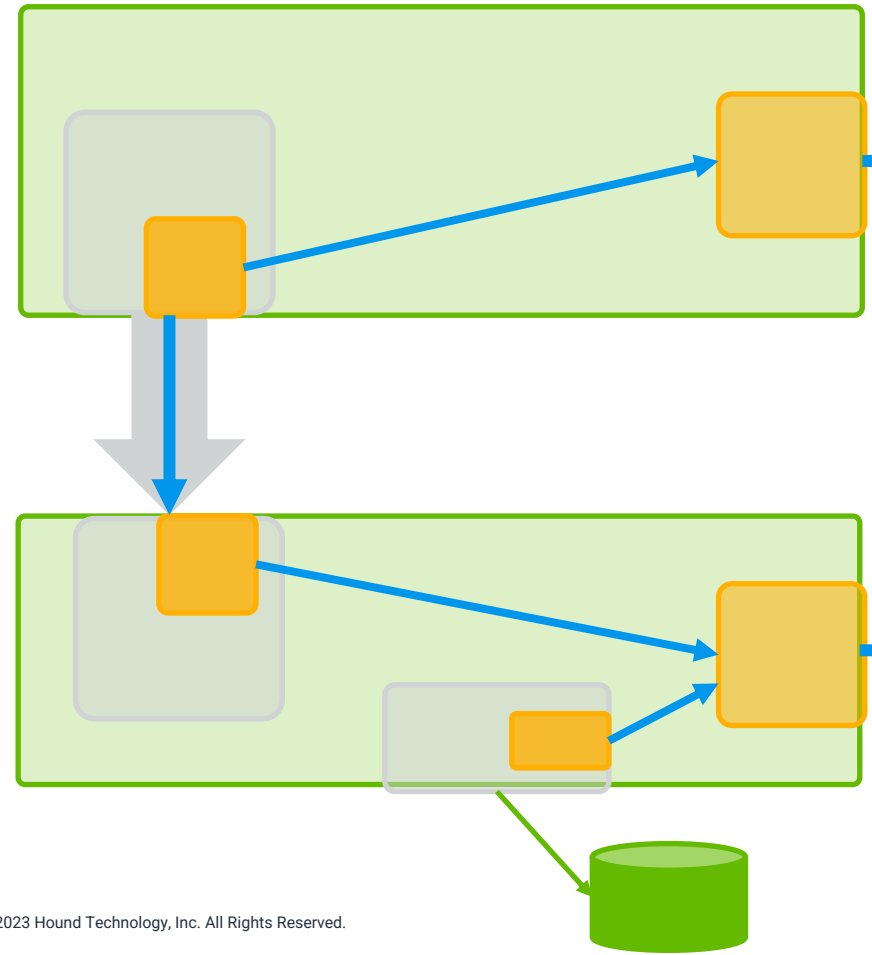
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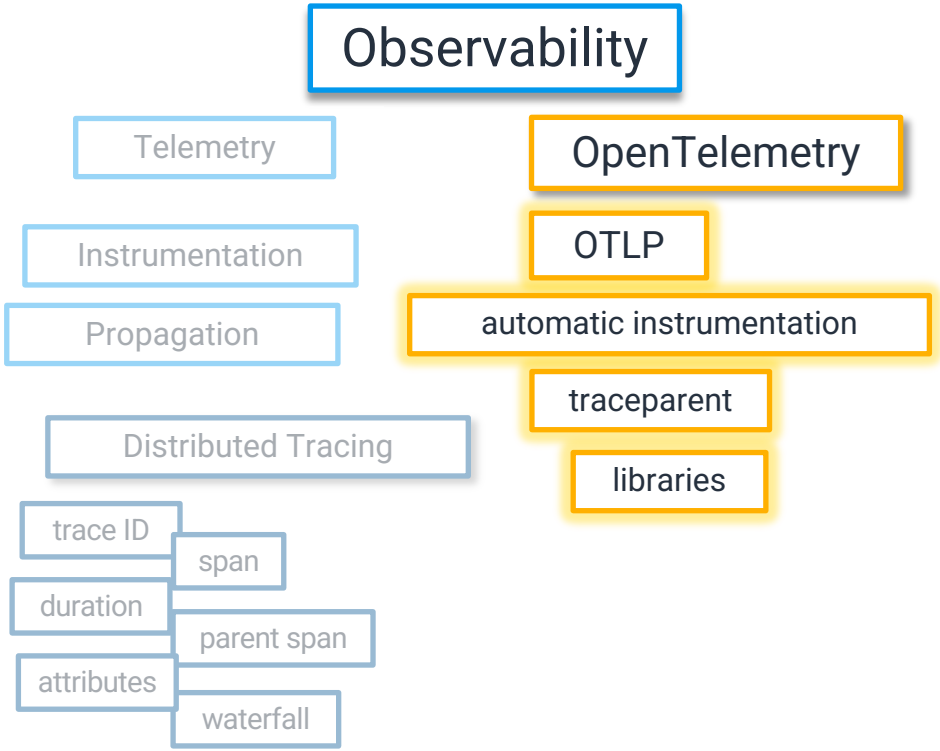


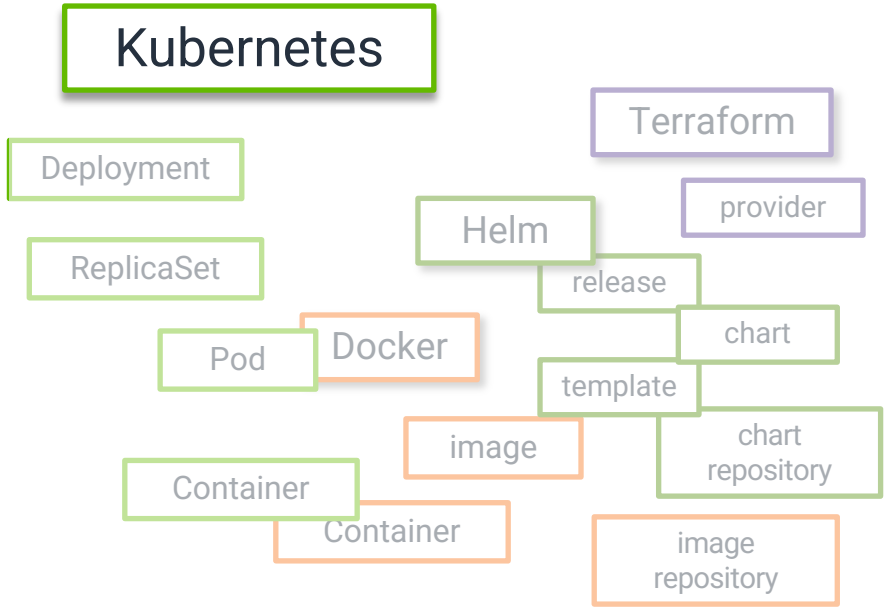
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automatic
instrumentation

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release

chart

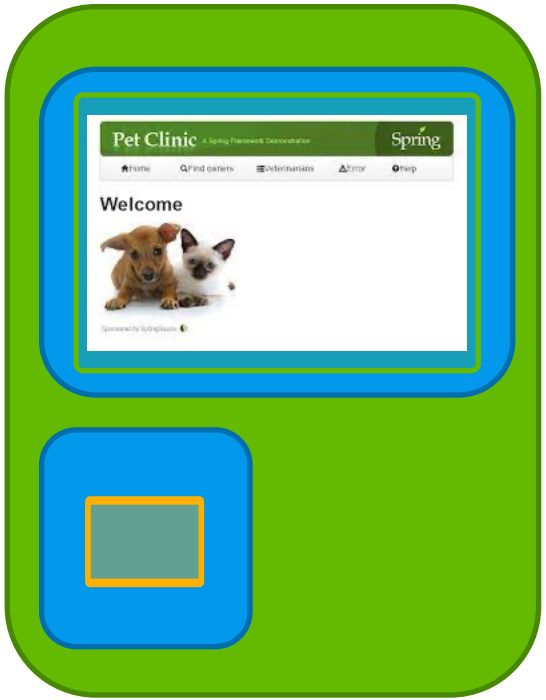
template

image

chart repository

image repository

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inject-java: "true"

Instrumentation

OpenTelemetry Operator

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Owner Information

Name	Joe Larry
Address	asldfkj
City	asdlkf
Telephone	1324132956

Edit Owner | Add New Pet

Pets and Visits

Name
pixie

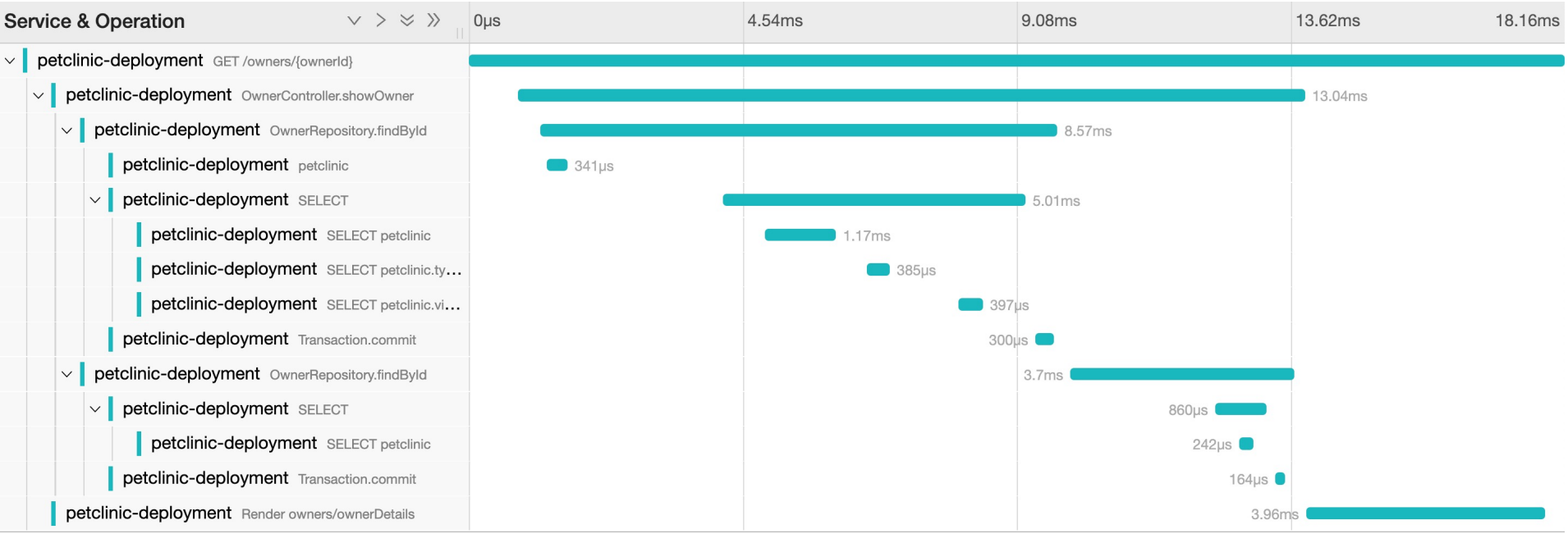
Birth Date
2023-09-04

Type
bird

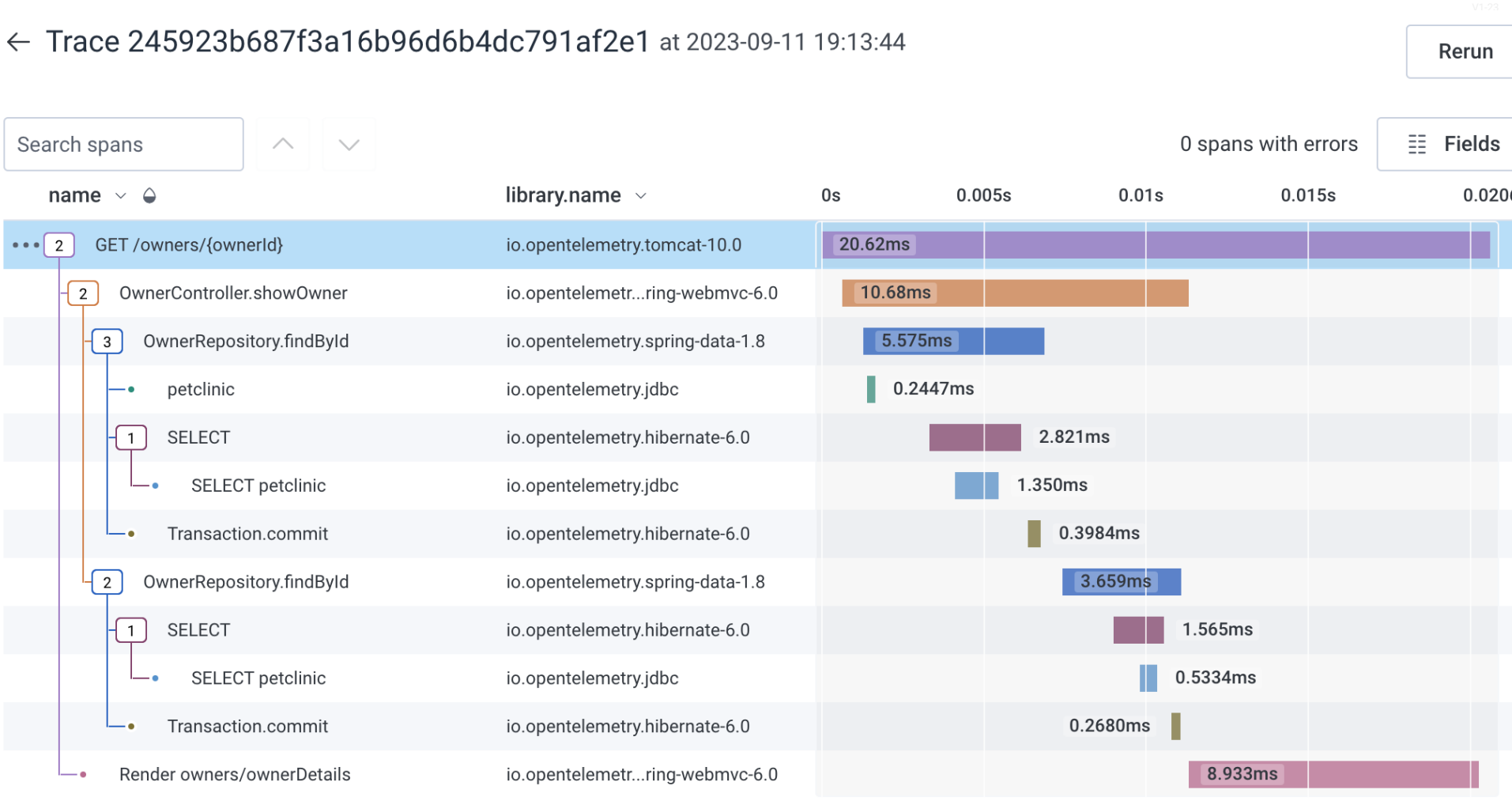
Visit Date	Description
2023-09-10	burp

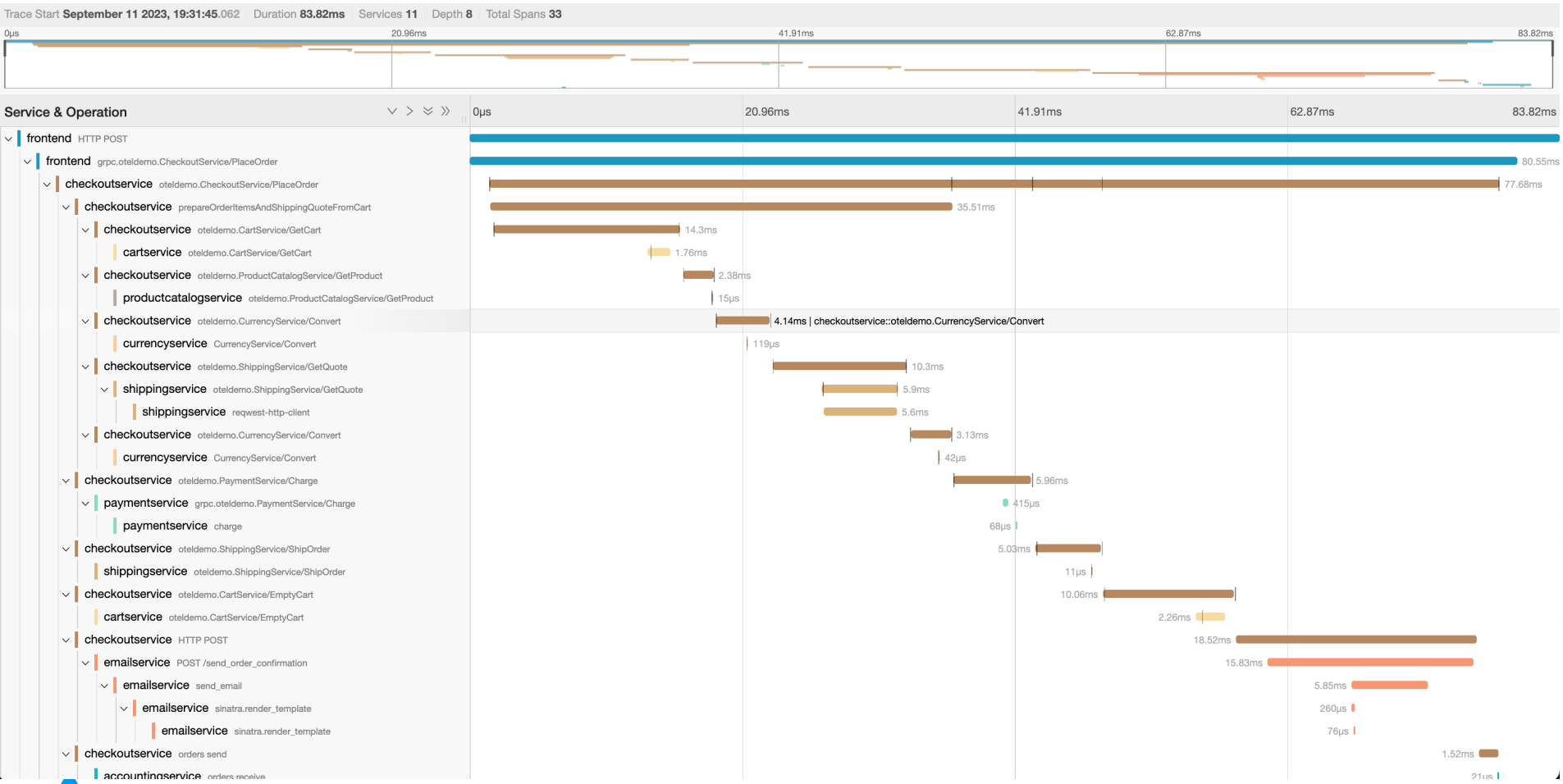
Edit Pet Add Visit

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Trace 245923b687f3a16b96d6b4dc791af2e1 at 2023-09-11 19:13:44
Rerun
Search spans
0 spans with errors
Fields
name
library.name
0s
0.005s
0.01s
0.015s
GET /owners/{ownerId}
io.opentelemetry.tomcat-10.0
20.62ms
OwnerController.showOwner
io.opentelemetr...ring-webmvc-6.0
10.68ms
OwnerRepository.findById
io.opentelemetry.spring-data-1.8
5.575ms
petclinic
io.opentelemetry.jdbc
0.2447ms
SELECT
io.opentelemetry.hibernate-6.0
2.821ms
SELECT petclinic
io.opentelemetry.jdbc
1.350ms
Transaction.commit
io.opentelemetry.hibernate-6.0
0.3984ms
OwnerRepository.findById
io.opentelemetry.spring-data-1.8
3.659ms
SELECT
io.opentelemetry.hibernate-6.0
1.565ms
SELECT petclinic
io.opentelemetry.jdbc
0.5334ms
Transaction.commit
io.opentelemetry.hibernate-6.0
0.2680ms
Render owners/ownerDetails
io.opentelemetr...ring-webmvc-6.0
8.933ms



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Automatic Instrumentation: the scaffolding

HTTP POST

Service: **frontend** | Duration: **337.57ms** | Start Time: **11**

Tags

http.client_ip	38.98.231.57
http.flavor	1.1
http.host	k8s-oteldemo-22aaaf0b73-1367568571.us-west-2.elb.amazonaws.com
http.method	POST
http.request_content_length_uncompressed	374
http.scheme	http
http.target	/api/checkout
http.url	http://k8s-oteldemo-22aaaf0b73-1367568571.us-west-2.elb.amazonaws.com/api/checkout?currencyCode=USD
http.user_agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/112.0.0.0 Safari/537.36
internal.span.format	proto
net.host.name	k8s-oteldemo-22aaaf0b73-1367568571.us-west-2.elb.amazonaws.com
net.transport	ip_tcp
otel.library.name	@opentelemetry/instrumentation-http
otel.library.version	0.34.0
span.kind	server

Custom Instrumentation: the serious value

oteldemo.CheckoutService/PlaceOrder

Service: checkouts

Tags

app.order.amount	218
app.order.id	f91f683c-d811-11ed-98ac-72a3f910c218
app.order.items.count	1
app.shipping.amount	8
app.shipping.tracking.id	8a0d9b1b-3c98-41d3-8b04-65d2d6658f92
app.user.currency	USD
app.user.id	d064154a-fac5-4be0-a283-49d3a1945a8b
internal.span.format	proto
net.peer.ip	10.0.3.89
net.peer.port	54604
otel.library.name	go.opentelemetry.io/contrib/instrumentation/google.golang.org/grpc/otelgrpc
otel.library.version	semver:0.32.0

Kubernetes-specific instrumentation

container.id	03aad13949f7b902ff9b35bca4a79e9a74a7ed45d25a9c95f556e0696a0a84ef
host.arch	amd64
host.name	petclinic-deployment-56d64c8cf8-k9zwl
k8s.container.name	petclinic
k8s.deployment.name	petclinic-deployment
k8s.namespace.name	default
k8s.node.name	ip-10-0-1-216.us-west-2.compute.internal
k8s.pod.ip	10.0.1.100
k8s.pod.name	petclinic-deployment-56d64c8cf8-k9zwl
k8s.pod.start_time	2023-09-10 23:20:45 +0000 UTC
k8s.pod.uid	b74d6fca-ffb2-4e69-8aa4-4e3ad7d17761
k8s.replicaset.name	petclinic-deployment-56d64c8cf8
os.description	Linux 5.10.186-179.751.amzn2.x86_64

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Observability

Telemetry

Instrumentation

Propagation

Distributed Tracing

trace ID

span

duration

parent span

attributes

waterfall

OpenTelemetry

OTLP

automatic instrumentation

traceparent

libraries

OTel Operator

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pipeline

telemetry backend

Kubernetes

Deployment

ReplicaSet

Pod

Docker

Container

Container

Operator

Custom Resource

annotation

Terraform

provider

Helm

release

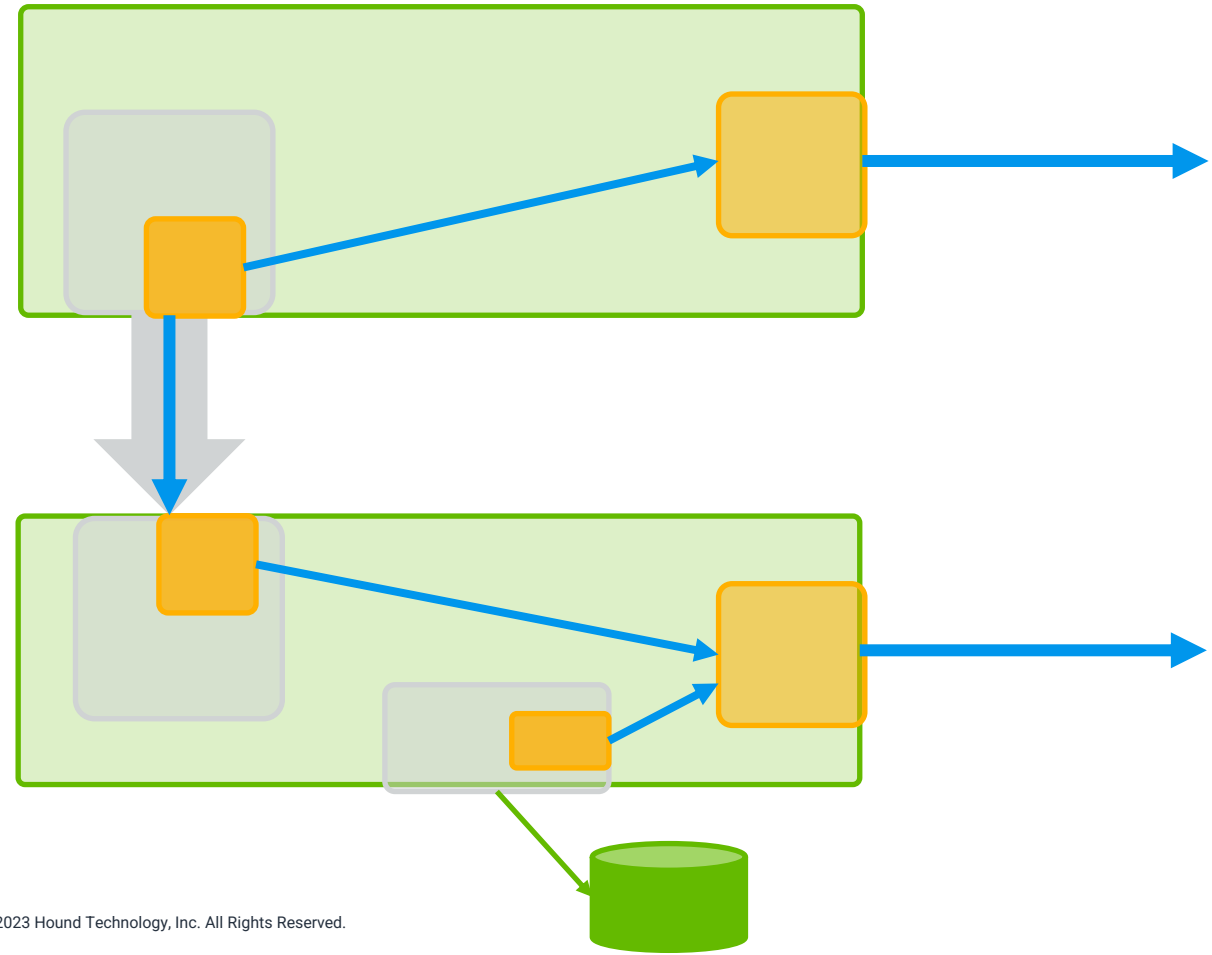
chart

template

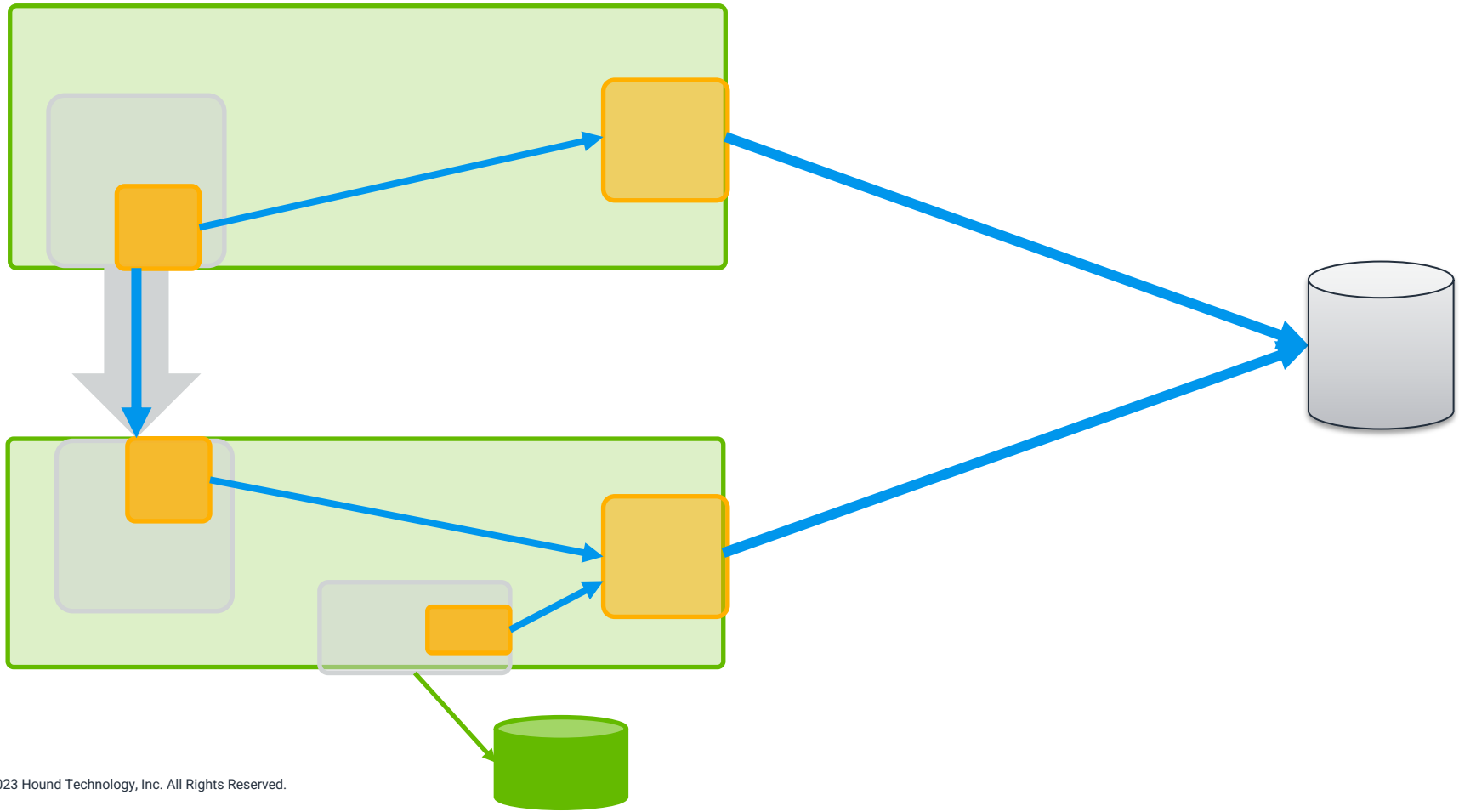
image

chart repository

image repository

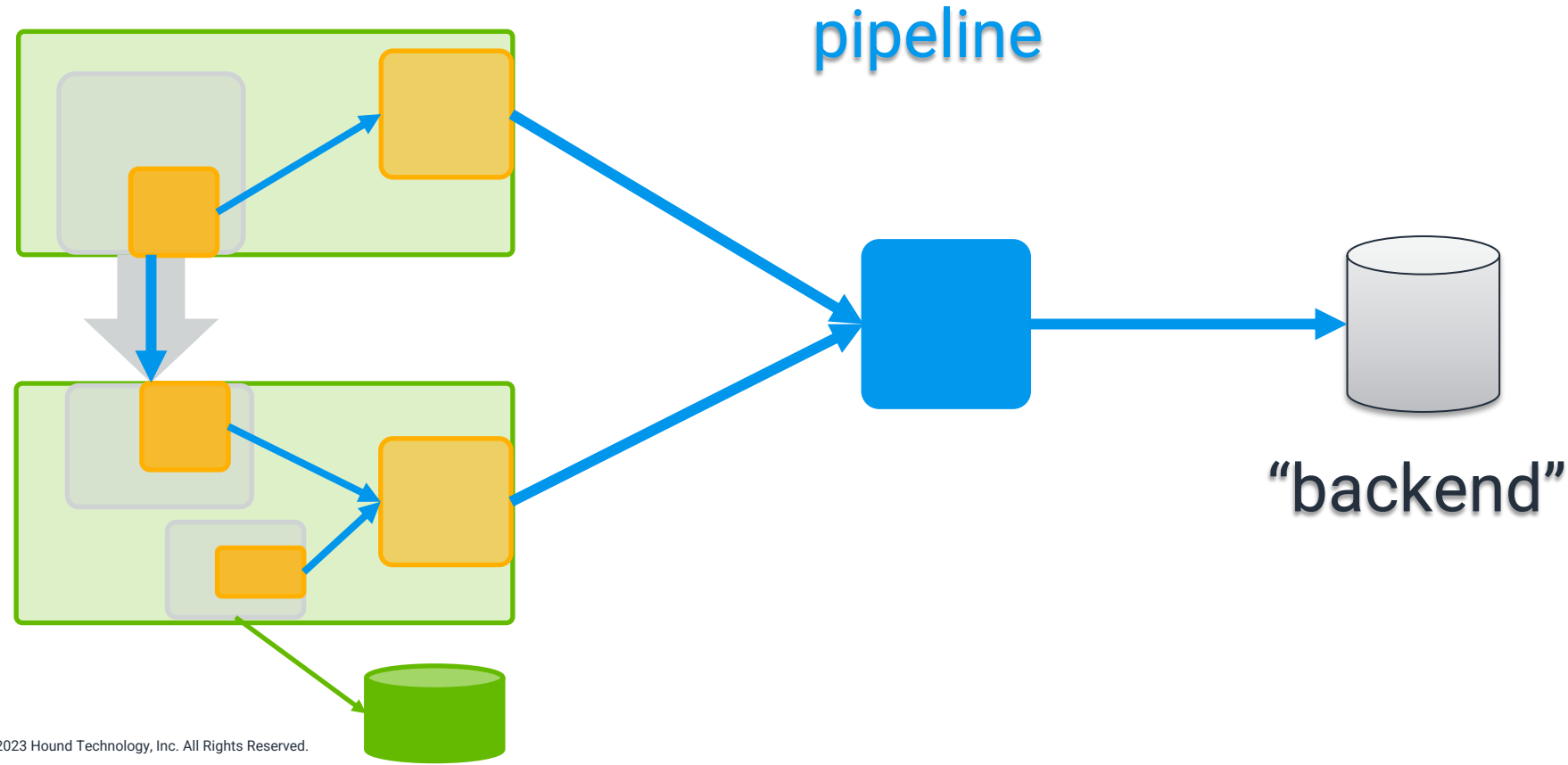


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instrumentation



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Observability

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Helm

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chart

template

image

chart repository

image repository

Container

Container

Operator

Custom Resource

OTel Collector

pipeline

receiver

processor

exporter

telemetry backend

Service

Ingress

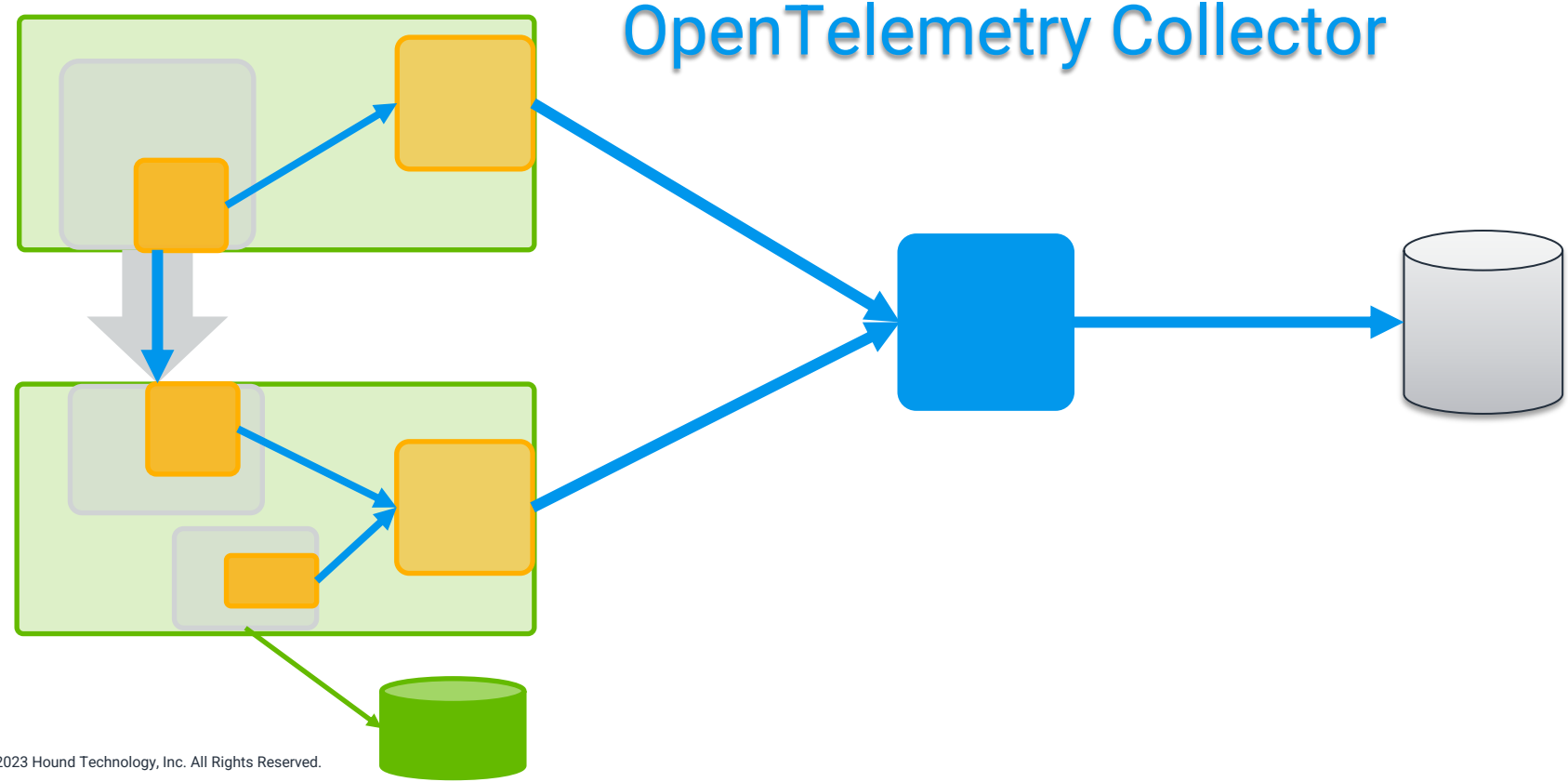
Daemonset

sidecar

Node

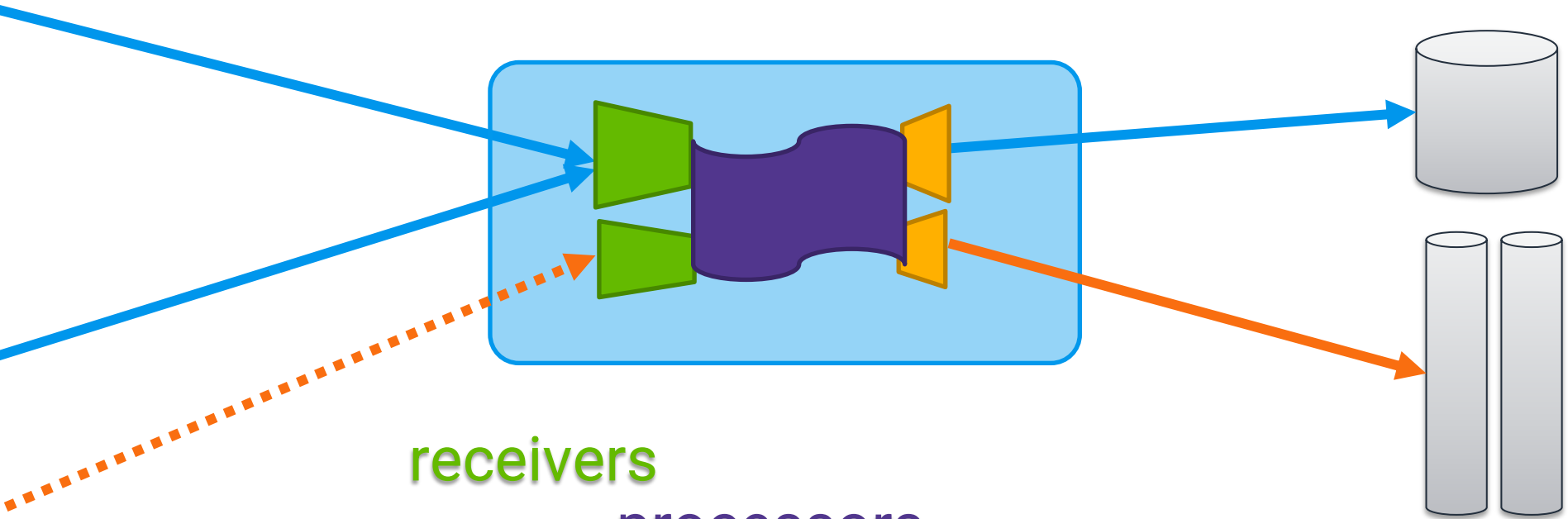
cluster

OpenTelemetry Collector



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OpenTelemetry Collector



receivers

processors

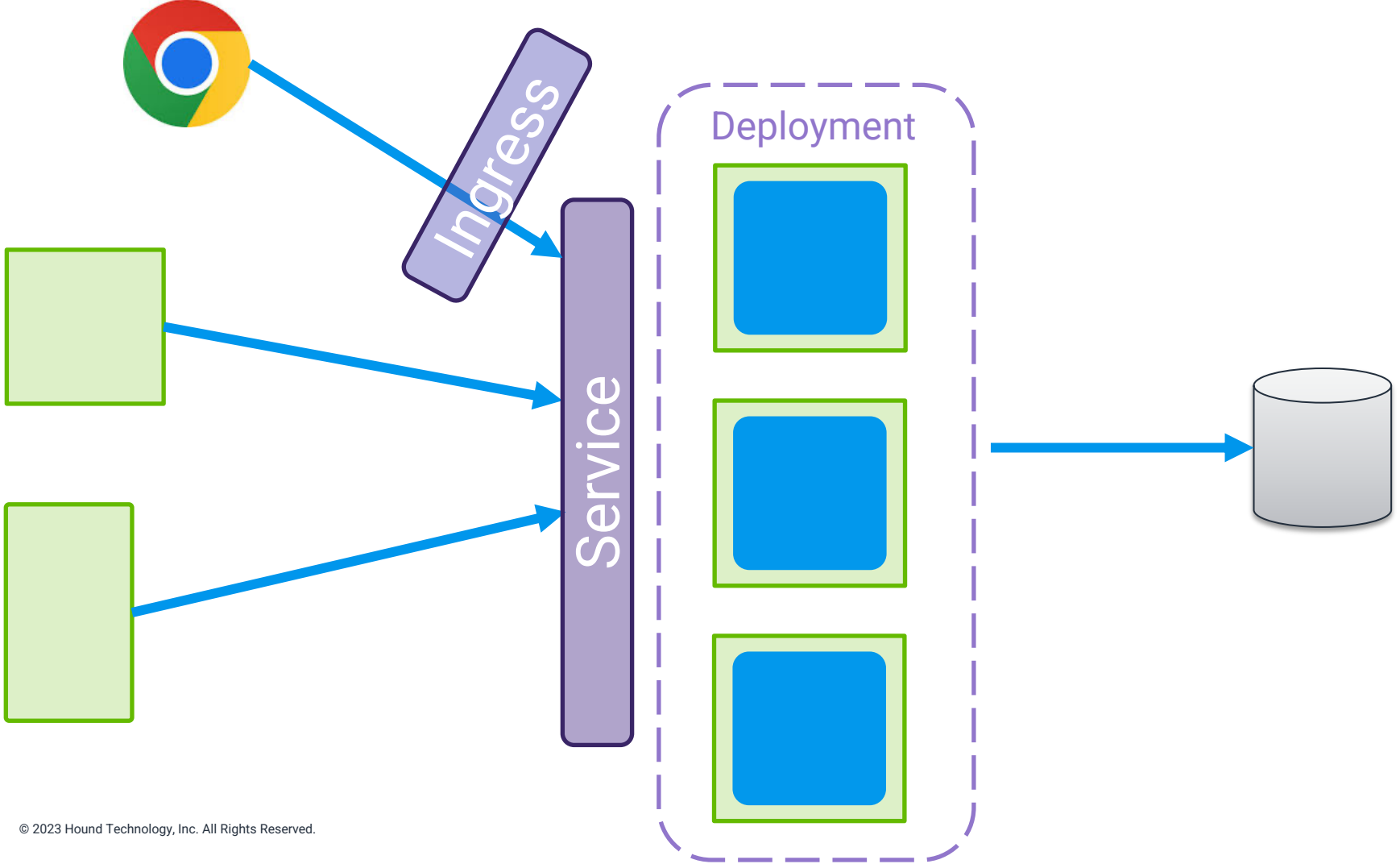
exporters

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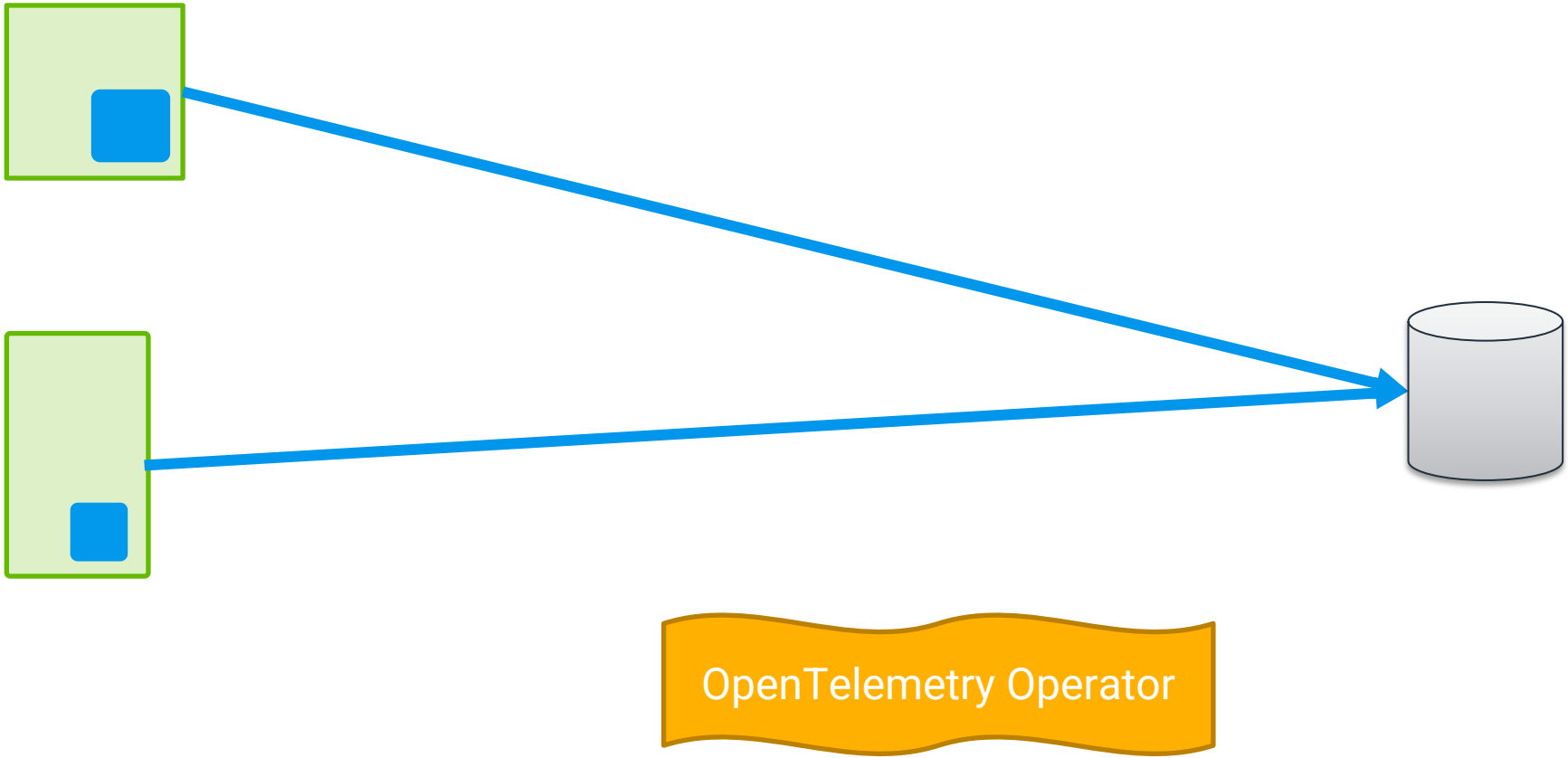
OpenTelemetry Collector

- Compatible with other formats
- Add attributes
- Filter data
- Send to multiple backends
- Scrape data

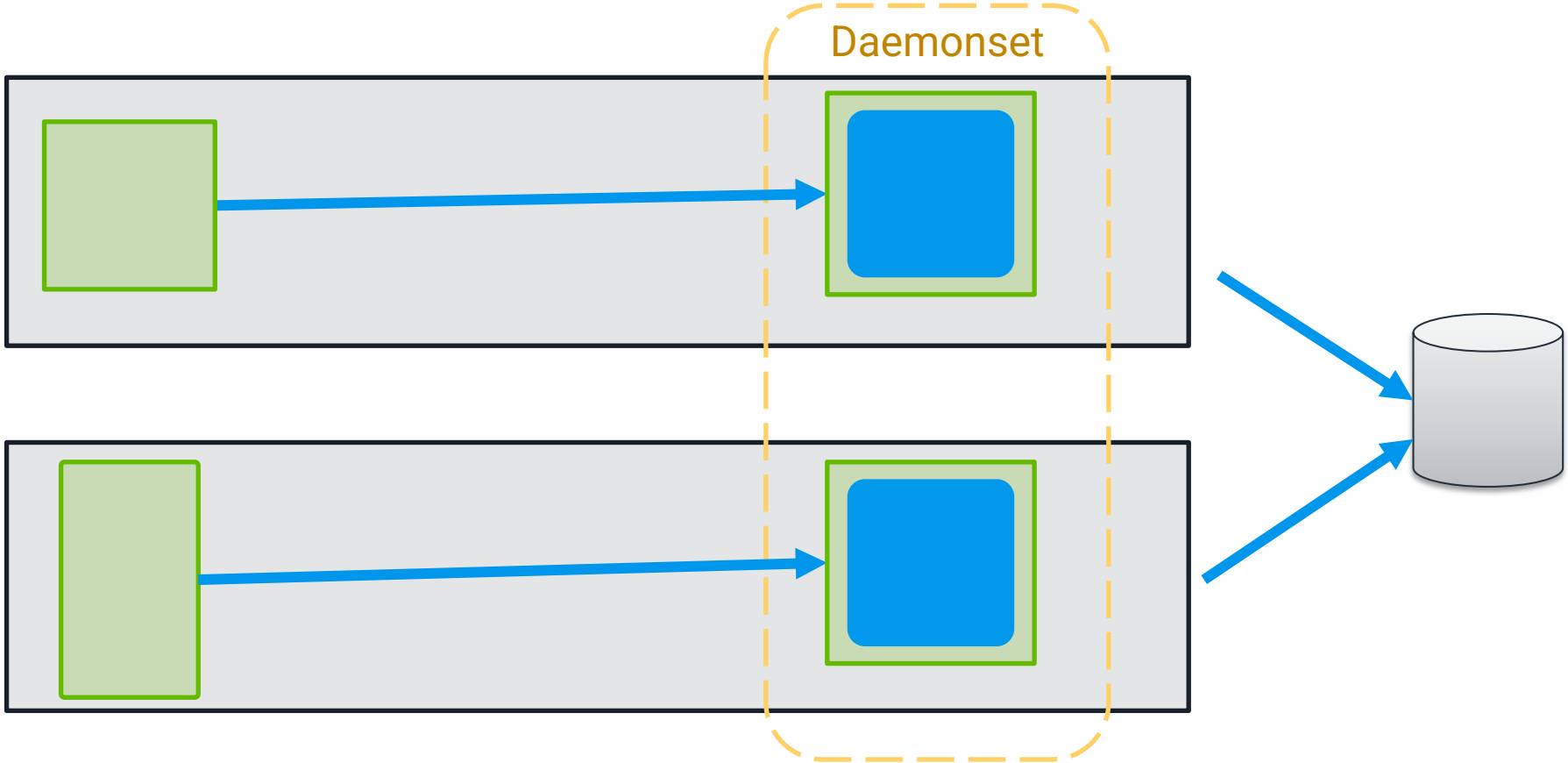
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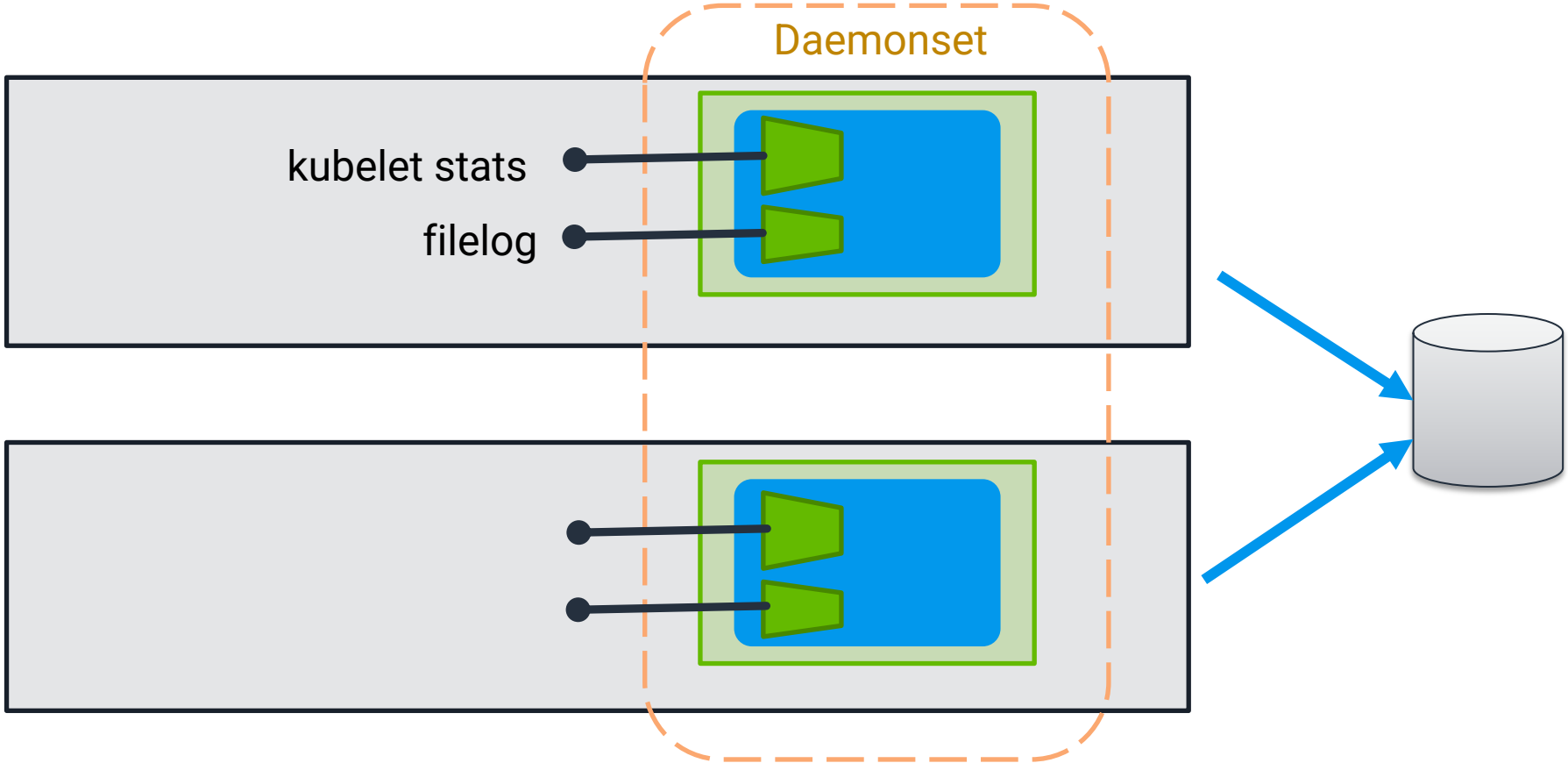
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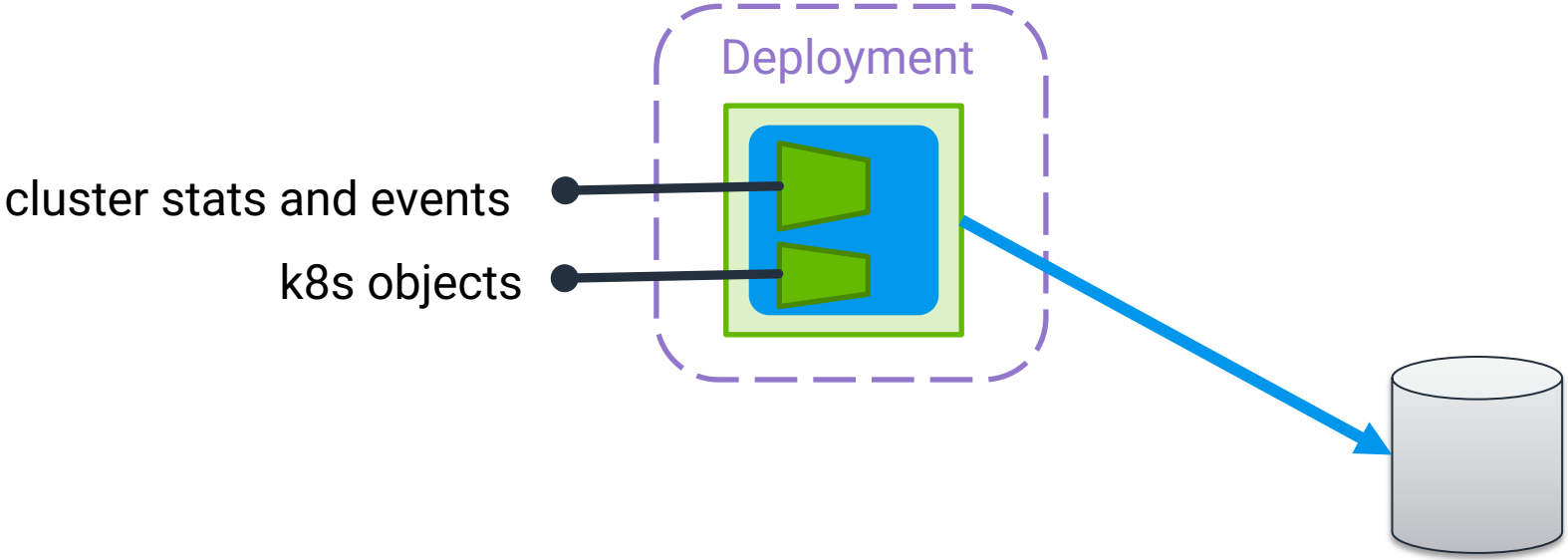
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Some Kubernetes Stuff

Apply query filters

Go to board

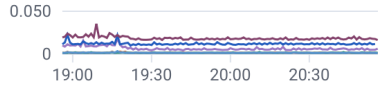
COUNT_DISTINCT(container.id)



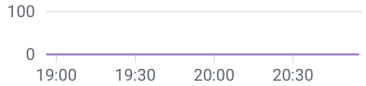
AVG(k8s.daemonset.ready_nodes)



MAX(container.cpu.utilization)



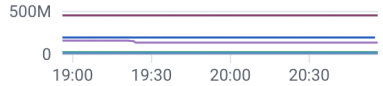
SUM(k8s.container.restarts)



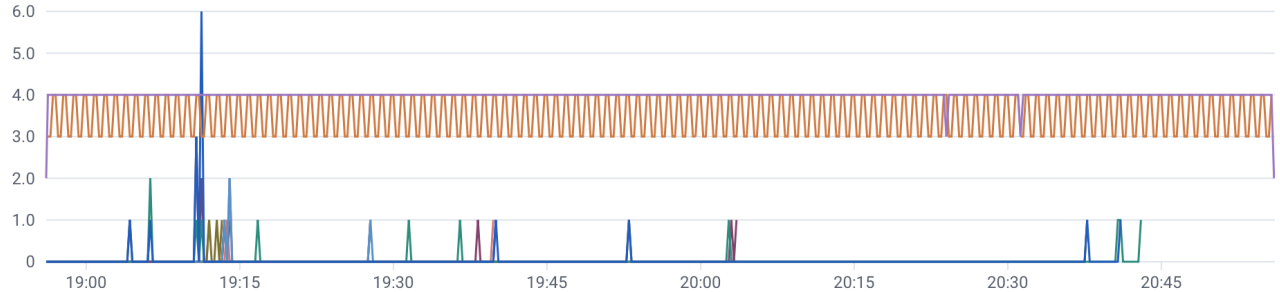
AVG(k8s.daemonset.desired_scheduled_n...



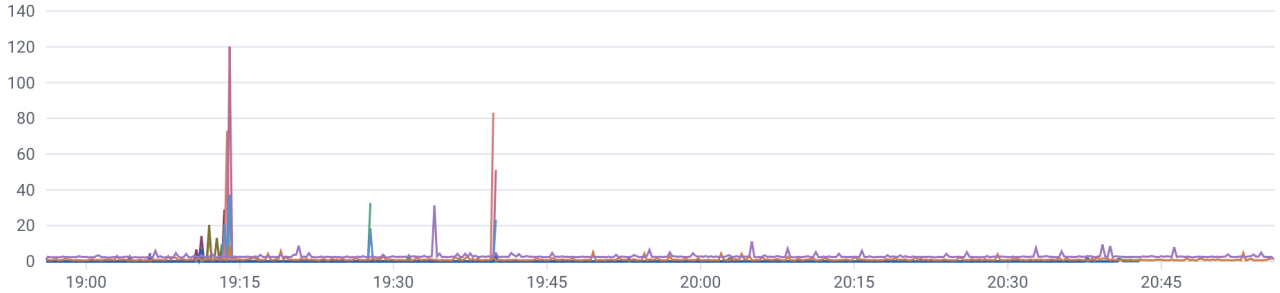
MAX(container.memory.usage)



COUNT

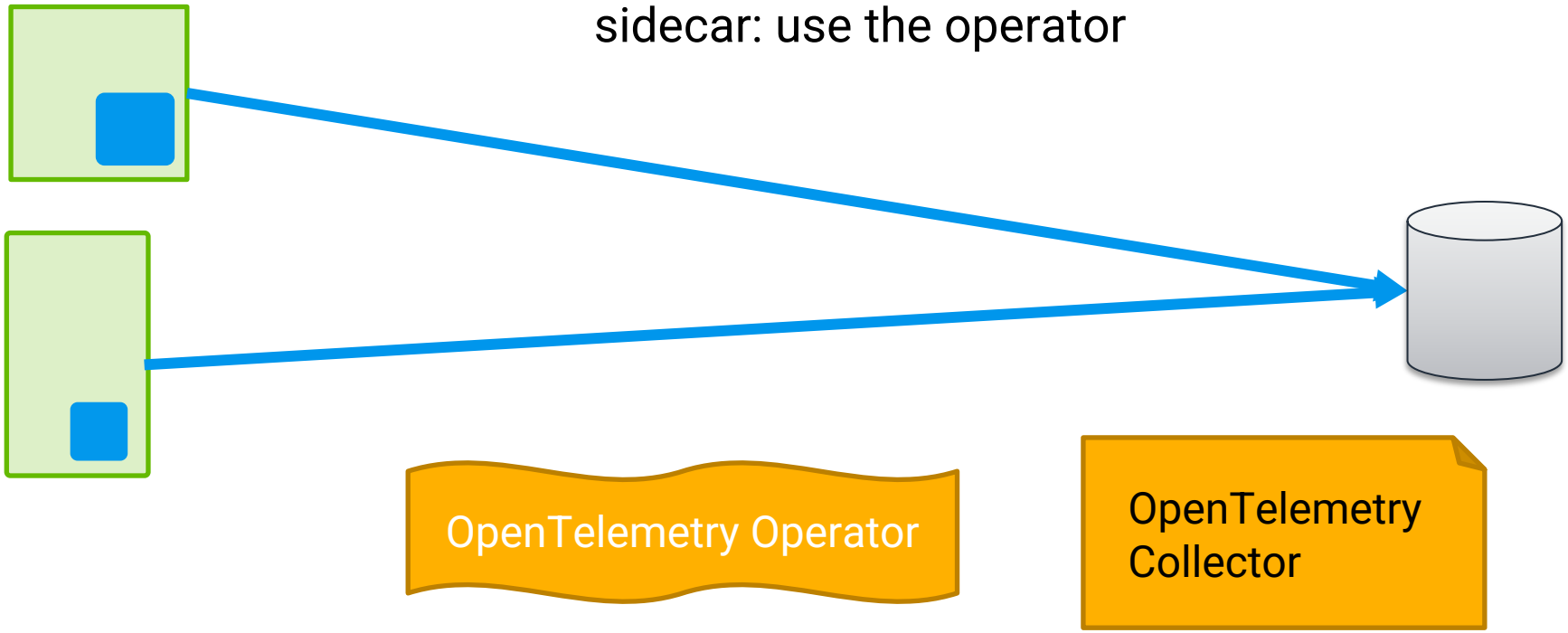


P95(duration_ms)



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Deploying the OTel Collector

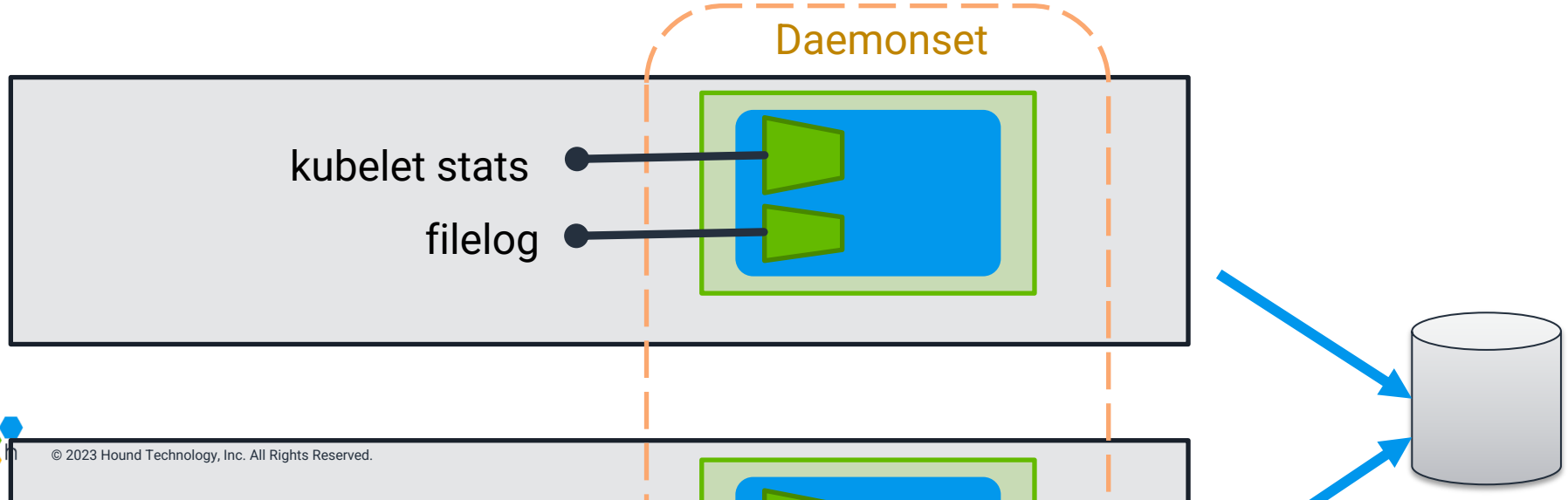


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Deploying the OTel Collector

daemonset: use the OTel Collector helm chart

```
presets:
  kubernetesAttributes:
    enabled: true
  kubeletMetrics:
    enabled: true
  logsCollection:
    enabled: true
```

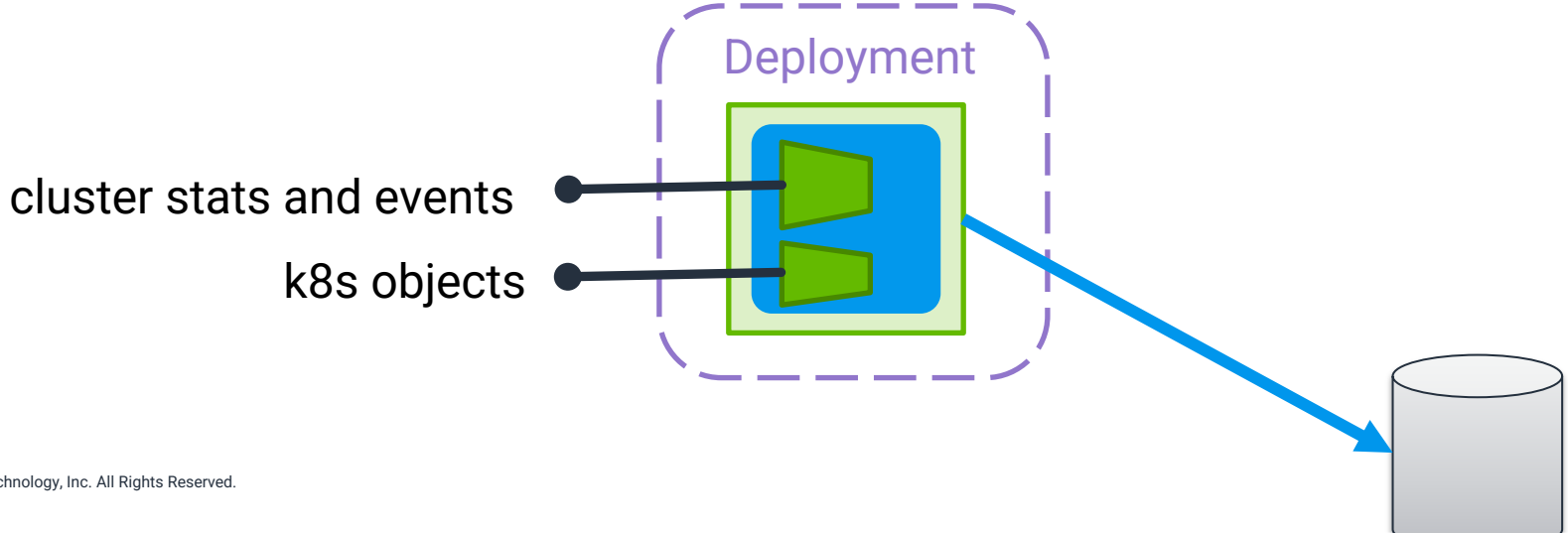


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Deploying the OTel Collector

cluster: use the OTel Collector helm chart

```
presets:
  clusterMetrics:
    enabled: true
  kubernetesEvents:
    enabled: true
```

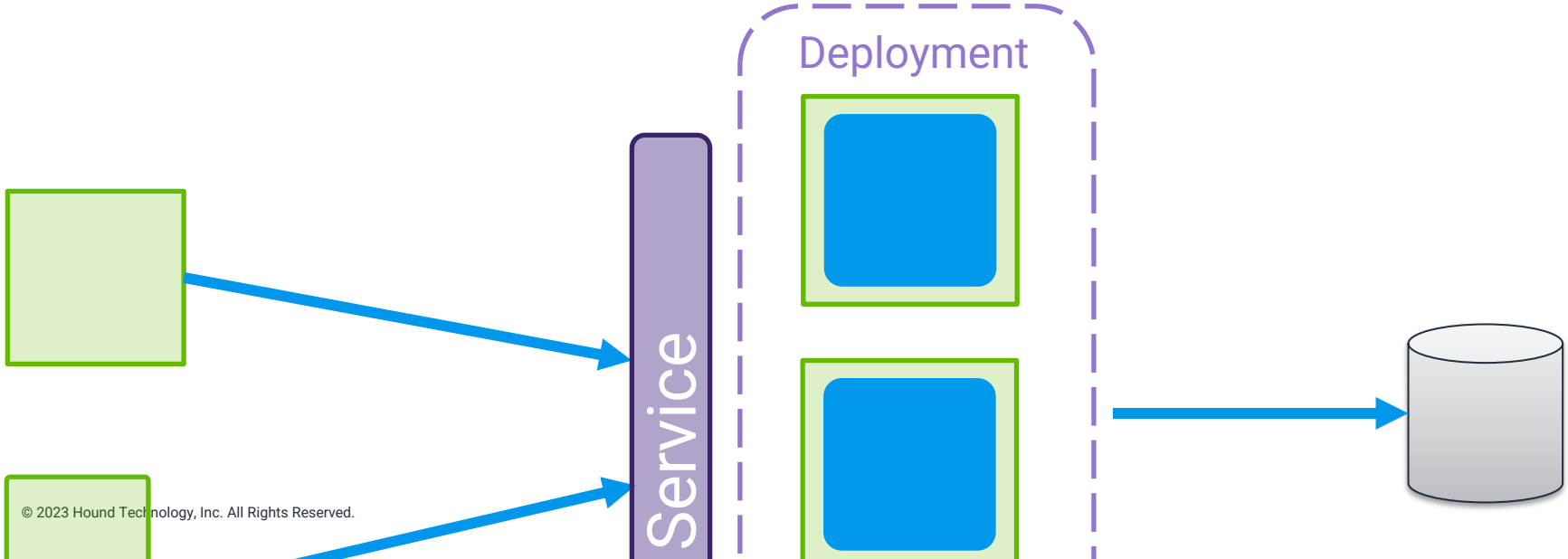


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Deploying the OTel Collector

deployment: use the OTel Collector helm chart

```
presets:
  kubernetesAttributes:
    enabled: true
```



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Search this site...

- Instrumentation
- Collector
- Kubernetes
  - Getting Started
  - Collector
  - Helm Charts
  - Kubernetes Operator
- FaaS
- Migration
- Specs
- Acknowledgements

Getting Started

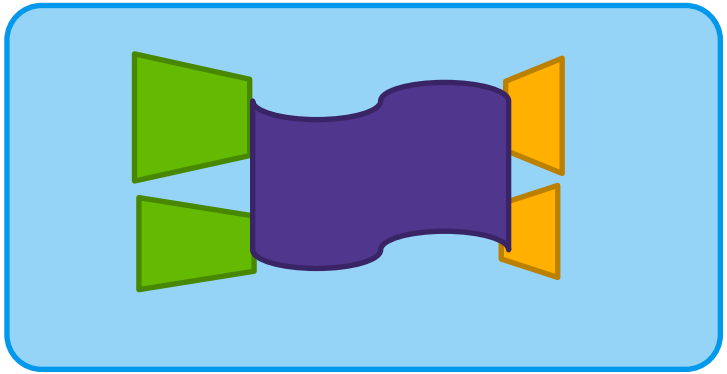
This page will walk you through the fastest way to get started monitoring your Kubernetes cluster using OpenTelemetry. It will focus on collecting metrics and logs for Kubernetes clusters, nodes, pods, and containers, as well as enabling the cluster to support services emitting OTLP data.

If you're looking to see OpenTelemetry in action with Kubernetes, the best place to start is the OpenTelemetry Demo. The demo is intended to illustrate the implementation of OpenTelemetry, but it is not intended to be an example of how to monitor Kubernetes itself. Once you finish with this walkthrough, it can be a fun experiment to install the demo and see how all the monitoring responds to an active workload.

If you're looking to start migrating from Prometheus to OpenTelemetry, or if you're interested in using the OpenTelemetry Collector to collect Prometheus metrics, see

Choosing a Collector Image

OpenTelemetry Collector



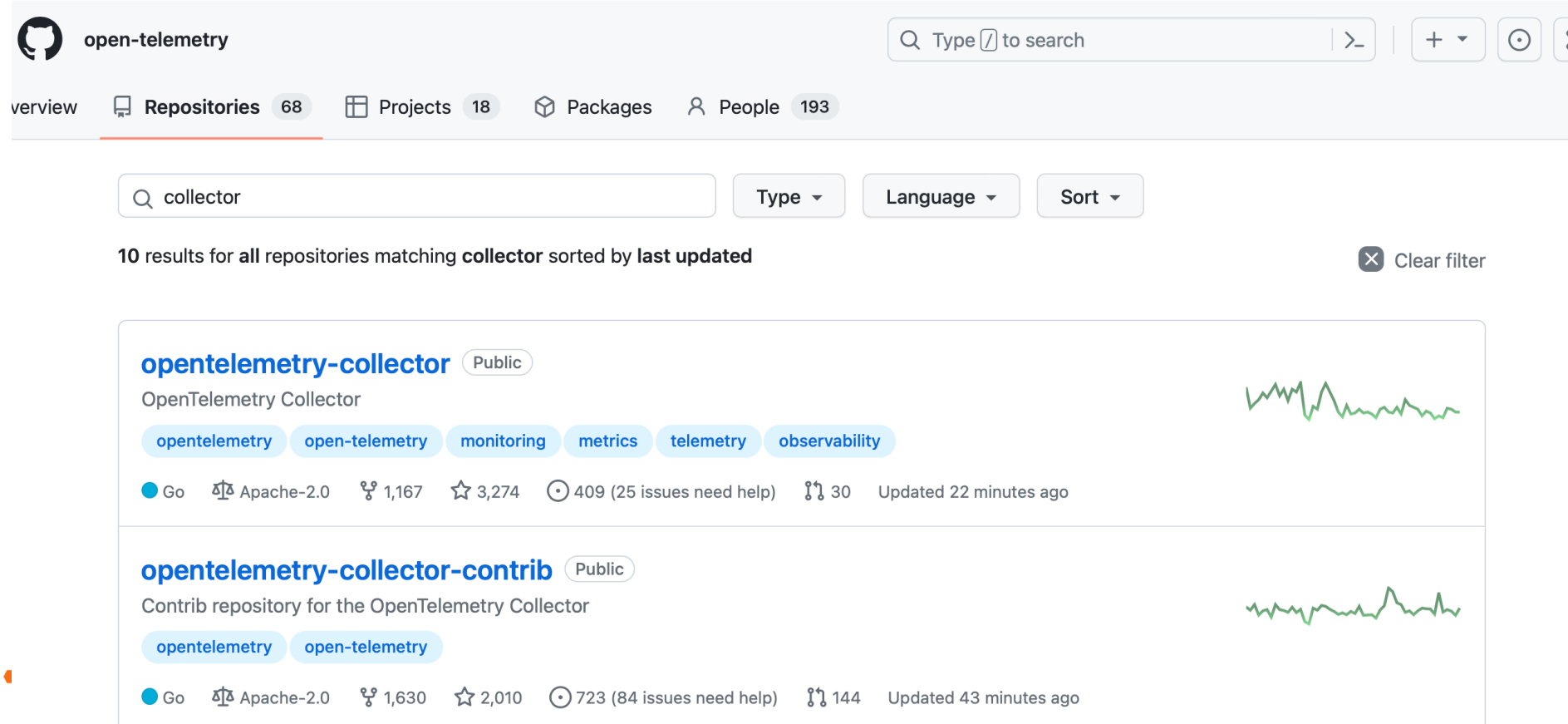
receivers

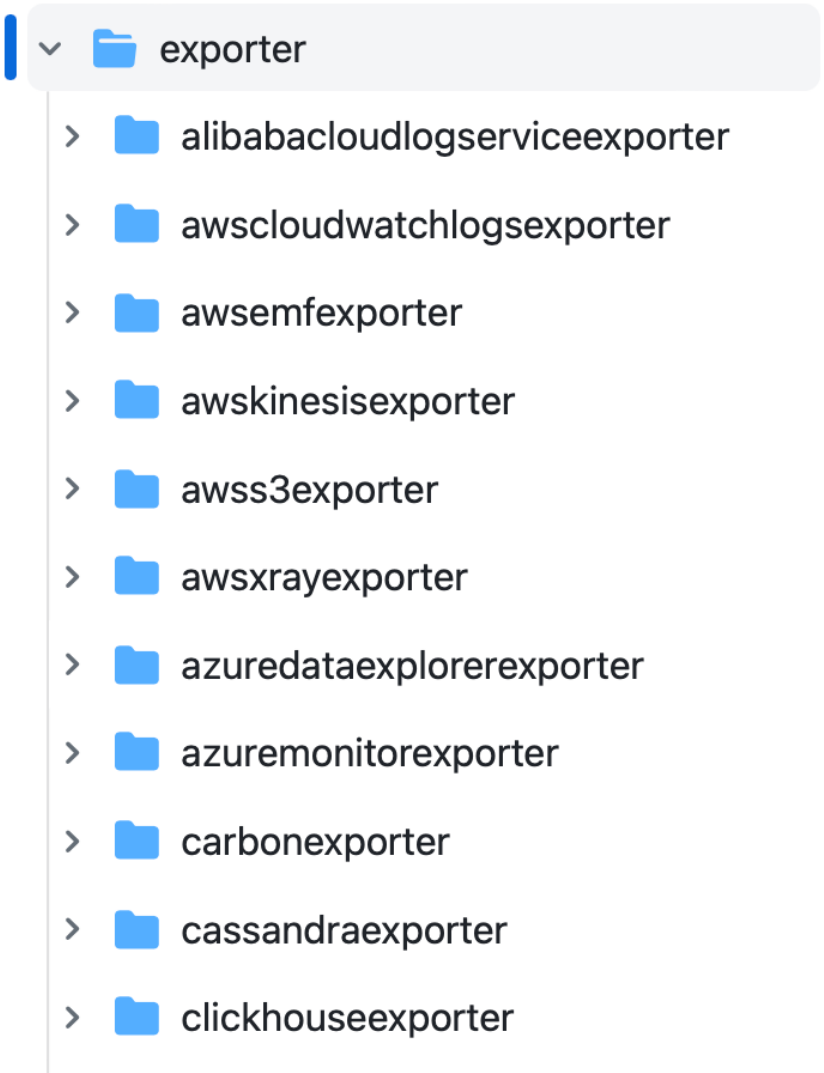
processors

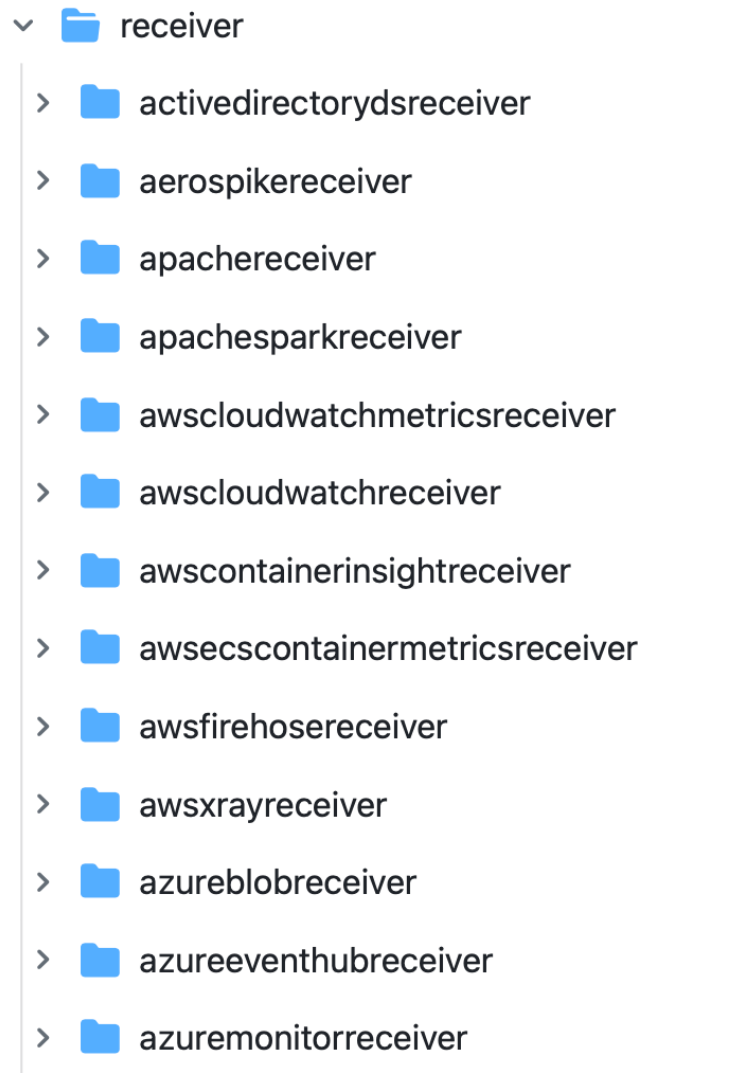
exporters

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Choosing Collector Components




exporter
alibabacloudlogserviceexporter
awscloudwatchlogsexporter
awsemfexporter
awskinesisexporter
awss3exporter
awsxrayexporter
azuredataexplorerexporter
azuremonitorexporter
carbonexporter
cassandraexporter
clickhouseexporter


receiver
activedirectorydsreceiver
aerospikereceiver
apachereceiver
apachesparkreceiver
awscloudwatchmetricsreceiver
awscloudwatchreceiver
awscontainerinsightreceiver
awsecscontainermetricsreceiver
awsfirehosereceiver
awsxrayreceiver
azureblobreceiver
azureeventhubreceiver
azuremonitorreceiver

7 results for **all** repositories matching **java** sorted by **last updated**

Clear filter

opentelemetry-java Public

OpenTelemetry Java SDK

opentelemetry

Java Apache-2.0 742 1,638 117 (10 issues need help) 16 Updated 2 hours ago



opentelemetry-java-contrib Public

Java Apache-2.0 93 100 45 (3 issues need help) 7 Updated 3 hours ago



opentelemetry-java-instrumentation Public

OpenTelemetry auto-instrumentation and instrumentation libraries for Java

Java Apache-2.0 660 1,436 286 (5 issues need help) 46 Updated 3 hours ago



opentelemetry-java-examples Public

Java Apache-2.0 77 110 5 3 Updated 4 hours ago



semantic-conventions-java Public

Java generated classes for semantic conventions

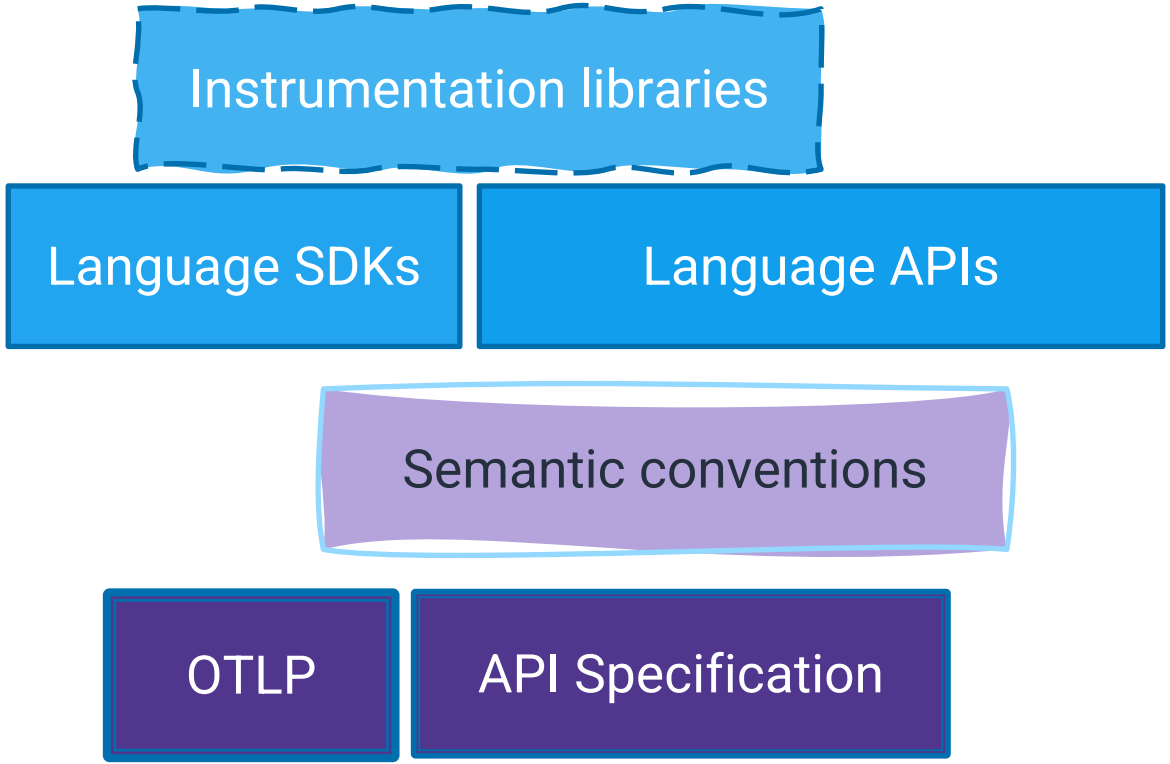
Java Apache-2.0 1 3 5 0 Updated 3 days ago



opentelemetry-proto-java Public

Java Bindings for the OpenTelemetry Protocol (OTLP)

OpenTelemetry is many projects



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Observability

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Instrumentation

Propagation

Distributed Tracing

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parent span

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Operator

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Service

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sidecar

Node

cluster

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provider

Helm

release

chart

template

image

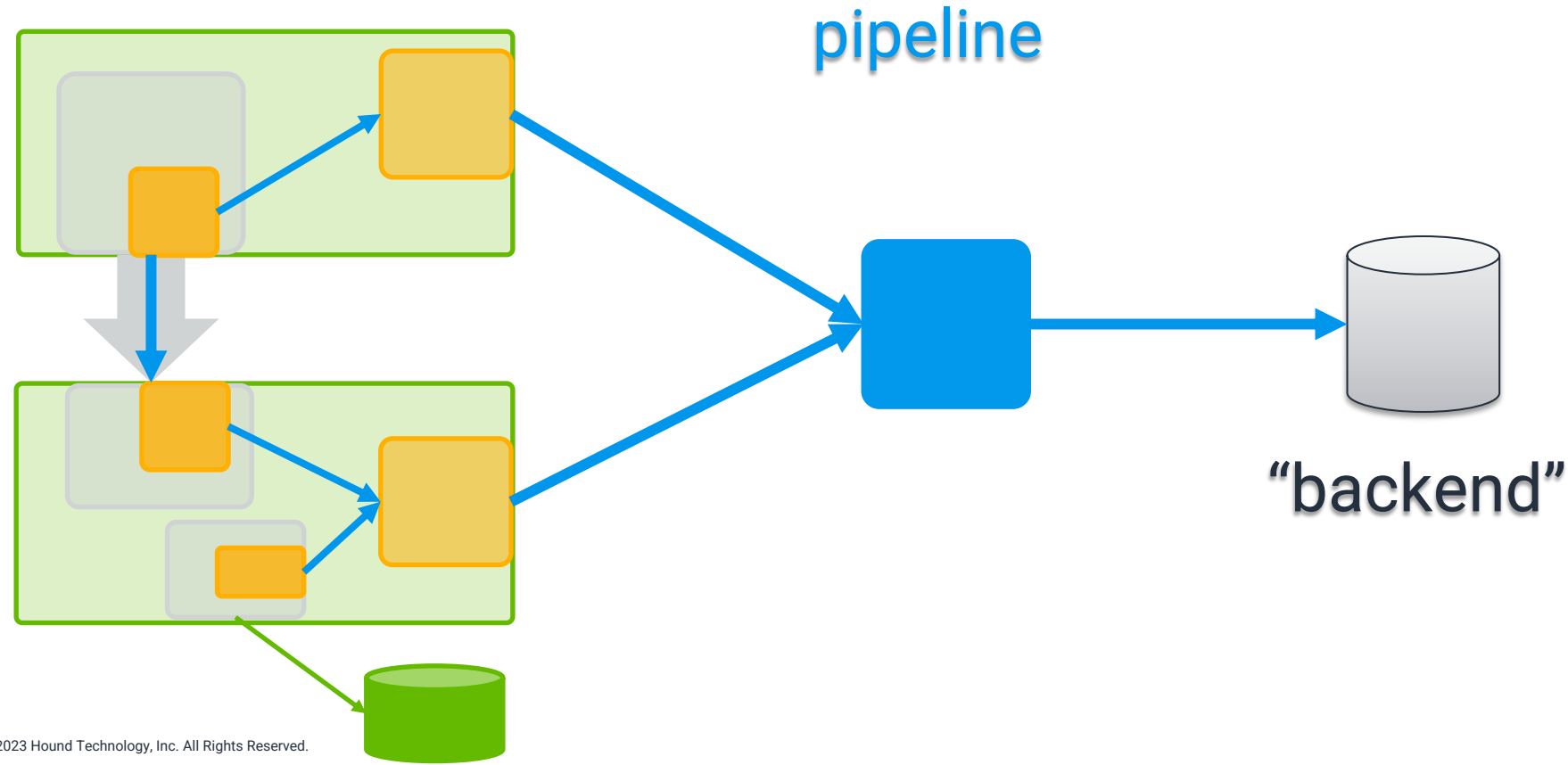
chart repository

image repository

Docker

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instrumentation



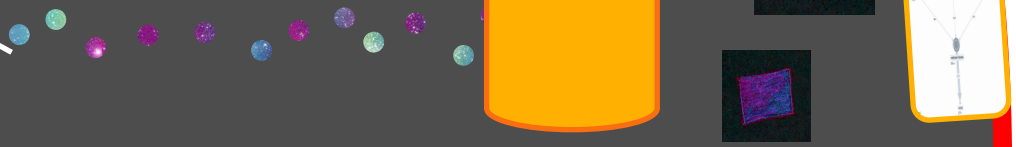
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Instrumentation

Telemetry

Observability

```
report(…)
```



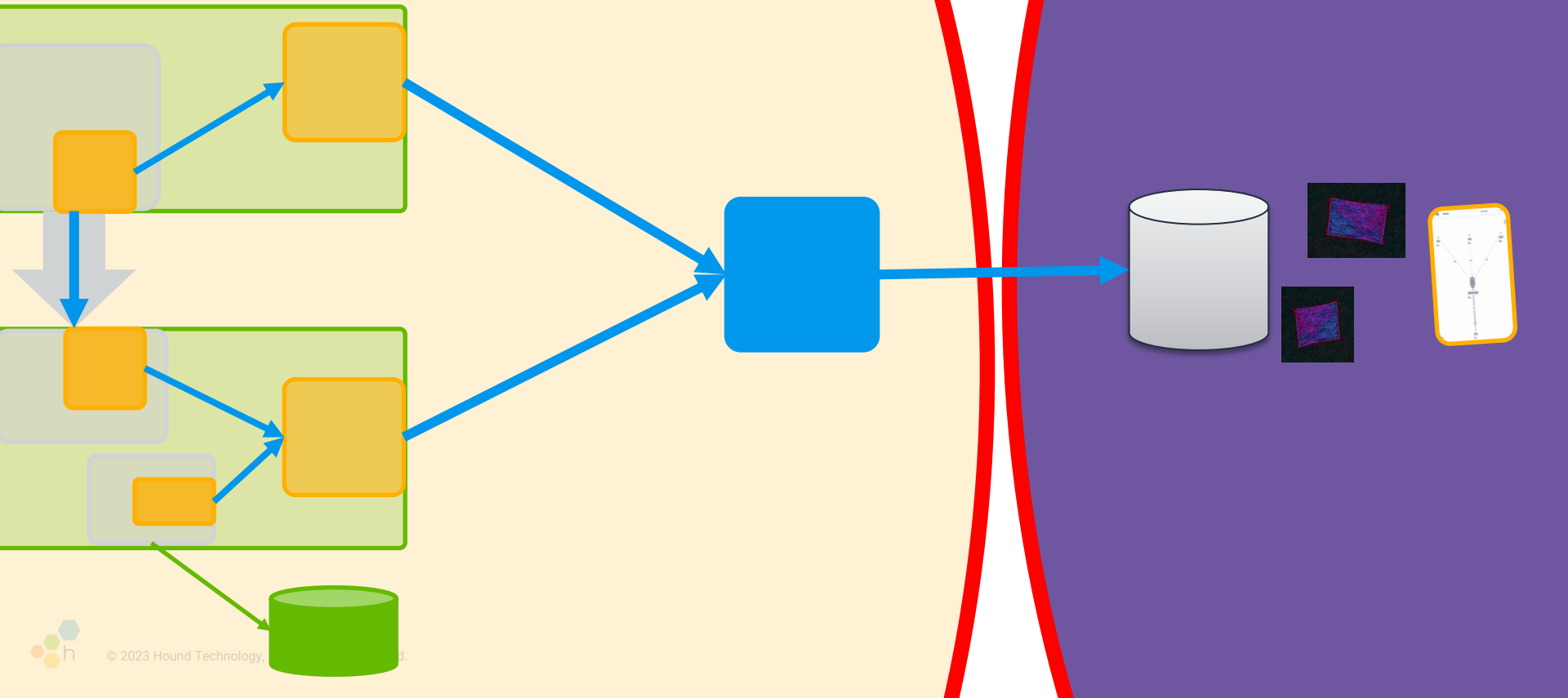
“Telemetry Backend”



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Step 1: Use OpenTelemetry

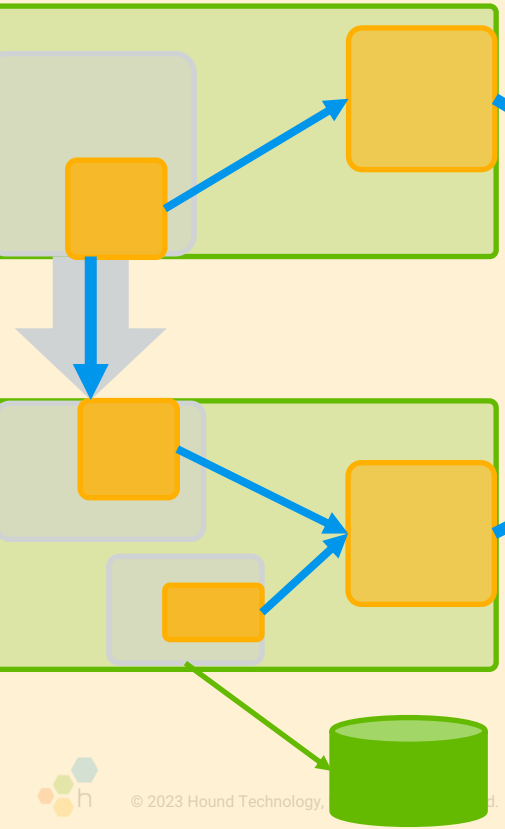
Choose or change your tooling later.

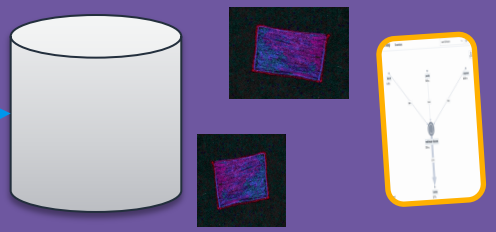


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In your network:
stateless
open source
under your control

Observability Tool:
different failure domain
stateful
can be SaaS





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Consideration: Cost

- Metrics: reduce cardinality.
- Logs: shove them in S3, use traces instead 😉
- Traces: **sample**



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Consideration: Performance

- Move instrumentation libraries into application builds
  - include only what you need
  - add custom attributes! Get more value!

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Consideration: Security

- Reduce surface area
  - build your collector images
  - choose instrumentation libraries in applications

- Filter data in the collector
  - redact or disguise PII

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Consideration: Upkeep

- Do you have an observability team?
  - gotta configure and operate the pipeline.
  - internal libraries are great for instrumentation.
- Backends are $$ to run
  - and $$$$ to keep up to the latest standards

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OpenTelemetry

Kubernetes



CLOUD NATIVE
COMPUTING FOUNDATION

a story of software maturity

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Observability

Telemetry

Instrumentation

Propagation

Distributed Tracing

trace ID

span

duration

parent span

attributes

waterfall

semantic conventions

pipeline

telemetry backend

OpenTelemetry

OTLP

automatic instrumentation

traceparent

libraries

OTel Operator

Instrumentation

OTel Collector

SDK

receiver

API

processor

exporter

Kubernetes

Deployment

ReplicaSet

Pod

Docker

Container

Container

Operator

Custom Resource

annotation

Service

Ingress

Terraform

provider

Helm

release

chart

template

image

chart repository

image repository

Daemonset

sidecar

Node

cluster

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Observability

OpenTelemetry

- API
- automatic instrumentation
- Instrumentation
- libraries

Distributed Tracing

- trace ID
- span
- duration
- parent span
- attributes
- waterfall

Kubernetes

- Deployment
- Pod
- Container
- Service
- Ingress

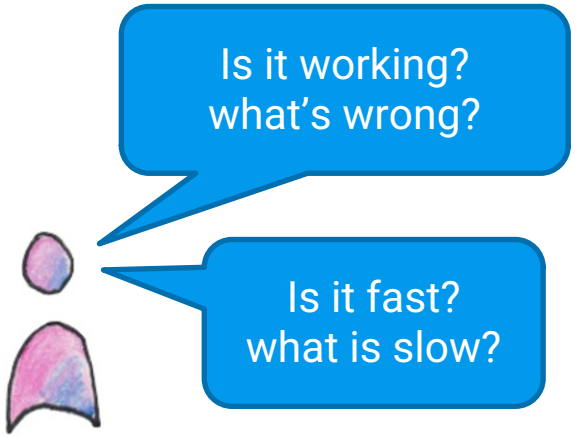
Docker

- image
- Container
- image repository

Helm

- chart
- release
- template

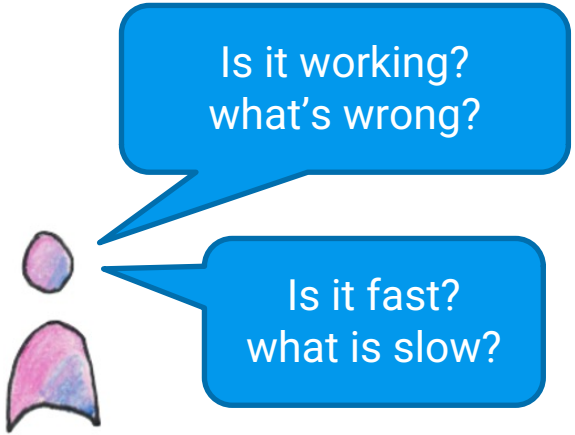
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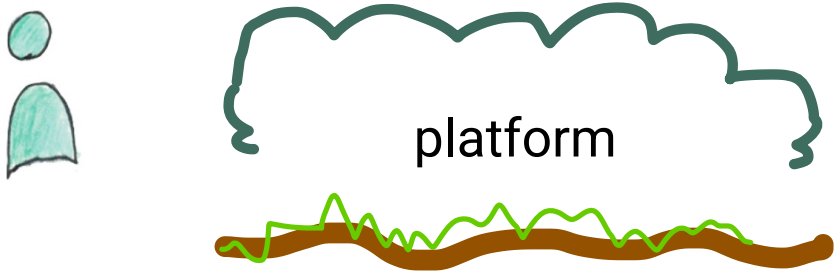
app dev*ops*: observability

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app dev*ops*: observability



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Care about app + runtime
Care what it does in prod
Use the observability tool

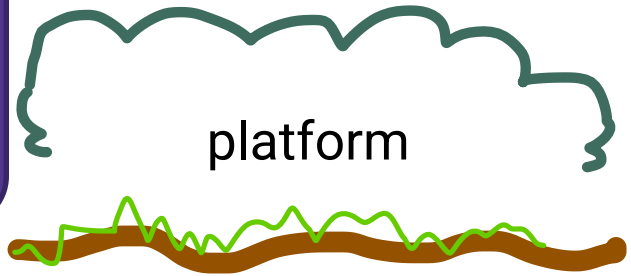




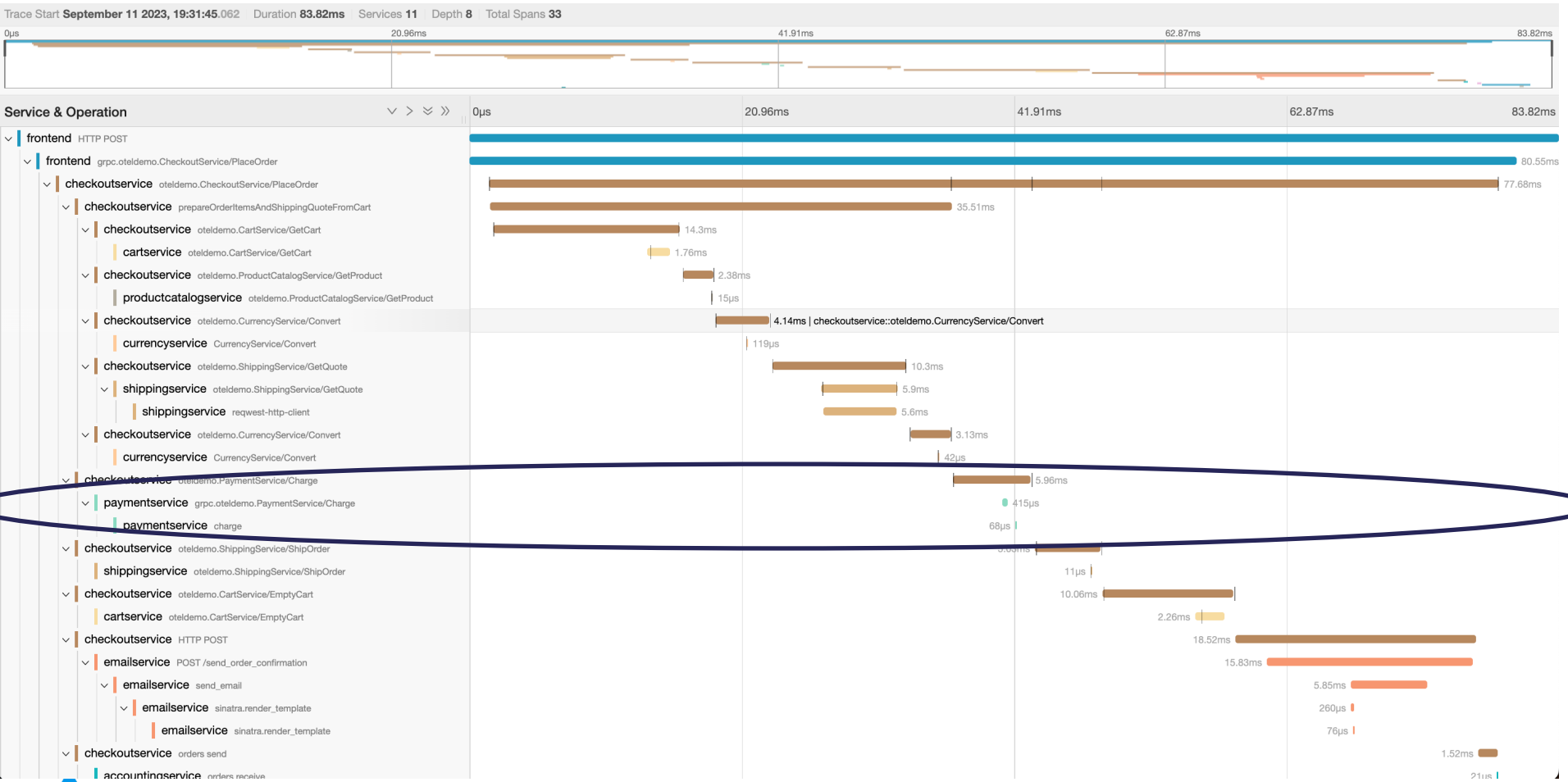
app dev*ops*: observability

Keep k8s running
and the observability pipeline
Guidance & expertise





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Some Kubernetes Stuff

Apply query filters

Go to board

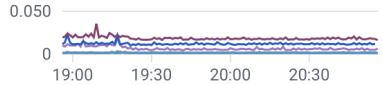
COUNT_DISTINCT(container.id)



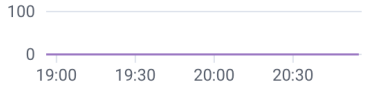
AVG(k8s.daemonset.ready_nodes)



MAX(container.cpu.utilization)



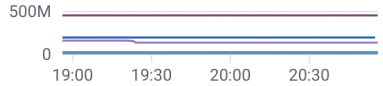
SUM(k8s.container.restarts)



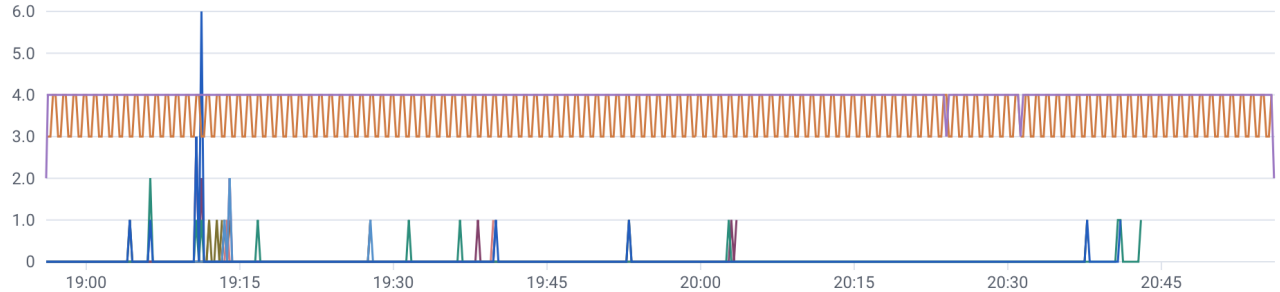
AVG(k8s.daemonset.desired_scheduled_n...



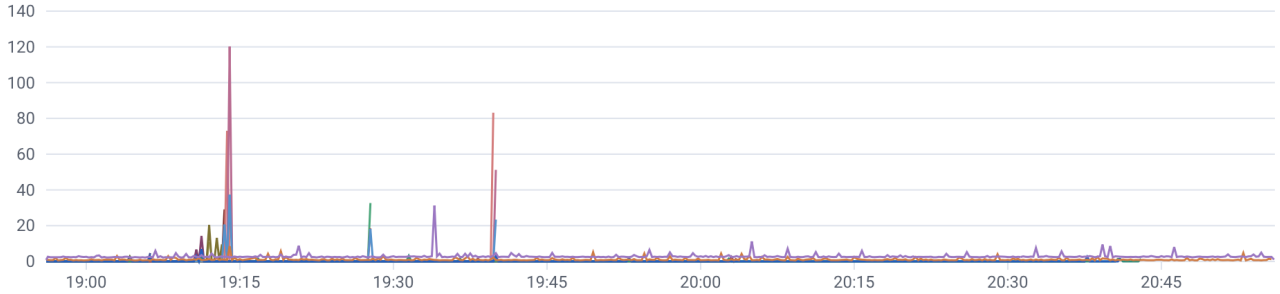
MAX(container.memory.usage)



COUNT



P95(duration_ms)



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https://www.honeycomb.io/observing-kubernetes-with-opentelemetry

www.honeycomb.io