Stop reinventing the wheel with Istio

Mete Atamel

Developer Advocate at Google

@meteatamel

Google Cloud

The need for Istio

Containers, Kubernetes

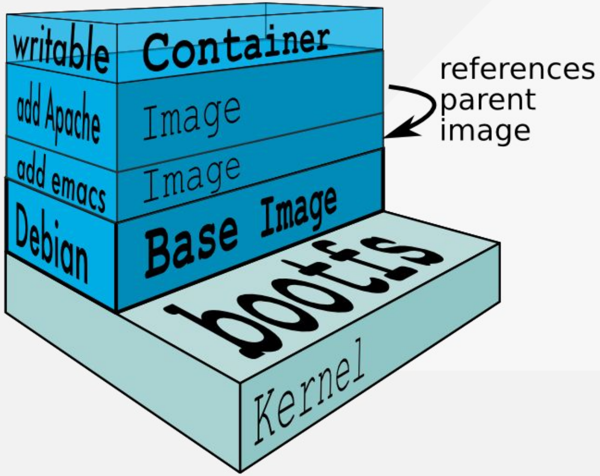
01

What is a container?

A **lightweight** way to virtualize applications

Linux (or Windows) processes

Lightweight	Easily deployable
Hermetically sealed	Introspectable
Isolated	Composable



Docker: Tooling for the masses

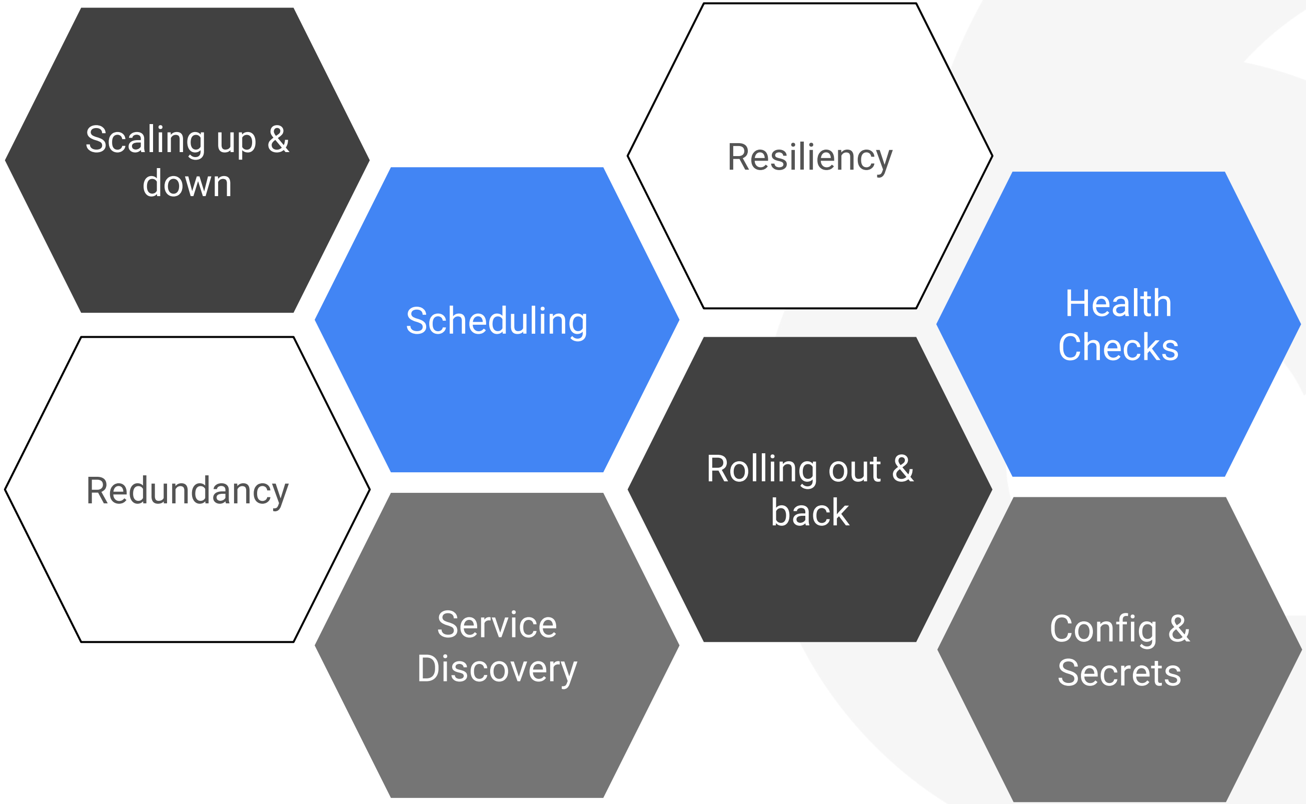
Docker is a container runtime and image format

Dockerfile defines the dependencies, environment and the code to run

Container is a consistent invocation of a Dockerfile

```
FROM debian:latest

RUN apt-get update
RUN apt-get install -y nginx

CMD [“nginx”,”-g”,”daemon off;”]

EXPOSE 80
```

Containers are not enough



Scaling up & down

Scheduling

Resiliency

Health Checks

Redundancy

Service Discovery

Rolling out & back

Config & Secrets

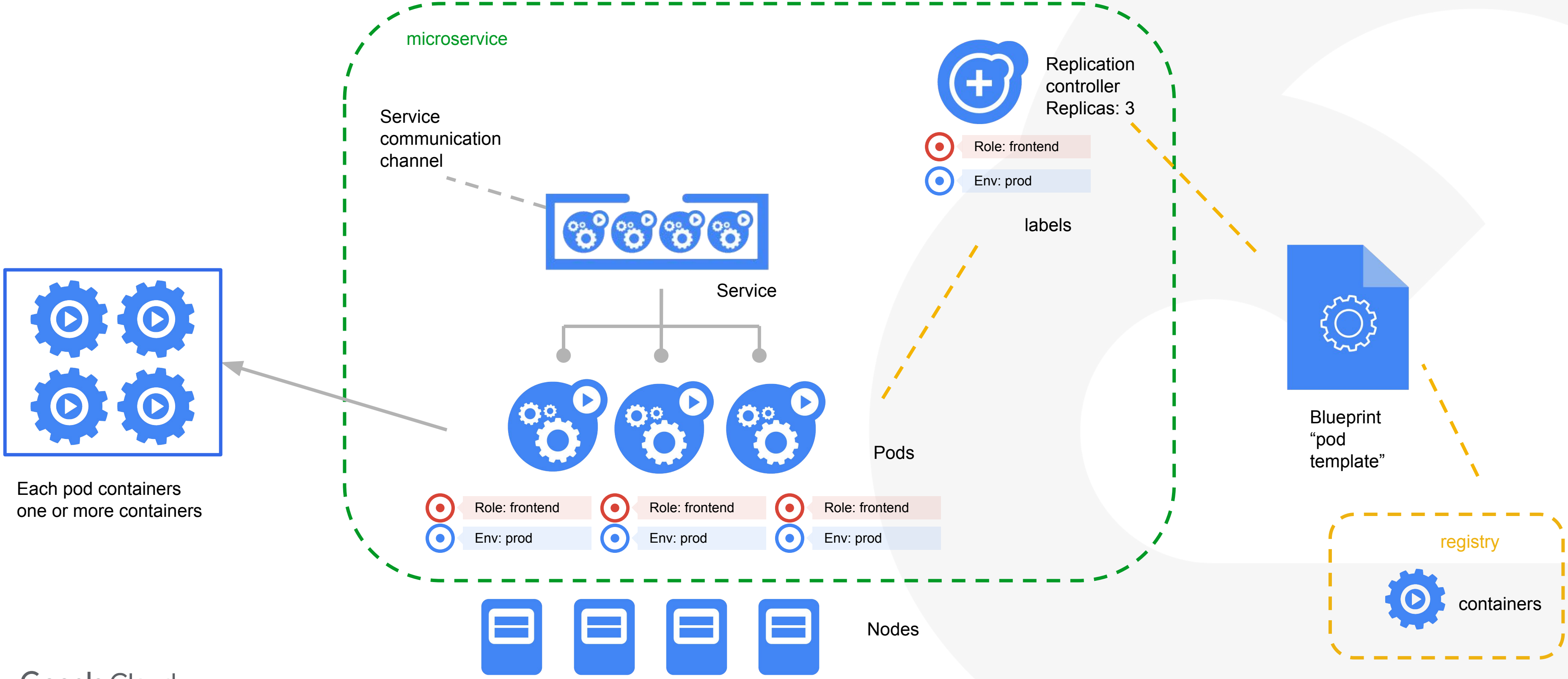
Kubernetes

Κυβερνήτης means *“governor”* in Greek

- Manages container clusters
- Inspired and informed by Google’s internal container system called Borg
- Supports multiple cloud and bare-metal environments
- **100% Open source**, written in Go

Manage applications, not machines

Microservices in Kubernetes world



microservice

Service communication channel

Service

Replication controller
Replicas: 3

Role: frontend

Env: prod

labels

Pods

Role: frontend

Env: prod

Role: frontend

Env: prod

Role: frontend

Env: prod

Nodes

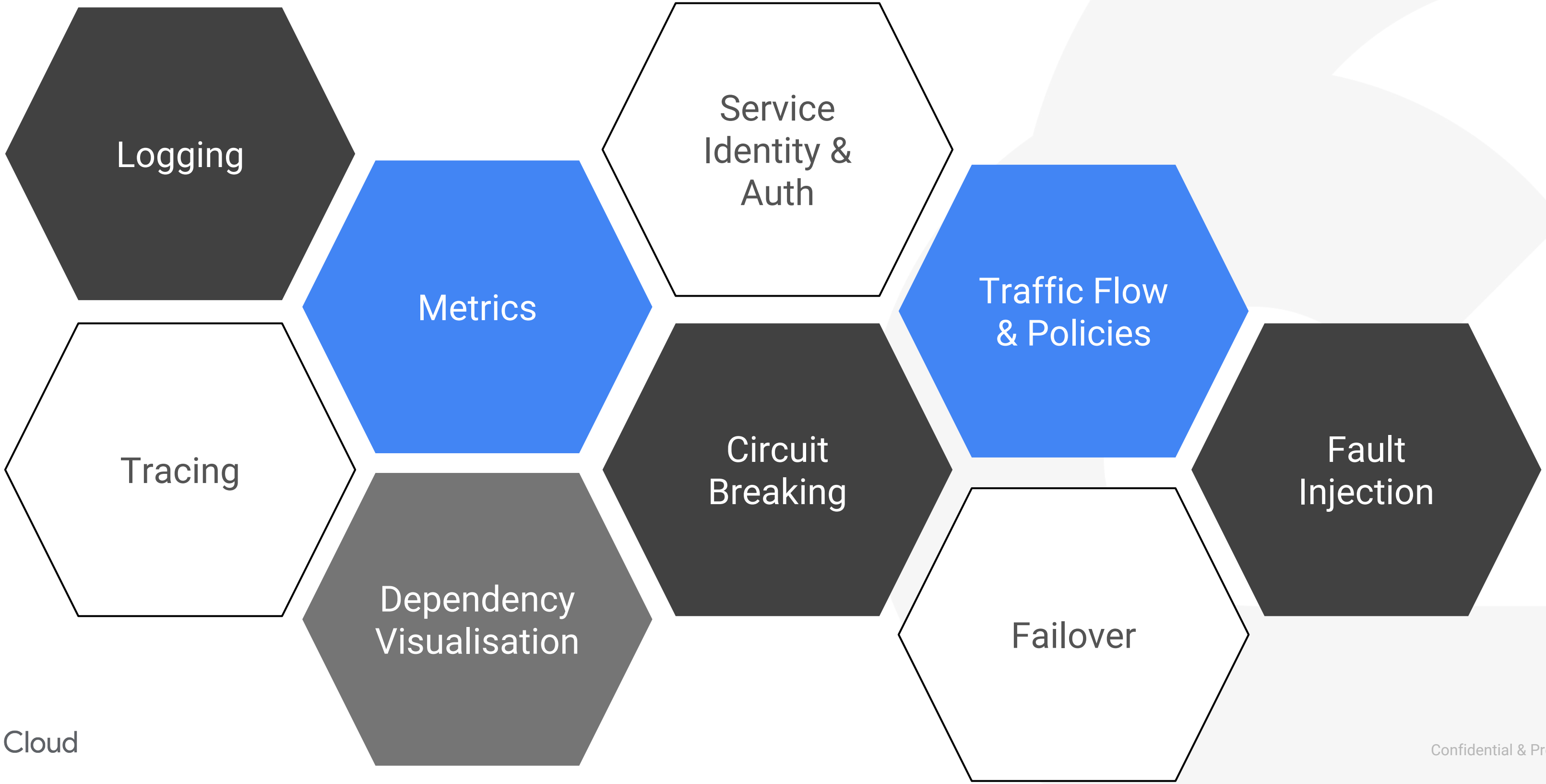
Each pod containers one or more containers

Blueprint “pod template”

registry

containers

Kubernetes is not enough either



Logging

Metrics

Service Identity & Auth

Traffic Flow & Policies

Tracing

Dependency Visualisation

Circuit Breaking

Failover

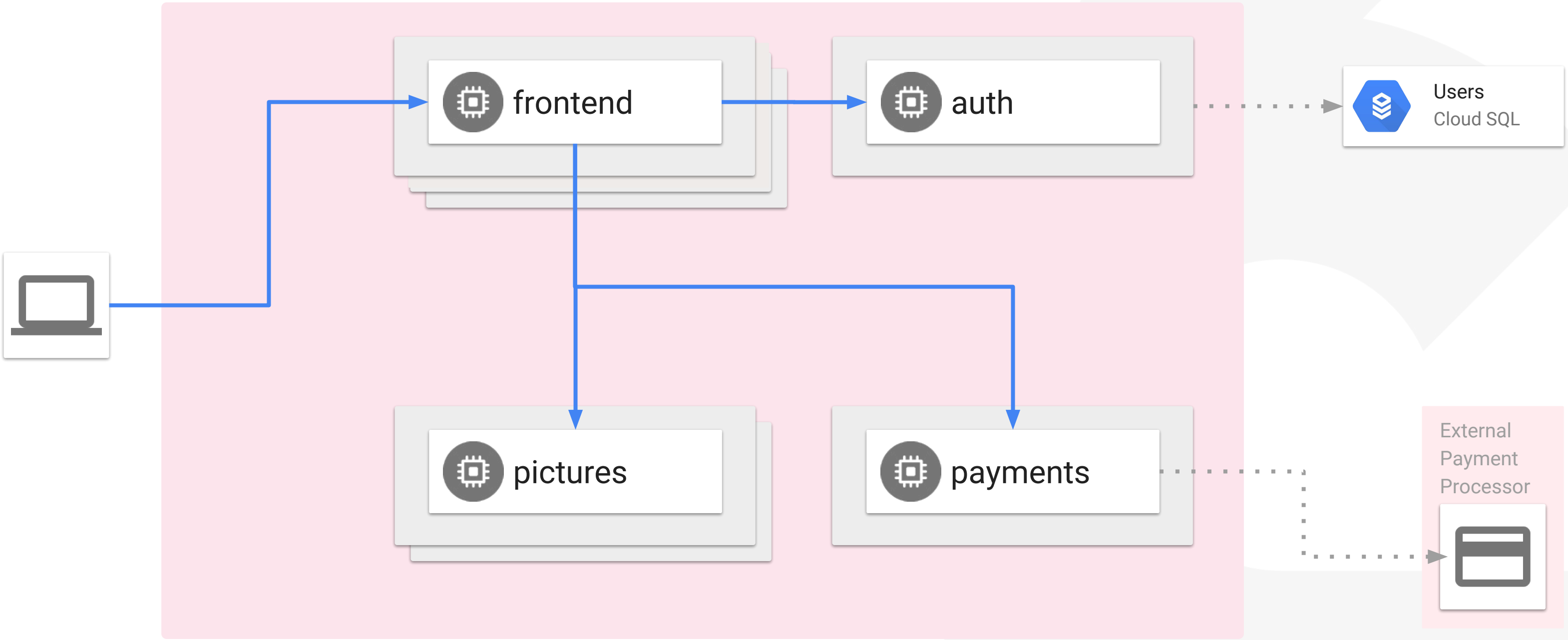
Fault Injection

02

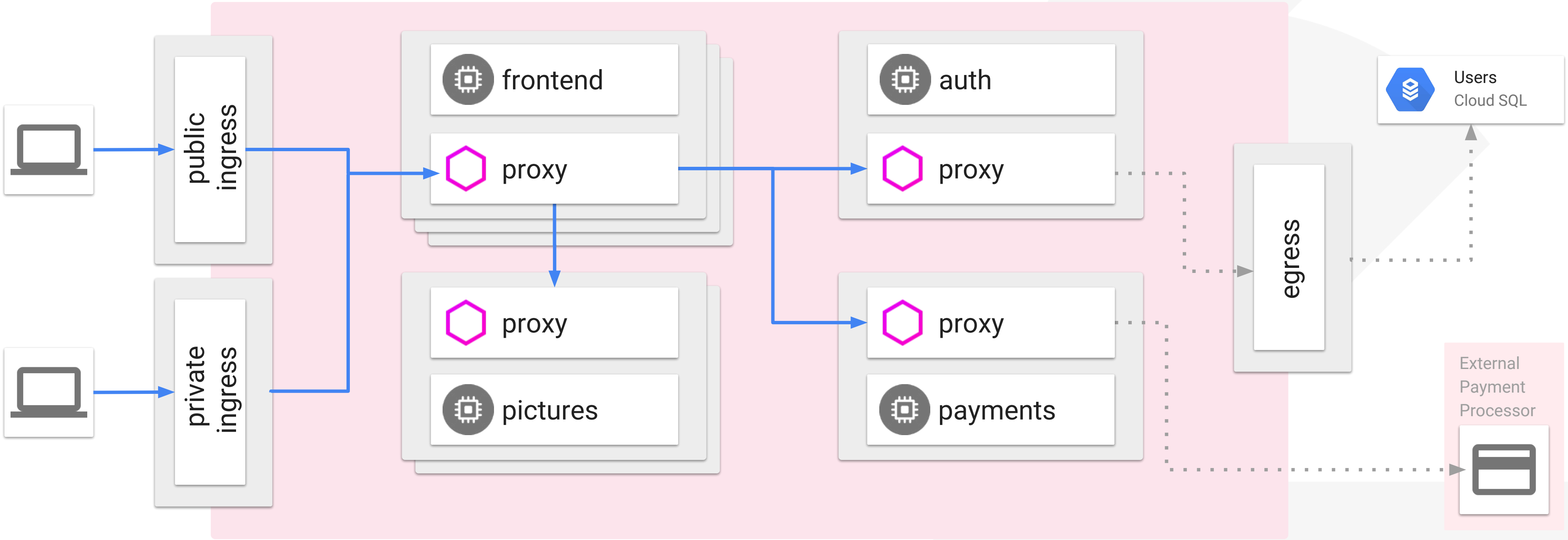
Ιστιο means “sail” in Greek

Istio: An open framework for connecting, securing, managing and monitoring services

Service architecture without Istio



Service architecture with Istio



Google Cloud

Istio in a single slide

Platform support: Kubernetes (Nomad, Mesos, Cloud Foundry)

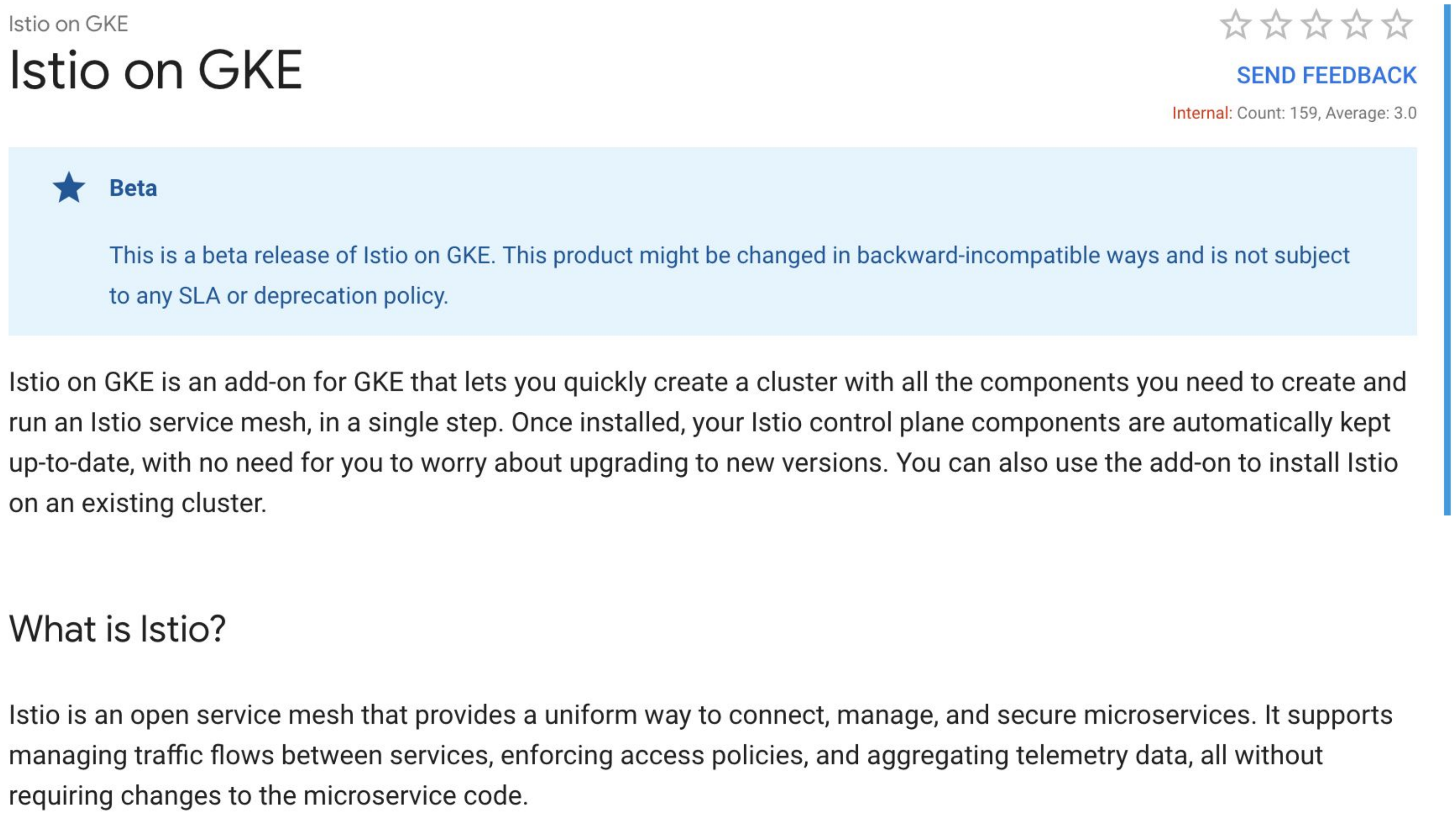
Current version: 1.0.6

Observability: Metrics, metrics query/visualization, trace spans, dependency visualisation

Service Identity & Security: Verifiable service identity, mutual auth

Traffic Management:

- Dynamic traffic control
- Ingress/egress routing
- Timeouts, retries and fault injection
- Policy enforcement and quote management



Istio on GKE

Istio on GKE

☆☆☆☆☆

SEND FEEDBACK

Internal: Count: 159, Average: 3.0

★ **Beta**

This is a beta release of Istio on GKE. This product might be changed in backward-incompatible ways and is not subject to any SLA or deprecation policy.

Istio on GKE is an add-on for GKE that lets you quickly create a cluster with all the components you need to create and run an Istio service mesh, in a single step. Once installed, your Istio control plane components are automatically kept up-to-date, with no need for you to worry about upgrading to new versions. You can also use the add-on to install Istio on an existing cluster.

What is Istio?

Istio is an open service mesh that provides a uniform way to connect, manage, and secure microservices. It supports managing traffic flows between services, enforcing access policies, and aggregating telemetry data, all without requiring changes to the microservice code.

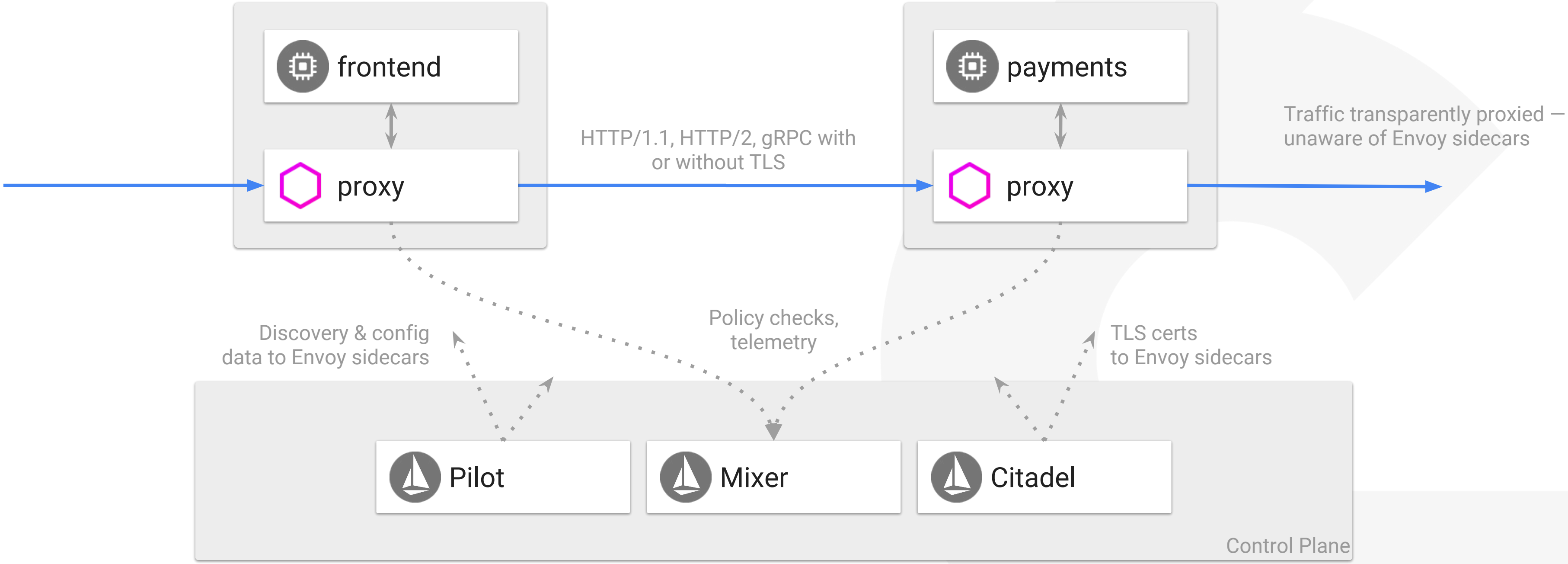
```
$ gcloud beta container clusters create istio-demo \
    --addons=Istio --istio-config=auth=MTLS_STRICT \
    --cluster-version=latest \
    --machine-type=n1-standard-2 \
    --num-nodes=4

Creating cluster istio-demo in europe-west4-a
Created[https://container.googleapis.com/v1beta1/projects/istio-project2517/zones/europe-west4-a/clus
ters/istio-demo]
NAME        LOCATION        MASTER_VERSION  MASTER_IP     MACHINE_TYPE   NODE_VERSION  NUM_NODES  STATUS
istio-demo  europe-west4-a  1.12.5-gke.5    35.204.5.121  n1-standard-2  1.12.5-gke.5  4          RUNNING
```

```
$ kubectl create clusterrolebinding cluster-admin-binding \
    --clusterrole=cluster-admin \
    --user=$(gcloud config get-value core/account)

clusterrolebinding "cluster-admin-binding" created
```

Building Blocks

Envoy, Mixer, Pilot, Citadel

Istio Architecture

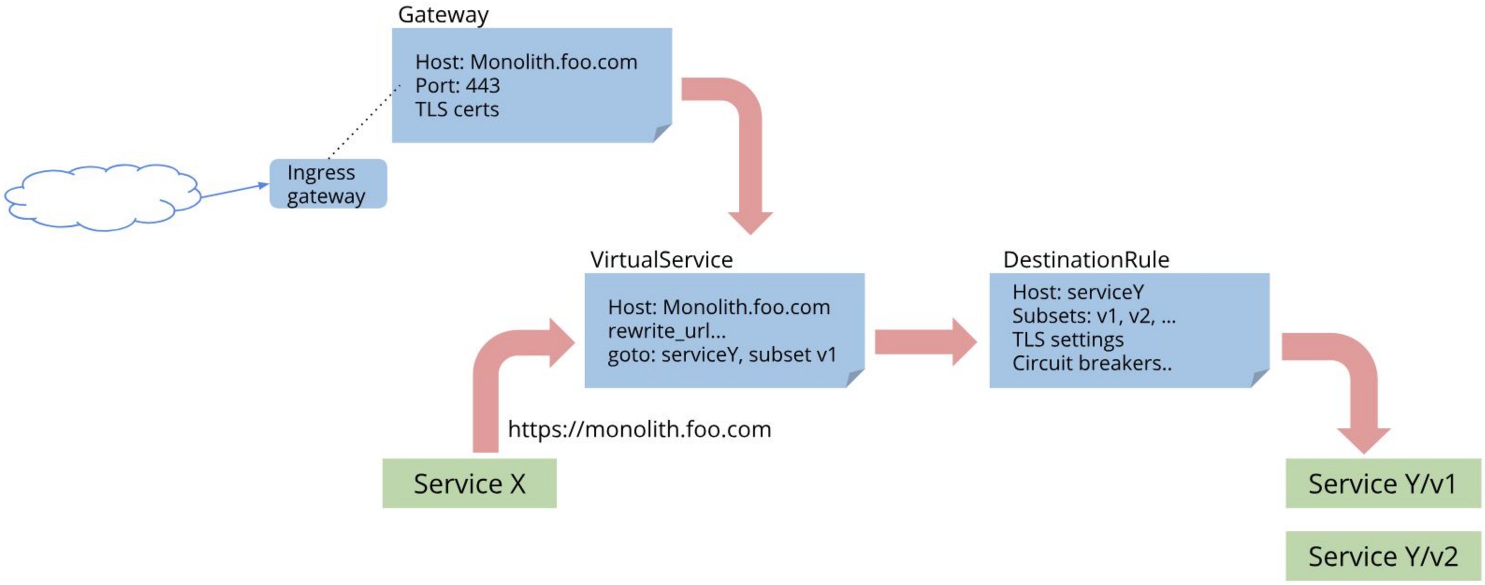


Demo: Deploy App

Routing API

04

Istio Routing



Gateway

Host: Monolith.foo.com
Port: 443
TLS certs

Ingress gateway

VirtualService

Host: Monolith.foo.com
rewrite_url...
goto: serviceY, subset v1

DestinationRule

Host: serviceY
Subsets: v1, v2, ...
TLS settings
Circuit breakers..

https://monolith.foo.com

Service X

Service Y/v1

Service Y/v2

Relationship between different v1alpha3 elements

Add-ons

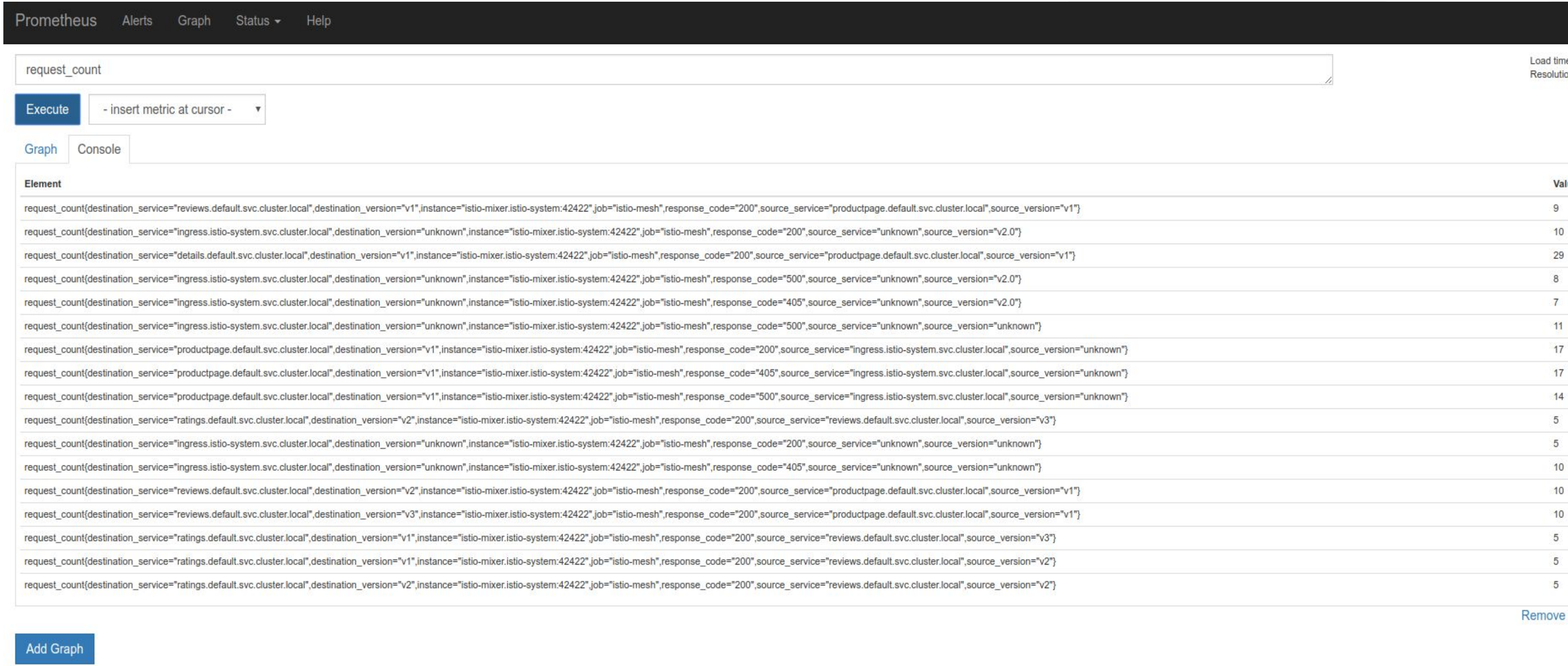
Prometheus, Grafana, Jaeger/Zipkin, ServiceGraph

05

Install Prometheus

```
$ curl
https://storage.googleapis.com/gke-release/istio/release/1.0.3-gke.3/patches/instal
l-prometheus.yaml | kubectl apply -n istio-system -f -

service "prometheus" created
deployment.extensions "prometheus" created

$ kubectl get svc prometheus -n istio-system
NAME          TYPE         CLUSTER-IP     EXTERNAL-IP   PORT(S)
AGE
prometheus    ClusterIP    10.31.250.92   <none>        9090/TCP
```

Prometheus: Query metrics



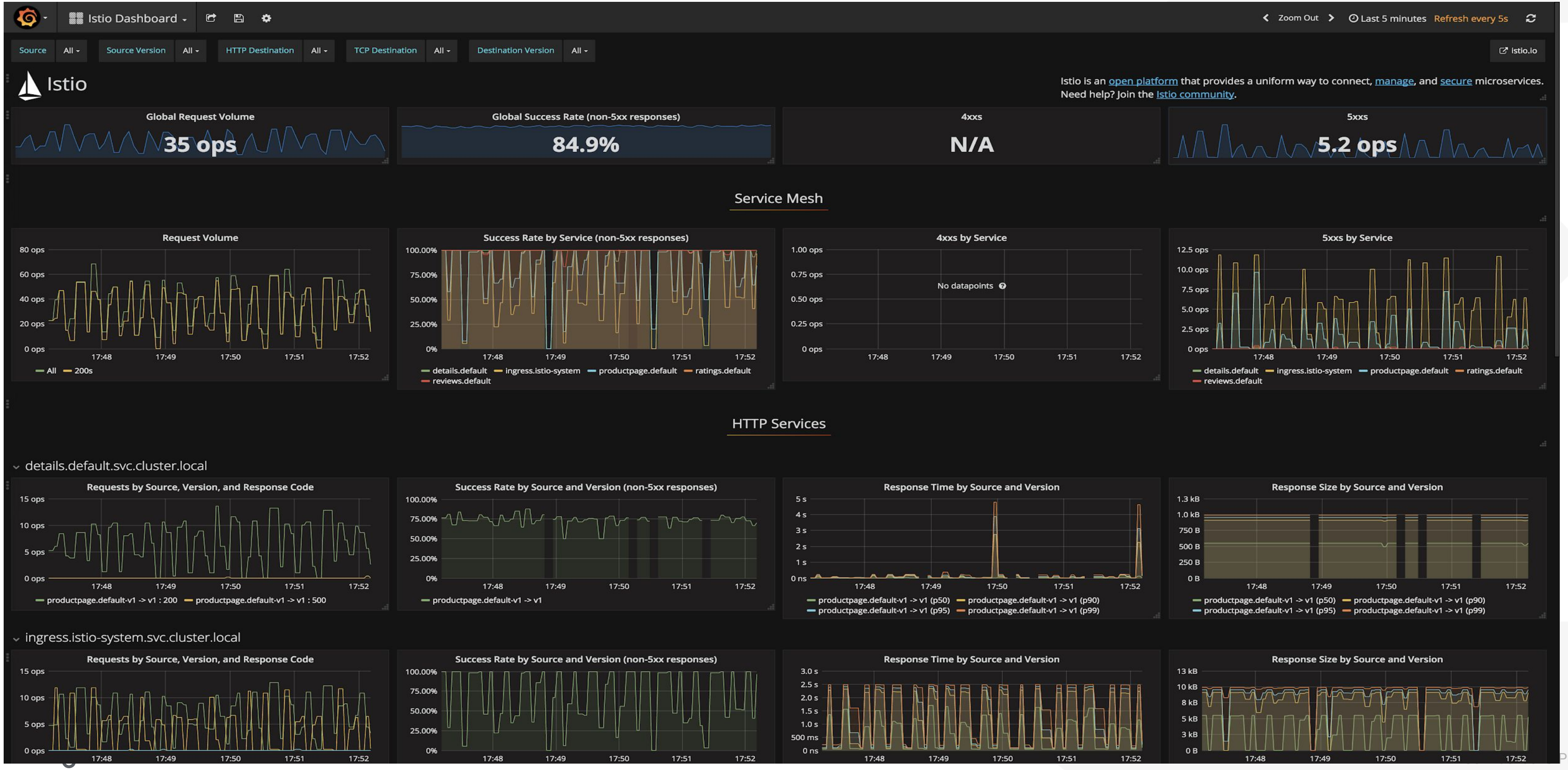
request_count

Element	Val
request_count{destination_service="reviews.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="productpage.default.svc.cluster.local",source_version="v1"}	9
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="unknown",source_version="v2.0"}	10
request_count{destination_service="details.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="productpage.default.svc.cluster.local",source_version="v1"}	29
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="500",source_service="unknown",source_version="v2.0"}	8
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="405",source_service="unknown",source_version="v2.0"}	7
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="500",source_service="unknown",source_version="unknown"}	11
request_count{destination_service="productpage.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="ingress.istio-system.svc.cluster.local",source_version="unknown"}	17
request_count{destination_service="productpage.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="405",source_service="ingress.istio-system.svc.cluster.local",source_version="unknown"}	17
request_count{destination_service="productpage.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="500",source_service="ingress.istio-system.svc.cluster.local",source_version="unknown"}	14
request_count{destination_service="ratings.default.svc.cluster.local",destination_version="v2",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="reviews.default.svc.cluster.local",source_version="v3"}	5
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="unknown",source_version="unknown"}	5
request_count{destination_service="ingress.istio-system.svc.cluster.local",destination_version="unknown",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="405",source_service="unknown",source_version="unknown"}	10
request_count{destination_service="reviews.default.svc.cluster.local",destination_version="v2",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="productpage.default.svc.cluster.local",source_version="v1"}	10
request_count{destination_service="reviews.default.svc.cluster.local",destination_version="v3",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="productpage.default.svc.cluster.local",source_version="v1"}	10
request_count{destination_service="ratings.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="reviews.default.svc.cluster.local",source_version="v3"}	5
request_count{destination_service="ratings.default.svc.cluster.local",destination_version="v1",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="reviews.default.svc.cluster.local",source_version="v2"}	5
request_count{destination_service="ratings.default.svc.cluster.local",destination_version="v2",instance="istio-mixer.istio-system:42422",job="istio-mesh",response_code="200",source_service="reviews.default.svc.cluster.local",source_version="v2"}	5

Install Grafana

```
$ curl
https://storage.googleapis.com/gke-release/istio/release/1.0.3-gke.3/patches/instal
l-grafana.yaml | kubectl apply -n istio-system -f -

service "grafana" created
deployment.extensions "grafana" created

$ kubectl get svc grafana -n istio-system
NAME          TYPE         CLUSTER-IP     EXTERNAL-IP   PORT(S)
AGE
grafana   ClusterIP   10.31.251.158   <none>        3000/TCP
```

Grafana: Visualize metrics



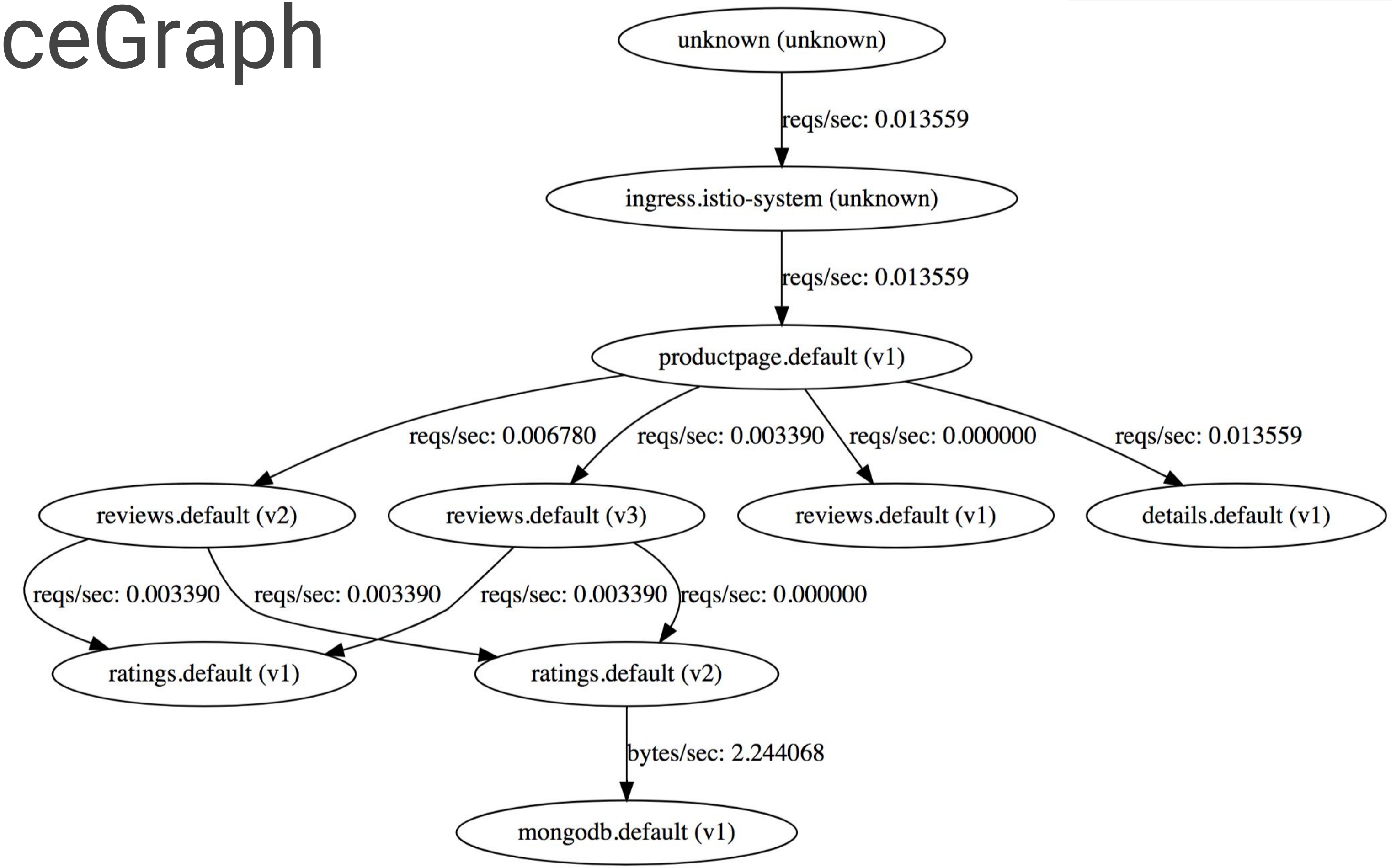
Istio is an open platform that provides a uniform way to connect, manage, and secure microservices.
Need help? Join the Istio community.

Istio Dashboard
Zoom Out
Last 5 minutes
Refresh every 5s
Source
All
Source Version
All
HTTP Destination
All
TCP Destination
All
Destination Version
All
istio.io
Istio
Global Request Volume
35 ops
Global Success Rate (non-5xx responses)
84.9%
4xxs
N/A
5xxs
5.2 ops
Service Mesh
Request Volume
80 ops
60 ops
40 ops
20 ops
0 ops
17:48
17:49
17:50
17:51
17:52
All
200s
Success Rate by Service (non-5xx responses)
100.00%
75.00%
50.00%
25.00%
0%
details.default
ingress.istio-system
productpage.default
ratings.default
reviews.default
4xxs by Service
1.00 ops
0.75 ops
0.50 ops
0.25 ops
0 ops
No datapoints
5xxs by Service
12.5 ops
10.0 ops
7.5 ops
5.0 ops
2.5 ops
0 ops
details.default
ingress.istio-system
productpage.default
ratings.default
reviews.default
HTTP Services
details.default.svc.cluster.local
Requests by Source, Version, and Response Code
15 ops
10 ops
5 ops
0 ops
productpage.default-v1 -> v1 : 200
productpage.default-v1 -> v1 : 500
Success Rate by Source and Version (non-5xx responses)
productpage.default-v1 -> v1
Response Time by Source and Version
5 s
4 s
3 s
2 s
1 s
0 ns
productpage.default-v1 -> v1 (p50)
productpage.default-v1 -> v1 (p90)
productpage.default-v1 -> v1 (p95)
productpage.default-v1 -> v1 (p99)
Response Size by Source and Version
1.3 kB
1.0 kB
750 B
500 B
250 B
0 B
productpage.default-v1 -> v1 (p50)
productpage.default-v1 -> v1 (p90)
productpage.default-v1 -> v1 (p95)
productpage.default-v1 -> v1 (p99)
ingress.istio-system.svc.cluster.local
Requests by Source, Version, and Response Code
15 ops
10 ops
5 ops
0 ops
Success Rate by Source and Version (non-5xx responses)
100.00%
75.00%
50.00%
25.00%
0%
Response Time by Source and Version
3.0 s
2.5 s
2.0 s
1.5 s
1.0 s
500 ms
0 ns
Response Size by Source and Version
13 kB
10 kB
8 kB
5 kB
3 kB
0 B

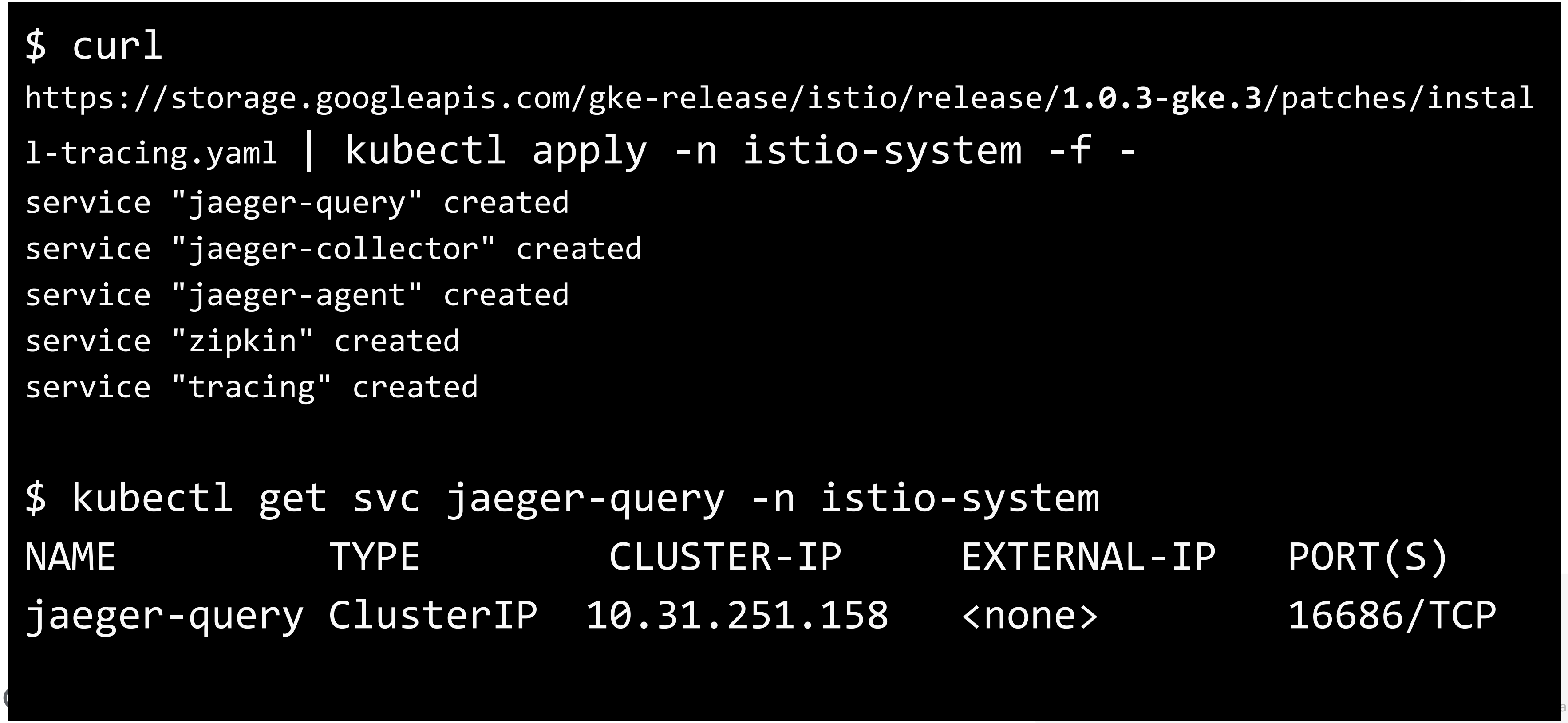
Install ServiceGraph

```
$ curl
https://storage.googleapis.com/gke-release/istio/release/1.0.3-gke.3/patches/instal
l-servicegraph.yaml | kubectl apply -n istio-system -f -

service "servicegraph" created
deployment.extensions "servicegraph" created

$ kubectl get svc servicegraph -n istio-system
NAME        TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)
servicegraph ClusterIP   10.31.251.158   <none>        8088/TCP
```

ServiceGraph

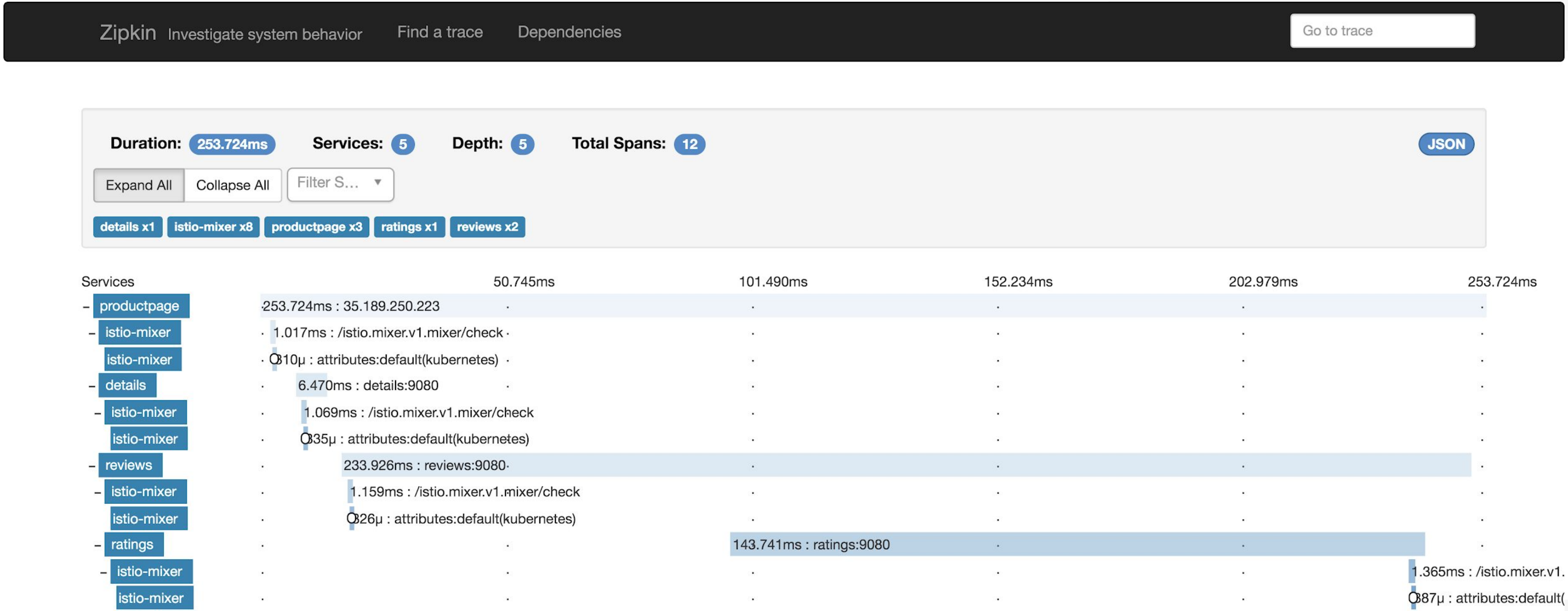


Install Tracing (Jaeger, Zipkin)



```
$ curl
https://storage.googleapis.com/gke-release/istio/release/1.0.3-gke.3/patches/instal
l-tracing.yaml | kubectl apply -n istio-system -f -
service "jaeger-query" created
service "jaeger-collector" created
service "jaeger-agent" created
service "zipkin" created
service "tracing" created

$ kubectl get svc jaeger-query -n istio-system
NAME         TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)
jaeger-query ClusterIP  10.31.251.158   <none>        16686/TCP
```

Jaeger/Zipkin: Tracing



Duration: 253.724ms Services: 5 Depth: 5 Total Spans: 12

details x1 istio-mixer x8 productpage x3 ratings x1 reviews x2

```
Services                50.745ms   101.490ms   152.234ms   202.979ms   253.724ms
- productpage           253.724ms : 35.189.250.223
 - istio-mixer          1.017ms : /istio.mixer.v1.mixer/check
   istio-mixer          310μ : attributes:default(kubernetes)
 - details              6.470ms : details:9080
  - istio-mixer         1.069ms : /istio.mixer.v1.mixer/check
    istio-mixer         335μ : attributes:default(kubernetes)
 - reviews              233.926ms : reviews:9080
  - istio-mixer         1.159ms : /istio.mixer.v1.mixer/check
    istio-mixer         326μ : attributes:default(kubernetes)
  - ratings             143.741ms : ratings:9080
   - istio-mixer        1.365ms : /istio.mixer.v1.
     istio-mixer        387μ : attributes:default(
```

Demo: Show add-ons

Traffic Management

Request Routing, Discovery & Load Balancing, Failure Recovery, Fault Injection

06

Google Cloud

Traffic Management

Istio’s traffic management decouples traffic flow from infrastructure

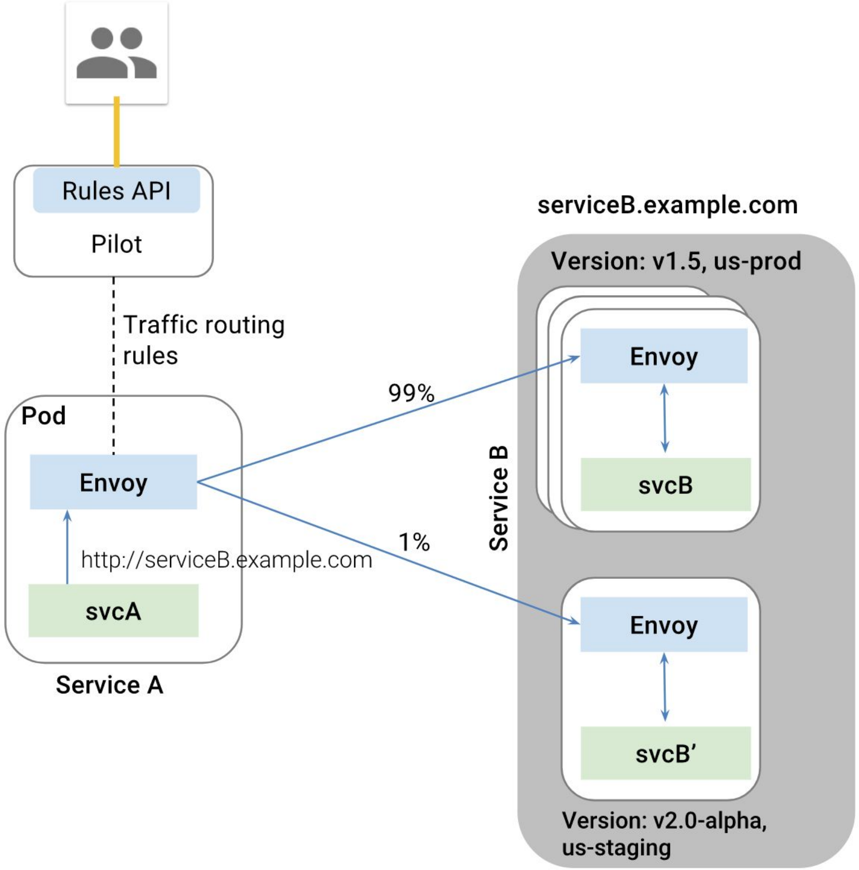
Discovery & load balancing across services

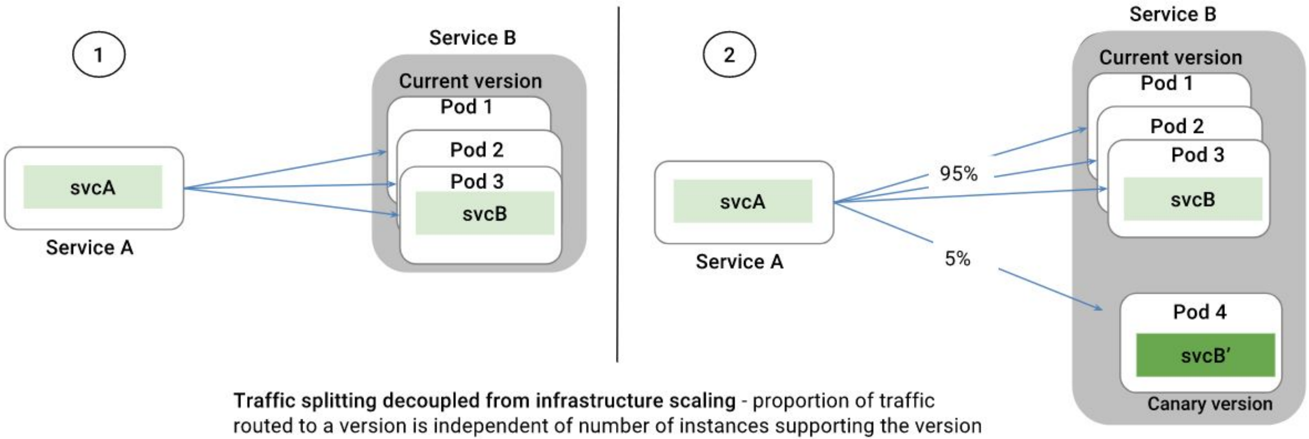
Dynamic request routing for A/B testing, gradual rollouts, canary releases

Failure recovery using timeouts, retries, and circuit breakers

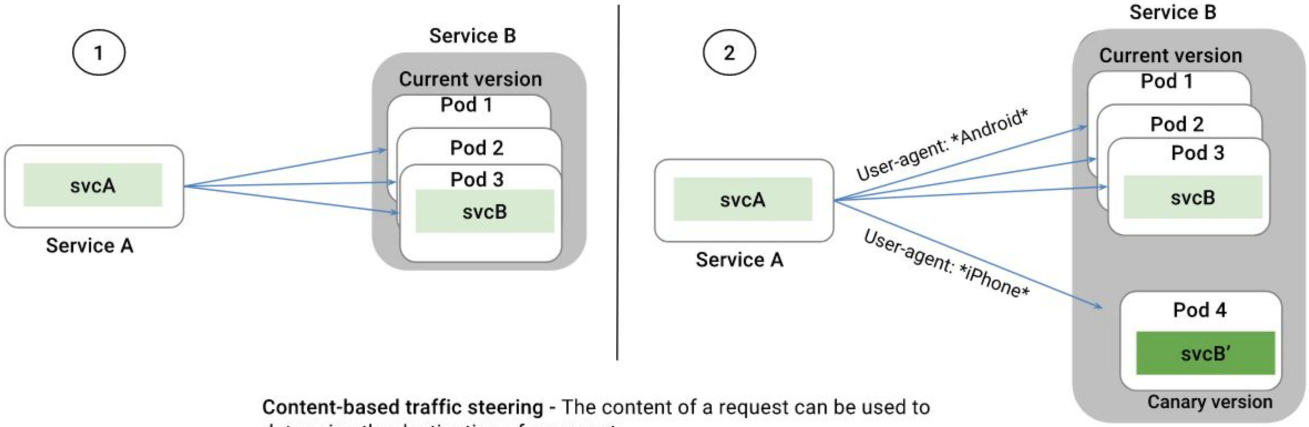
Fault injection to test the compatibility of recovery policies across services

Request Routing





Traffic splitting decoupled from infrastructure scaling - proportion of traffic routed to a version is independent of number of instances supporting the version



Content-based traffic steering - The content of a request can be used to determine the destination of a request

Failure Handling

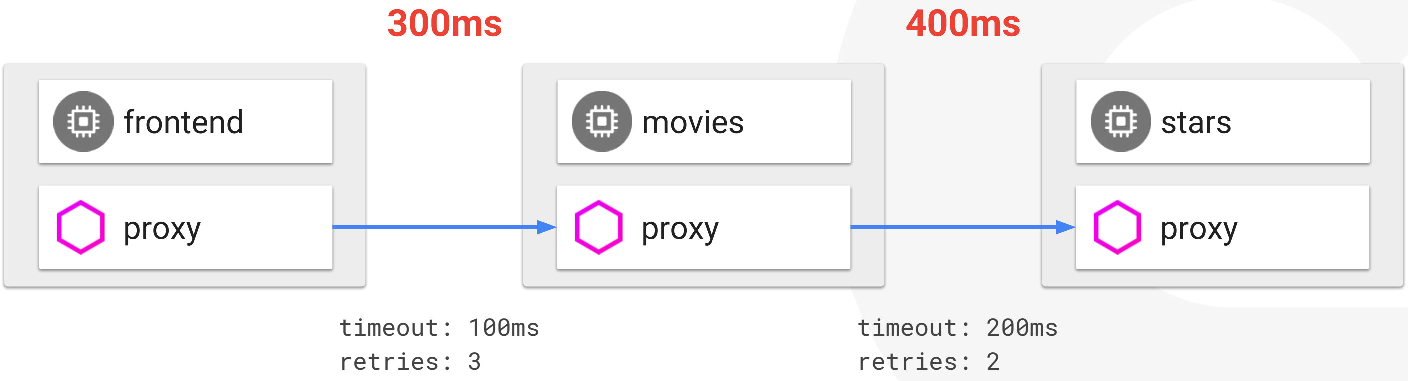
Out-of-the-box opt-in failure recovery features such as:

- Default **timeout** for HTTP requests is 15 seconds but configurable
- The number of **retries** for a given HTTP request
- **Limits** on number of concurrent connections
- **Circuit breakers** can be set based on a number of criteria such as connection and request limits

Fault Injection

The faults can be either delays or aborts. Examples:

- 5 second delay in 10% of the requests to the “v1” version of the service
- Return HTTP 400 error for 10% of the requests to the service “v1”



Demo: Traffic Management

Thank you!

Mete Atamel

@meteatamel

https://codelabs.developers.google.com/codelabs/cloud-istio-aspnetcore-part1
https://codelabs.developers.google.com/codelabs/cloud-istio-aspnetcore-part2

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