Service Mesh in a Nutshell

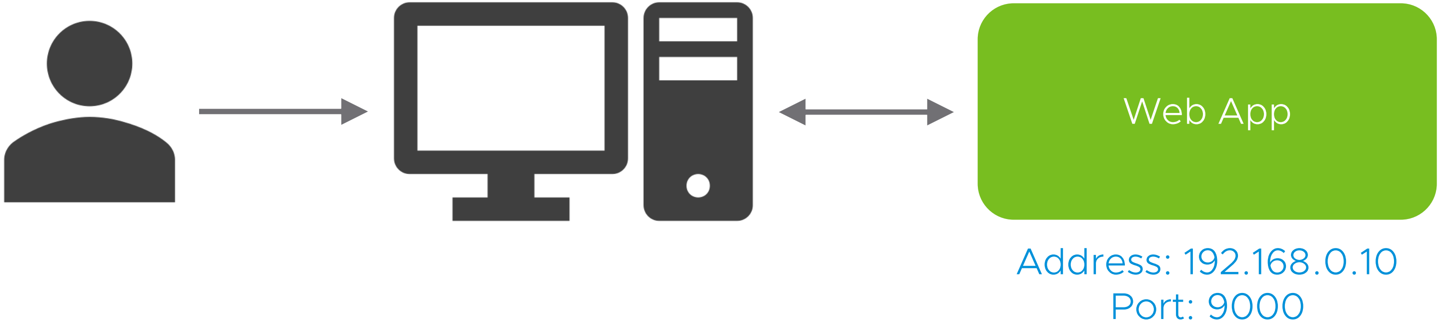
Open Source Summit NA 2019

Venil Noronha

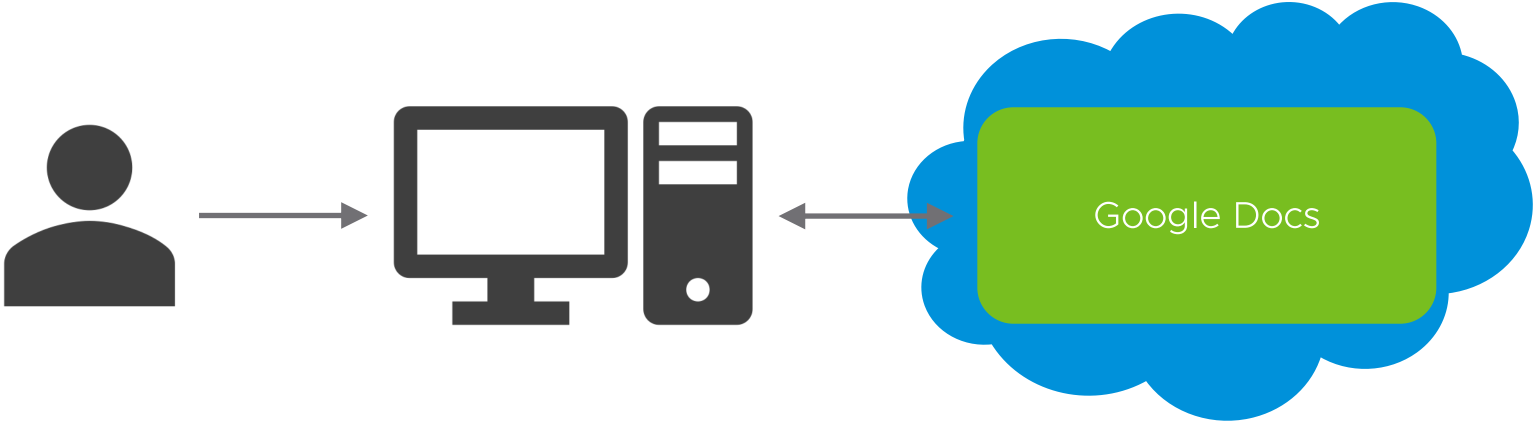
Open Source Technology Center, VMware

Software as a Service

Software as a Service

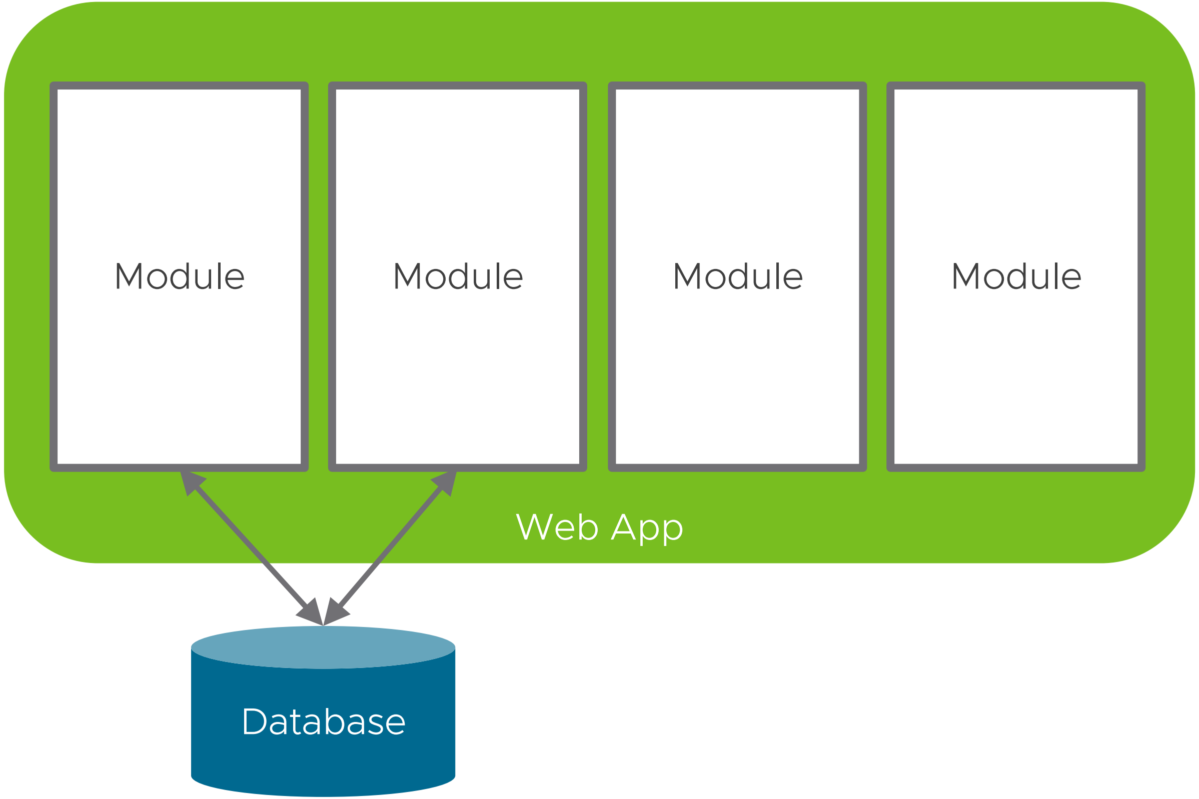

Web App
Address: 192.168.0.10
Port: 9000

Software as a Service

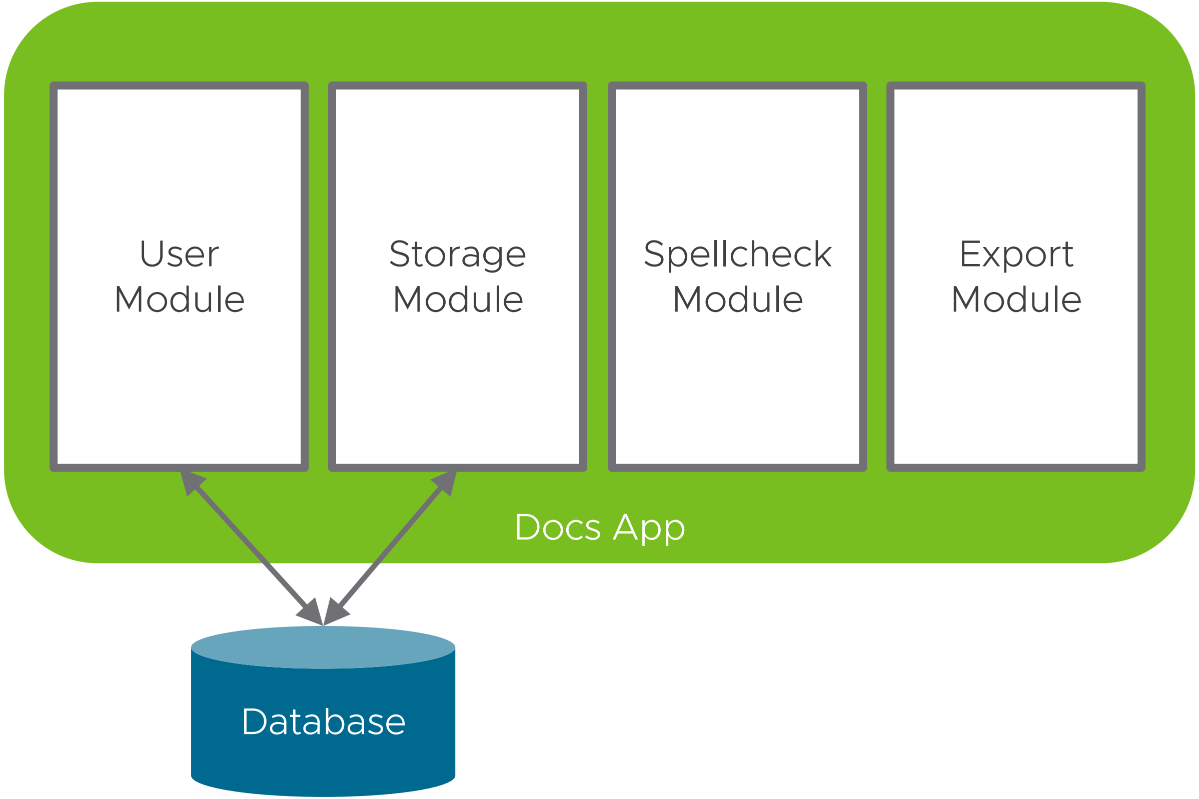

Google Docs

Address: docs.google.com
Port: 80

A Monolithic Web App


Module
Module
Module
Module
Web App
Database

A Monolithic Web App


User Module
Storage Module
Spellcheck Module
Export Module
Docs App
Database

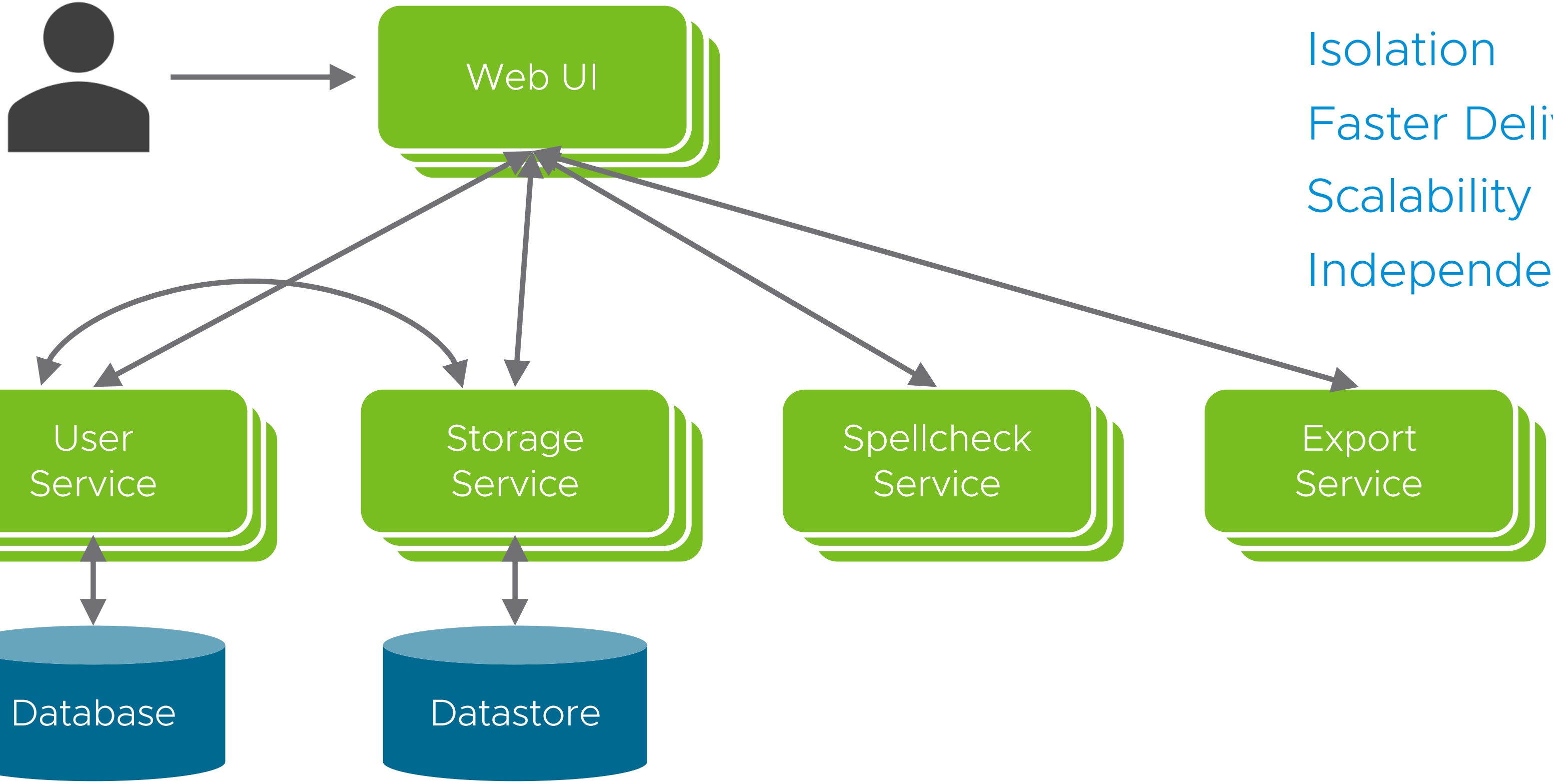
Overall Failure

Slow Delivery

Bounded Scaling

Technology Lock-In

The Microservices Architecture


Web UI
User Service
Storage Service
Spellcheck Service
Export Service
Database
Datastore

Isolation

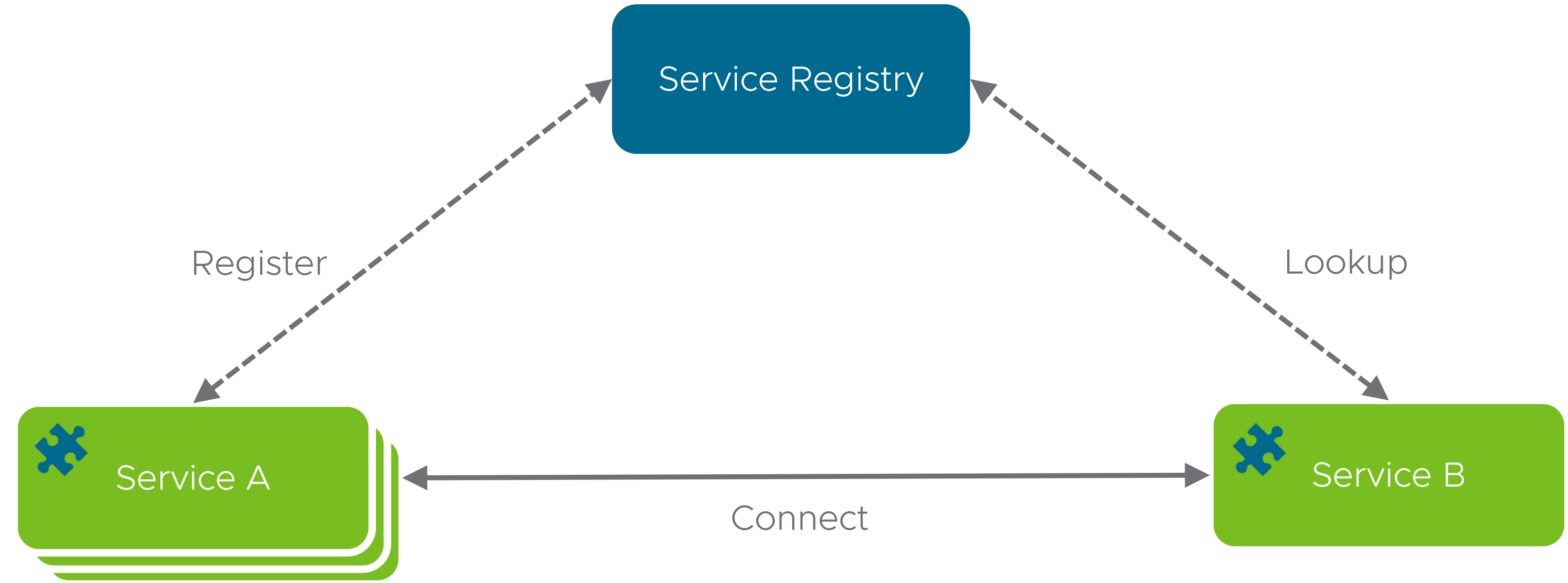
Faster Delivery

Scalability

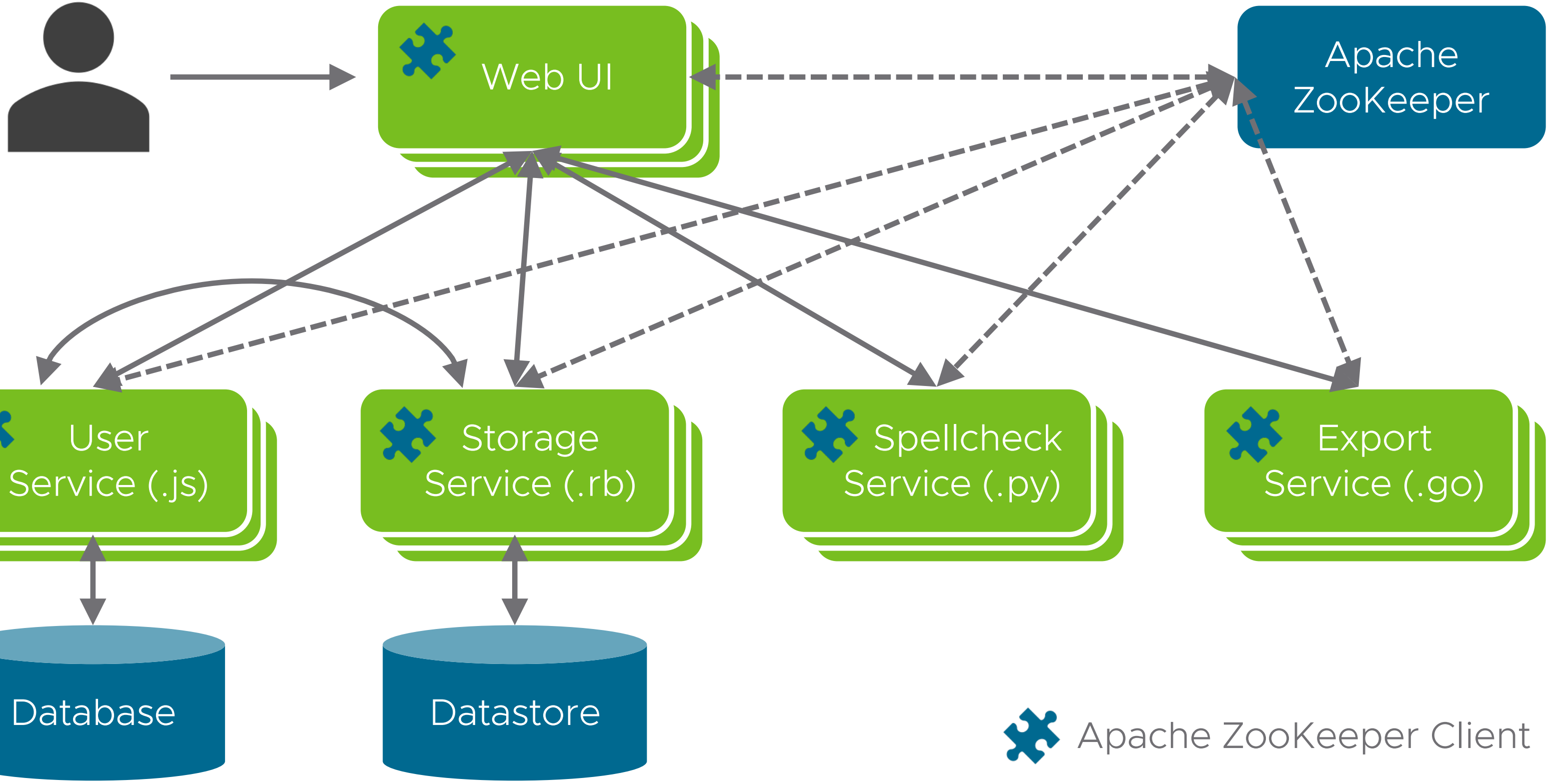
Independence

Service Discovery

Service Discovery & Management Library


Service Registry
Register
Lookup
Service A
Connect
Service B

The Microservices Architecture


Web UI
Apache ZooKeeper
User Service (.js)
Storage Service (.rb)
Spellcheck Service (.py)
Export Service (.go)
Database
Datastore

🧩 Apache ZooKeeper Client

Challenges with Microservices

Canary Deployments

Rate Limiting

Blue Green Deployments

Distributed Tracing

Service Discovery

Failure Testing

Load Balancing

Retries

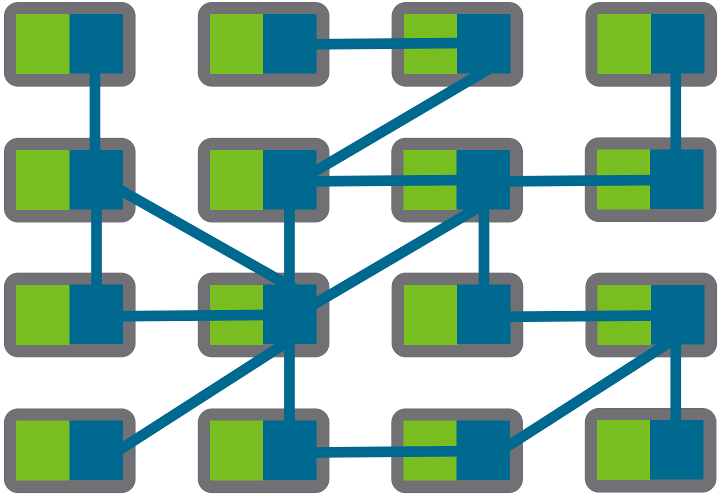
Monitoring

Circuit Breaking

Service Graphs

What is a Service Mesh?

- Dedicated infrastructure layer
- Handles service-to-service communication
- Manages complex topology of services
- Array of lightweight network proxies
- Deployed alongside application code
- Doesn’t need the application to be aware



Service Mesh Implementations

Data Plane

envoy

PROJECT CALICO

træfik

CONDUIT

Kong

HashiCorp Consul

cilium

HAPROXY

NGINX

nginMesh

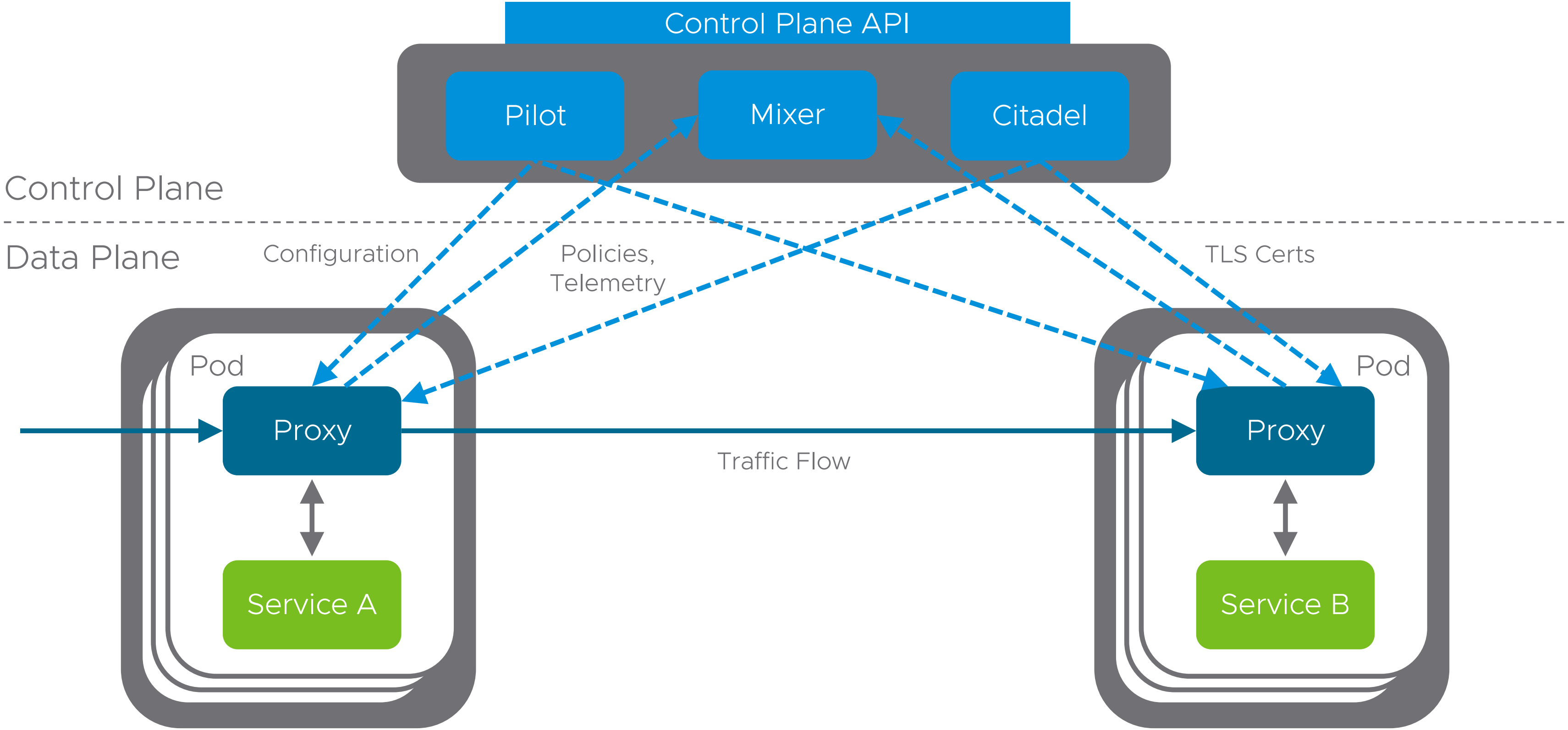
Control Plane

Istio

linkerd

Ambassador

Istio Architecture


Control Plane API
Pilot
Mixer
Citadel
Control Plane
Data Plane
Configuration
Policies,
Telemetry
TLS Certs
Pod
Proxy
Service A
Traffic Flow
Pod
Proxy
Service B

Benefits of a Service Mesh

Discoverable

Services can find each other

Resilient

Built-in robustness frameworks, load balancing & test infrastructure

Configurable

Configure services dynamically at runtime

Observable

Standardized metrics, logging, monitoring & distributed tracing

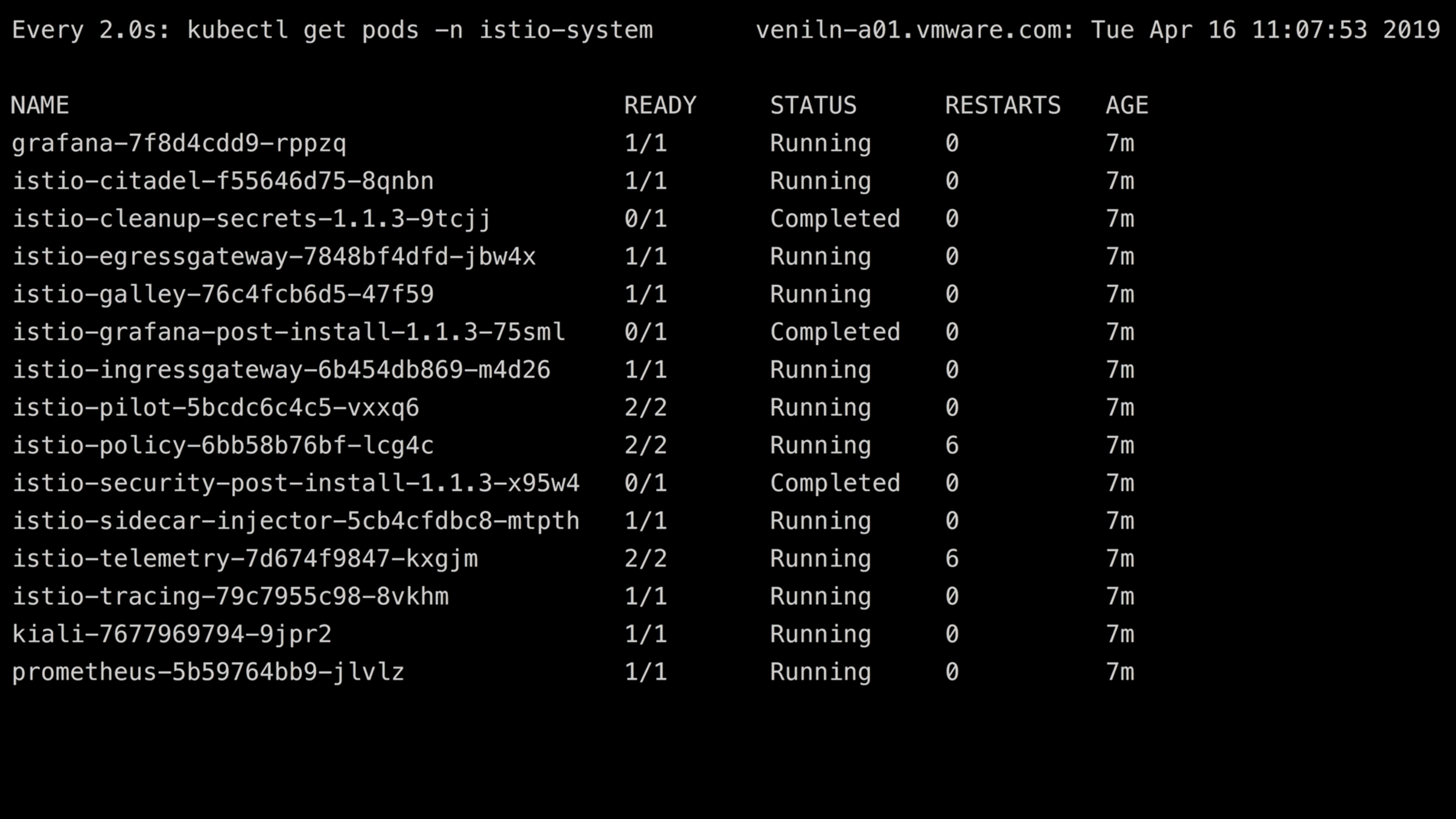
Secure

Encrypt and protect service communication

Istio Demo

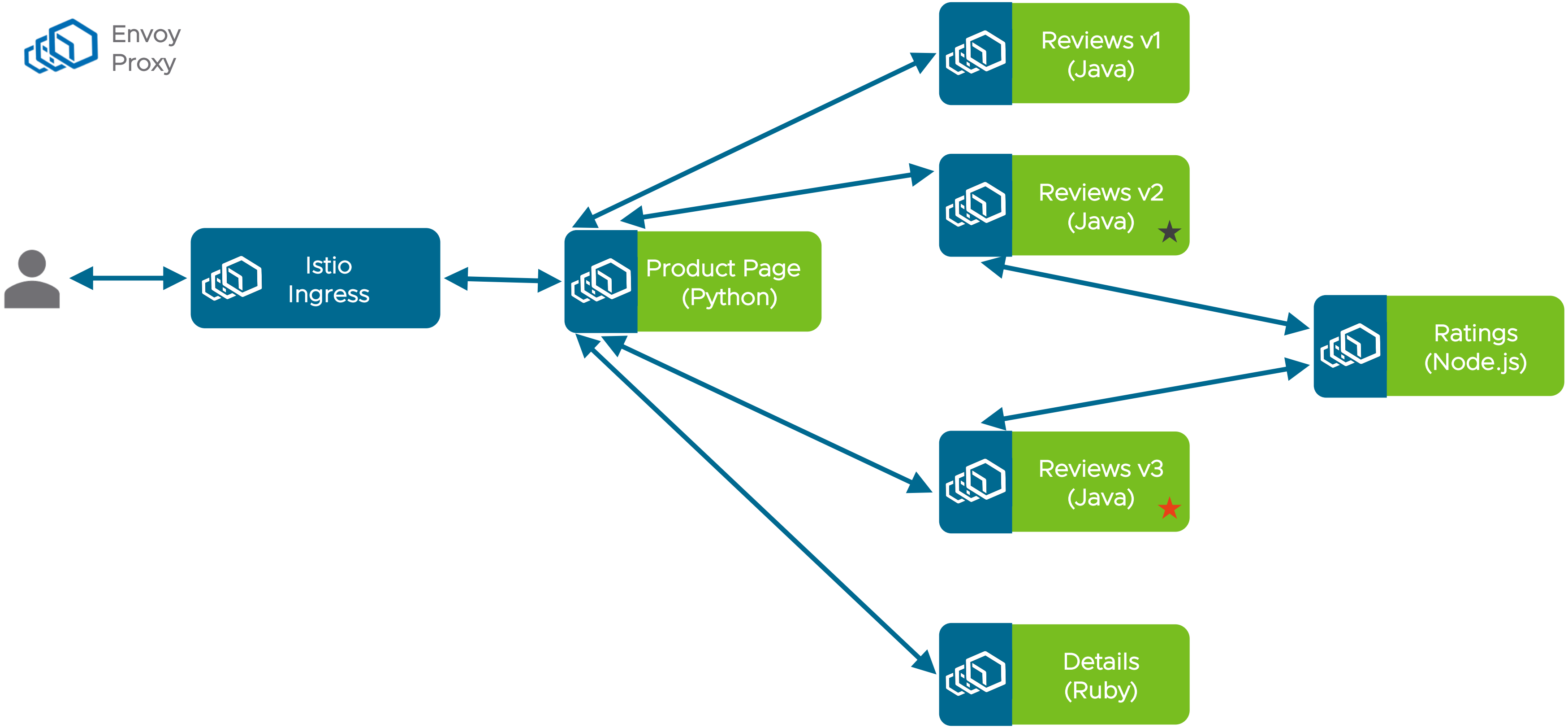
- Kubernetes Setup
- Istio Setup
- Bookinfo Sample
- Request Routing
- Metrics Dashboard
- Distributed Tracing
- Service Graph

```
$ make start-minikube
minikube start --bootstrapper=kubeadm \
               --memory=8192 \
               --cpus=4 \
               --kubernetes-version=v1.10.0 \
               --vm-driver=virtualbox
There is a newer version of minikube available (v1.0.0).  Download it
 here:
https://github.com/kubernetes/minikube/releases/tag/v1.0.0

To disable this notification, run the following:
minikube config set WantUpdateNotification false
Starting local Kubernetes v1.10.0 cluster...
Starting VM...
Downloading Minikube ISO
 120.92 MB / 153.08 MB [==========================>-------]  78.99% 9s
```



```
Every 2.0s: kubectl get pods -n istio-system       veniln-a01.vmware.com: Tue Apr 16 11:07:53 2019

NAME                                      READY     STATUS      RESTARTS   AGE
grafana-7f8d4cdd9-rppzq                   1/1       Running     0          7m
istio-citadel-f55646d75-8qnbn             1/1       Running     0          7m
istio-cleanup-secrets-1.1.3-9tcjj         0/1       Completed   0          7m
istio-egressgateway-7848bf4dfd-jbw4x      1/1       Running     0          7m
istio-galley-76c4fcb6d5-47f59             1/1       Running     0          7m
istio-grafana-post-install-1.1.3-75sml    0/1       Completed   0          7m
istio-ingressgateway-6b454db869-m4d26     1/1       Running     0          7m
istio-pilot-5bcdc6c4c5-vxxq6              2/2       Running     0          7m
istio-policy-6bb58b76bf-lcg4c             2/2       Running     6          7m
istio-security-post-install-1.1.3-x95w4   0/1       Completed   0          7m
istio-sidecar-injector-5cb4cfdbc8-mtpth   1/1       Running     0          7m
istio-telemetry-7d674f9847-kxgjm          2/2       Running     6          7m
istio-tracing-79c7955c98-8vkhm            1/1       Running     0          7m
kiali-7677969794-9jpr2                    1/1       Running     0          7m
prometheus-5b59764bb9-jlvlz               1/1       Running     0          7m
```

Bookinfo Architecture



Envoy Proxy

Istio Ingress

Product Page (Python)

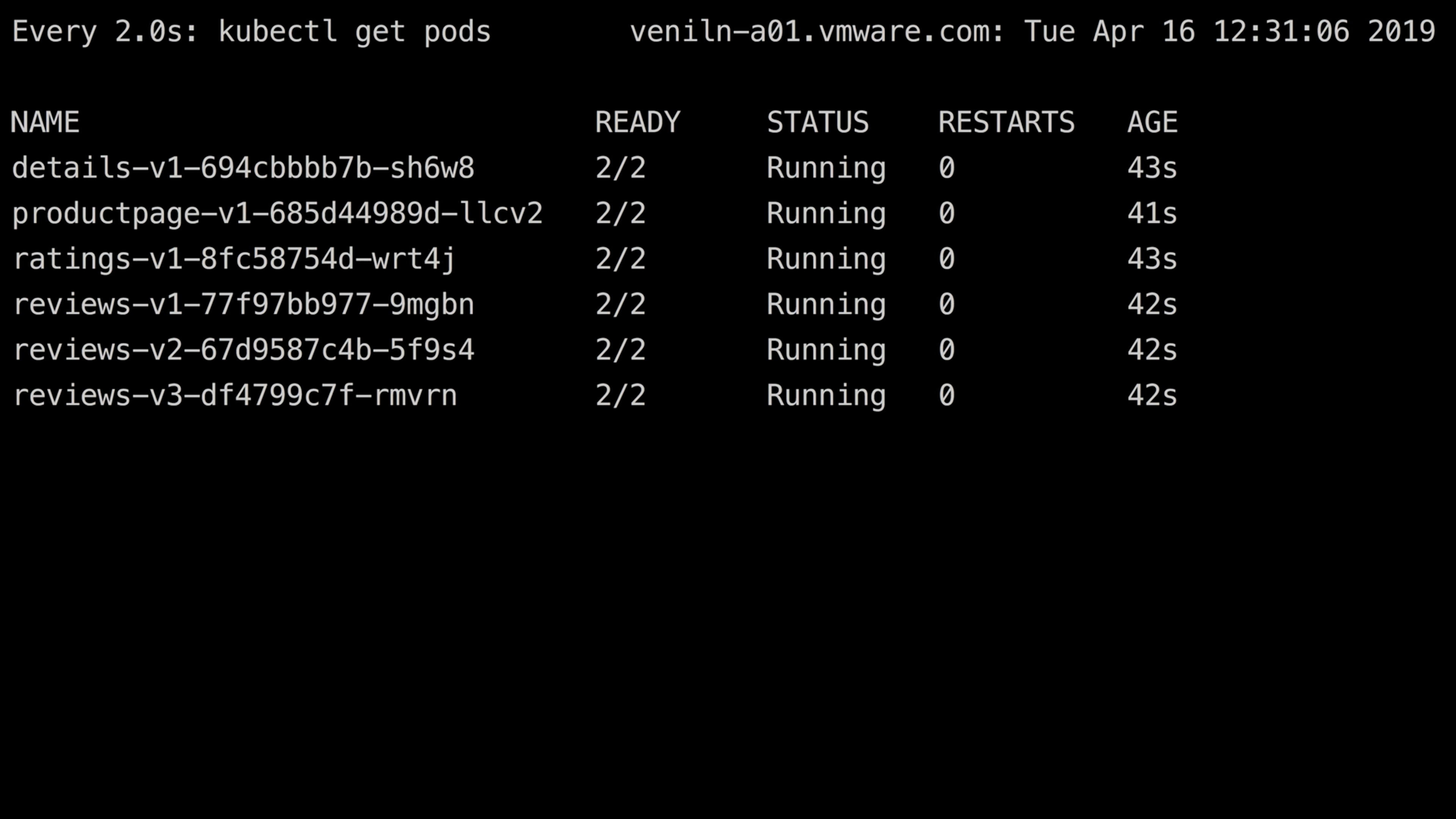
Reviews v1 (Java)

Reviews v2 (Java) ★

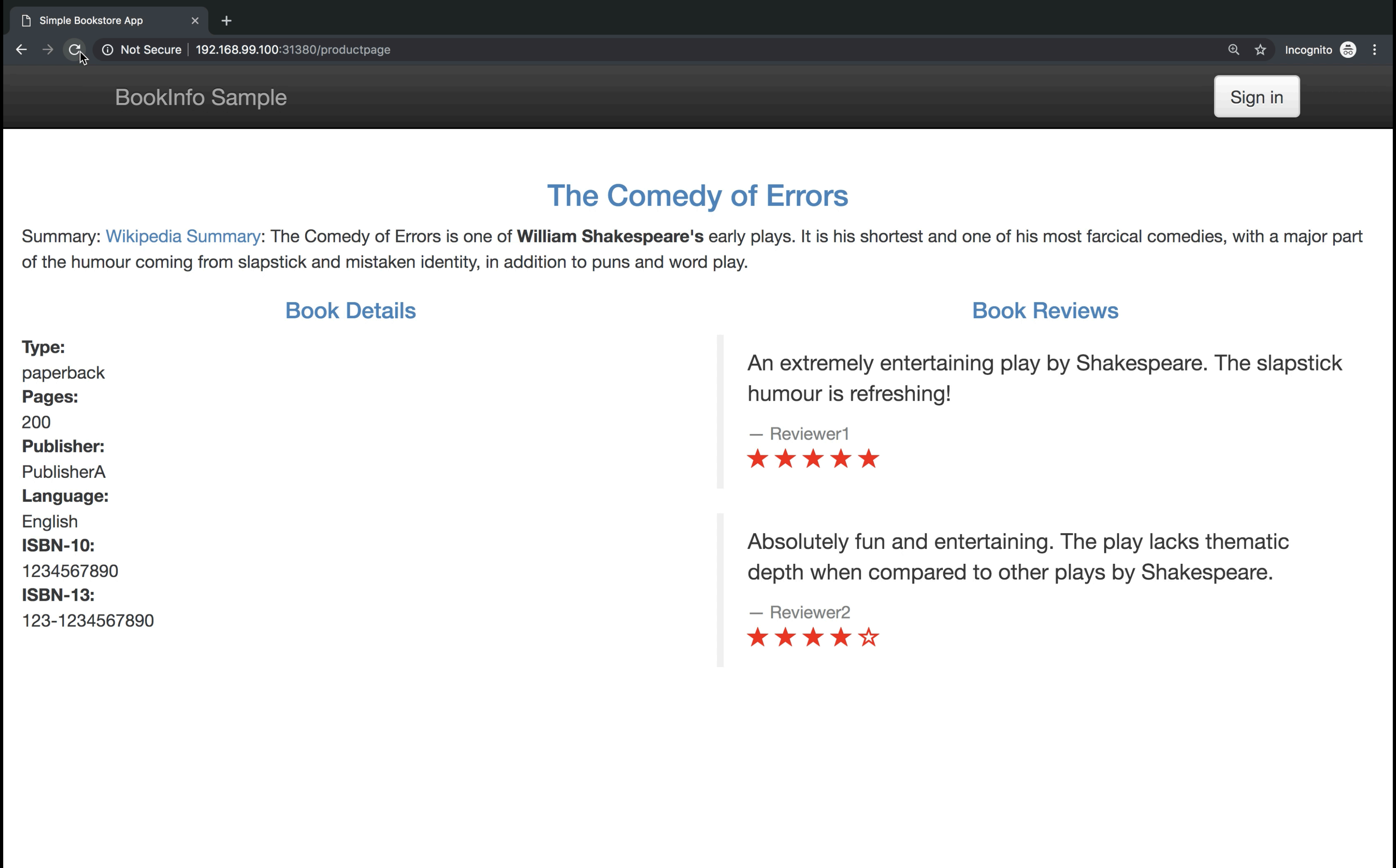
Reviews v3 (Java) ★

Ratings (Node.js)

Details (Ruby)



```
Every 2.0s: kubectl get pods        veniln-a01.vmware.com: Tue Apr 16 12:31:06 2019


NAME                              READY     STATUS    RESTARTS   AGE
details-v1-694cbbbb7b-sh6w8       2/2       Running   0          43s
productpage-v1-685d44989d-llcv2   2/2       Running   0          41s
ratings-v1-8fc58754d-wrt4j        2/2       Running   0          43s
reviews-v1-77f97bb977-9mgbn       2/2       Running   0          42s
reviews-v2-67d9587c4b-5f9s4       2/2       Running   0          42s
reviews-v3-df4799c7f-rmvrn        2/2       Running   0          42s
```


Simple Bookstore App
Not Secure
192.168.99.100:31380/productpage
Incognito
BookInfo Sample
Sign in

The Comedy of Errors

Summary: Wikipedia Summary: The Comedy of Errors is one of **William Shakespeare's** early plays. It is his shortest and one of his most farcical comedies, with a major part of the humour coming from slapstick and mistaken identity, in addition to puns and word play.

Book Details

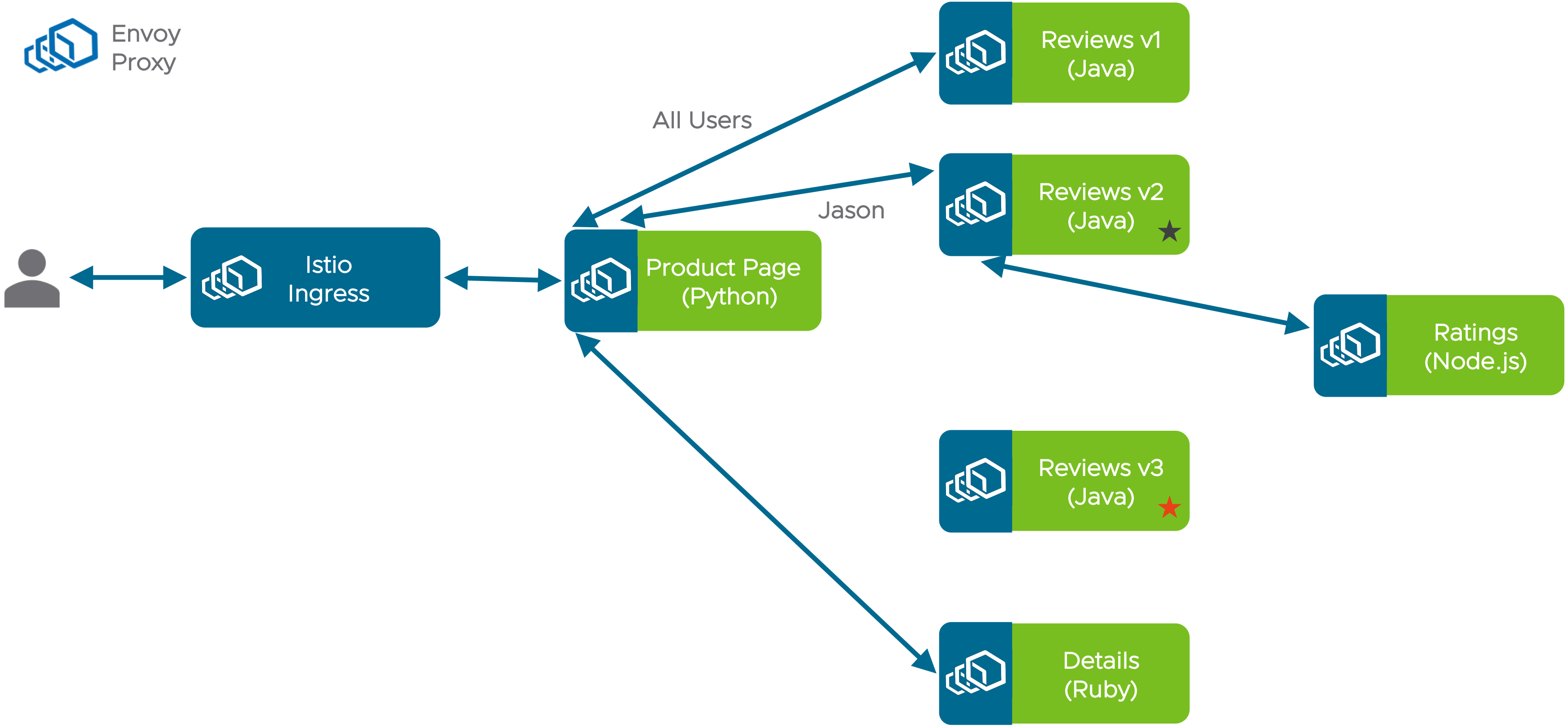
Type:
paperback
Pages:
200
Publisher:
PublisherA
Language:
English
ISBN-10:
1234567890
ISBN-13:
123-1234567890

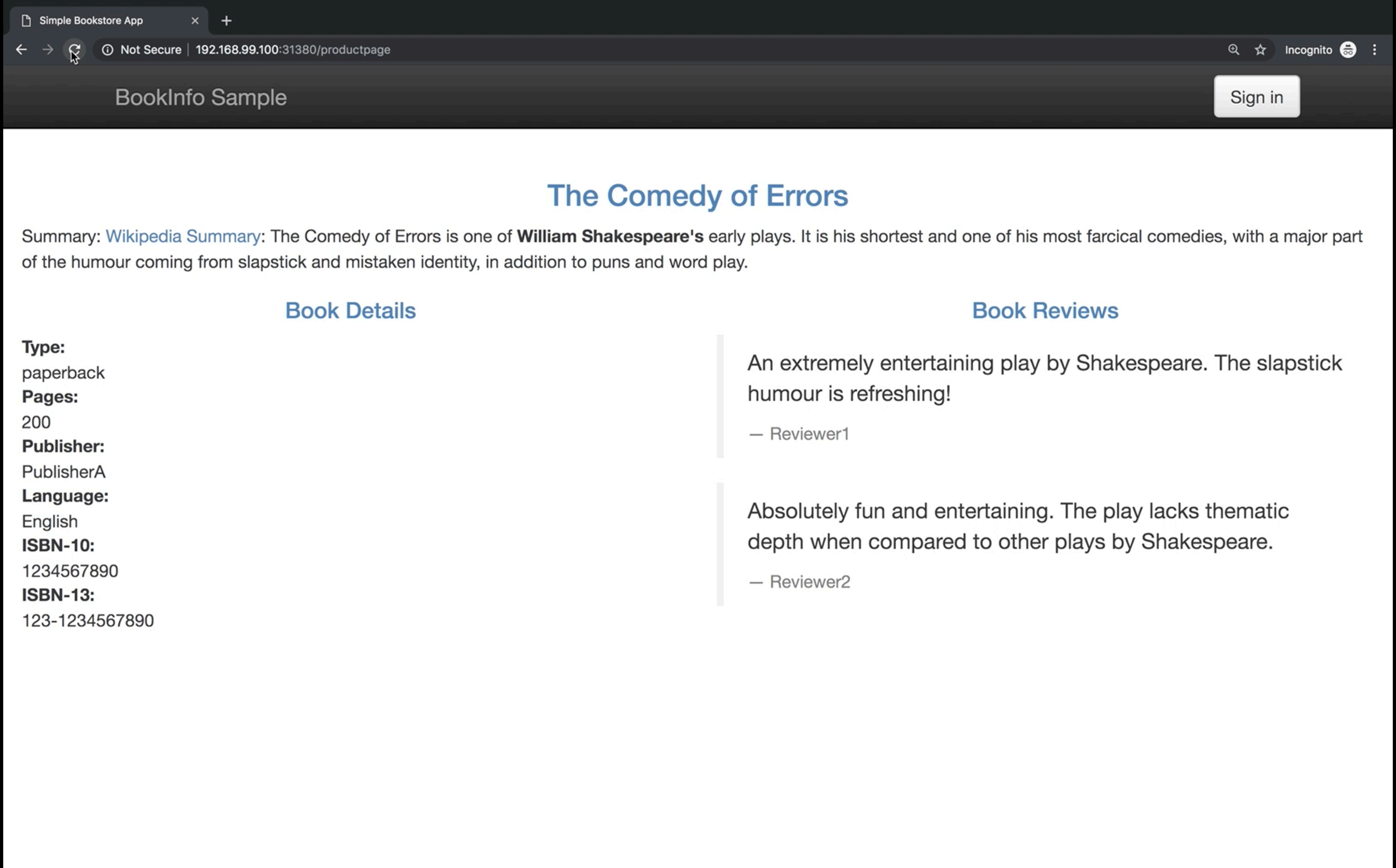
Book Reviews

> An extremely entertaining play by Shakespeare. The slapstick humour is refreshing!
>
> — Reviewer1
> ★★★★★

> Absolutely fun and entertaining. The play lacks thematic depth when compared to other plays by Shakespeare.
>
> — Reviewer2
> ★★★★☆

Request Routing


Envoy
Proxy
All Users
Jason
Istio
Ingress
Product Page
(Python)
Reviews v1
(Java)
Reviews v2
(Java) ★
Ratings
(Node.js)
Reviews v3
(Java) ★
Details
(Ruby)


Simple Bookstore App
Not Secure
192.168.99.100:31380/productpage
Incognito
BookInfo Sample
Sign in

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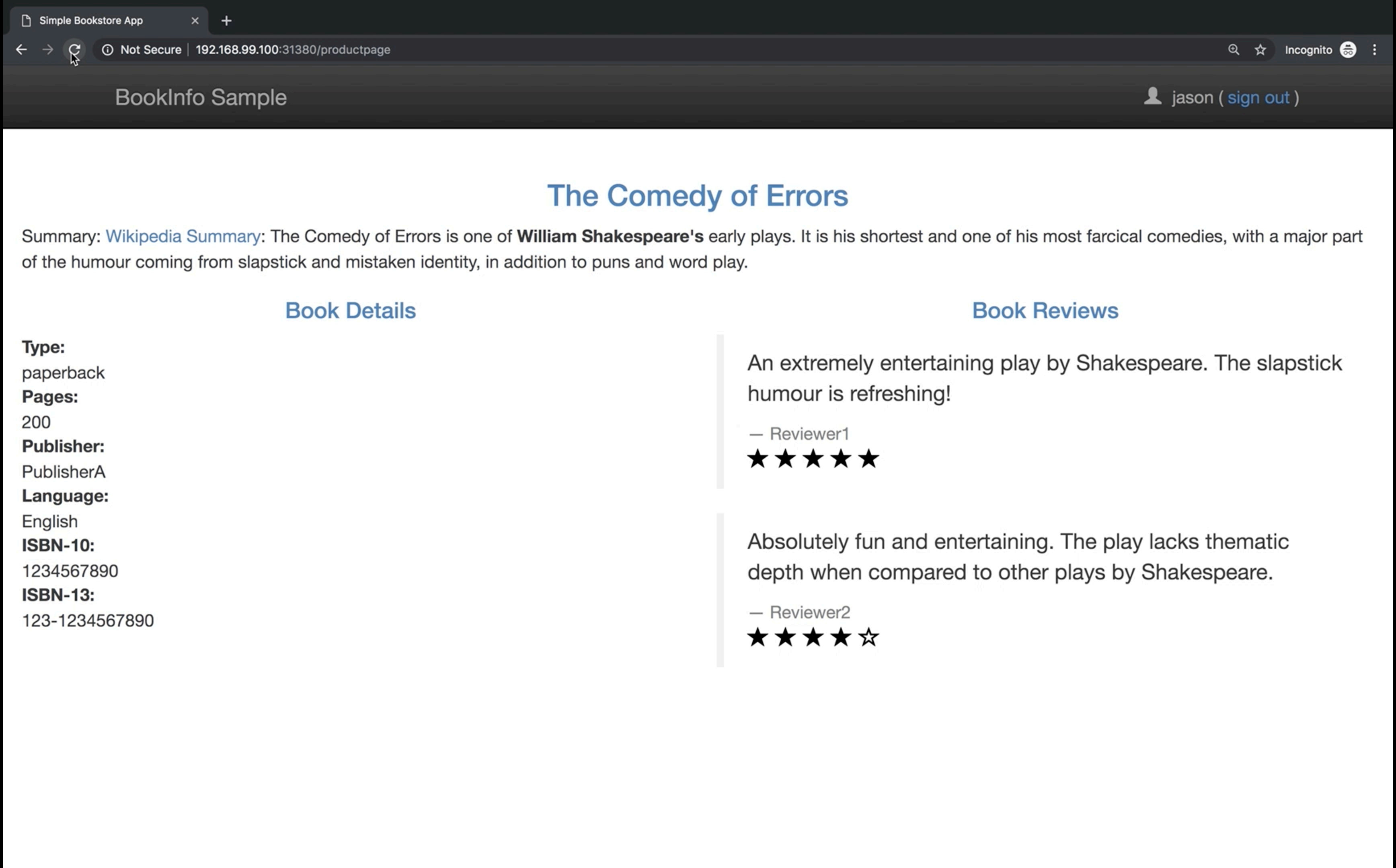
>
> — Reviewer2

```
$ kubectl apply -f samples/bookinfo/networking/virtual-service-review
s-test-v2.yaml
virtualservice.networking.istio.io/reviews configured
$ █
```


Simple Bookstore App
Not Secure
192.168.99.100:31380/productpage
Incognito

BookInfo Sample

jason (sign out)

The Comedy of Errors

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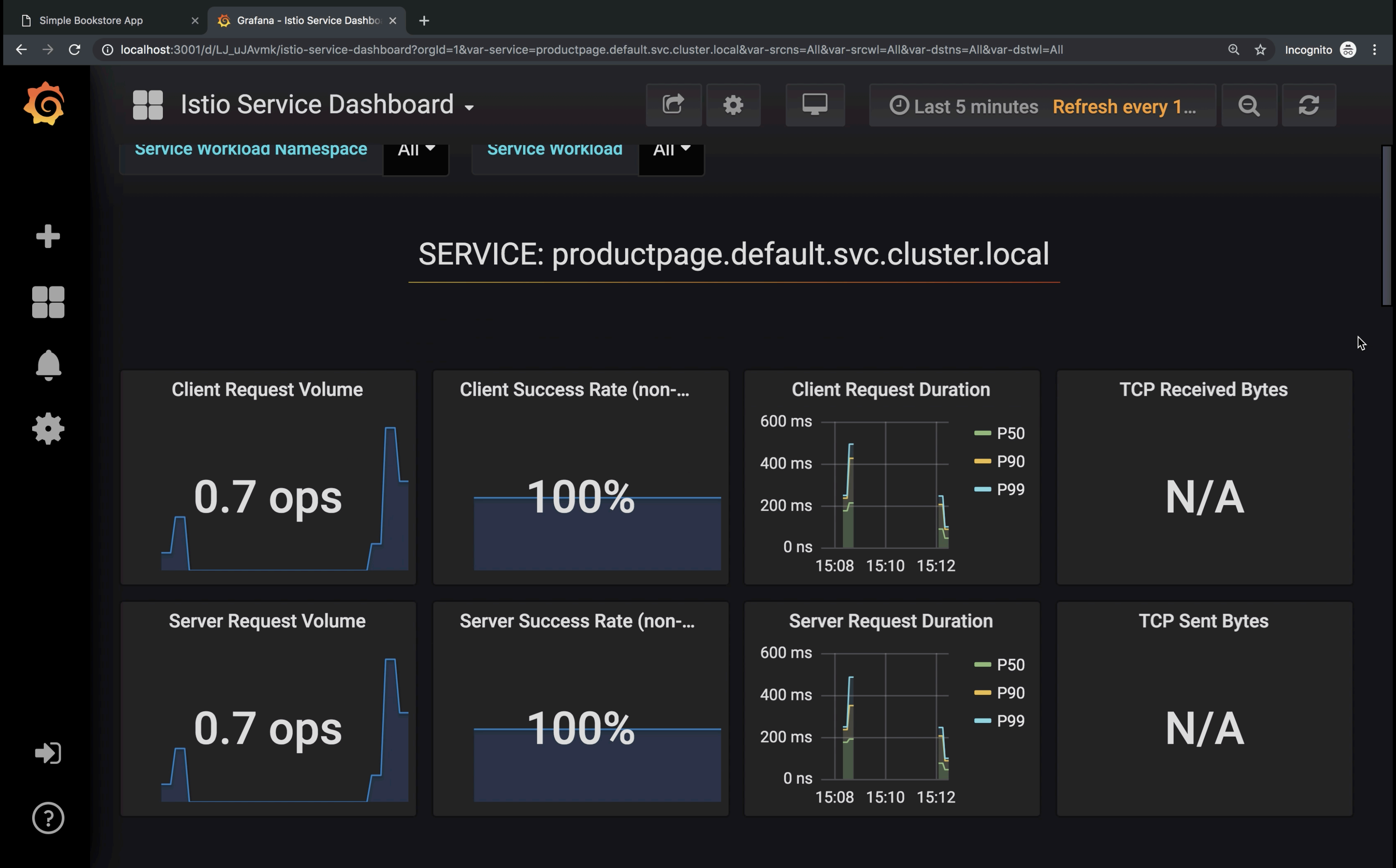
>
> — Reviewer2
>
> ★★★★☆



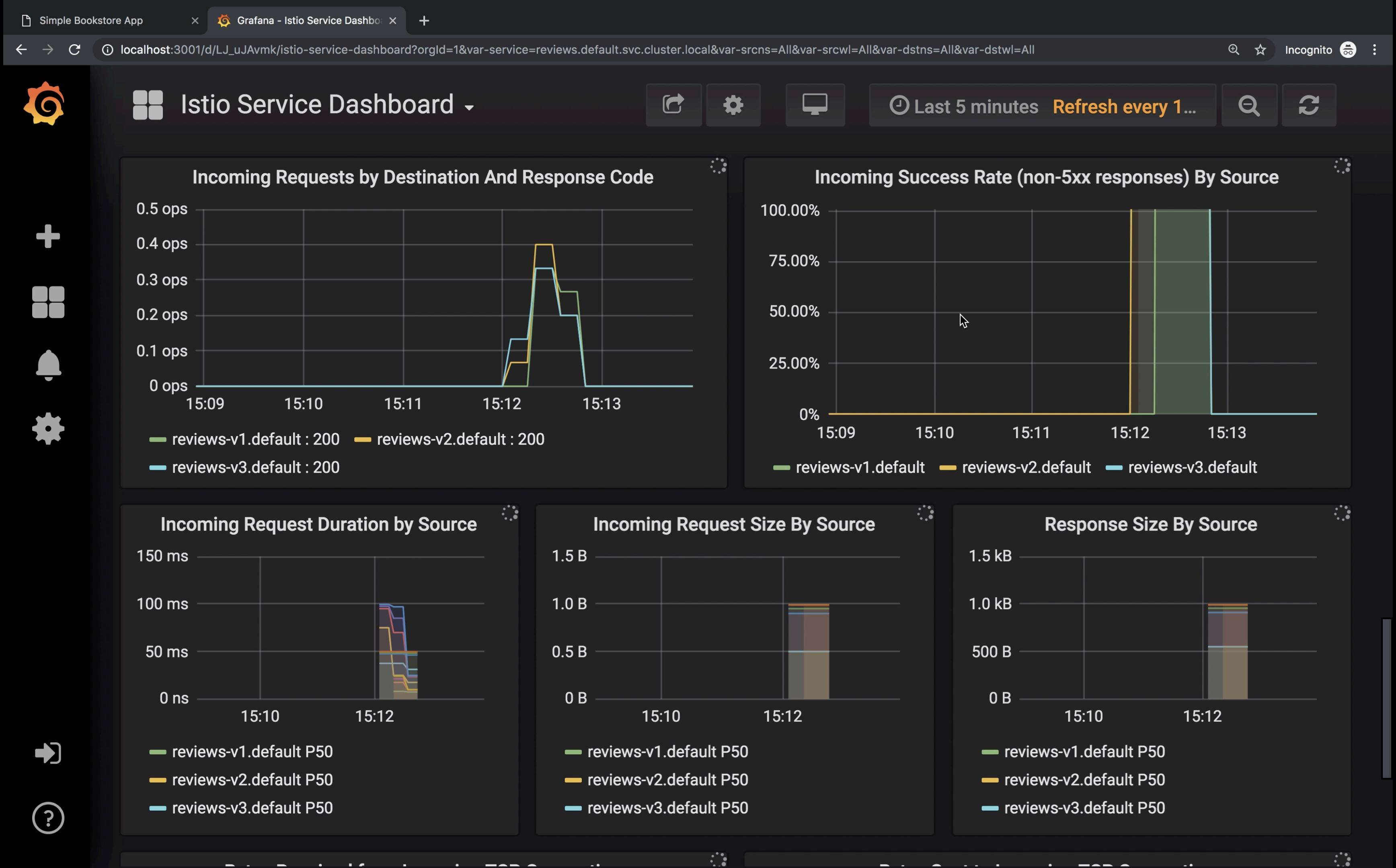
Simple Bookstore App
Grafana - Istio Service Dashbo
Incognito
Istio Service Dashboard
Last 5 minutes
Refresh every 1...
Client Request Volume
0.7 ops
Client Success Rate (non-...
100%
Client Request Duration
600 ms
400 ms
200 ms
0 ns
15:08
15:10
15:12
P50
P90
P99
TCP Received Bytes
N/A
Server Request Volume
0.7 ops
Server Success Rate (non-...
100%
Server Request Duration
600 ms
400 ms
200 ms
0 ns
15:08
15:10
15:12
P50
P90
P99
TCP Sent Bytes
N/A

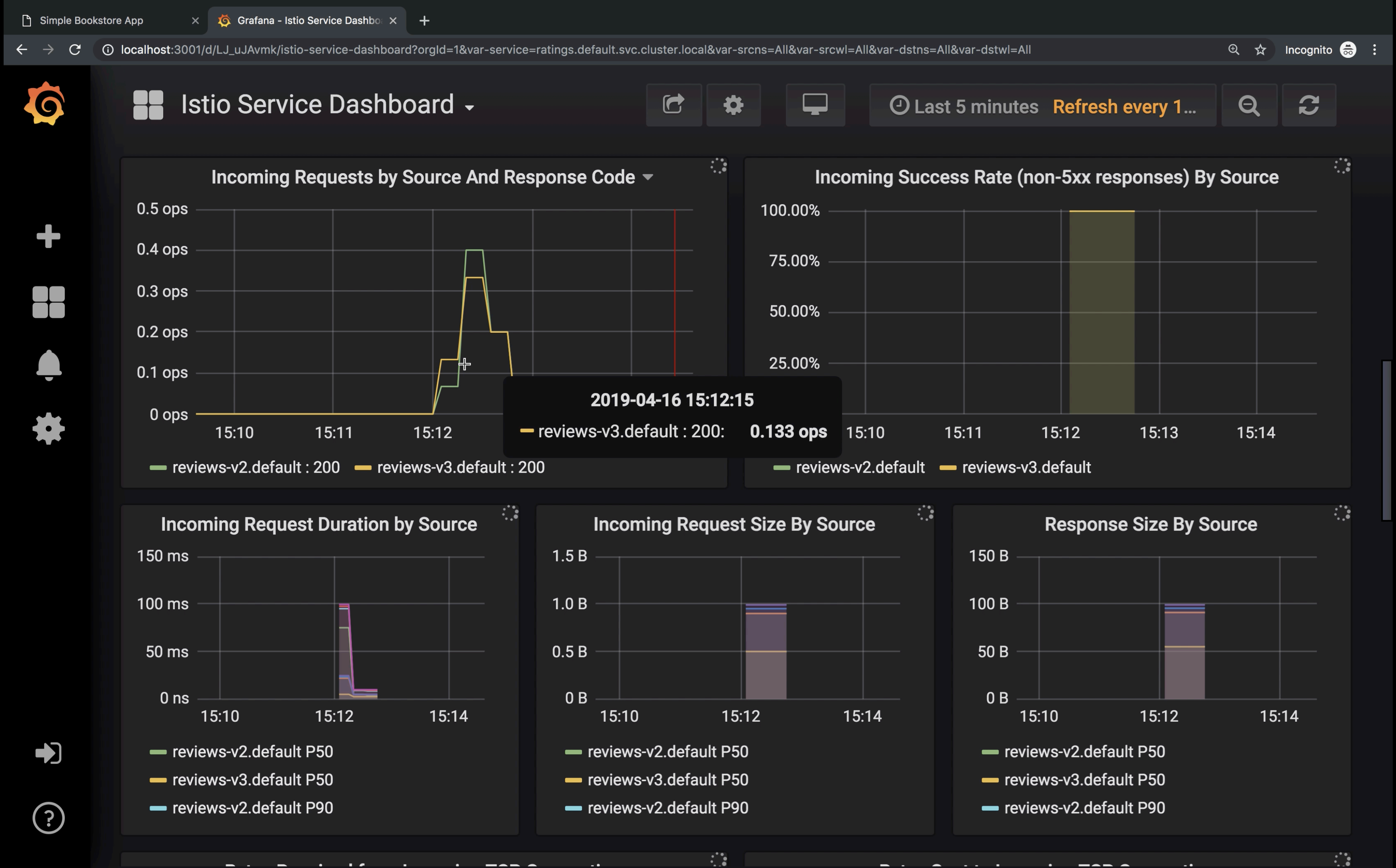
localhost:3001/d/LJ_uJAvmk/istio-service-dashboard?orgId=1&var-service=productpage.default.svc.cluster.local&var-srcns=All&var-srcwl=All&var-dstns=All&var-dstwl=All

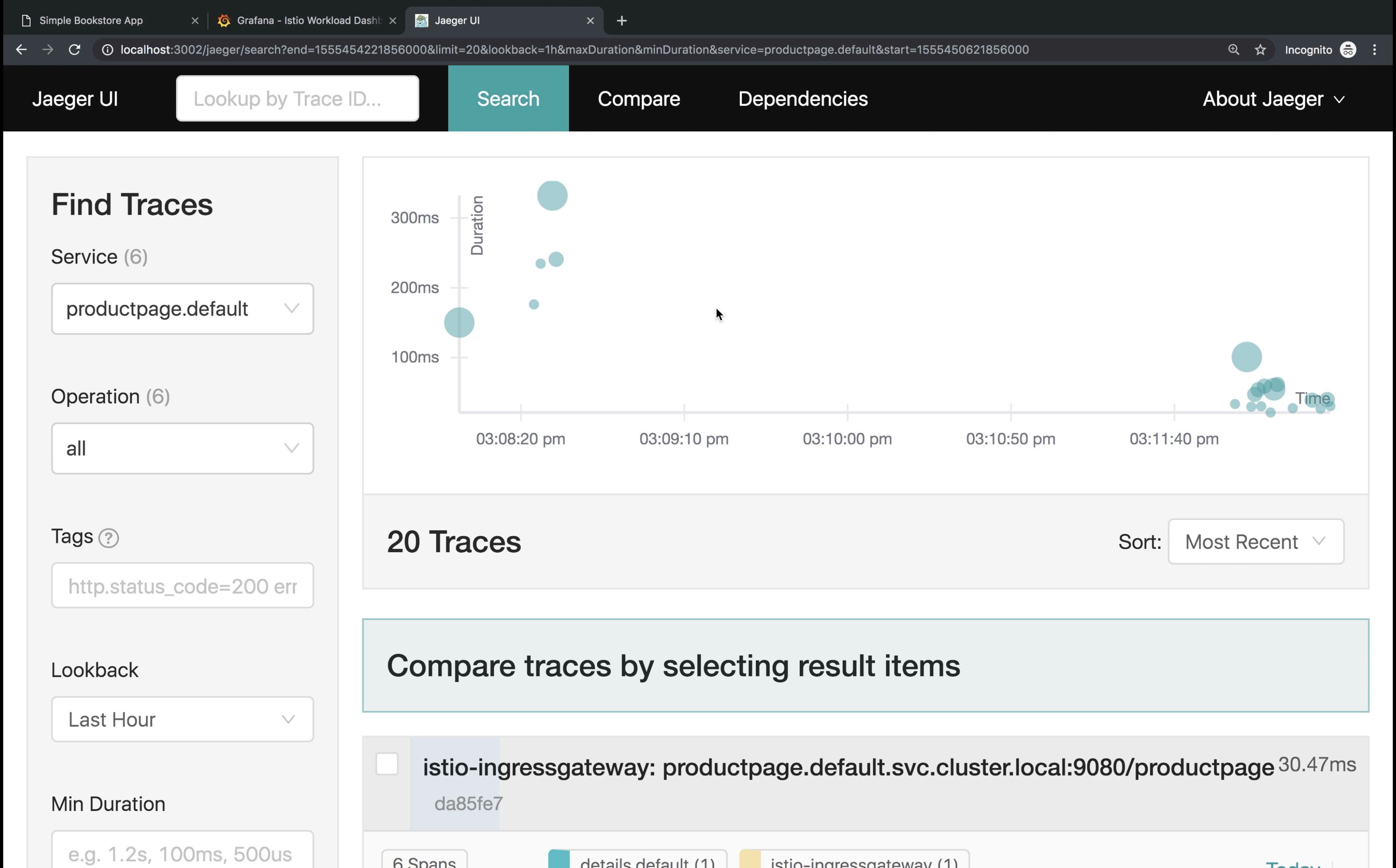
Service Workload Namespace: All

Service Workload: All

SERVICE: productpage.default.svc.cluster.local


Simple Bookstore App
Grafana - Istio Service Dashbo
localhost:3001/d/LJ_uJAvmk/istio-service-dashboard?orgId=1&var-service=reviews.default.svc.cluster.local&var-srcns=All&var-srcwl=All&var-dstns=All&var-dstwl=All
Incognito
Istio Service Dashboard
Last 5 minutes
Refresh every 1...
Incoming Requests by Destination And Response Code
0.5 ops
0.4 ops
0.3 ops
0.2 ops
0.1 ops
0 ops
15:09
15:10
15:11
15:12
15:13
reviews-v1.default : 200
reviews-v2.default : 200
reviews-v3.default : 200
Incoming Success Rate (non-5xx responses) By Source
100.00%
75.00%
50.00%
25.00%
0%
15:09
15:10
15:11
15:12
15:13
reviews-v1.default
reviews-v2.default
reviews-v3.default
Incoming Request Duration by Source
150 ms
100 ms
50 ms
0 ns
15:10
15:12
reviews-v1.default P50
reviews-v2.default P50
reviews-v3.default P50
Incoming Request Size By Source
1.5 B
1.0 B
0.5 B
0 B
15:10
15:12
reviews-v1.default P50
reviews-v2.default P50
reviews-v3.default P50
Response Size By Source
1.5 kB
1.0 kB
500 B
0 B
15:10
15:12
reviews-v1.default P50
reviews-v2.default P50
reviews-v3.default P50


Simple Bookstore App
Grafana - Istio Service Dashbo
localhost:3001/d/LJ_uJAvmk/istio-service-dashboard?orgId=1&var-service=ratings.default.svc.cluster.local&var-srcns=All&var-srcwl=All&var-dstns=All&var-dstwl=All
Incognito
Istio Service Dashboard
Last 5 minutes
Refresh every 1...
Incoming Requests by Source And Response Code
0.5 ops
0.4 ops
0.3 ops
0.2 ops
0.1 ops
0 ops
15:10
15:11
15:12
2019-04-16 15:12:15
reviews-v3.default : 200: 0.133 ops
reviews-v2.default : 200
reviews-v3.default : 200
Incoming Success Rate (non-5xx responses) By Source
100.00%
75.00%
50.00%
25.00%
15:10
15:11
15:12
15:13
15:14
reviews-v2.default
reviews-v3.default
Incoming Request Duration by Source
150 ms
100 ms
50 ms
0 ns
15:10
15:12
15:14
reviews-v2.default P50
reviews-v3.default P50
reviews-v2.default P90
Incoming Request Size By Source
1.5 B
1.0 B
0.5 B
0 B
15:10
15:12
15:14
reviews-v2.default P50
reviews-v3.default P50
reviews-v2.default P90
Response Size By Source
150 B
100 B
50 B
0 B
15:10
15:12
15:14
reviews-v2.default P50
reviews-v3.default P50
reviews-v2.default P90


Simple Bookstore App
Grafana - Istio Workload Dashb
Jaeger UI
Incognito
Jaeger UI
Lookup by Trace ID...
Search
Compare
Dependencies
About Jaeger
300ms
200ms
100ms
Duration
Time
03:08:20 pm
03:09:10 pm
03:10:00 pm
03:10:50 pm
03:11:40 pm

localhost:3002/jaeger/search?end=1555454221856000&limit=20&lookback=1h&maxDuration&minDuration&service=productpage.default&start=1555450621856000

Find Traces

Service (6): productpage.default

Operation (6): all

Tags: http.status_code=200 err

Lookback: Last Hour

Min Duration: e.g. 1.2s, 100ms, 500us

20 Traces

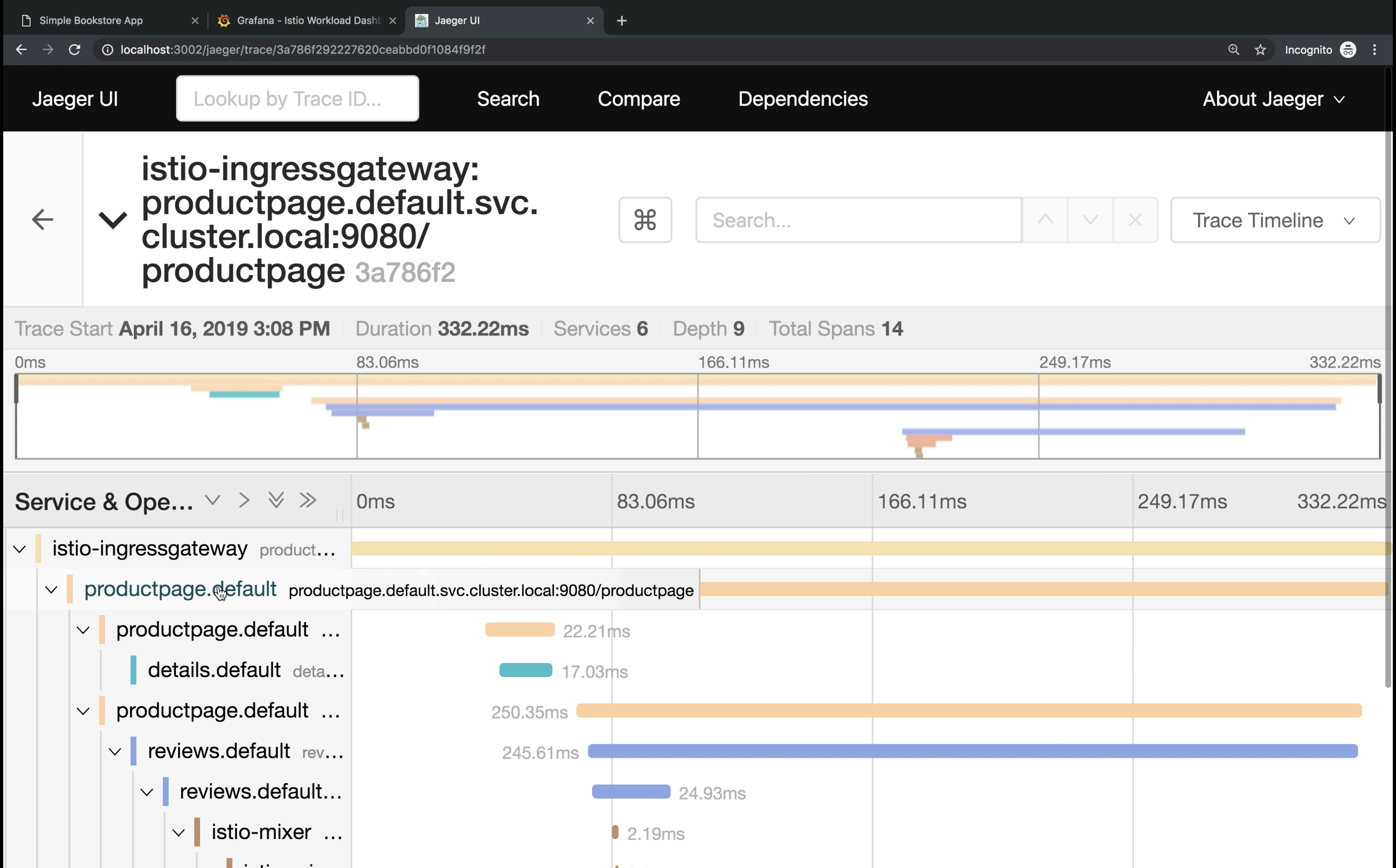
Sort: Most Recent

Compare traces by selecting result items

☐ istio-ingressgateway: productpage.default.svc.cluster.local:9080/productpage 30.47ms

da85fe7

6 Spans | details.default (1) | istio-ingressgateway (1)


Simple Bookstore App
Grafana - Istio Workload Dashb
Jaeger UI
localhost:3002/jaeger/trace/3a786f292227620ceabbd0f1084f9f2f
Incognito
Jaeger UI
Lookup by Trace ID...
Search
Compare
Dependencies
About Jaeger
Search...
Trace Timeline
0ms
83.06ms
166.11ms
249.17ms
332.22ms
Service & Ope...

istio-ingressgateway: productpage.default.svc.cluster.local:9080/productpage 3a786f2

Trace Start **April 16, 2019 3:08 PM** Duration **332.22ms** Services **6** Depth **9** Total Spans **14**

istio-ingressgateway product...

productpage.default productpage.default.svc.cluster.local:9080/productpage

productpage.default ... 22.21ms

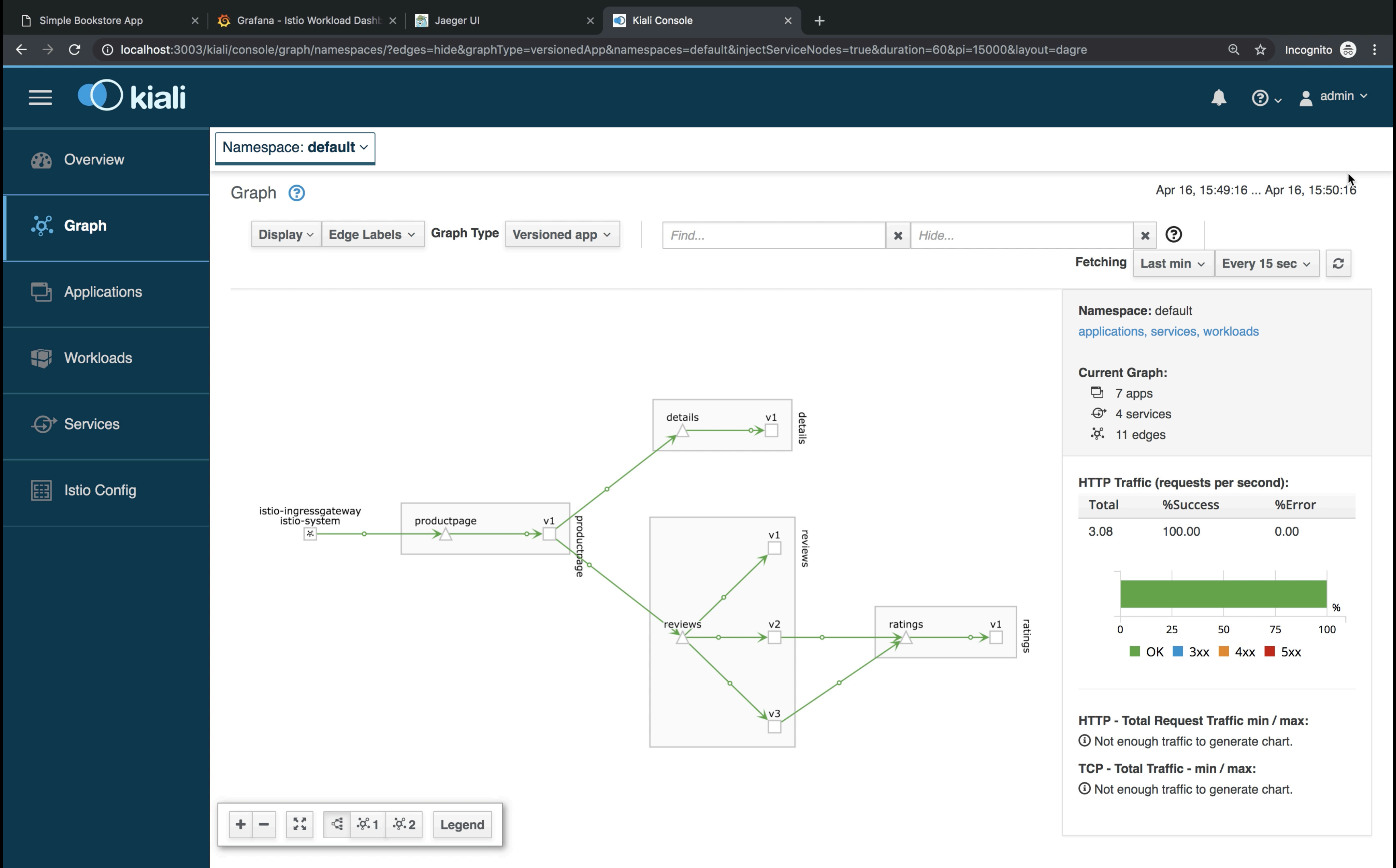
details.default deta... 17.03ms

productpage.default ... 250.35ms

reviews.default rev... 245.61ms

reviews.default... 24.93ms

istio-mixer ... 2.19ms



Simple Bookstore App
Grafana - Istio Workload Dashb
Jaeger UI
Kiali Console
localhost:3003/kiali/console/graph/namespaces/?edges=hide&graphType=versionedApp&namespaces=default&injectServiceNodes=true&duration=60&pi=15000&layout=dagre
Incognito
kiali
admin
Overview
Graph
Applications
Workloads
Services
Istio Config
Namespace: default
Graph
Display
Edge Labels
Graph Type
Versioned app
Find...
Hide...
Fetching
Last min
Every 15 sec
istio-ingressgateway
istio-system
productpage
v1
productpage
details
v1
details
reviews
v1
v2
v3
reviews
ratings
v1
ratings
1
2
Legend

Apr 16, 15:49:16 ... Apr 16, 15:50:16

Namespace: default

applications, services, workloads

Current Graph:

- 7 apps
- 4 services
- 11 edges

HTTP Traffic (requests per second):

Total	%Success	%Error
3.08	100.00	0.00

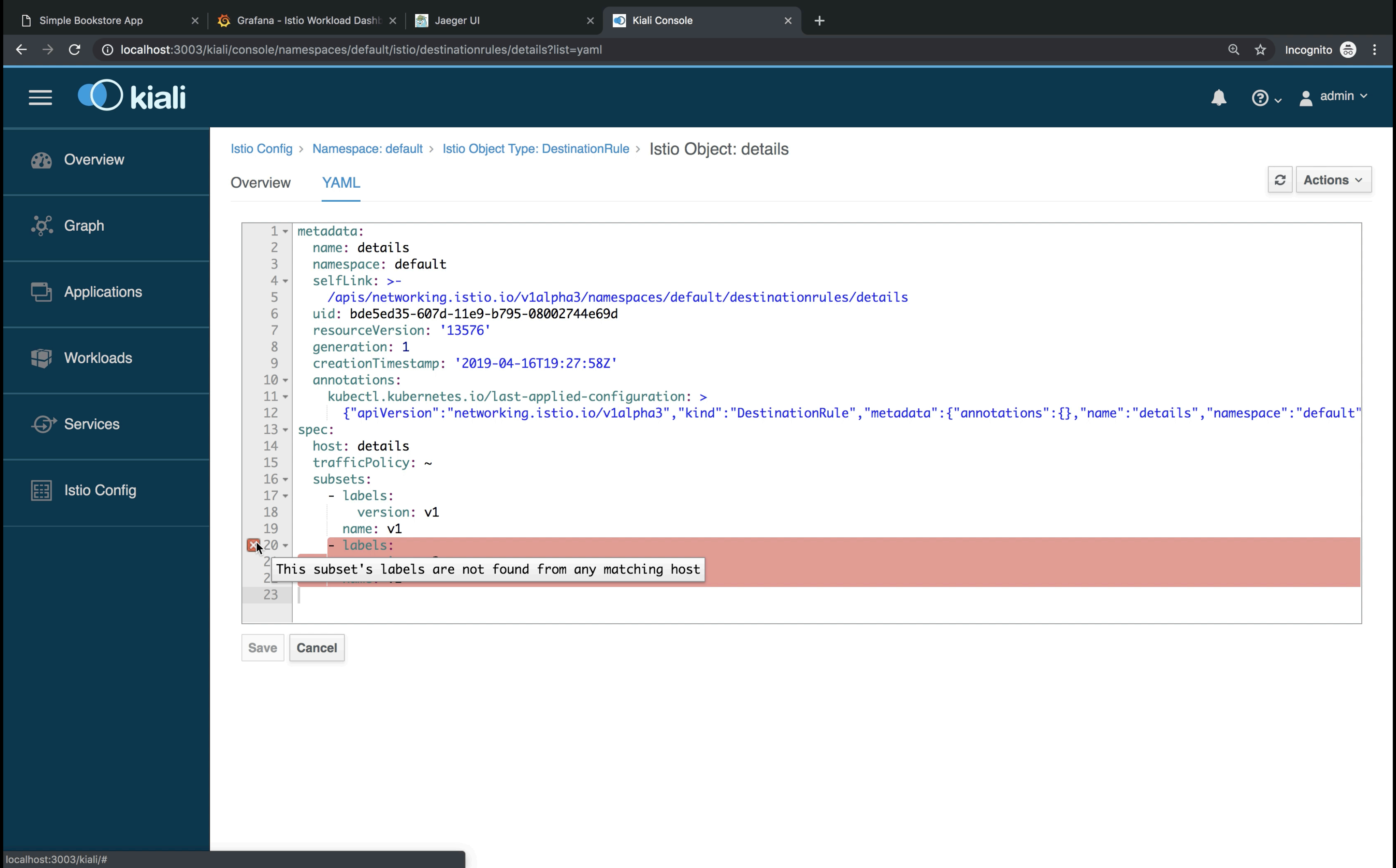
%
0
25
50
75
100
🟩 OK
🟦 3xx
🟧 4xx
🟥 5xx

HTTP - Total Request Traffic min / max:

ⓘ Not enough traffic to generate chart.

TCP - Total Traffic - min / max:

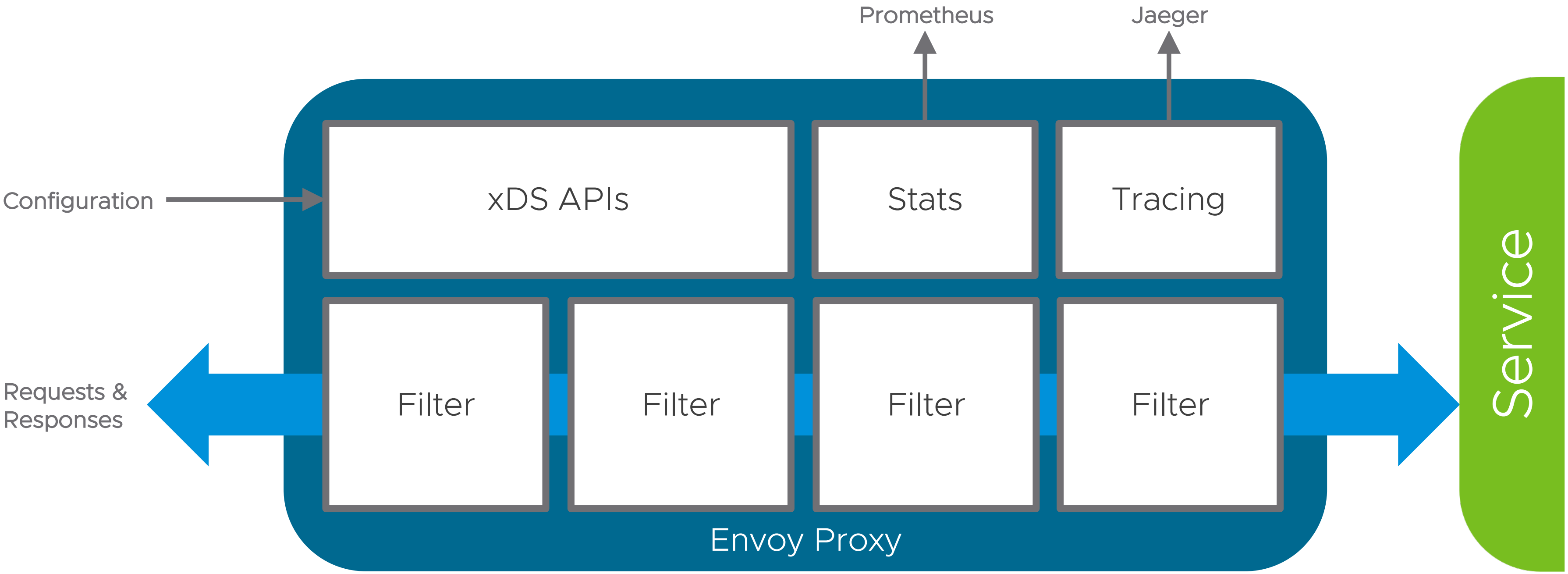
ⓘ Not enough traffic to generate chart.


Simple Bookstore App
Grafana - Istio Workload Dashb
Jaeger UI
Kiali Console
localhost:3003/kiali/console/namespaces/default/istio/destinationrules/details?list=yaml
Incognito
kiali
admin
Overview
Graph
Applications
Workloads
Services
Istio Config
Istio Config › Namespace: default › Istio Object Type: DestinationRule › Istio Object: details
Overview
YAML
Actions
Save
Cancel
localhost:3003/kiali/#

```
metadata:
  name: details
  namespace: default
  selfLink: >-
    /apis/networking.istio.io/v1alpha3/namespaces/default/destinationrules/details
  uid: bde5ed35-607d-11e9-b795-08002744e69d
  resourceVersion: '13576'
  generation: 1
  creationTimestamp: '2019-04-16T19:27:58Z'
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: >
      {"apiVersion":"networking.istio.io/v1alpha3","kind":"DestinationRule","metadata":{"annotations":{},"name":"details","namespace":"default"
spec:
  host: details
  trafficPolicy: ~
  subsets:
    - labels:
        version: v1
      name: v1
    - labels:
```

This subset's labels are not found from any matching host

The Envoy Proxy


Prometheus
Jaeger
Configuration
xDS APIs
Stats
Tracing
Requests &
Responses
Filter
Filter
Filter
Filter
Envoy Proxy
Service

gRPC – JSON Transcoder

Rate Limiting

Pros & Cons of Service Mesh

Pros

- Generic functionality is decoupled from Microservice code
- Freedom to choose the Microservice implementation language
- Standardized Tracing, Logging, Security, Access Control, etc.

Cons

- Service calls go through an extra hop i.e. the proxy sidecar
- Addresses only a subset of problems
- Not fully ready for large scale deployments

Thank You

istio.io

envoyproxy.io

venilnoronha.io

venilnoronha

venilnoronha