Istio on Kubernetes: Enter the Service Mesh

Burr Sutter (burrsutter.com)

bit.ly/istio-tutorial

Upcoming 3 hour classes/workshops

9 Steps to Awesome with Kubernetes

May 21, 2019
https://learning.oreilly.com/live-training/courses/9-steps-to-awesome-with-kubernetes/0636920258643/

Istio on Kubernetes: Enter the Service Mesh

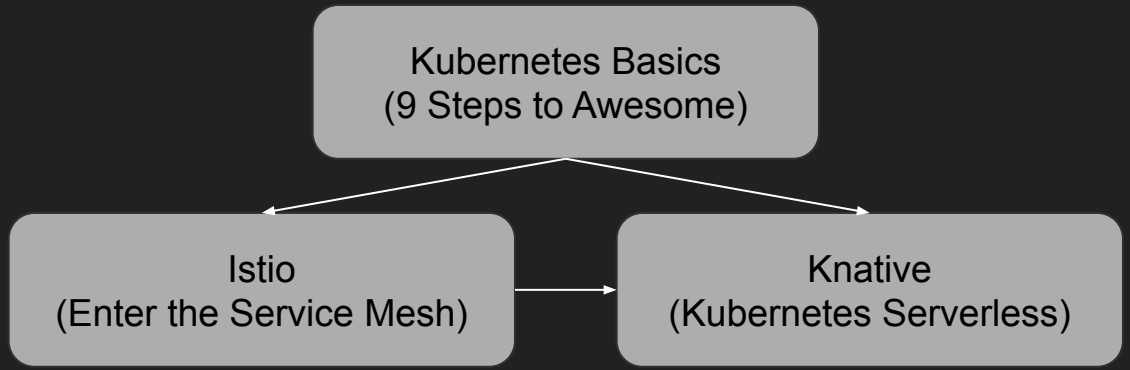
May 22, 2019
https://learning.oreilly.com/live-training/courses/istio-on-kubernetes-enter-the-service-mesh/0636920258735/

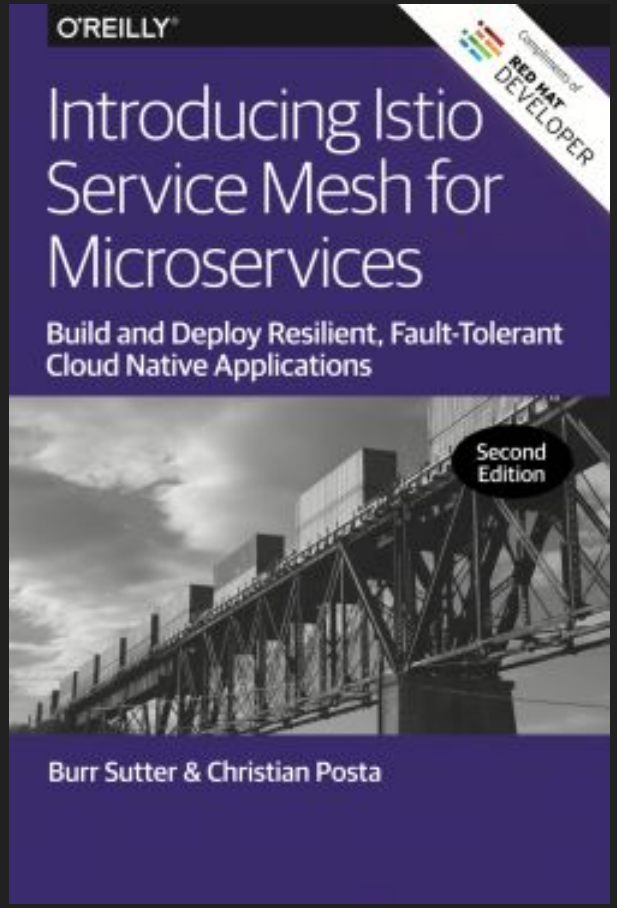
June 21, 2019
https://learning.oreilly.com/live-training/courses/istio-on-kubernetes-enter-the-service-mesh/0636920271147/

Kubernetes Serverless with Knative

May 29, 2019
https://learning.oreilly.com/live-training/courses/kubernetes-serverless-with-knative/0636920258865/

June 20, 2019
https://learning.oreilly.com/live-training/courses/kubernetes-serverless-with-knative/0636920271055/

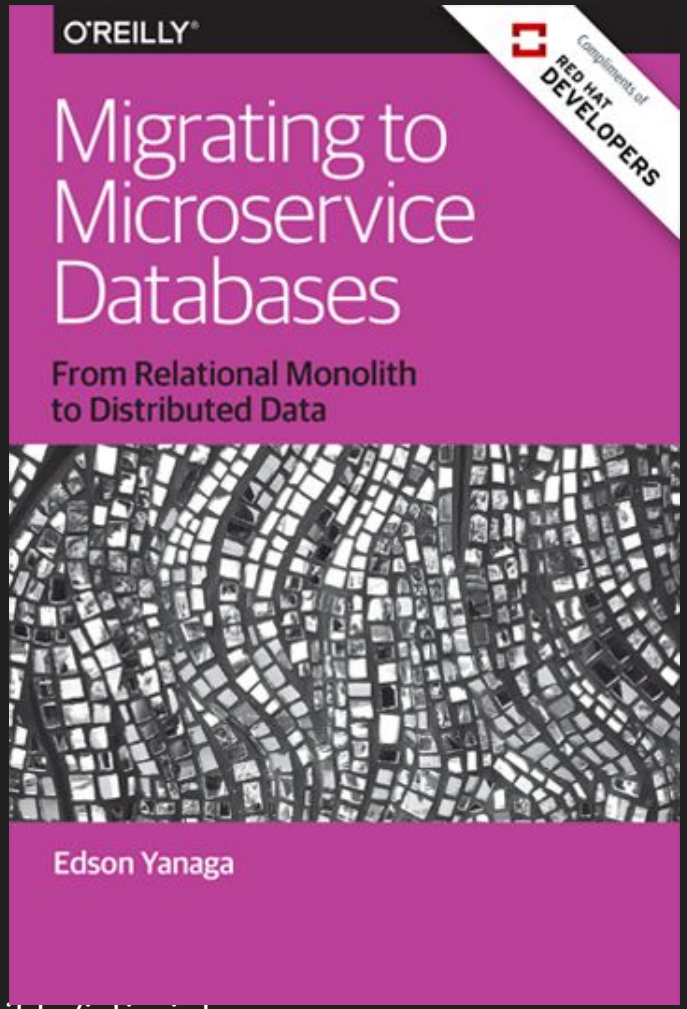




bit.ly/istiobook

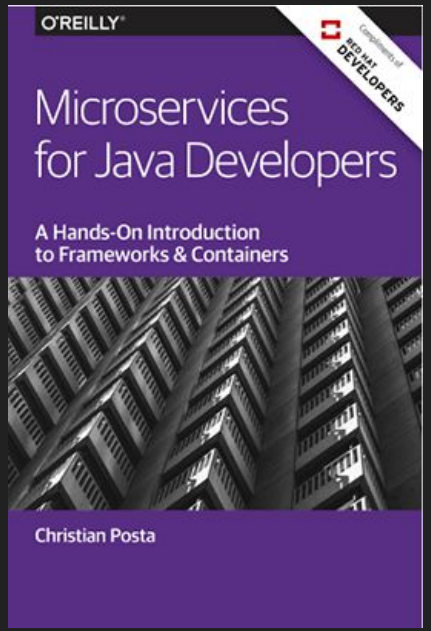
2nd Edition

RED HAT DEVELOPER



bit.ly/mono2microdb

bit.ly/javamicroservicesbook



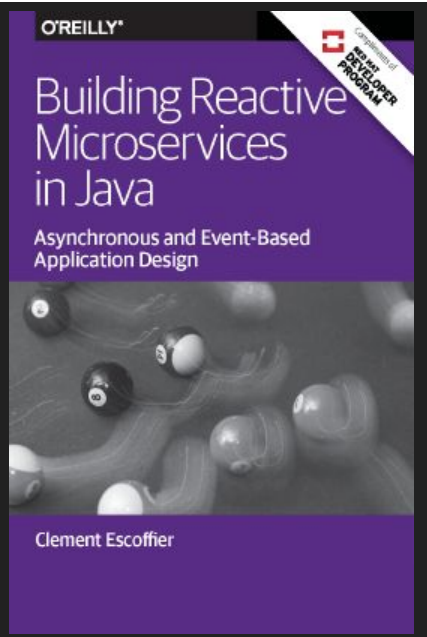
Free eBooks from developers.redhat.com

Microservices Introductory Materials

MSA Demo: bit.ly/msa-instructions
MSA Slides: bit.ly/microservicesdeepdive
Video Training: bit.ly/microservicesvideo
Kubernetes for Java Developers
9 Steps to Awesome with Kubernetes

Advanced Materials

bit.ly/reactivemicroservicesbook



bit.ly/istio-tutorial

bit.ly/knative-tutorial

learn.openshift.com/servicemesh

bit.ly/istio-intro

RED HAT DEVELOPER

Exercise Setup

Minishift
https://redhat-developer-demos.github.io/istio-tutorial/istio-tutorial/1.1.x/1setup.html

Minikube
https://istio.io/docs/setup/kubernetes/platform-setup/minikube/

```
kubectl apply -f install/kubernetes/helm/istio-init/files/crd-11.yaml
```

```
kubectl apply -f install/kubernetes/istio-demo.yaml
```

https://istio.io/docs/setup/kubernetes/quick-start/#verifying-the-installation

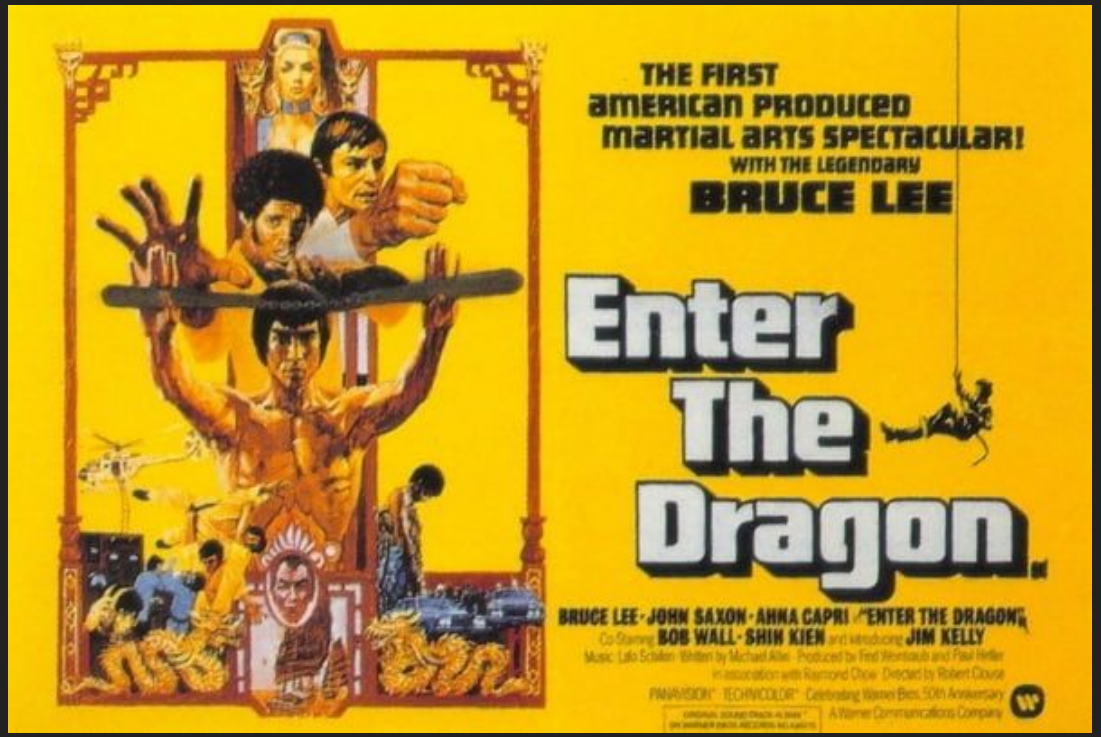
Testing/Demo/Minishift & Minikube Scripts
https://github.com/burrsutter/scripts-istio

Istio Tutorial Exercises (bit.ly/istio-tutorial)

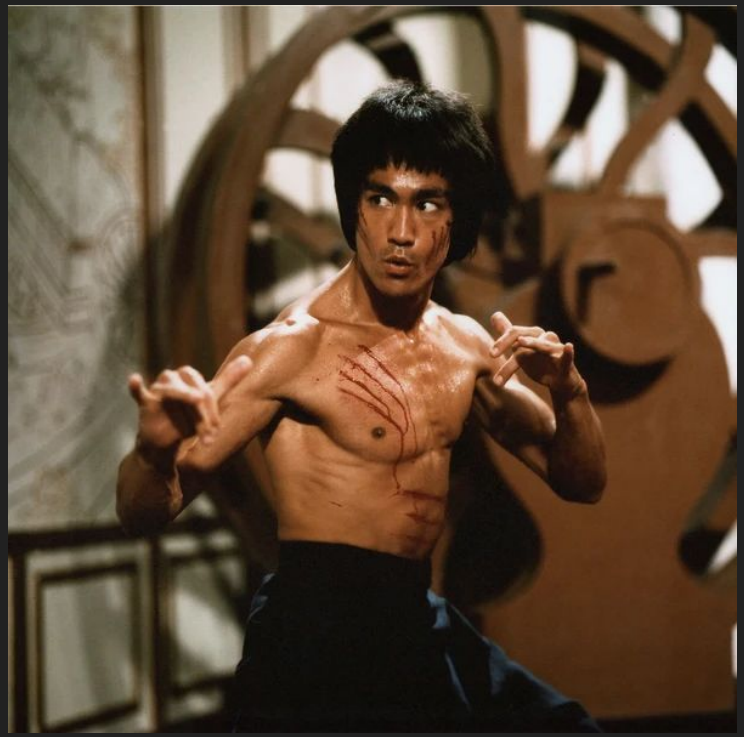
- Setup
- Deploy Microservices
- Traffic Control: Simple Routing
- Traffic Control: Advanced Routing
- Chaos
- Service Resiliency & Circuit Breaking
- Security

Agenda

- Why Service Mesh
- Observability
- Istio Architecture & Introduction
- Traffic Control
- Service Resiliency & Circuit Breaking
- Chaos Testing
- Egress
- Security



https://www.flickeringmyth.com/2018/07/deadpool-2-director-in-talks-for-enter-the-dragon-remake/



https://www.watershed.co.uk/whatson/9037/enter-the-dragon

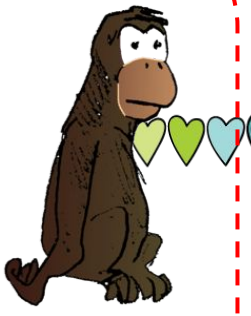
Your Journey to Awesomeness

Re-Org to DevOps

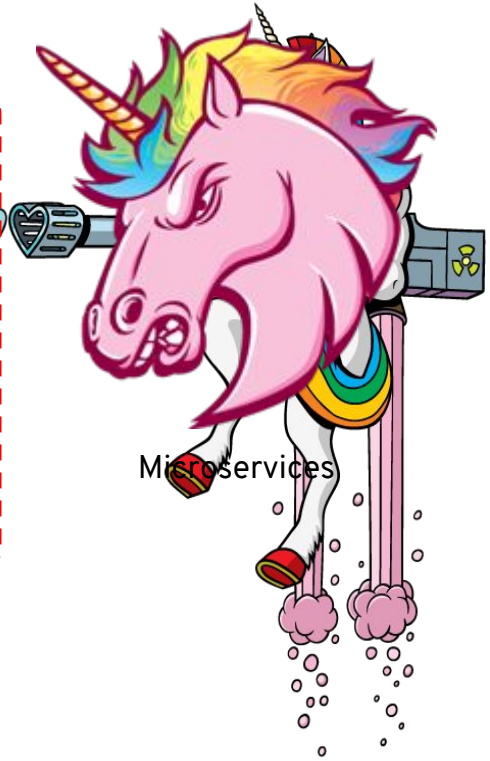
Self-Service, On-Demand, Elastic Infrastructure

Automation

CI & CD Deployment Pipeline

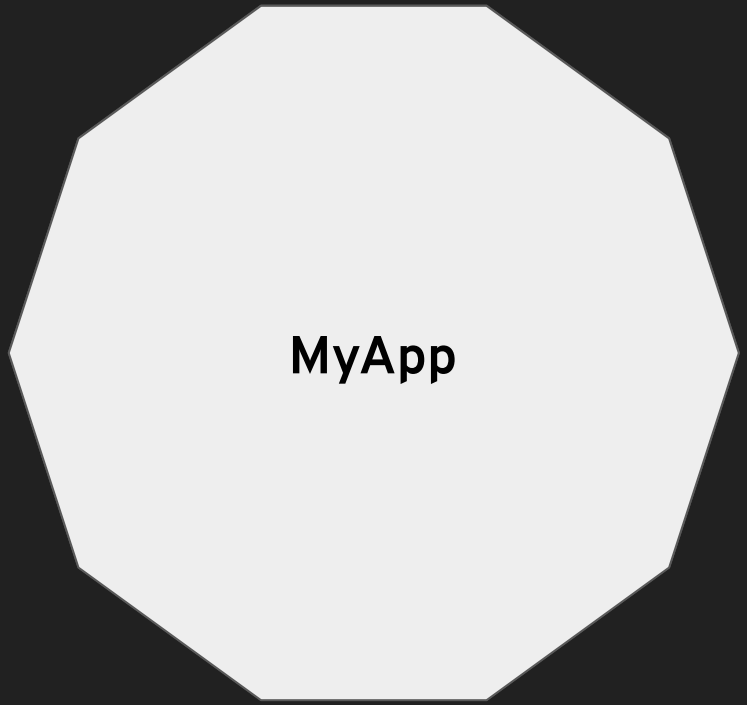


Advanced Deployment Techniques

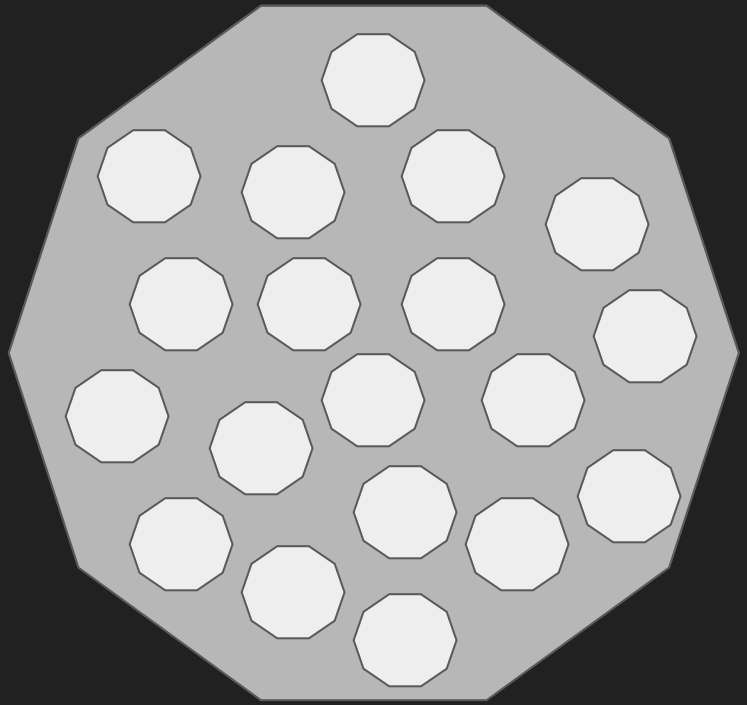


Microservices

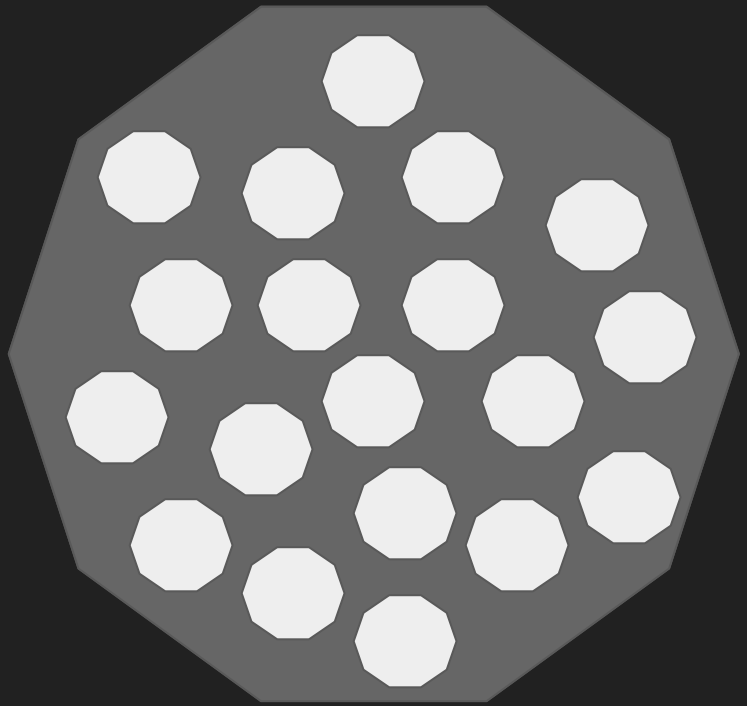
Monolith



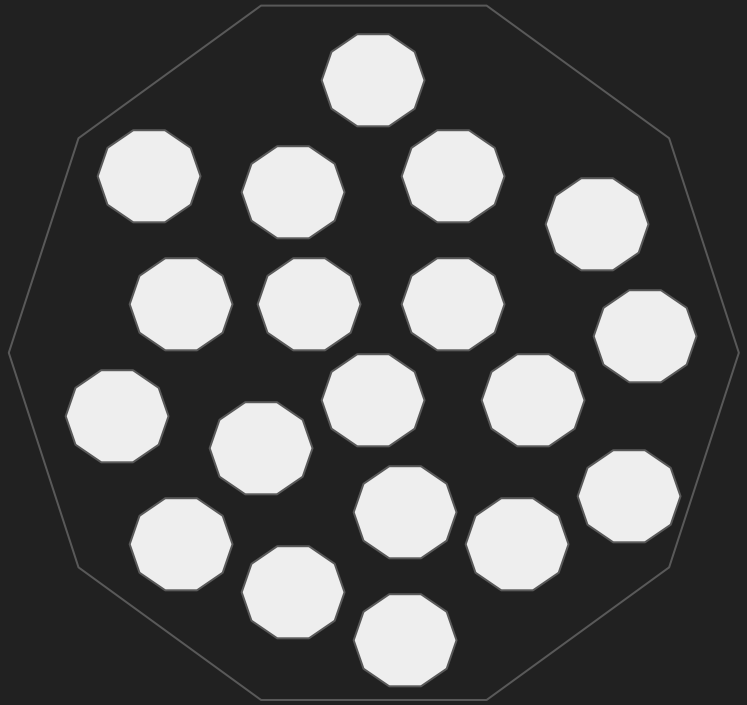
The Application



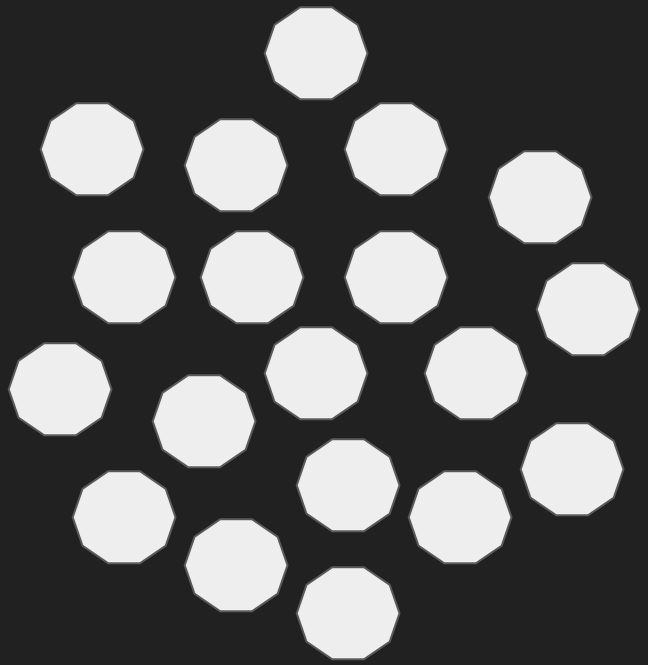
Modules



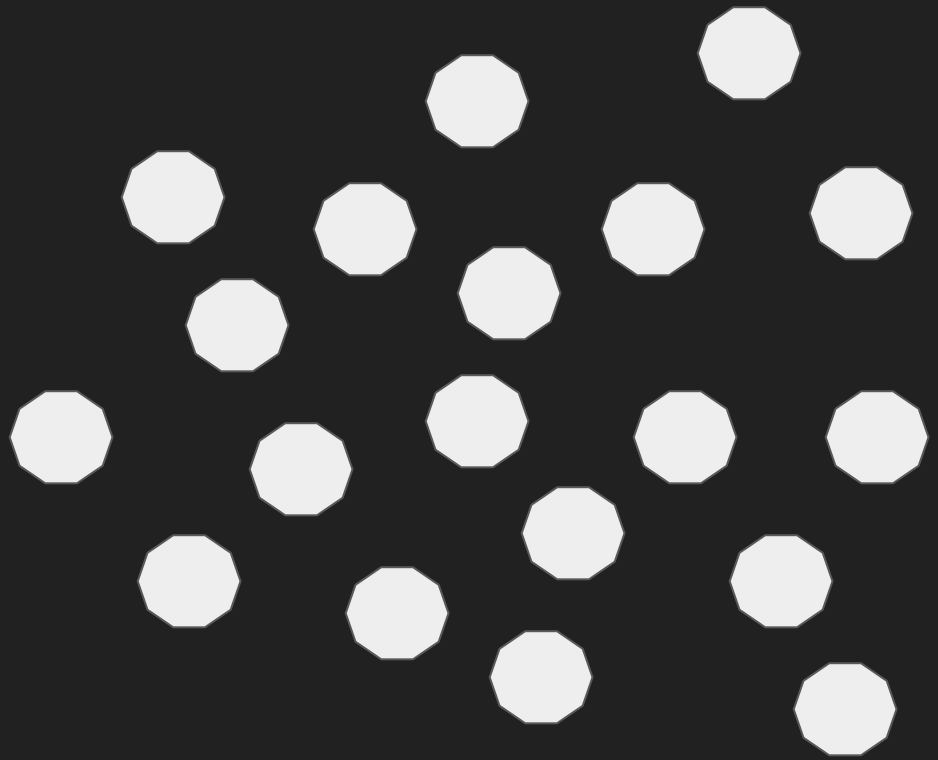
Microservices



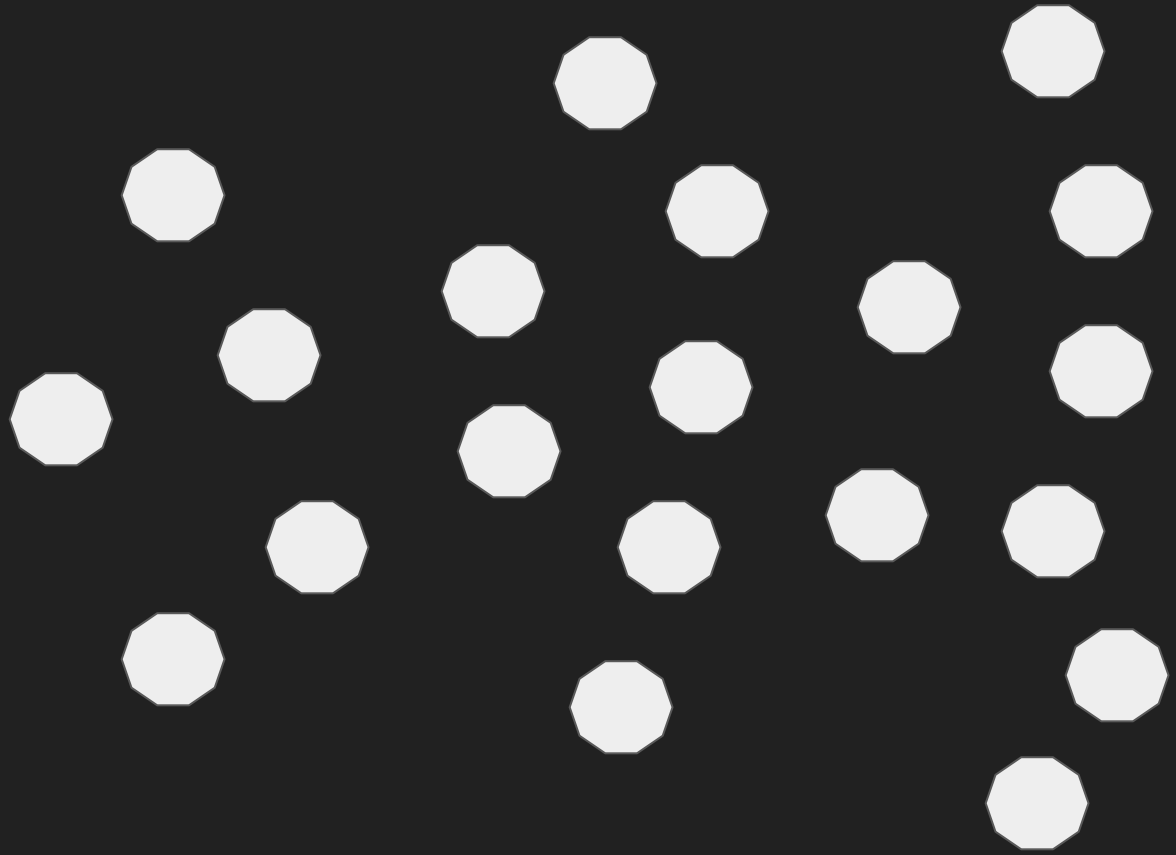
Microservices



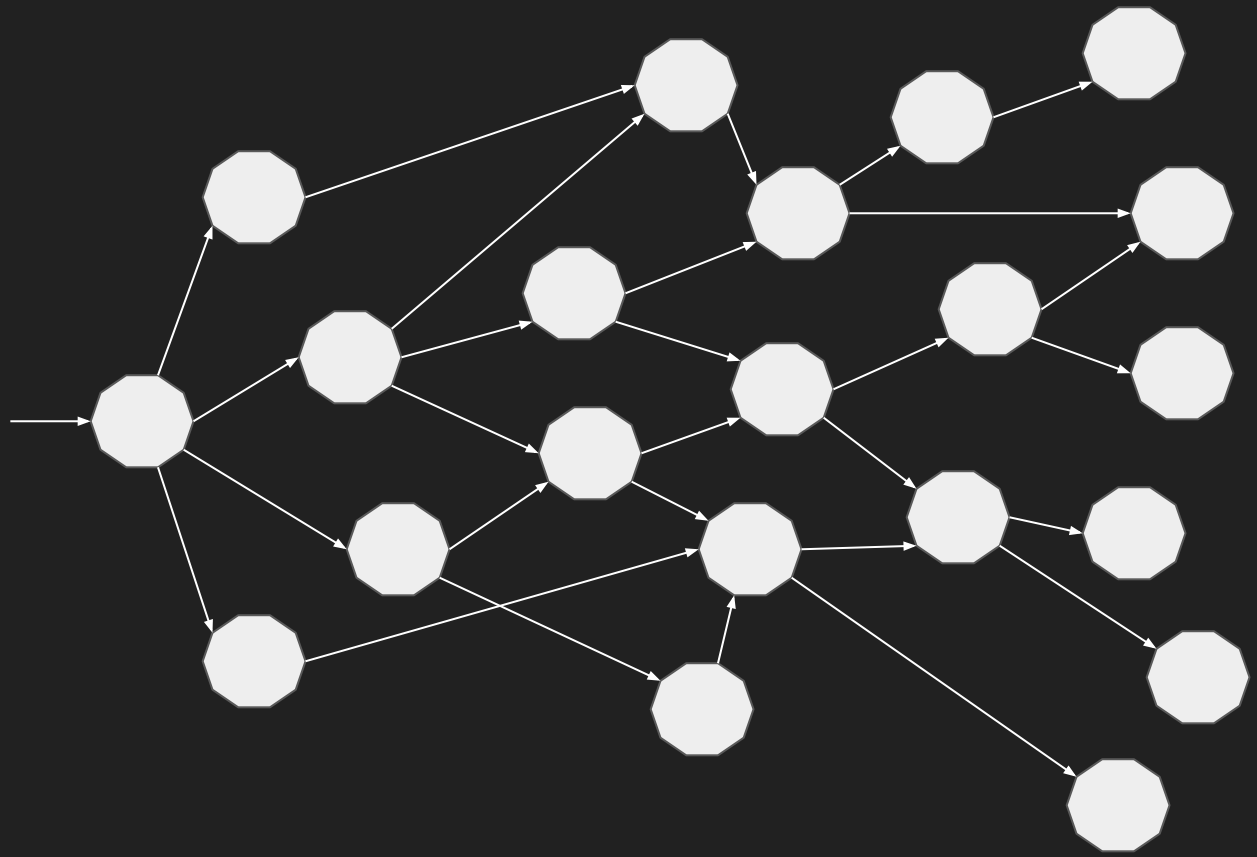
Microservices



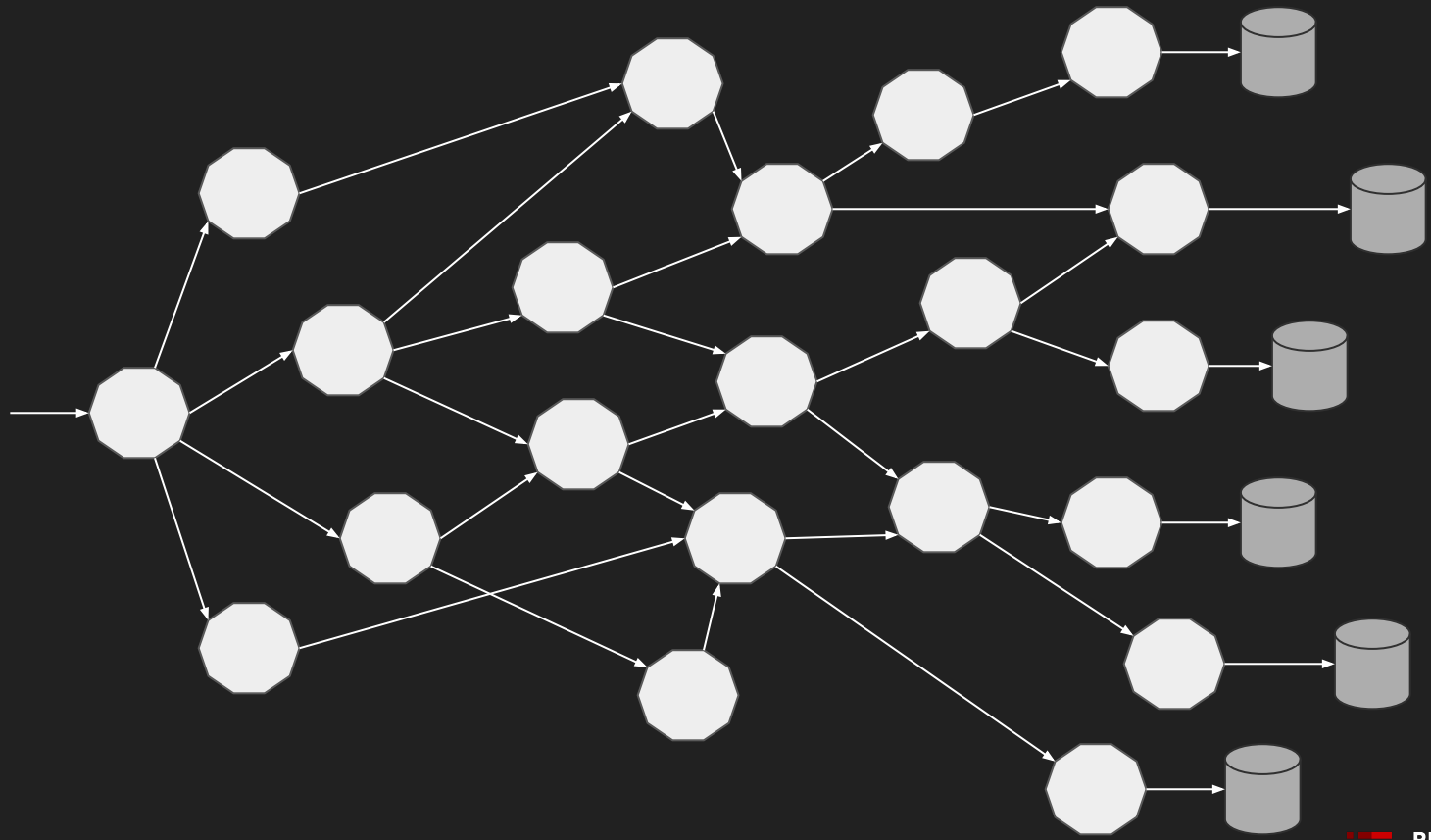
Microservices



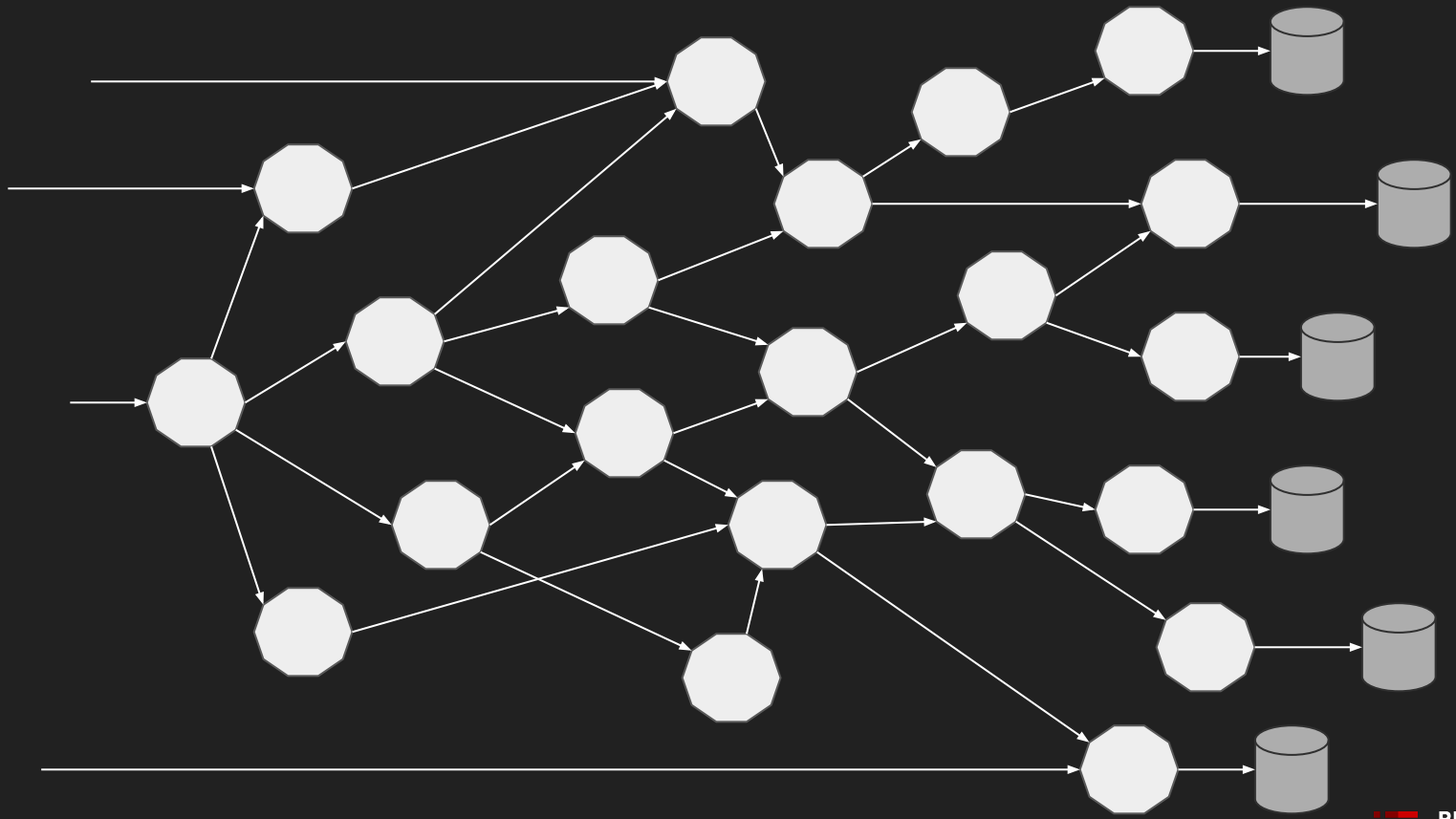
Network of Services



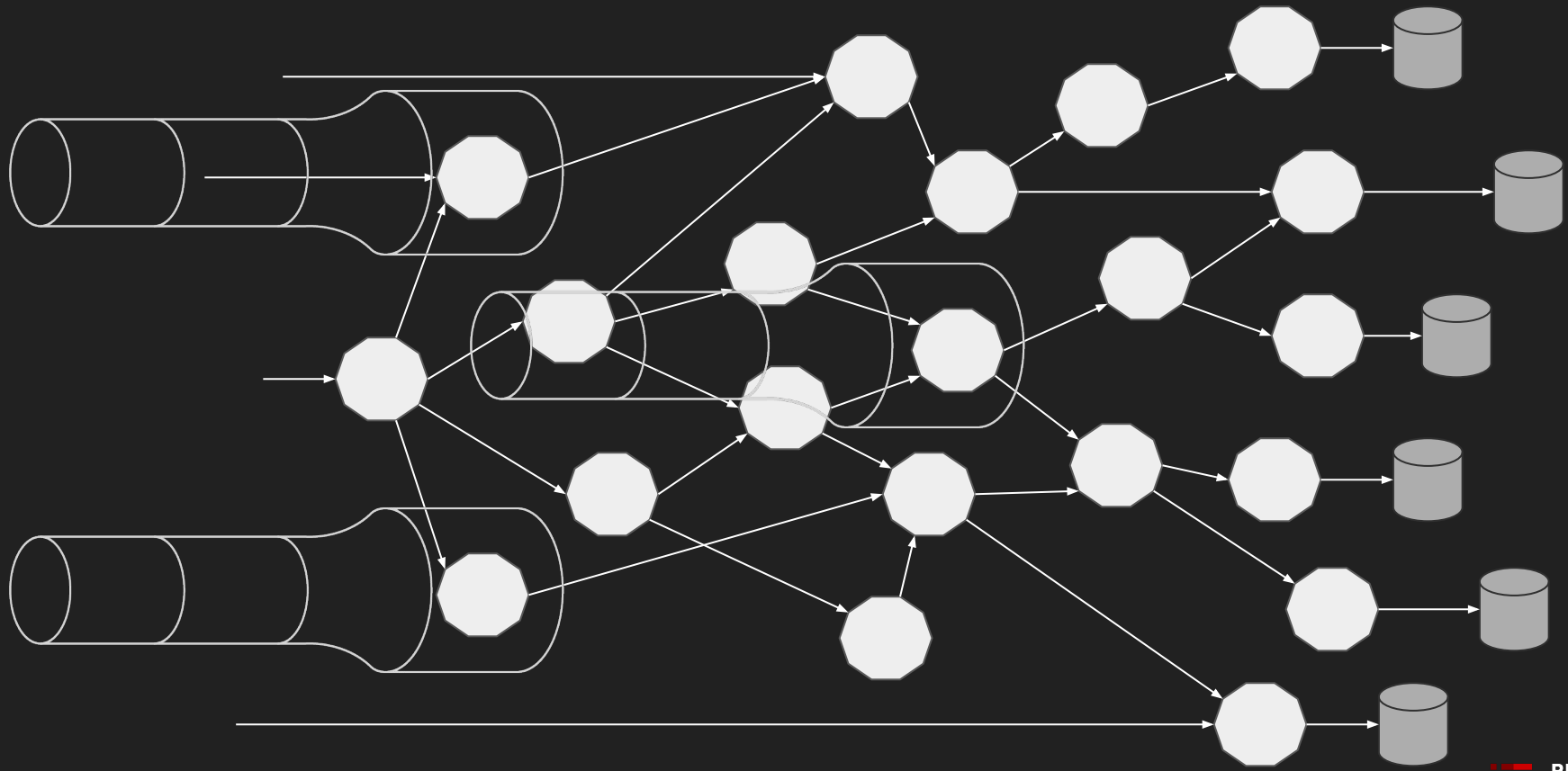
Microservices own their Data



Multiple Points of Entry

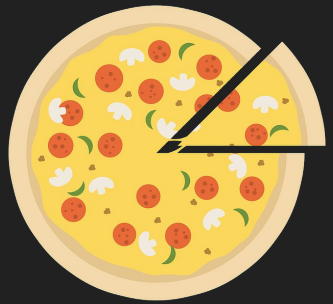


Multiple Teams, Multiple Pipelines



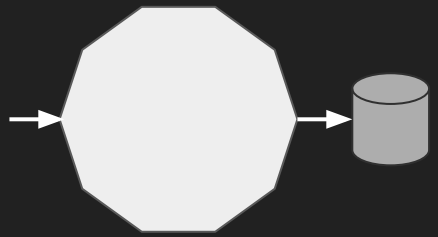
Microservices Principles

1. Deployment **Independence** - updates to an individual microservice have no negative impact to any other component of the system. Optimized for **Replacement**
2. Organized around **business** capabilities
3. **Products** not Projects
4. **API** Focused
5. **Smart** endpoints and dumb pipes
6. Decentralized Governance
7. Decentralized Data Management
8. Infrastructure Automation (infrastructure as code)
9. Design for failure
10. Evolutionary Design



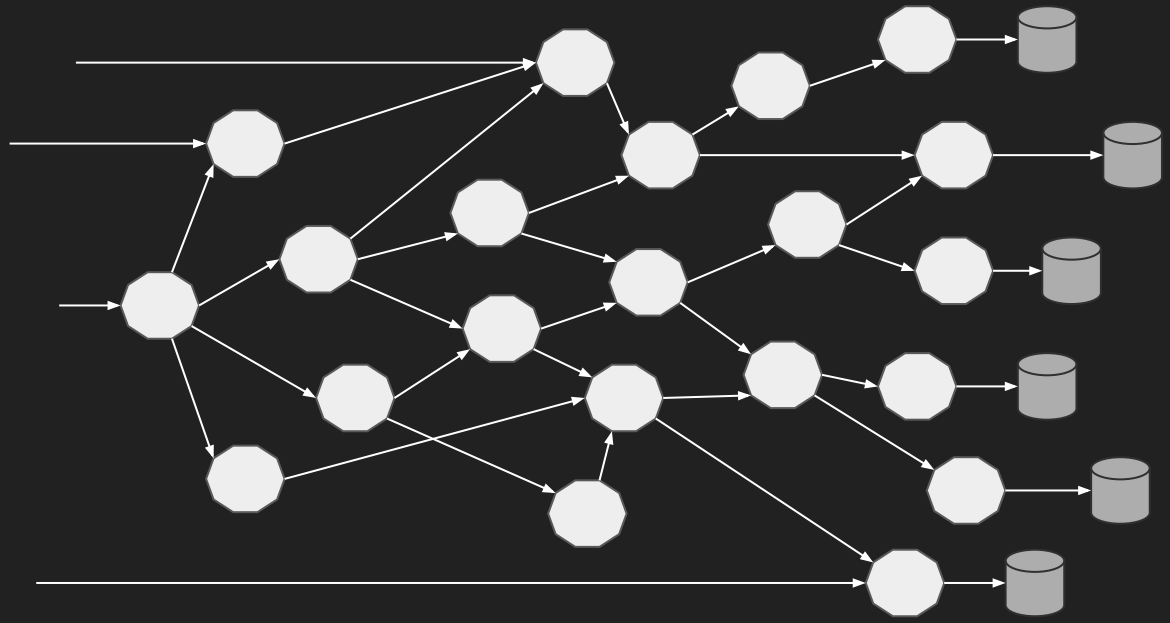
2 Pizza Team

Old School

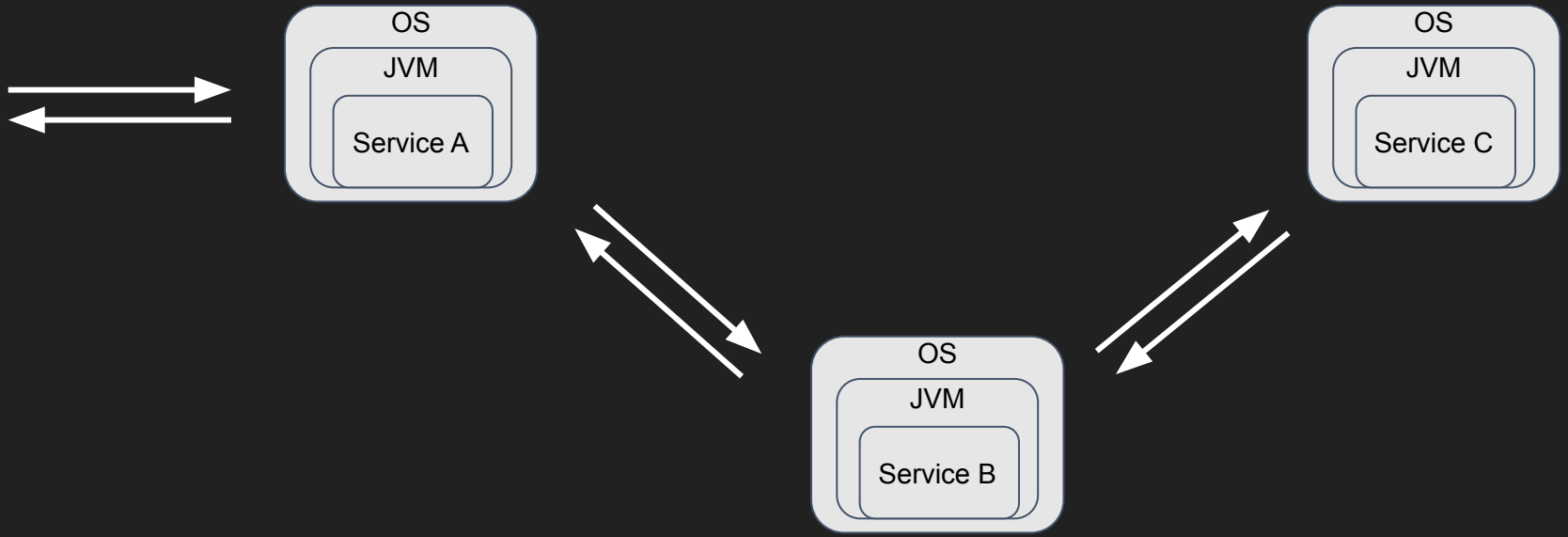


Love Thy Mono

New School



Microservices == Distributed Computing

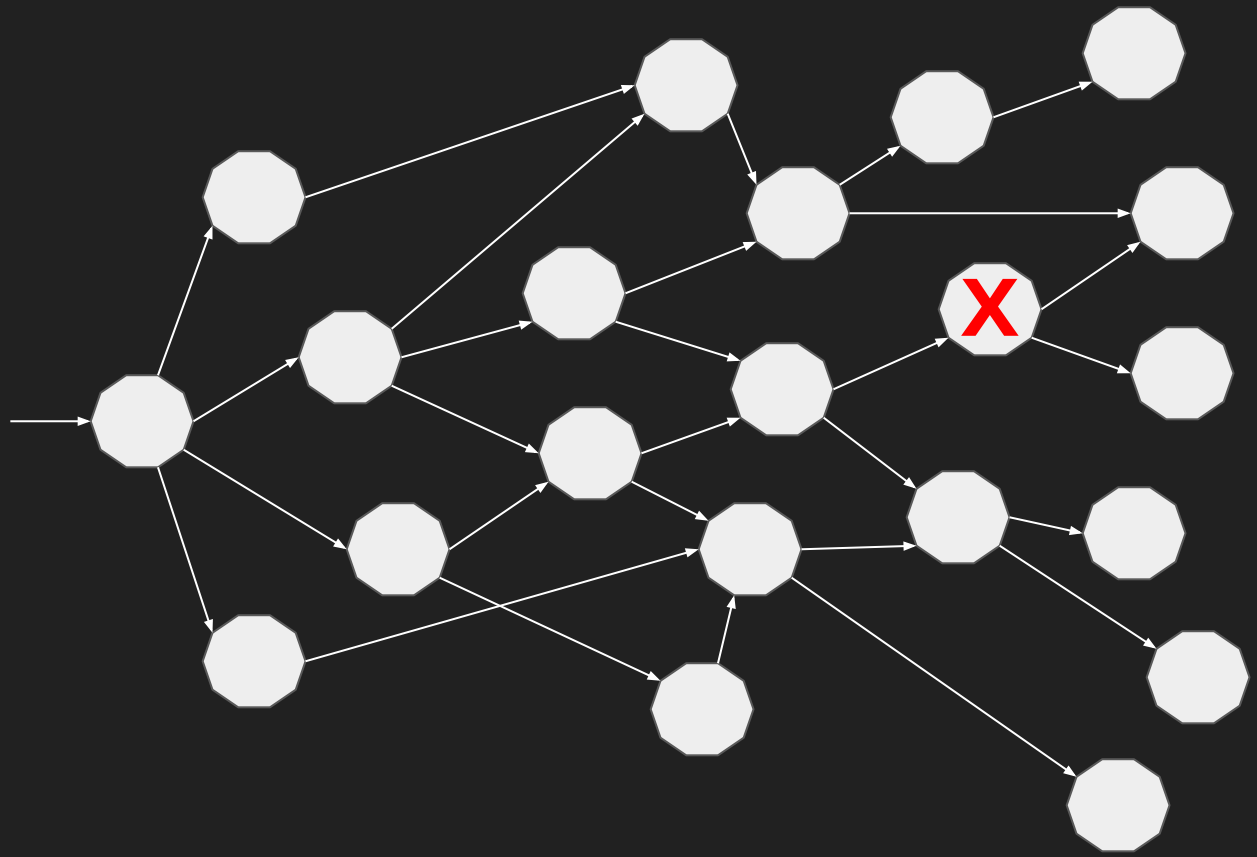


Fallacies of Distributed Computing

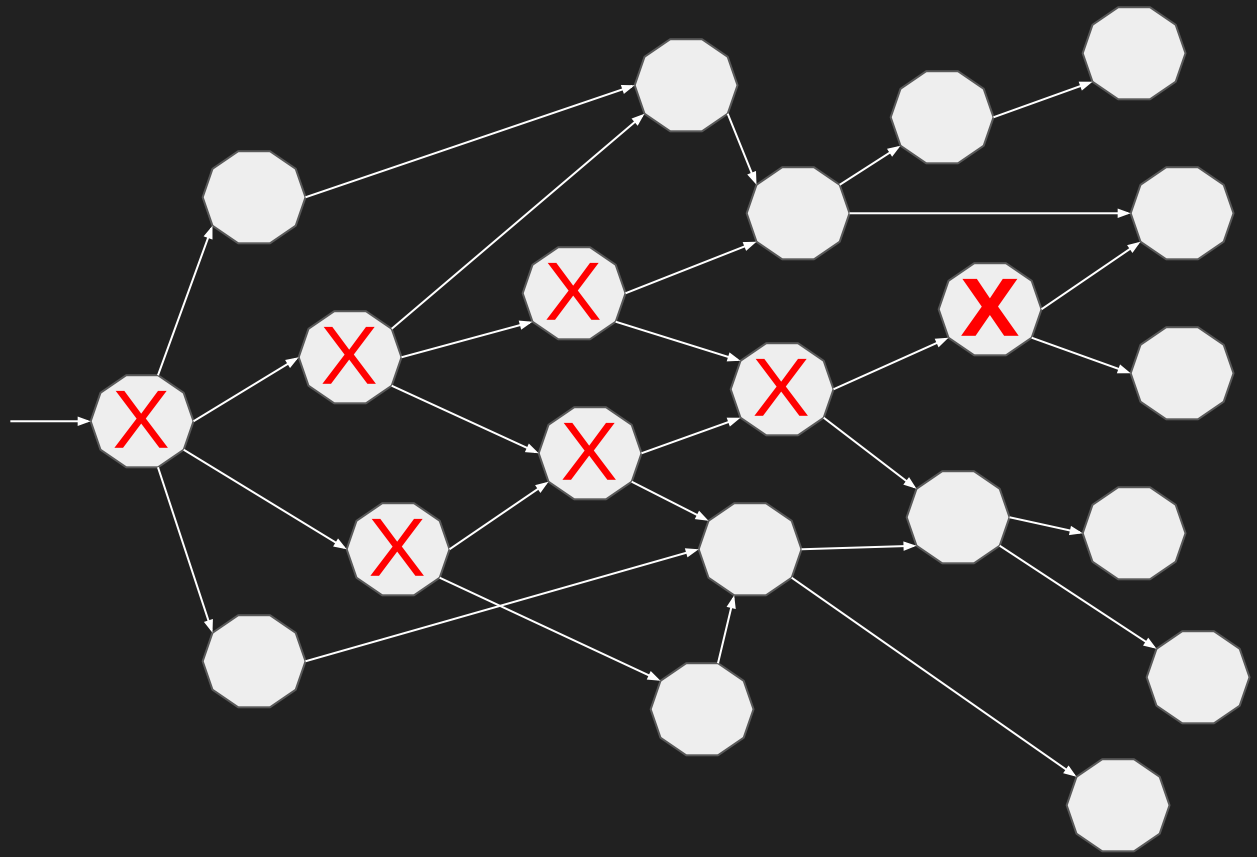
- The Network is Reliable
- Latency is zero
- Bandwidth is infinite
- Topology does not change
- There is one administrator
- Transport cost is zero
- The network is homogeneous

https://en.wikipedia.org/wiki/Fallacies_of_distributed_computing

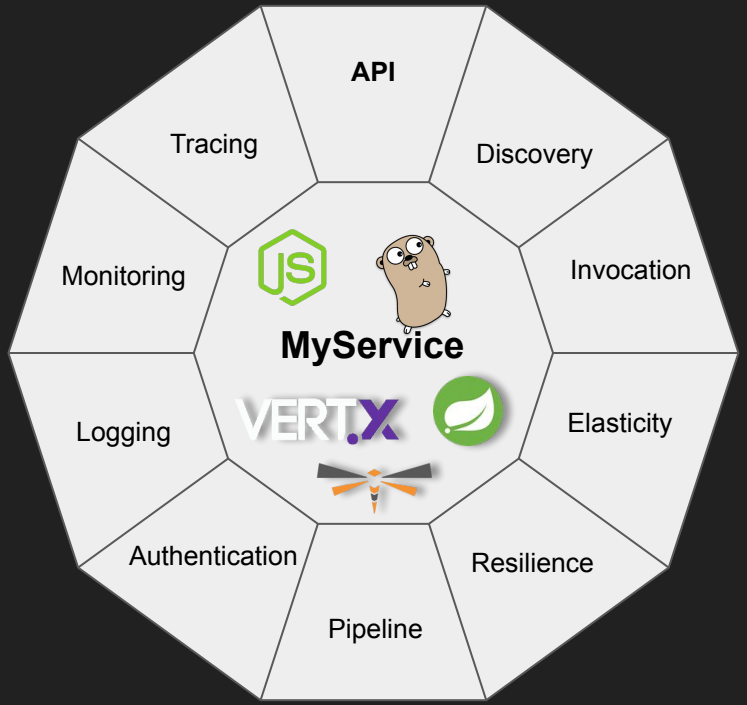
Failure of a Service



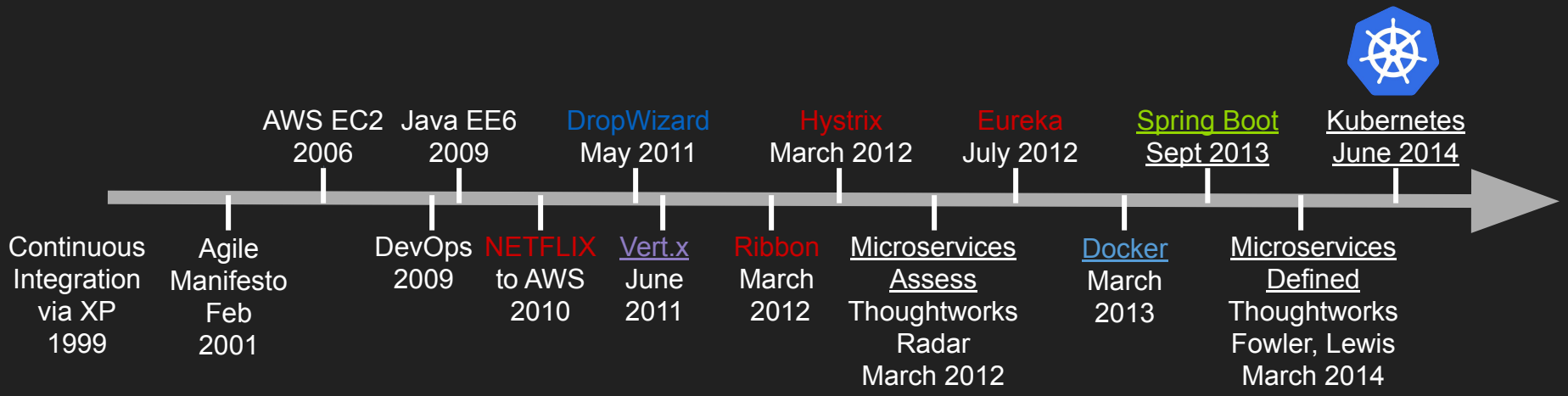
Cascading Failure



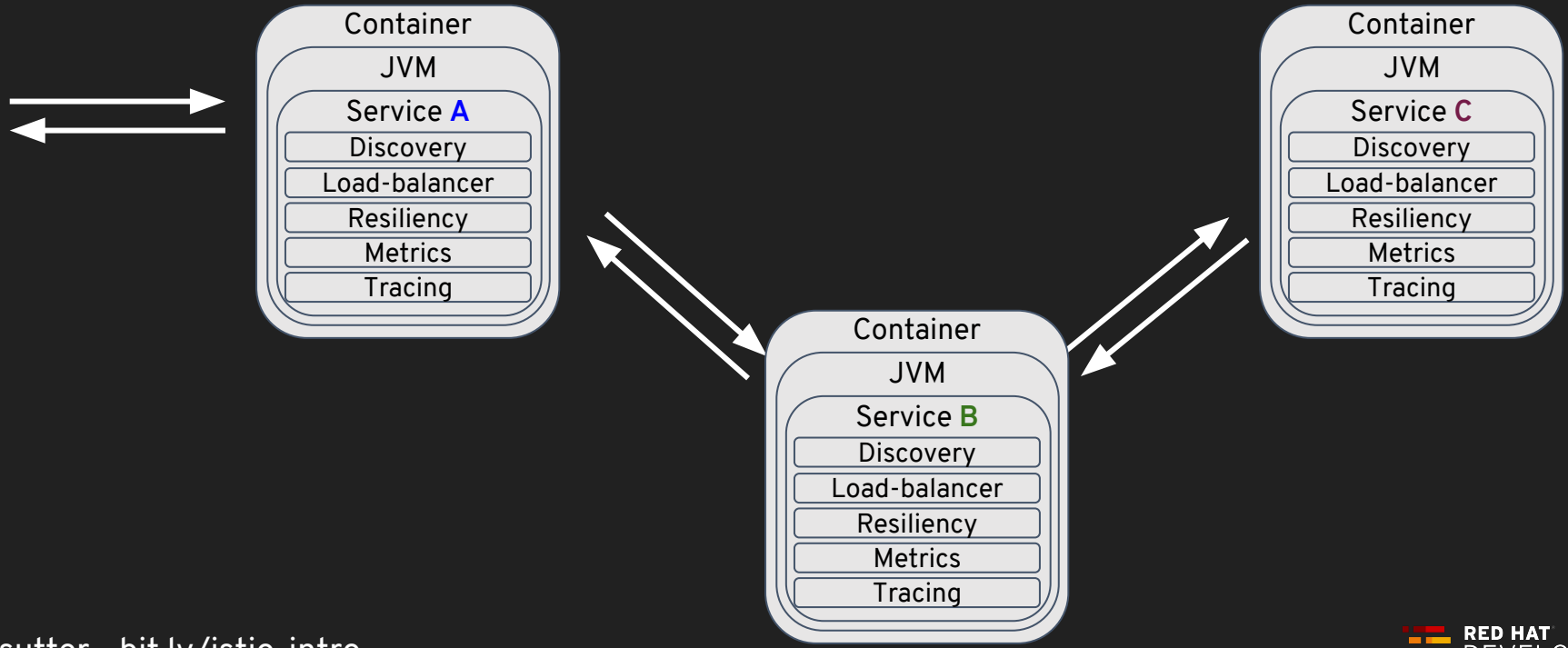
Microservices'ilities



History of Microservices



Microservices embedding Capabilities

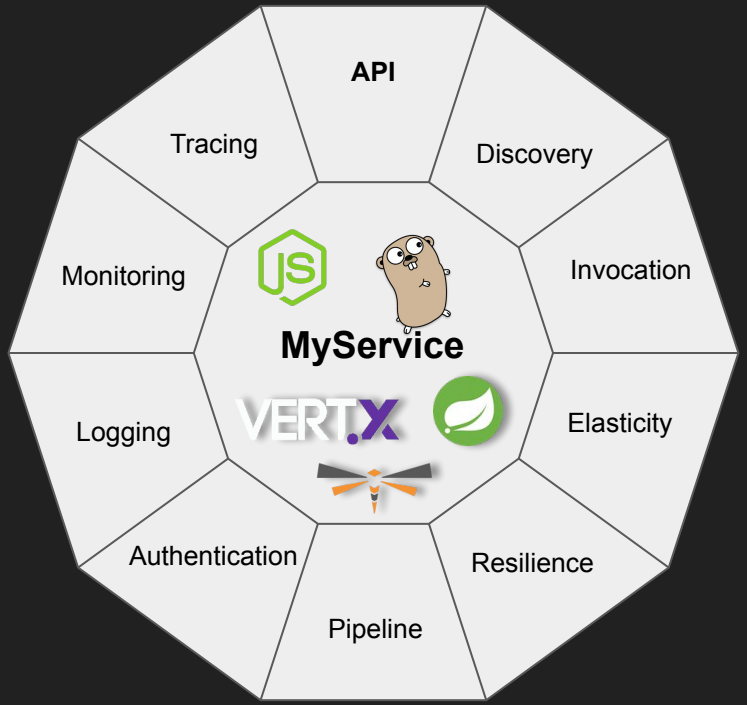


What's Wrong with Netflix OSS?

Java Only

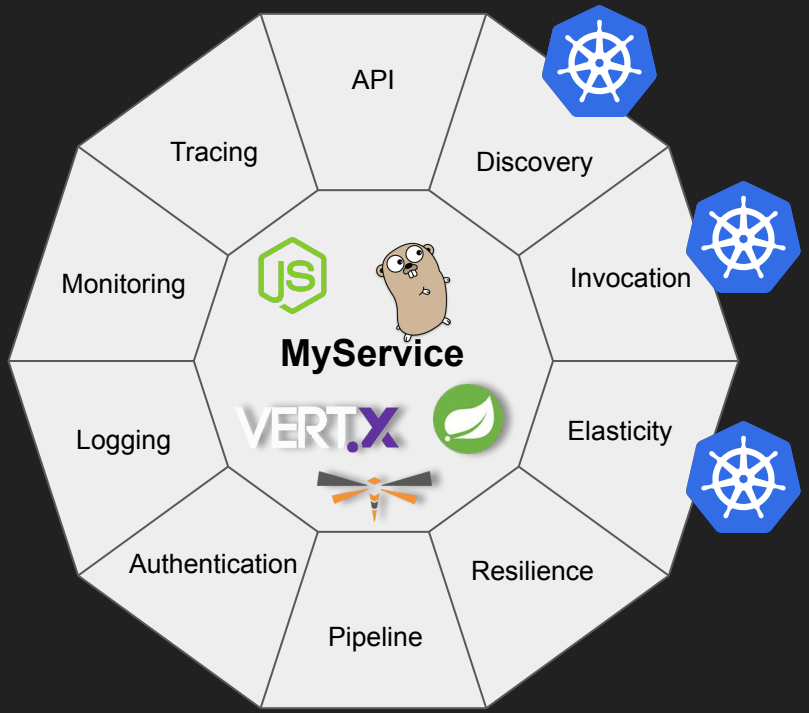
Adds a lot of libraries to YOUR code

Microservices'ilities

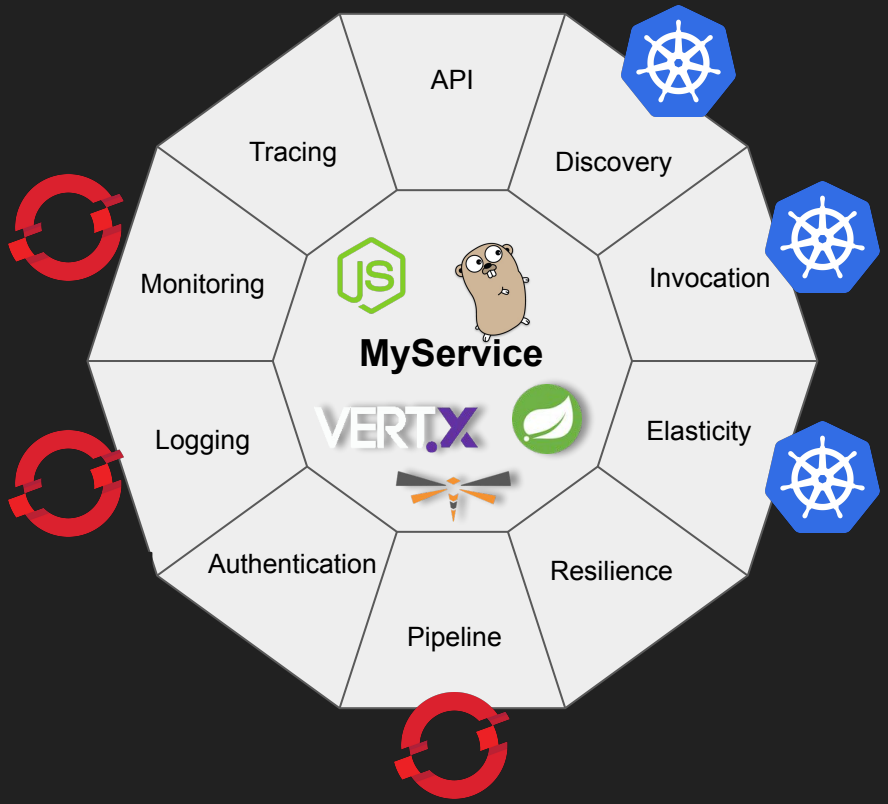


OPENSHIFT

Microservices'ilities + Kubernetes



Microservices'ilities + OpenShift



Kubernetes/OpenShift Re-cap Demo

mvn package, docker build, kubectl apply -f deploy.yml

Istio - Sail

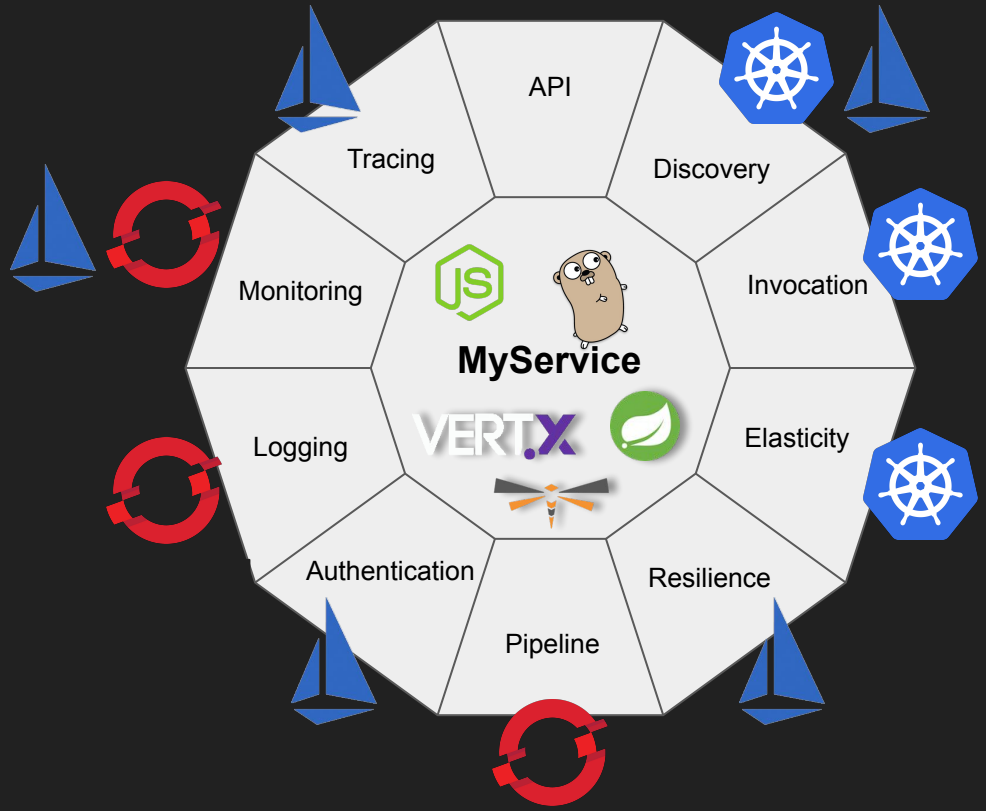
(Kubernetes - Helmsman or ship's pilot)

Service Mesh Defined

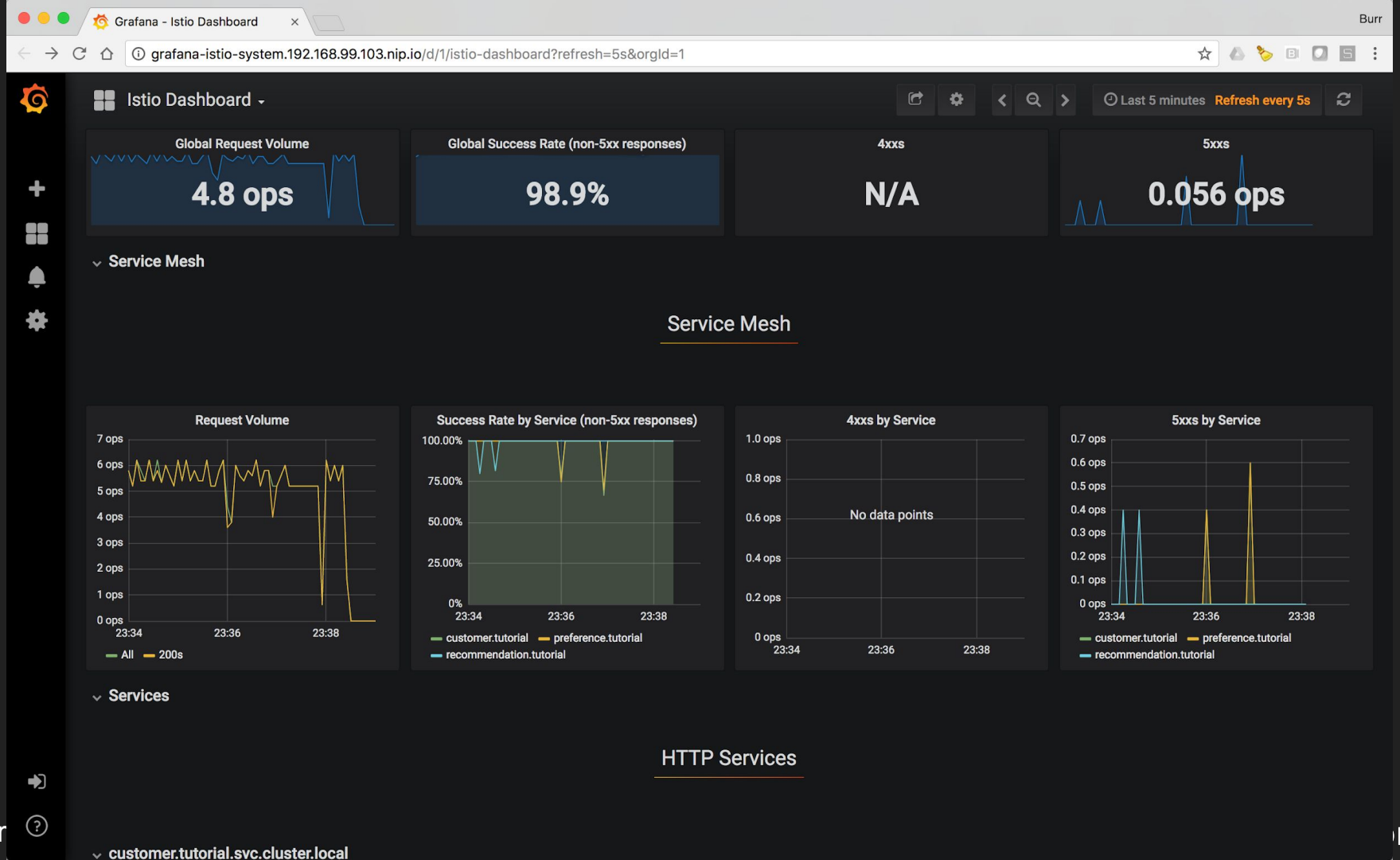
A service mesh is a dedicated infrastructure layer for handling service-to-service communication. It's responsible for the reliable delivery of requests through the complex topology of services that comprise a modern, cloud native application. In practice, the service mesh is typically implemented as an array of lightweight network proxies that are deployed alongside application code, without the application needing to be aware

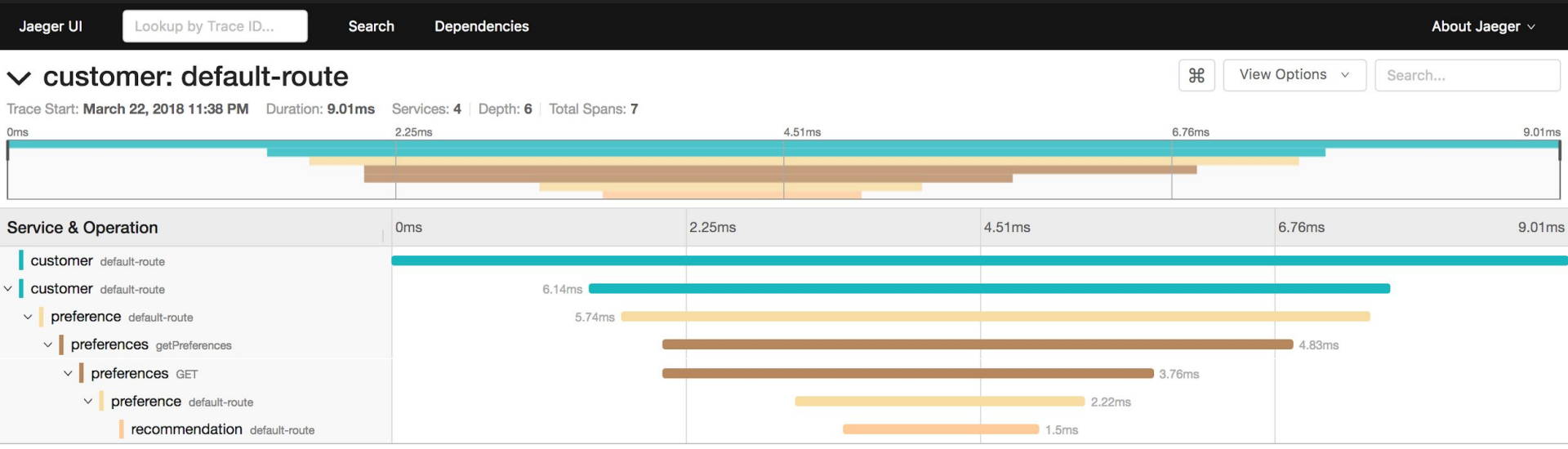
https://buoyant.io/2017/04/25/whats-a-service-mesh-and-why-do-i-need-one/

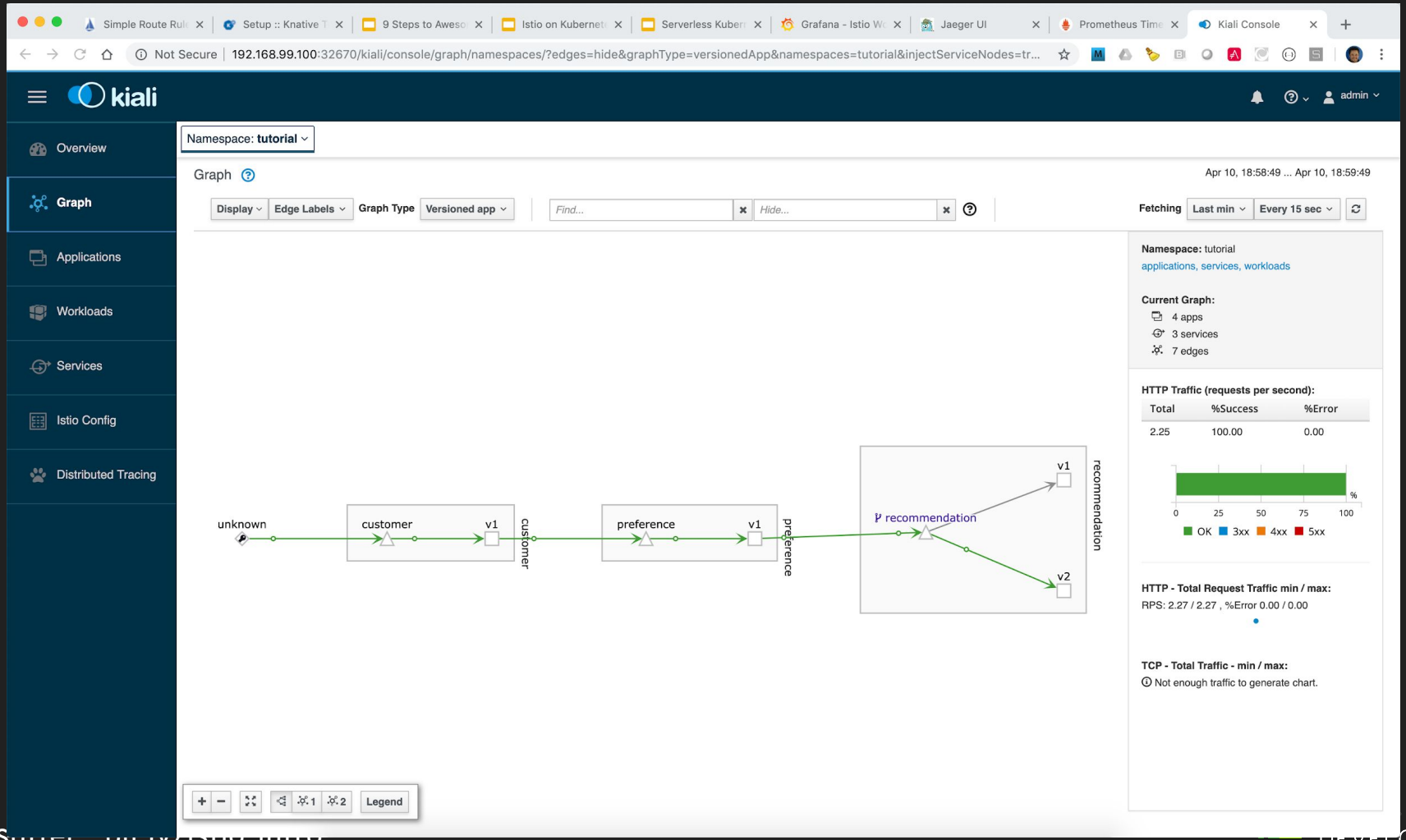
Microservices'ilities + Istio



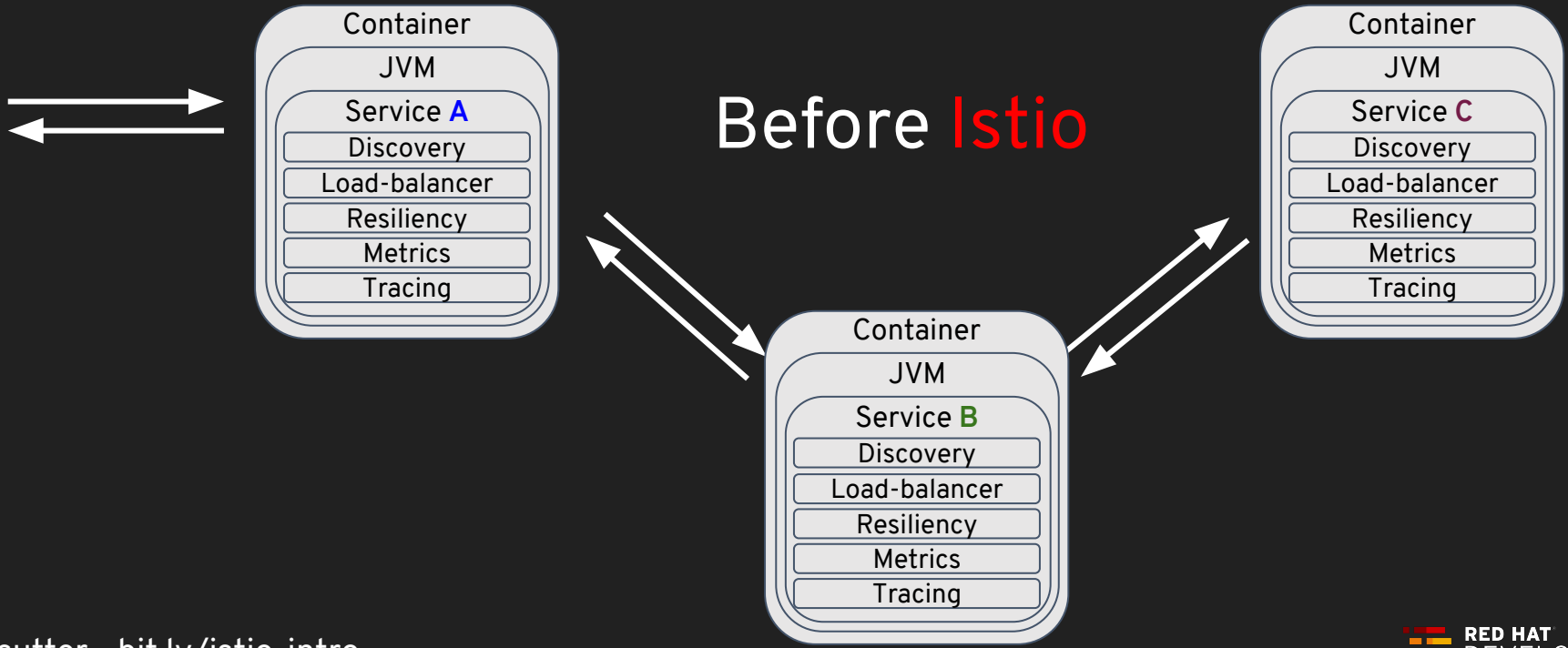
Observability


Grafana - Istio Dashboard
Burr
grafana-istio-system.192.168.99.103.nip.io/d/1/istio-dashboard?refresh=5s&orgId=1
Istio Dashboard
Last 5 minutes
Refresh every 5s
Global Request Volume
4.8 ops
Global Success Rate (non-5xx responses)
98.9%
4xxs
N/A
5xxs
0.056 ops
Service Mesh
Service Mesh
Request Volume
7 ops
6 ops
5 ops
4 ops
3 ops
2 ops
1 ops
0 ops
23:34
23:36
23:38
All
200s
Success Rate by Service (non-5xx responses)
100.00%
75.00%
50.00%
25.00%
0%
customer.tutorial
preference.tutorial
recommendation.tutorial
4xxs by Service
1.0 ops
0.8 ops
0.6 ops
0.4 ops
0.2 ops
0 ops
No data points
5xxs by Service
0.7 ops
0.6 ops
0.5 ops
0.4 ops
0.3 ops
0.2 ops
0.1 ops
Services
HTTP Services
customer.tutorial.svc.cluster.local

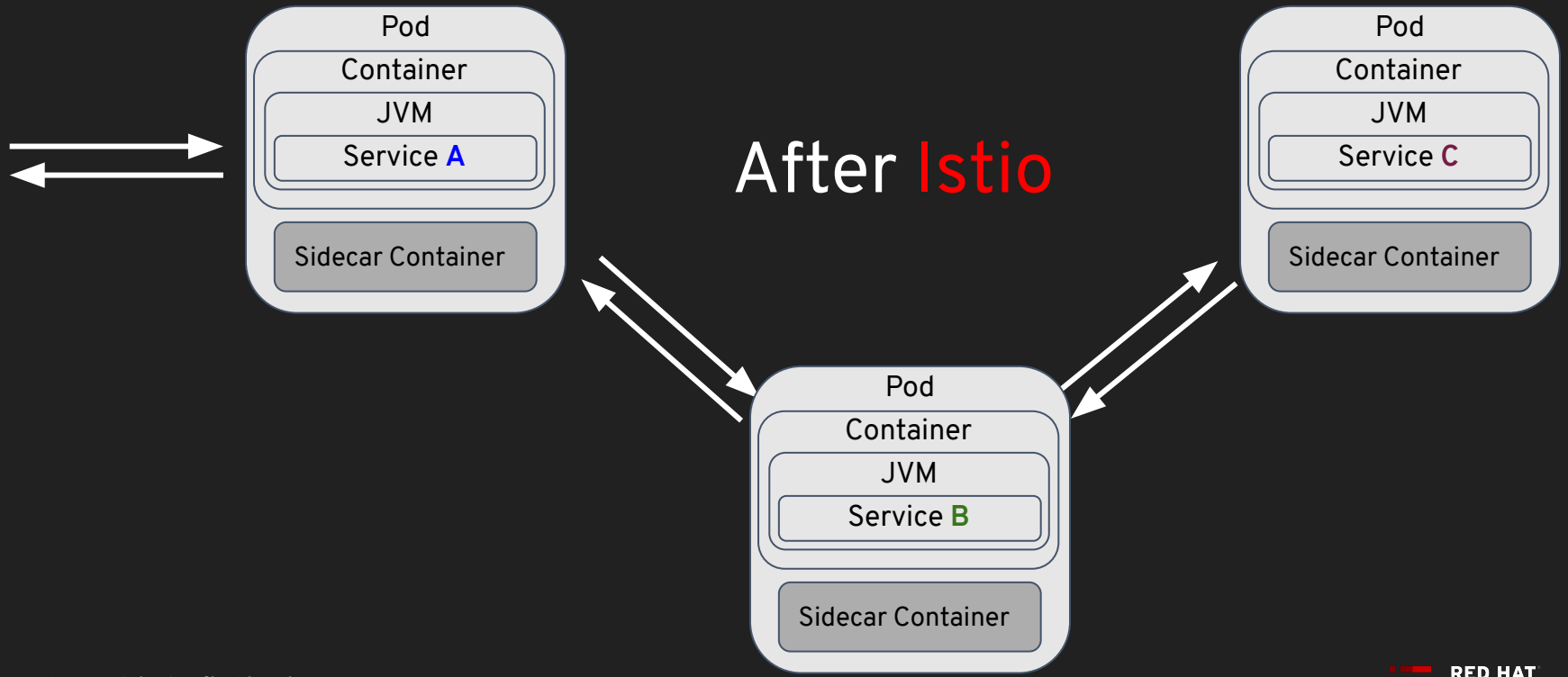



Simple Route Rul
Setup :: Knative T
9 Steps to Aweso
Istio on Kubernet
Serverless Kuber
Grafana - Istio W
Jaeger UI
Prometheus Time
Kiali Console
Not Secure
192.168.99.100:32670/kiali/console/graph/namespaces/?edges=hide&graphType=versionedApp&namespaces=tutorial&injectServiceNodes=tr...
kiali
admin
Overview
Graph
Applications
Workloads
Services
Istio Config
Distributed Tracing
Namespace: tutorial
Graph
Apr 10, 18:58:49 ... Apr 10, 18:59:49
Display
Edge Labels
Graph Type
Versioned app
Find...
Hide...
Fetching
Last min
Every 15 sec
unknown
customer
v1
customer
preference
v1
preference
recommendation
v1
v2
recommendation
Namespace: tutorial
applications, services, workloads
Current Graph:
4 apps
3 services
7 edges
HTTP Traffic (requests per second):
Total
%Success
%Error
2.25
100.00
0.00
0
25
50
75
100
%
OK
3xx
4xx
5xx
HTTP - Total Request Traffic min / max:
RPS: 2.27 / 2.27 , %Error 0.00 / 0.00
TCP - Total Traffic - min / max:
Not enough traffic to generate chart.
Legend

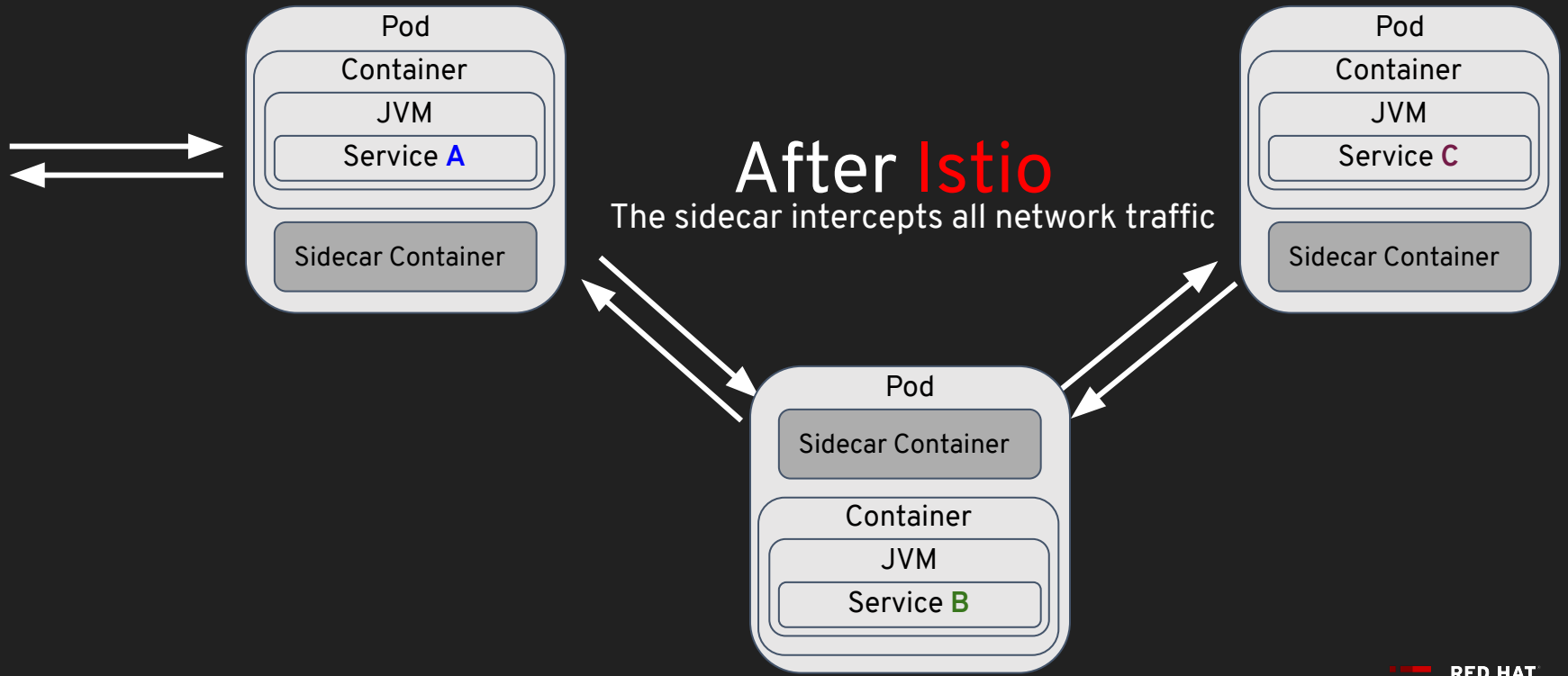
Microservices embedding Capabilities



Microservices externalizing Capabilities



Microservices externalizing Capabilities



Sidecar

https://www.imz-ural.com/blog/waffles-the-sidecar-dog

How to add an Istio-Proxy (sidecar)?

```
istioctl kube-inject -f NormalDeployment.yaml
```

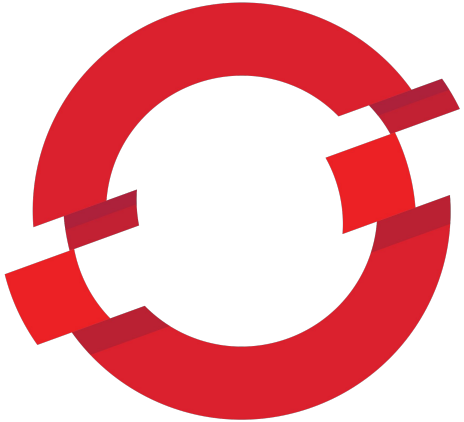
OR

```
kubectl label namespace myspace istio-injection=enabled
```

To "see" the sidecar:

```
kubectl describe deployment customer
```

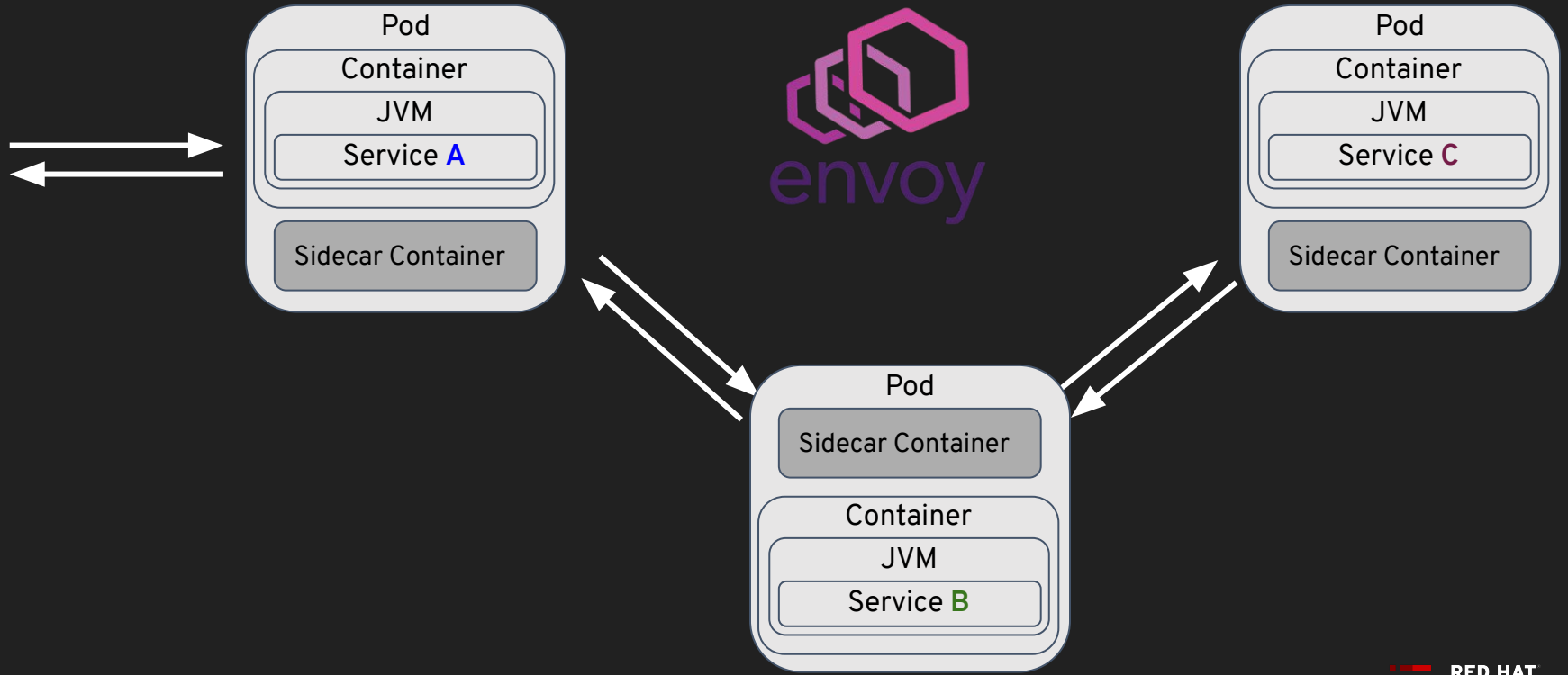
Better Microservices Platform circa 2018



OPENSHIFT

Polyglot Microservices Platform circa 2018

Envoy is the current sidecar

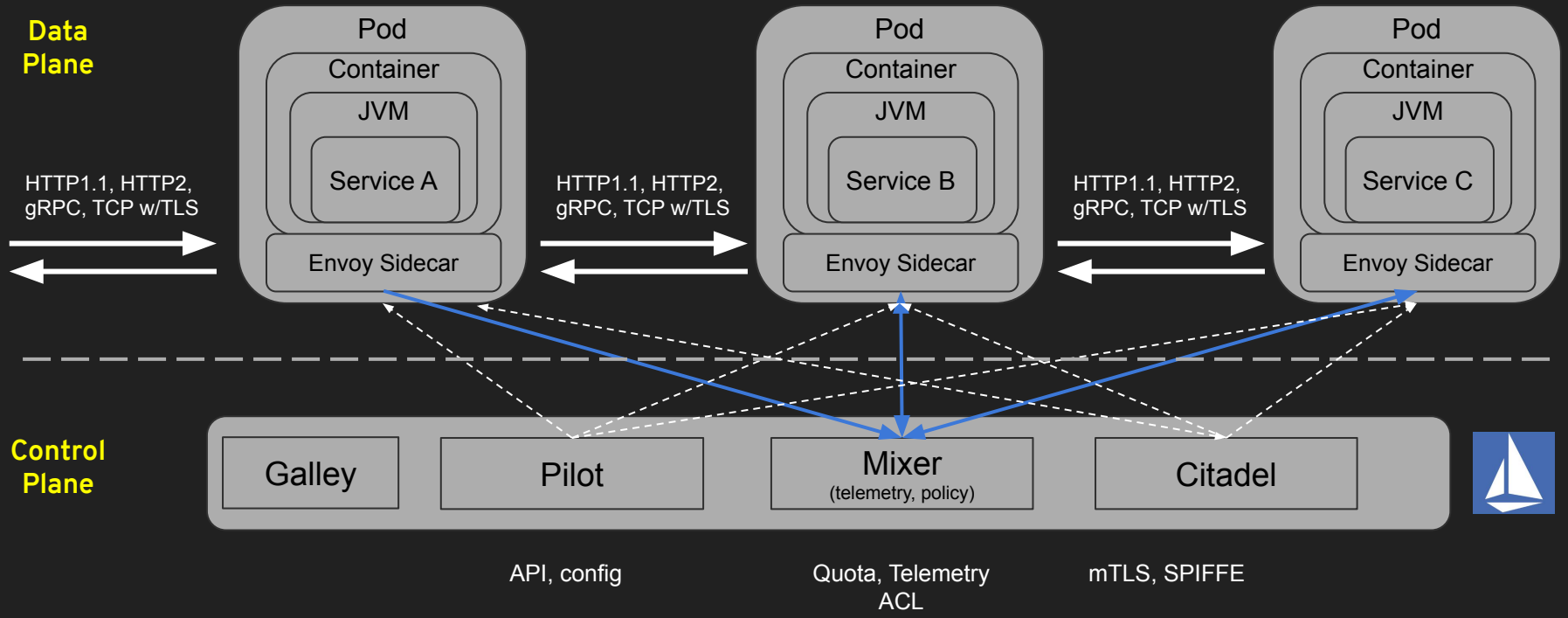


Next Generation Microservices - Service Mesh

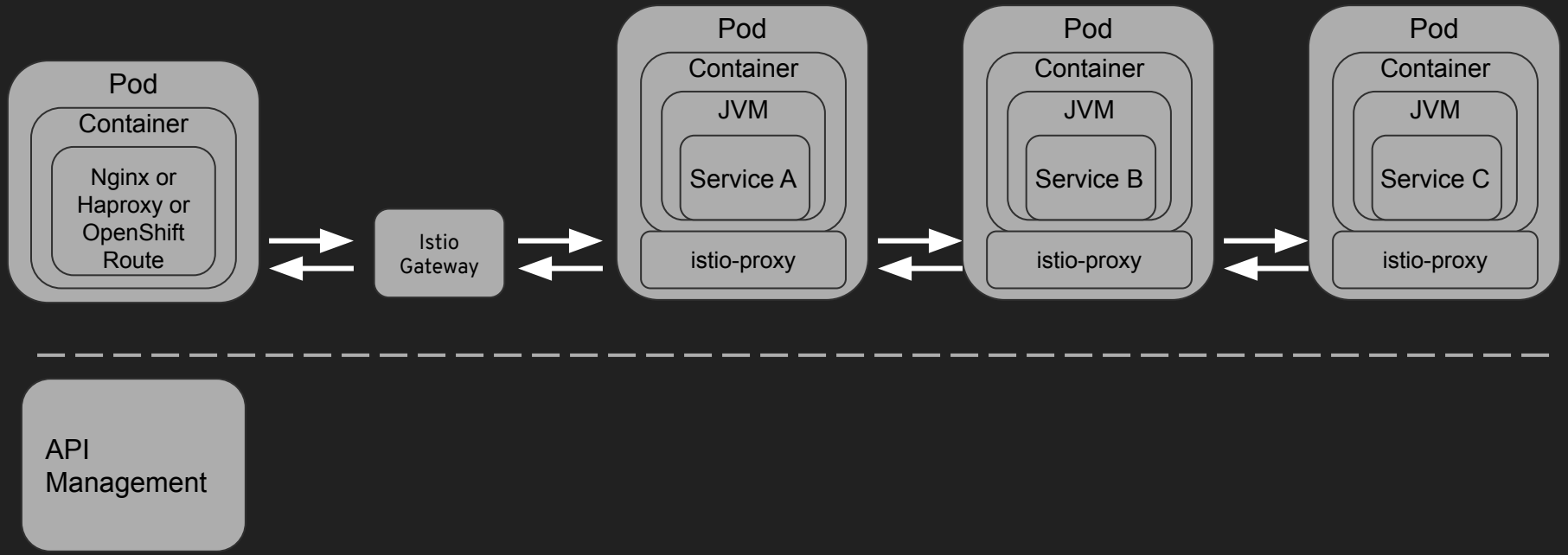
Code Independent (Polyglot)

- Intelligent Routing and Load-Balancing
  - Smarter Canary Releases
  - Dark Launch
- Chaos: Fault Injection
- Resilience: Circuit Breakers
- Observability & Telemetry: Metrics and Tracing
- Security: Encryption & Authorization
- Fleet wide policy enforcement

Istio Data Plane vs Control Plane



API Gateways



kubectl get crds

Adapters.config.istio.io
Apikeys.config.istio.io
Attributemanifests.config.istio.io
Authorizations.config.istio.io
Bypasses.config.istio.io
Checknothings.config.istio.io
Circonuses.config.istio.io
Cloudwatches.config.istio.io
Deniers.config.istio.io
Destinationrules.networking.istio.io
Dogstatsds.config.istio.io
Edges.config.istio.io
Envoyfilters.networking.istio.io
Fluentds.config.istio.io
Gateways.networking.istio.io
Handlers.config.istio.io
Httpapispecbindings.config.istio.io
Httpapispecs.config.istio.io
Instances.config.istio.io
Kubernetesenvs.config.istio.io
Kuberneteses.config.istio.io
Listcheckers.config.istio.io
Listentries.config.istio.io
Logentries.config.istio.io
Memquotas.config.istio.io
Meshpolicies.authentication.istio.io
Metrics.config.istio.io
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Quotaspecbindings.config.istio.io
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Rbacconfigs.rbac.istio.io
Rbacs.config.istio.io
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Reportnothings.config.istio.io
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Servicecontrolreports.config.istio.io
Servicecontrols.config.istio.io
Serviceentries.networking.istio.io
Servicerolebindings.rbac.istio.io
Serviceroles.rbac.istio.io
Signalfxs.config.istio.io
Solarwindses.config.istio.io
Stackdrivers.config.istio.io
Statsds.config.istio.io
Stdios.config.istio.io
Templates.config.istio.io
Tracespans.config.istio.io
Virtualservices.networking.istio.io

CustomResourceDefinitions
of Istio 1.0.x

kubectl api-resources | grep istio

Main Istio Resources (API Objects based on CRDs)

- VirtualService
  - defines the rules that control how requests for a service are routed within an Istio service mesh
  - routing logic, load weighting, chaos injection
- DestinationRule
  - configures the set of policies to be applied to a request after VirtualService routing has occurred
  - load-balancer, outlier, circuit breaker
- ServiceEntry - egress enablement
- Gateway - making a service external to cluster - Ingres
- Policy - enable mTLS
- ServiceRole - roles for RBAC
- ServiceRoleBinding - "users" for the ServiceRole

Exercises

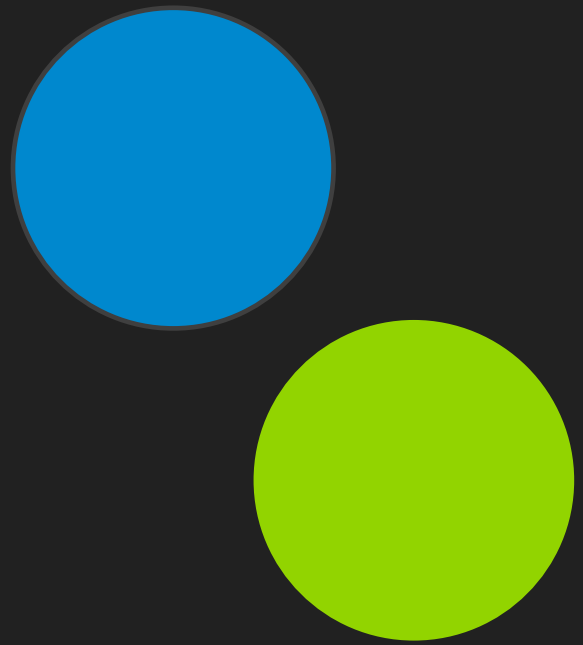
bit.ly/istio-tutorial

Traffic Control

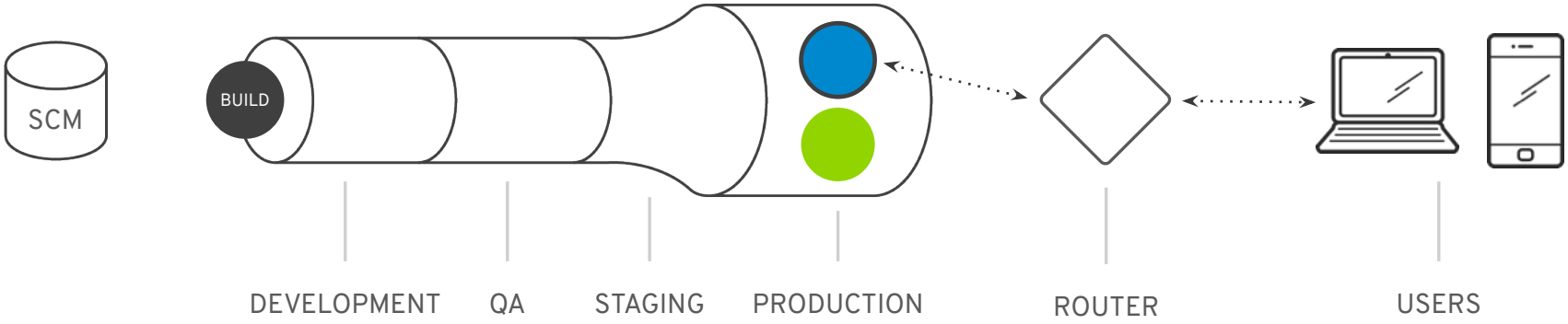
Traffic Control

- Blue/Green part of base Kubernetes/OpenShift
- Percentages not based on pod count - Canary Deployment
- Smart Canaries
- Dark Launch

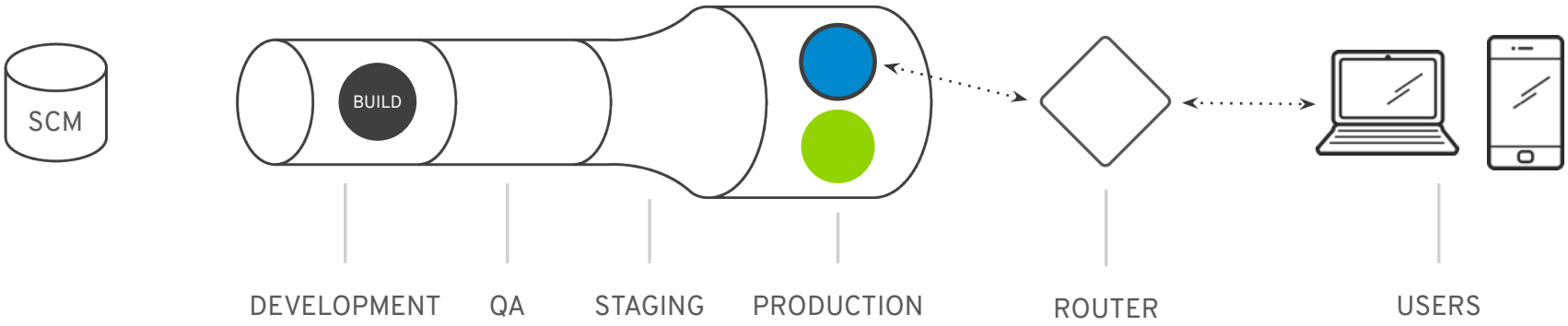
Blue/Green Deployment



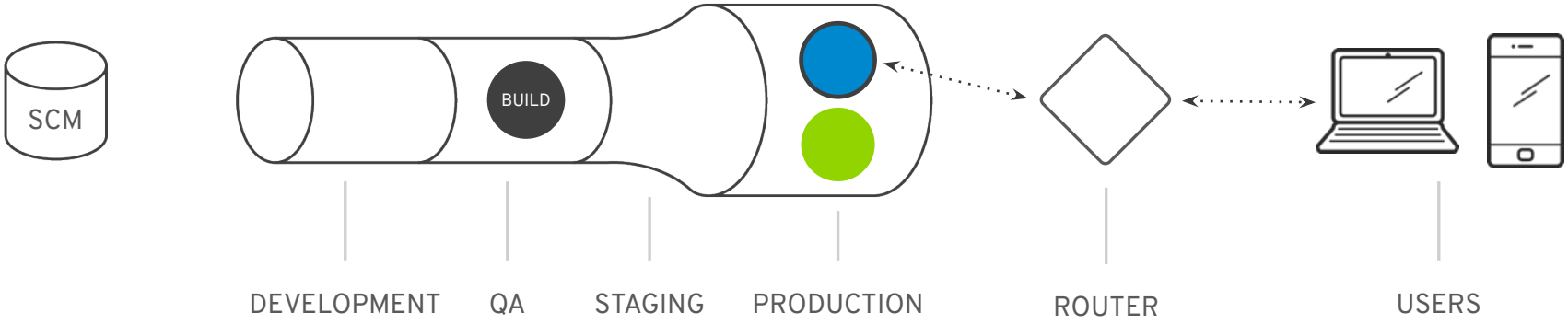
Blue/Green Deployment



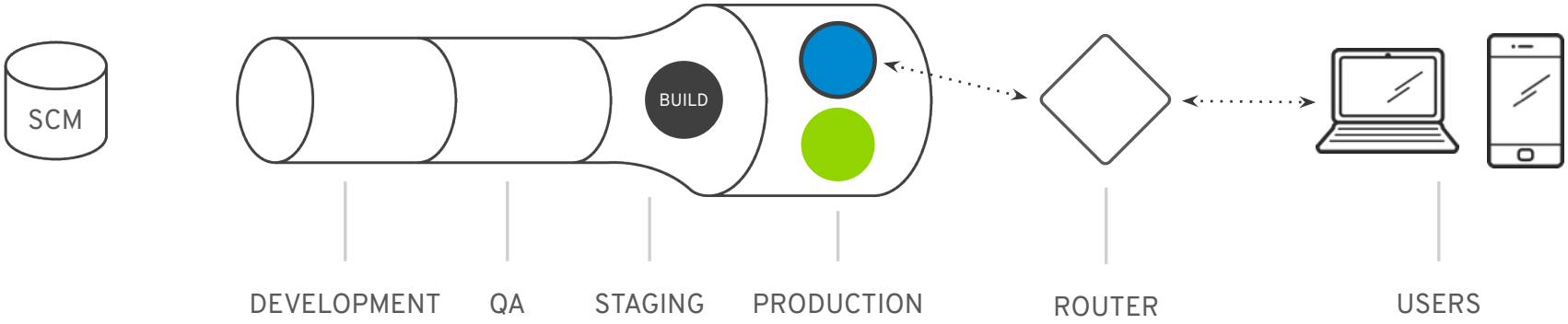
Blue/Green Deployment



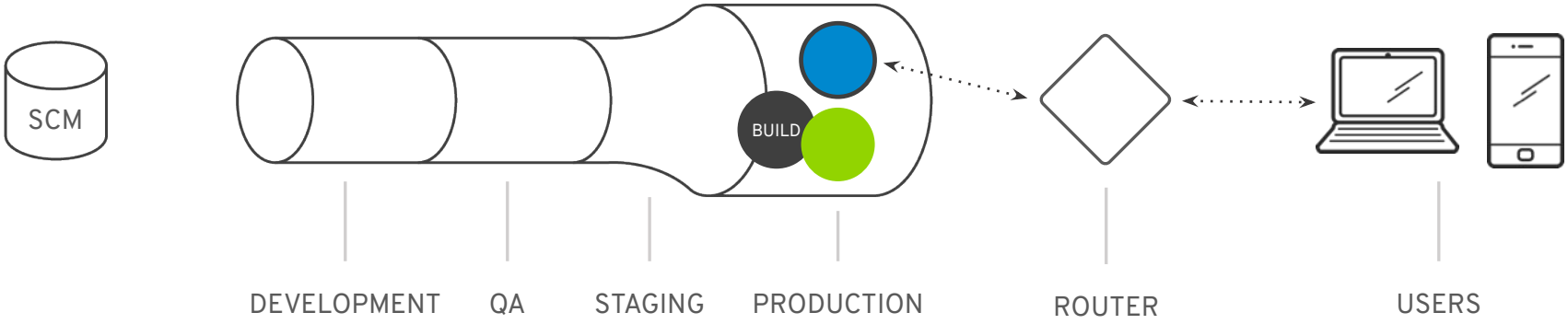
Blue/Green Deployment



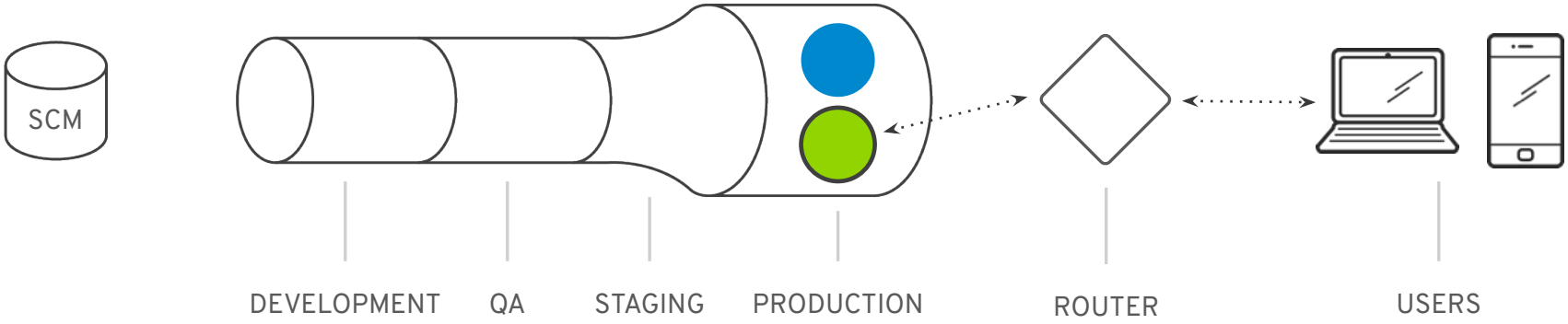
Blue/Green Deployment



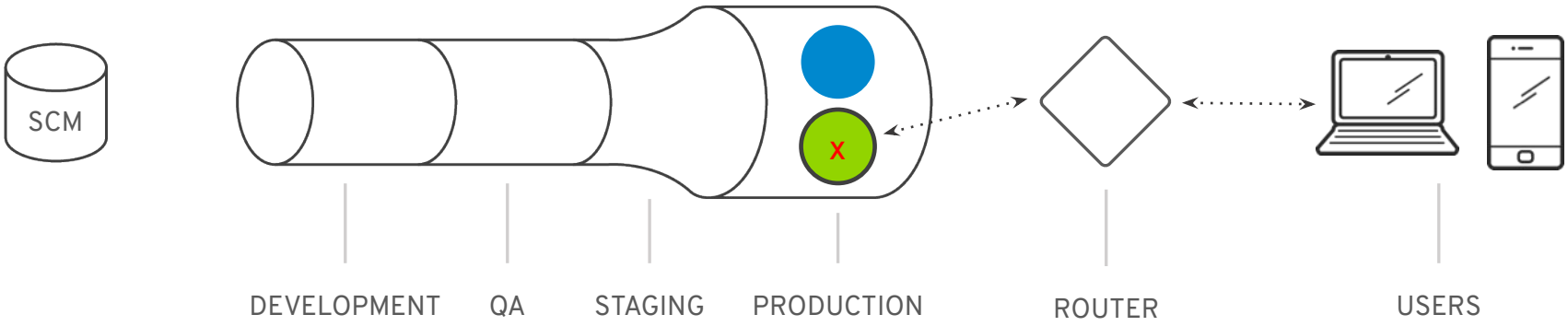
Blue/Green Deployment



Blue/Green Deployment



Blue/Green Deployment



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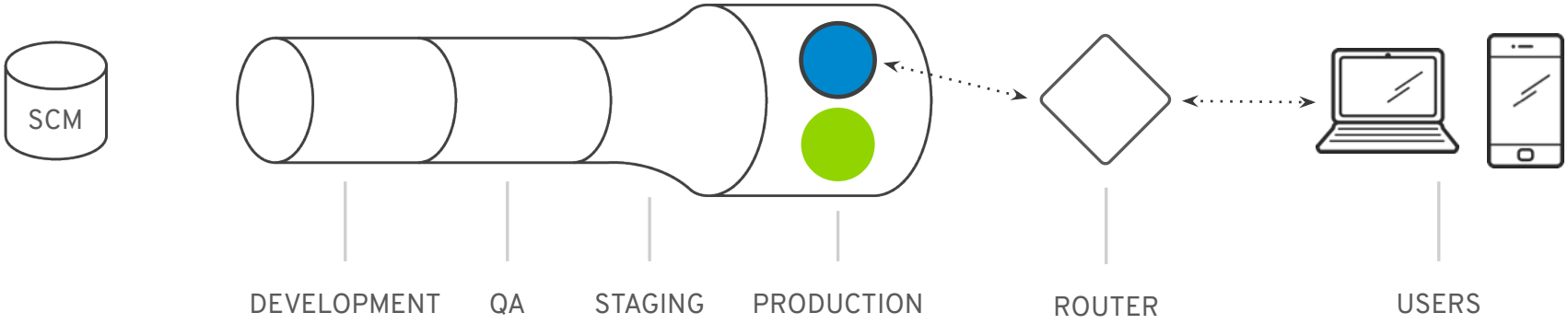
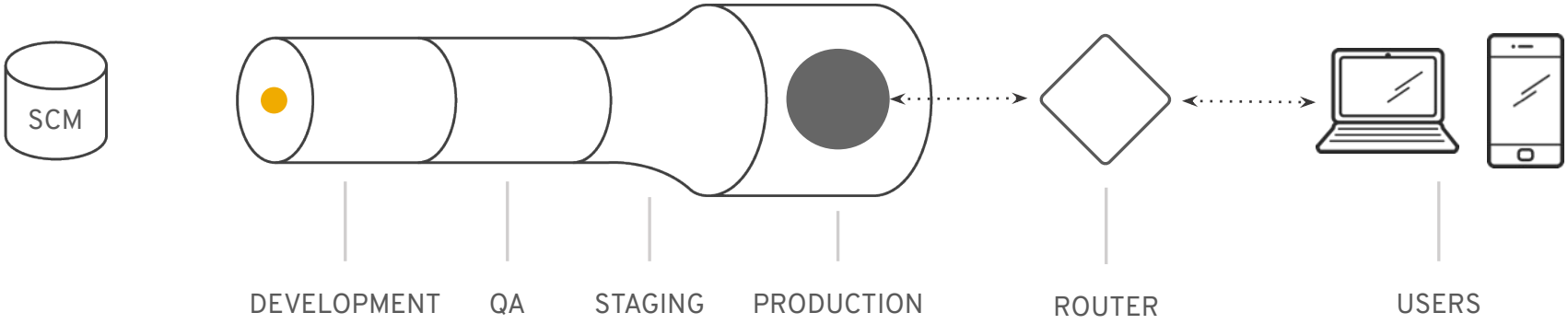
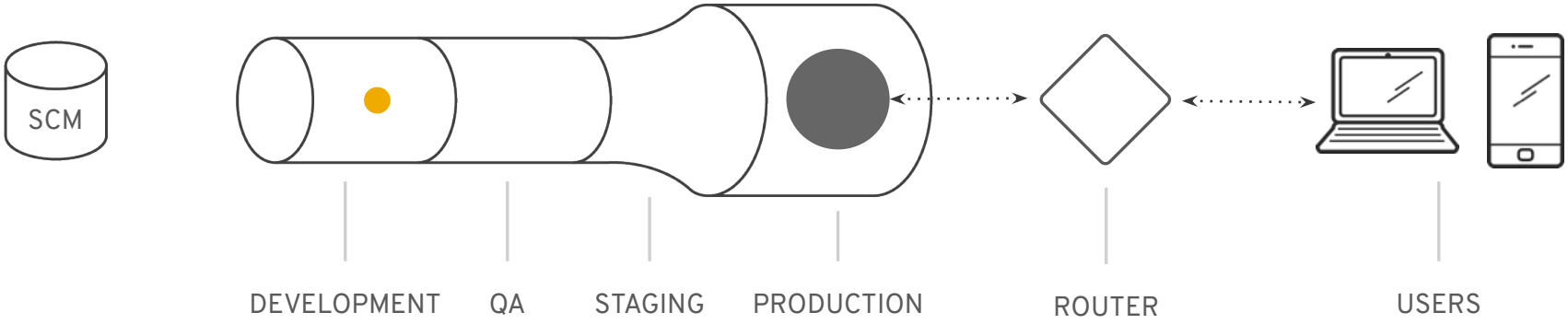


Canary Deployment

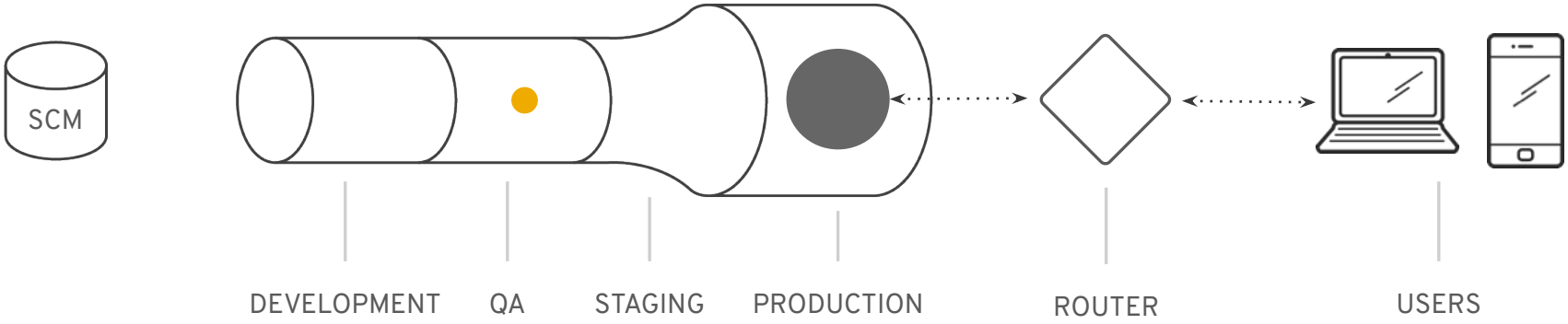
Canary Deployment



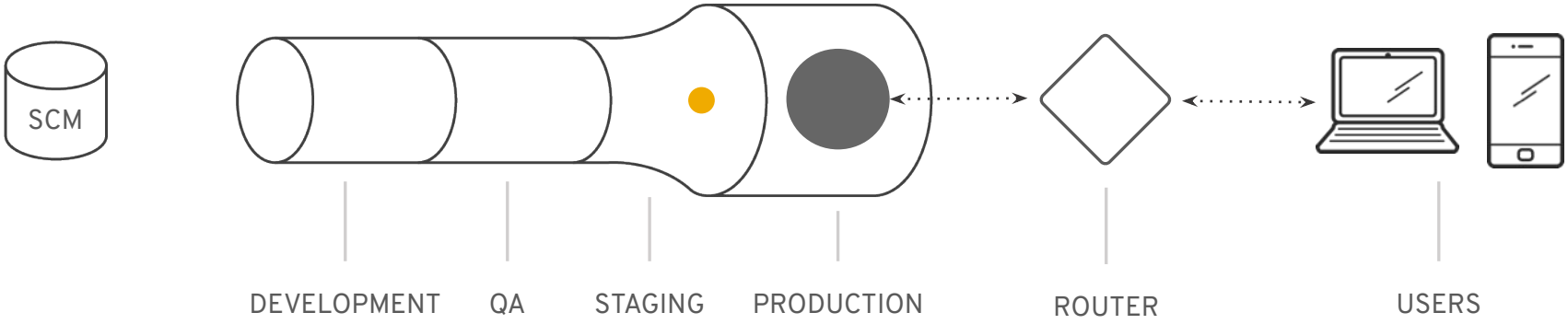
Canary Deployment



Canary Deployment



Canary Deployment



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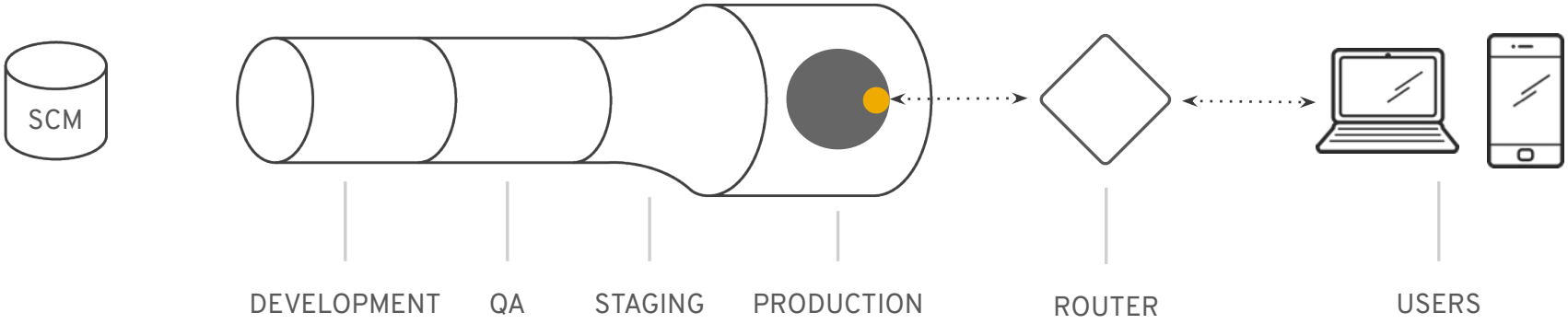

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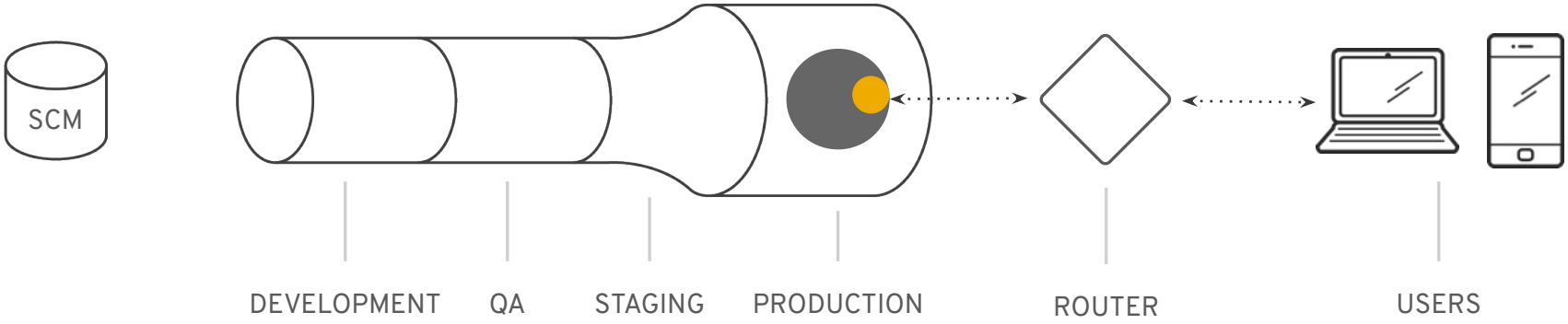

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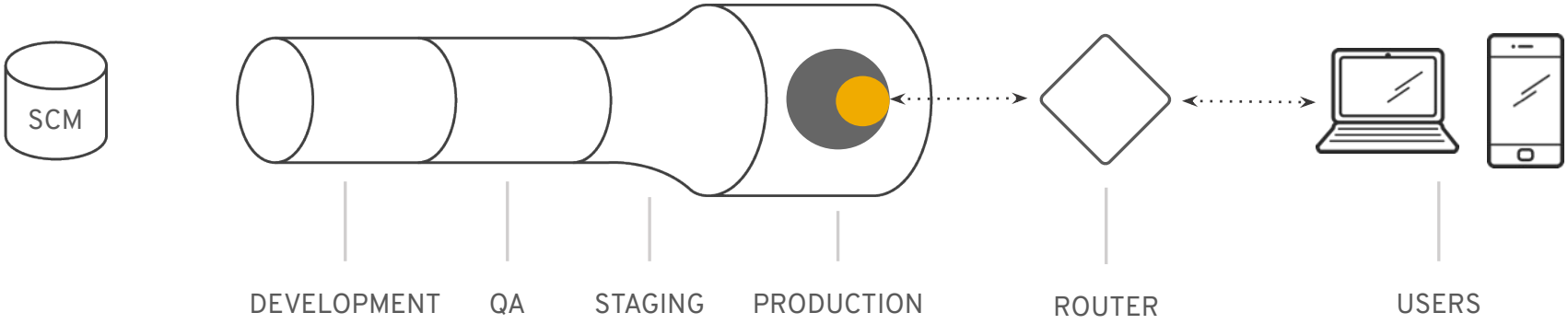
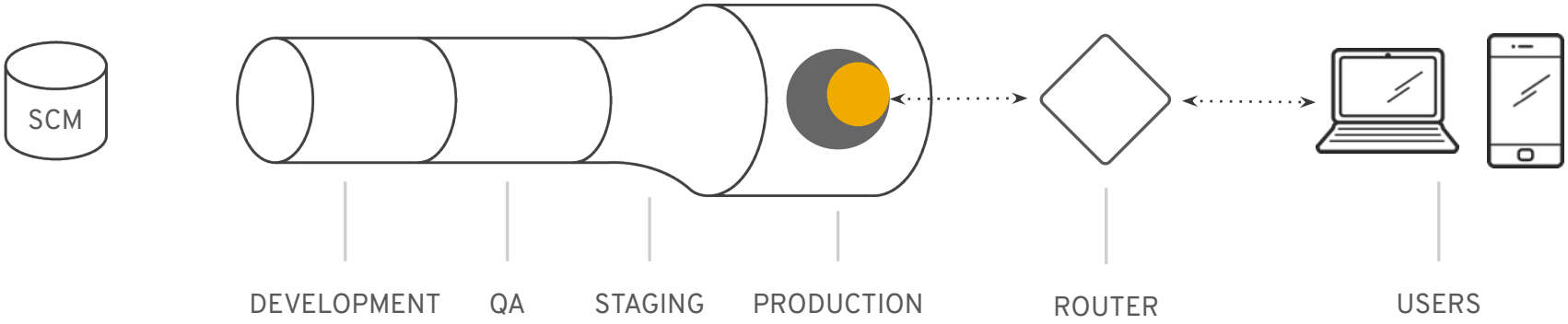
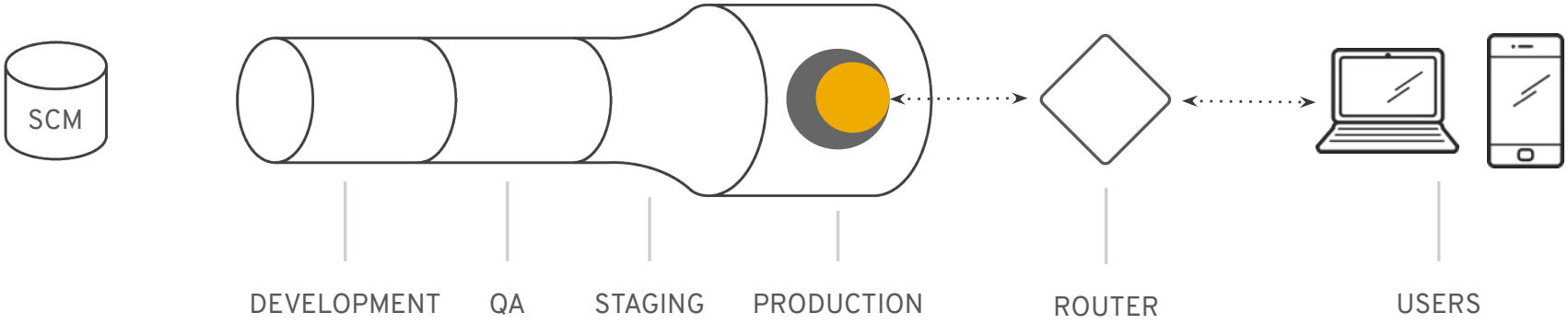


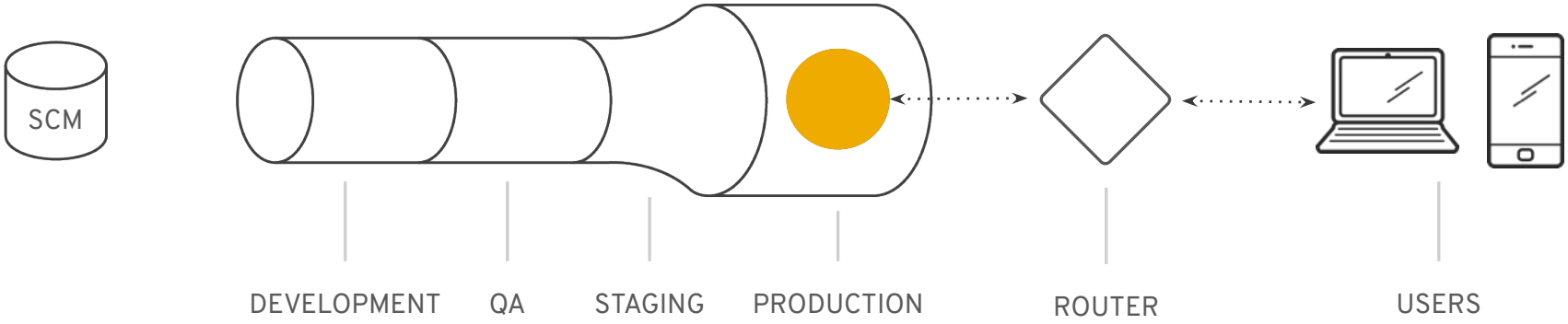
Canary Deployment



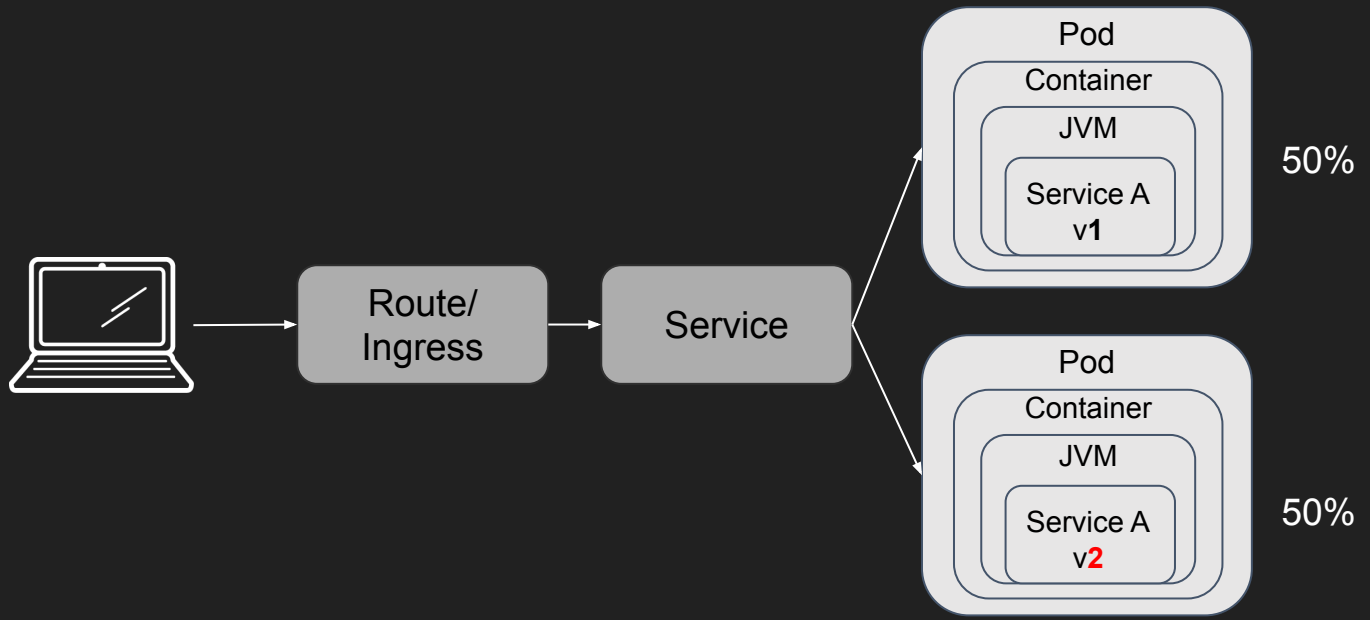
Canary Deployment



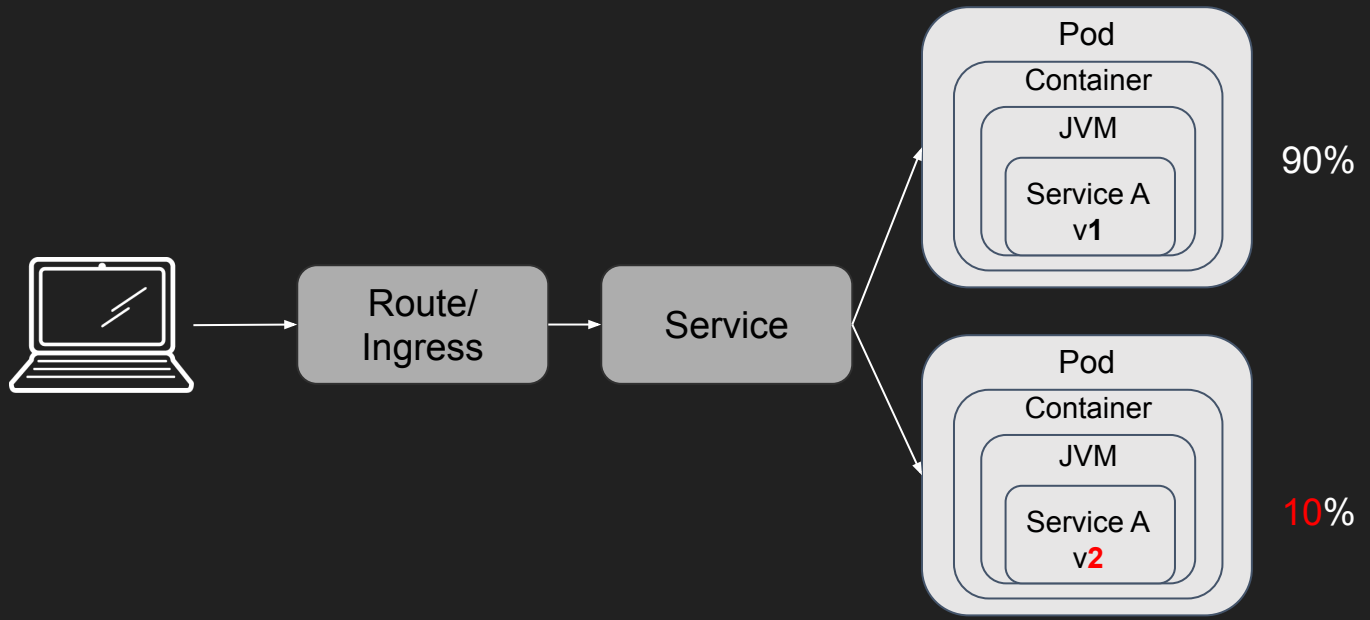
Canary Deployment



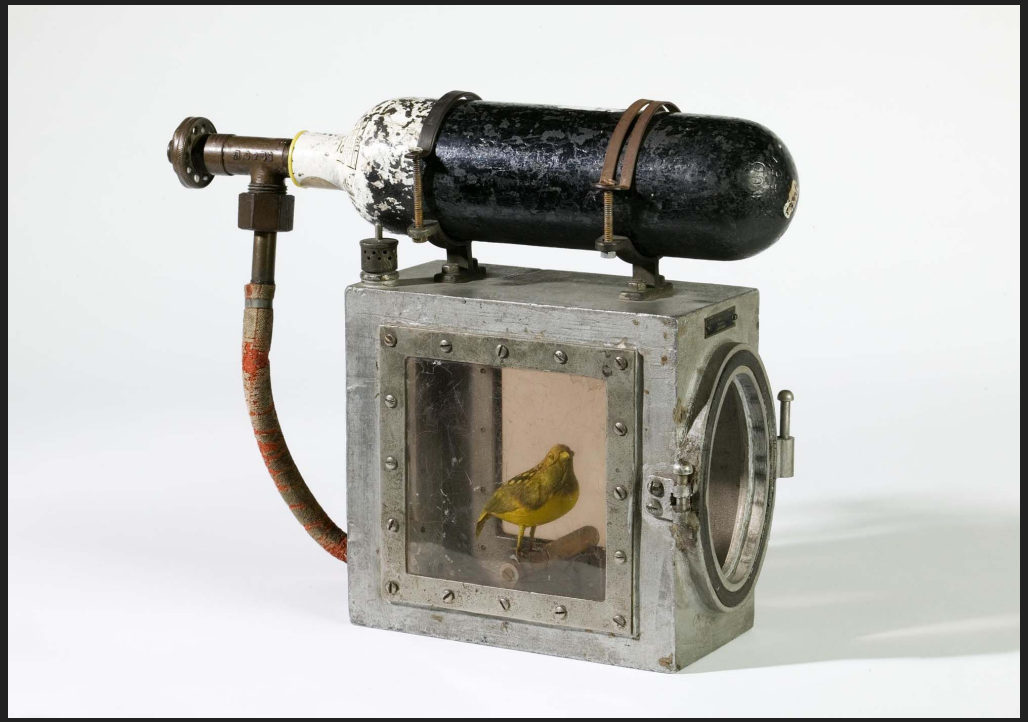
Canaries with Kubernetes



Canaries with Istio



Canary Resuscitator



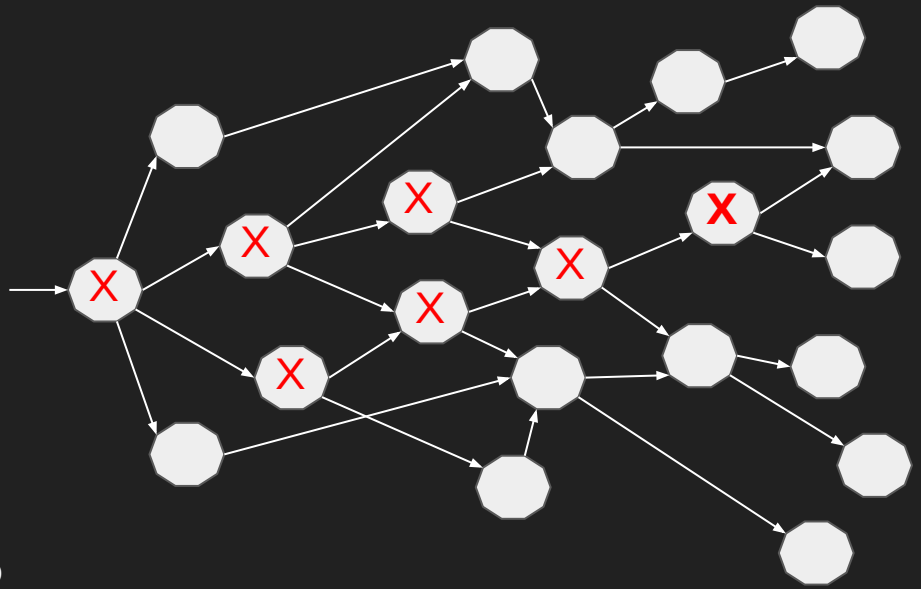
http://www.openculture.com/2018/05/the-device-invented-to-resuscitate-canaries-in-coal-mines-circa-1896.html

Thanks to **Paolo Antinori!**

Service Resiliency

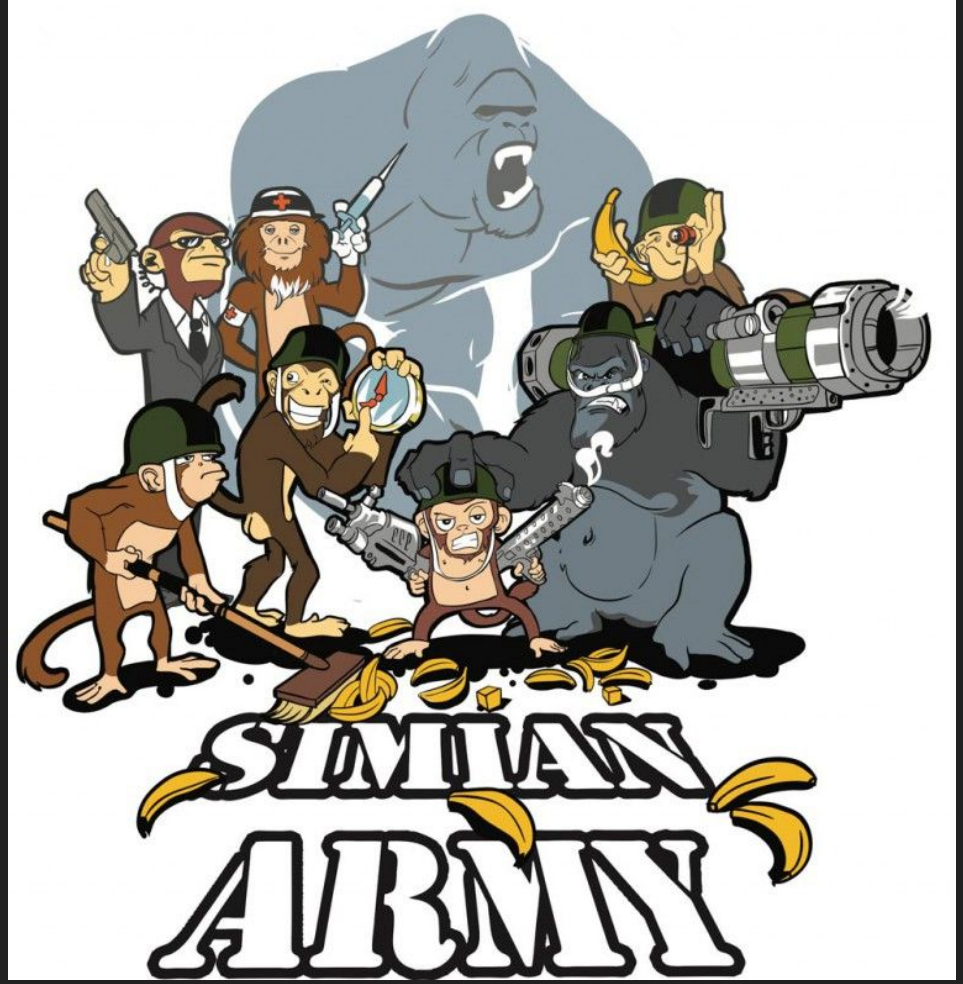
Service Resiliency

- Fail Fast: Latency Circuit Breaker



Chaos Testing

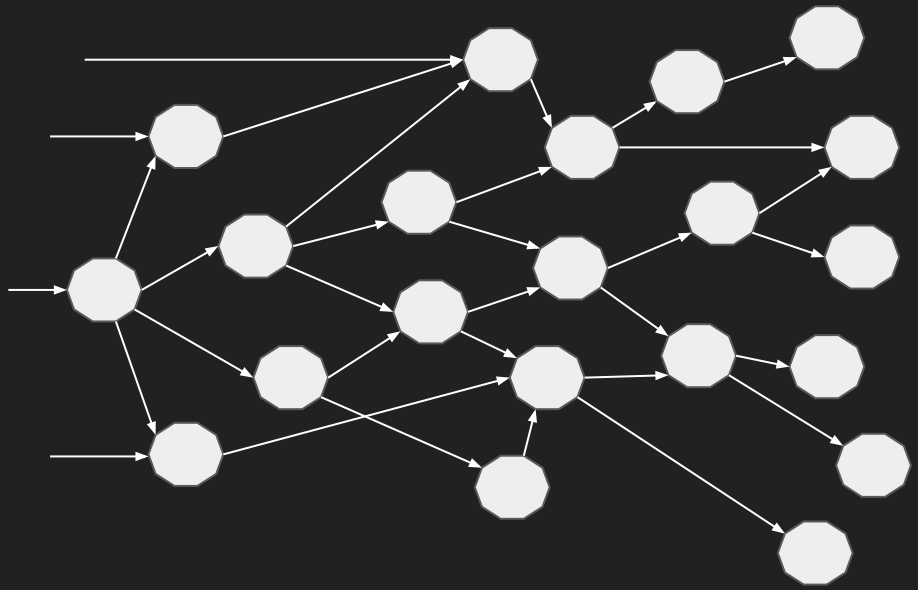
https://principlesofchaos.org/



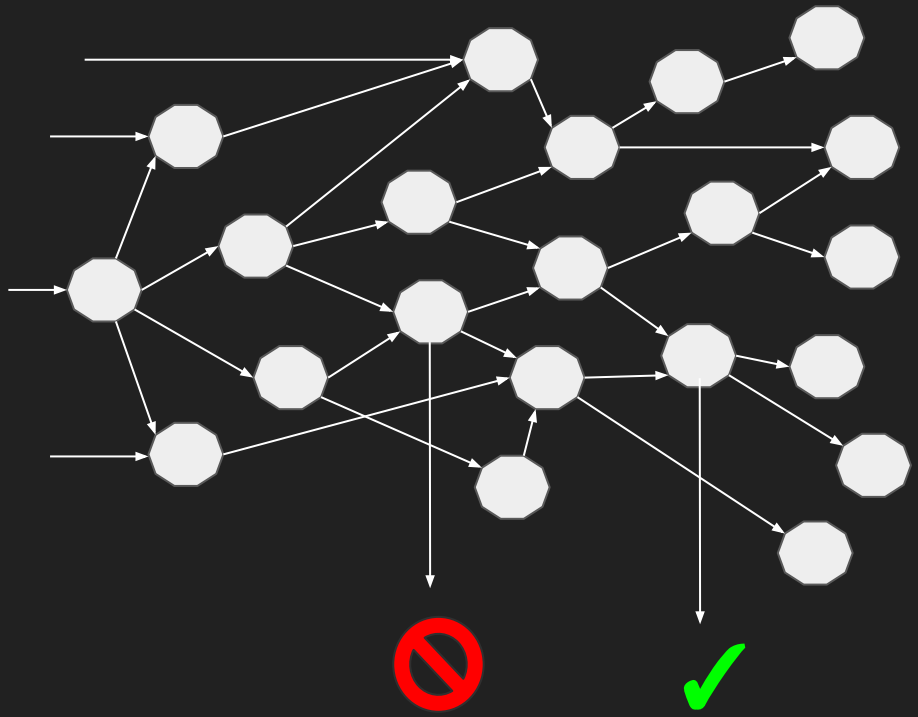
By Netflix - https://github.com/Netflix/SimianArmy/blob/master/assets/SimianArmy.png, Apache License 2.0, https://commons.wikimedia.org/w/index.php?curid=63503083

Egress

Most Communication Inbound & Internal



Outbound/Egress Blocked By Default



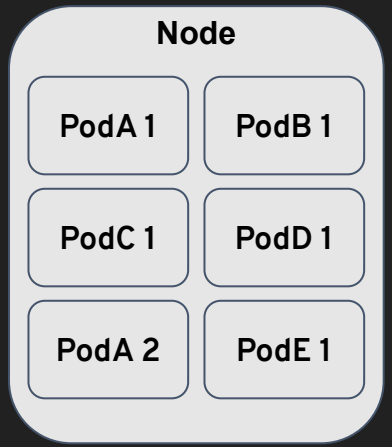
Security

Why Security?

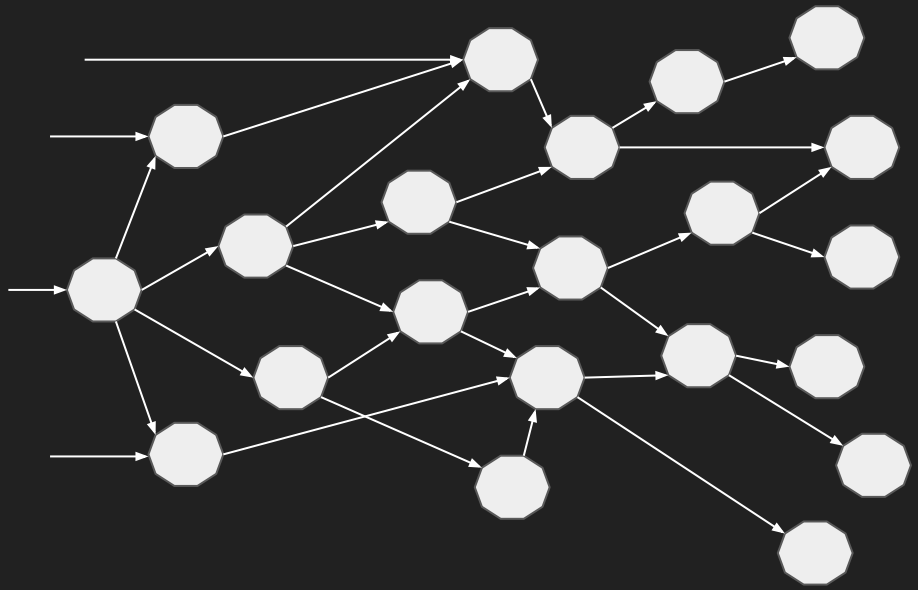
Our Teams:

A) Customer Success Engineering Team
B) Human Resources Engineering Team
C) Marketing Engineering Team
D) Manufacturing Engineering Team
E) Big Money Customer Engineering Team

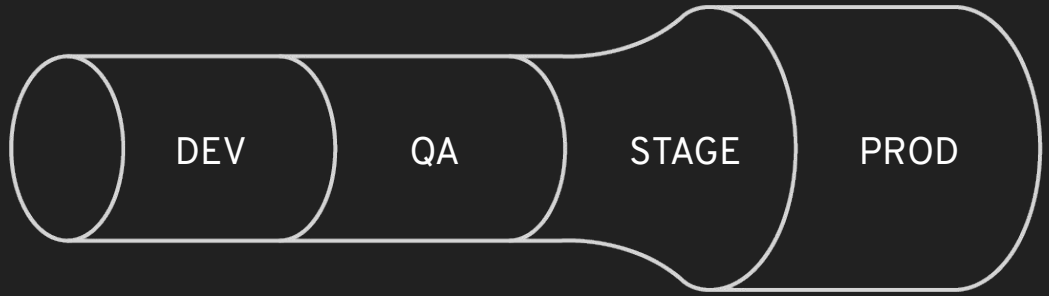
Shared Resources



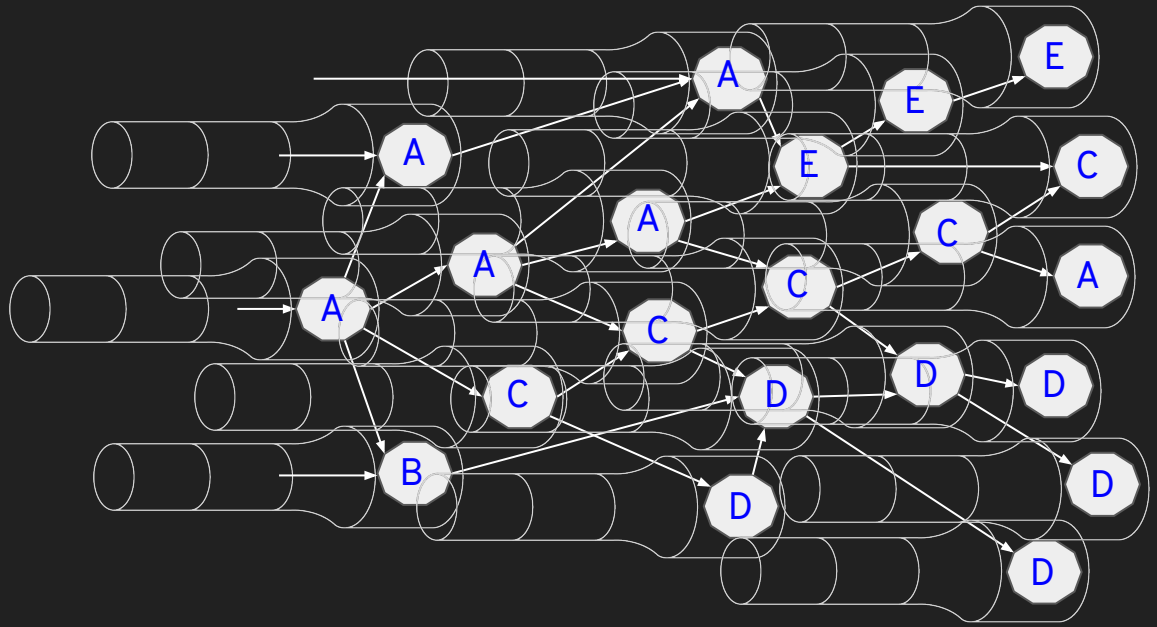
Our Service Mess



Our Pipelines



Our Services, Our Pipelines, Our Teams



Customer Success Engineering Team A
Human Resources Engineering Team B
Marketing Engineering Team C

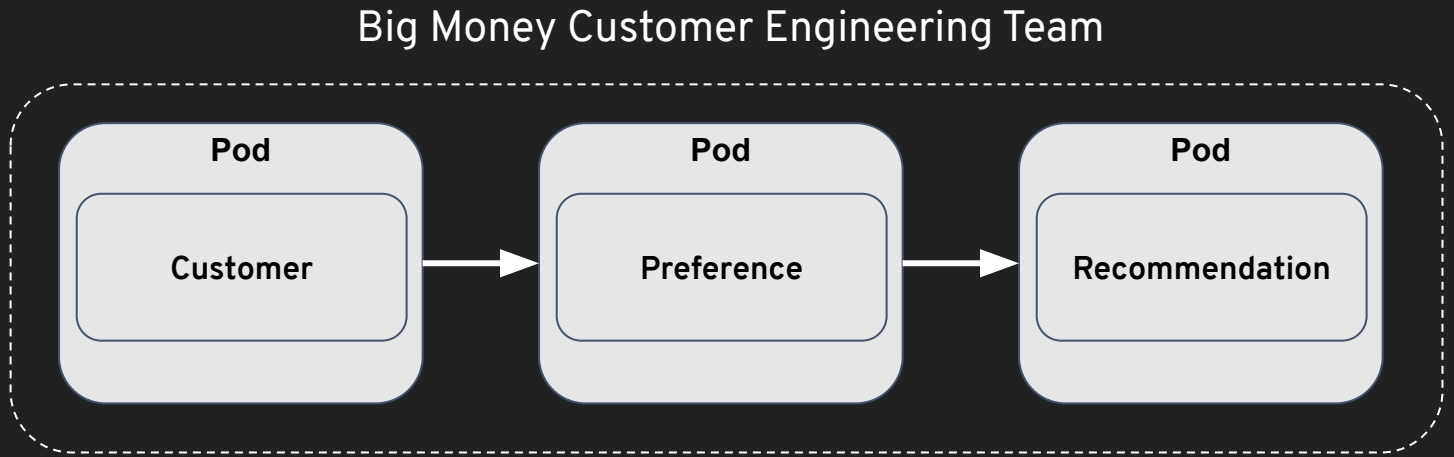
Manufacturing Engineering Team D
Big Money Customer Engineering Team E

Istio Security Capabilities

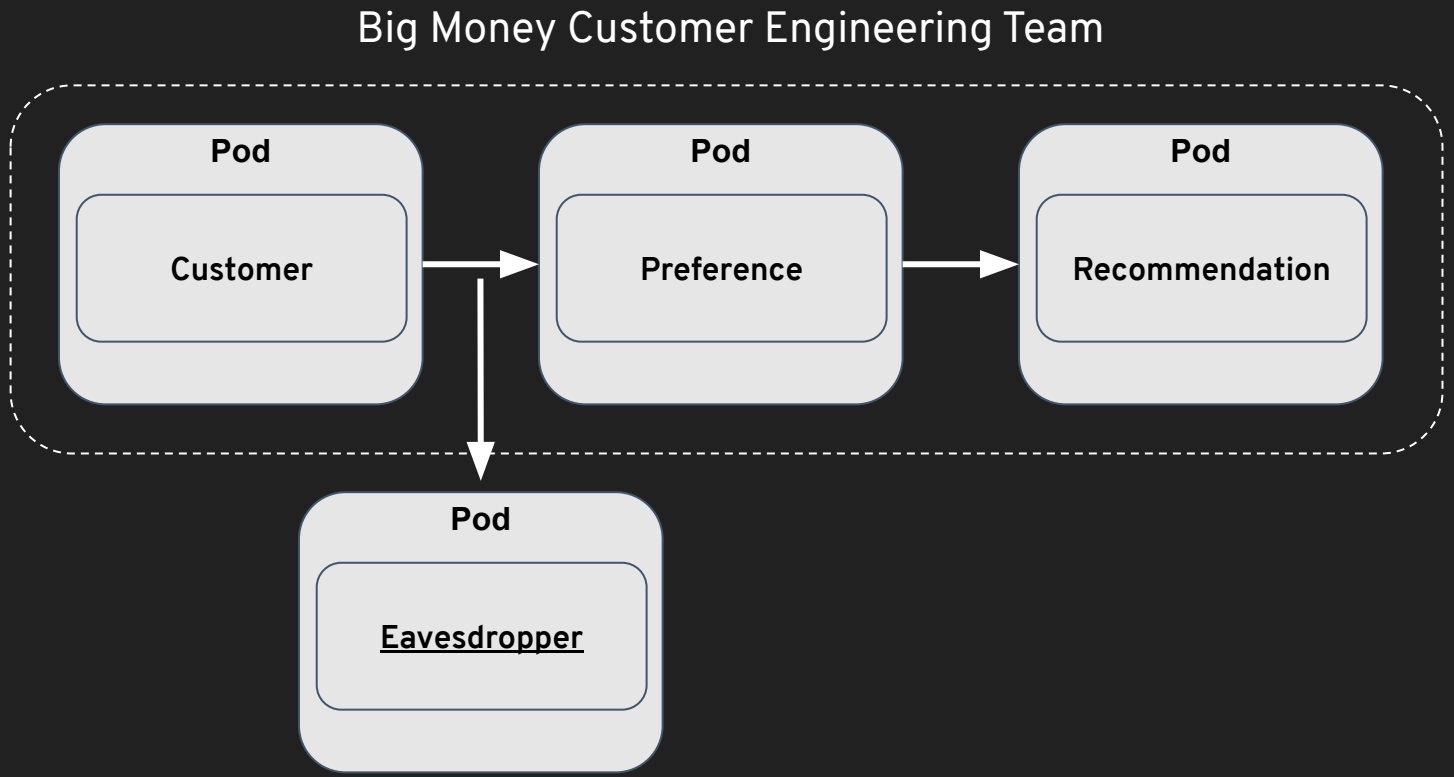
- mTLS - Encryption
- Access Control
- JSON Web Token (JWT) Authentication
- Role-based Access Control (RBAC) Authorization

Why Encryption?

Why Encryption?



Why Encryption?



istio-proxy@preference-v1-5485dc6f49-fspbb: /

istio | Shell | ...e-v1-5485dc6f49-fspbb: /

istio-proxy@preference-v1-5485dc6f49-fspbb: /

```
p,nop,TS val 9122945 ecr 9122943], length 172: HTTP: HTTP/1.1 200 OK
E.....@.@.1.....>..5.*E......Y......
..4...4.HTTP/1.1 200 OK
content-length: 47
x-envoy-upstream-service-time: 0
date: Mon, 24 Dec 2018 17:26:01 GMT
server: envoy

recommendation v1 from '66b7c9779c-75fpl': 347
```

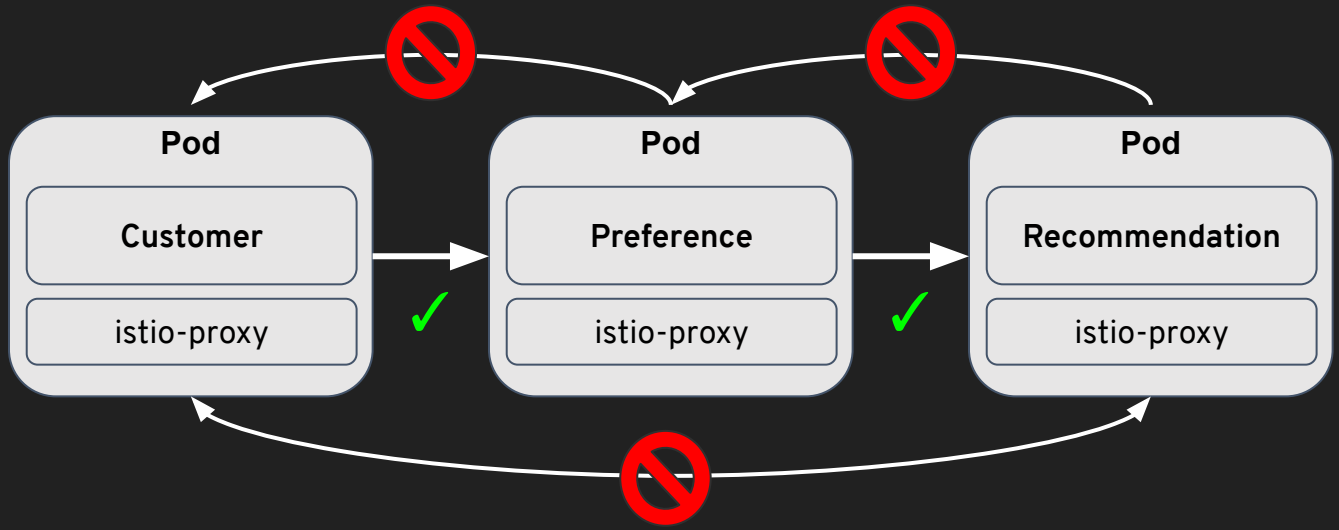
@preference-v1-5485dc6f49-fspbb:~

```
[jboss@preference-v1-5485dc6f49-fspbb ~]$ curl recommendation:8080
recommendation v2 from '7cbd9f9c79-nd69g': 341
[jboss@preference-v1-5485dc6f49-fspbb ~]$ curl recommendation:8080
recommendation v1 from '66b7c9779c-75fpl': 347
[jboss@preference-v1-5485dc6f49-fspbb ~]$
```

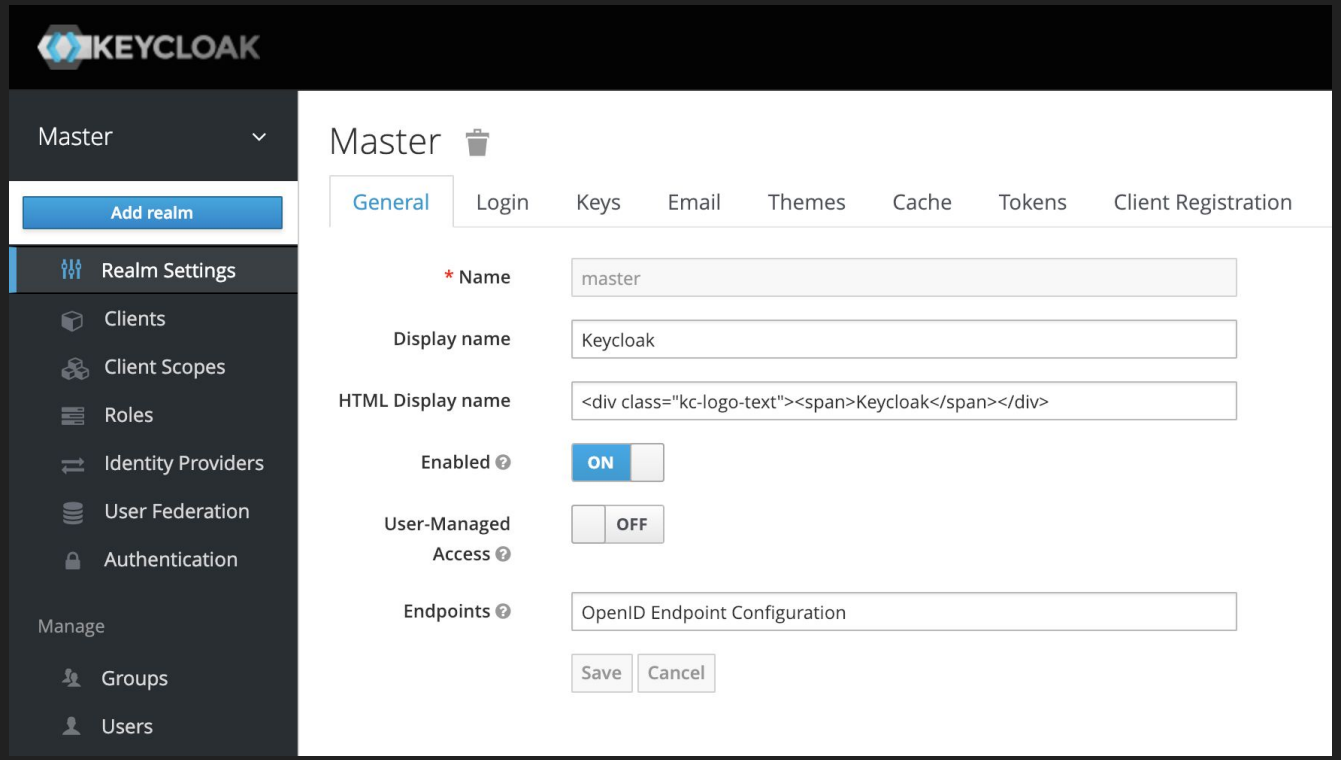
istio

```
~/minishift_1.27.0/istio-tutorial $
```

Access Control



JWT Issuer



1.0 Changes

- RouteRule -> VirtualService
- DestinationPolicy -> DestinationRule
- EgressRule -> ServiceEntry
- Ingress -> Gateway

The End

(but Serverless is coming)