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Jan 11 · 6 min read · Listen

Istio Traffic Shifting

What is Istio

- Istio is an open source service mesh that layers transparently onto existing distributed applications.
- Istio is the path to load balancing, service-to-service authentication, and monitoring — with few or no service code changes.

Deployment and Traffic shifting

- Traffic shifting makes it possible to gradually migrate traffic from one version of a micro service to another version. This usually happens when migrating from an older version of an app to a newer one. After doing some feature enhancement, first we should need to send small amount of traffic to the new version of service in the initial stage. After that gradually we can increase traffic percentage using service mesh.

Prerequisite

- First we need to start **minikube**.

```
minikube start
```

- Install **Istio** and **istioctl.**
- Here I am using simple spring boot rest api.

a) This is my old version.

```
1  package com.pramod.myapp;
2
3  import org.springframework.web.bind.annotation.GetMapping;
4  import org.springframework.web.bind.annotation.RequestMapping;
5  import org.springframework.web.bind.annotation.RestController;
6
7  @RestController
8  @RequestMapping("/api/v1")
9  public class HelloController {
10
11     @GetMapping("hello")
12     public String getHello() {
13         return "Hello World, This is version 1!";
14     }
15 }
```

HelloController.java hosted with ❤ by **GitHub** **view raw**

b) This is my new version file.

```java
package com.pramod.myapp;

import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
@RequestMapping("/api/v1")
public class HelloController {

    @GetMapping("hello")
    public String getHello() {
        return "Hello World, This is version 2!";
    }
}
```

HelloController.java hosted with ❤ by GitHub view raw

- First we should need to create two docker images for old version and new version. Here I am using local docker images. We can push docker images into docker hub and we can pull those images from the docker hub or registry when deploying in Kubernetes.
- Provides instructions to point your terminal's docker-cli to minikuber docker-env.

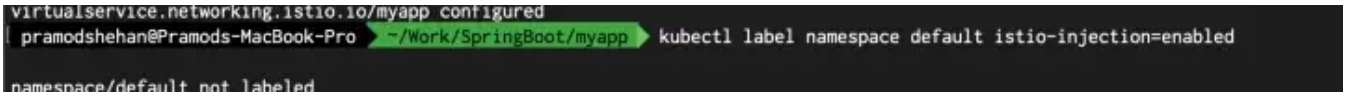
```
eval $(minikube docker-env)
```

- Build the jar file for each version and build the docker image.(how to dockerize SpringBoot application)
- Here we have 1.0 and 2.0 myapp docker images.

```
pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp docker images
REPOSITORY                      TAG       IMAGE ID       CREATED              SIZE
myapp                           2.0       278bfe5018c2   22 seconds ago       520MB
myapp                           1.0       2d0bcf24d286   About a minute ago   520MB
```

- We can use below mentioned **kubectl** command to add a namespace label to instruct Istio to automatically inject Envoy sidecar proxies.

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



- After enabled Istio in minikube, Istio-proxy(Envoy proxy) called docker conainer is running in each and every pods.

Deployment

- Now we can do all the deployments.

1. **First we should deploy myapp service and two pods for v1 and v2.**

Here **imagePullPolicy** is **Never** because I am using local docker images. We have two deployment definition for myapp-v1 and myapp-v2. myapp:1.0 is defined as v1 and myapp:2.0 is defined as v2.

```yaml
apiVersion: v1
kind: Service
metadata:
  name: myapp
  labels:
    app: myapp
    service: myapp
spec:
  ports:
    - port: 8080
      name: http
  selector:
    app: myapp
---
apiVersion: v1
kind: ServiceAccount
metadata:
  name: demo-myapp
  labels:
    account: myapp
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: myapp-v1
  labels:
    app: myapp
    version: v1
spec:
  replicas: 1
  selector:
    matchLabels:
      app: myapp
      version: v1
  template:
    metadata:
      labels:
        app: myapp
        version: v1
    spec:
      serviceAccountName: demo-myapp
      containers:
        - name: myapp
          image: myapp:1.0
          imagePullPolicy: Never
          ports:
            - containerPort: 8080
          volumeMounts:
```

```
            volumeMounts:
              - name: tmp
                mountPath: /tmp
            securityContext:
              runAsUser: 1000
        volumes:
```

```
zsh: command not found: kubeclt
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp kubectl apply -f myapp.yaml
service/myapp created
serviceaccount/demo-myapp created
deployment.apps/myapp-v1 created
deployment.apps/myapp-v2 created
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp
```

```
    name: myapp-v2
    labels:
      app: myapp
      version: v2
  spec:
    replicas: 1
    selector:
      matchLabels:
        app: myapp
        version: v2
    template:
      metadata:
```

```
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp kubectl get svc
NAME         TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)    AGE
kubernetes   ClusterIP   10.96.0.1      <none>        443/TCP    4d23h
myapp        ClusterIP   10.97.58.17    <none>        8080/TCP   35m
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp kubectl get pods
NAME                        READY   STATUS    RESTARTS   AGE
myapp-v1-6cc8bbccf6-svllg   2/2     Running   0          35m
myapp-v2-587b79c77d-nlglr   2/2     Running   0          35m
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp kubectl get deployments
NAME       READY   UP-TO-DATE   AVAILABLE   AGE
myapp-v1   1/1     1            1           35m
myapp-v2   1/1     1            1           35m
 pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp
```

```
              - name: tmp
                mountPath: /tmp
            securityContext:
              runAsUser: 1000
        volumes:
          - name: tmp
            emptyDir: {}
  ---
```

```
      containers:
        - name: myapp
```

```
      image: myapp:1.0
      imagePullPolicy: Never
```

```
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples kubectl get pods
NAME                     READY   STATUS    RESTARTS   AGE
myapp-v1-6cc8bbccf6-svllg   2/2     Running   0          6h44m
myapp-v2-587b79c77d-nlglr   2/2     Running   0          6h44m
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples
```

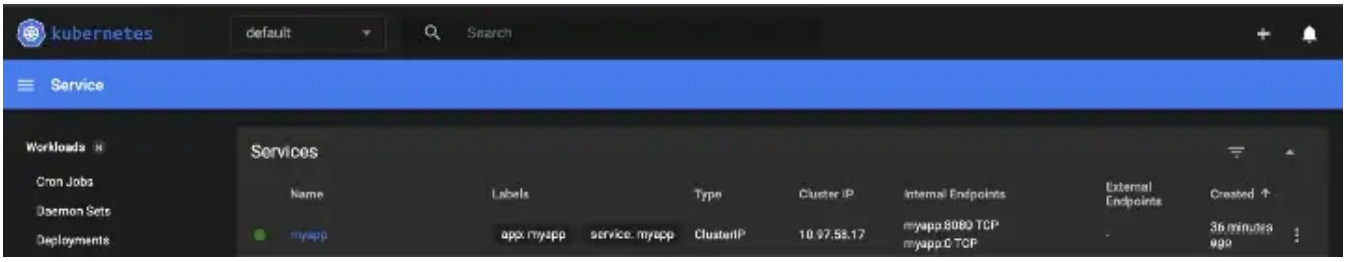
```
kubectl describe pods myapp-v1-6cc8bbccf6-svllg
```

```
Containers:
  myapp:
    Container ID:   docker://1c5d77ed3c2a0b1fd764dc44c69020fd0d787a77ab9111761bf906855a912bcb
    Image:          myapp:1.0
    Image ID:       docker://sha256:2d0bcf24d28627ea6f64ab434e7fd8c5f34a871cba8f09dcdbcee5d55a97ea4b
    Port:           8080/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Wed, 11 Jan 2023 23:16:54 +0800
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /tmp from tmp (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-l8bnf (ro)
  istio-proxy:
    Container ID:  docker://39640c8de738e8d727f4362e03105a7371d8deaa0c869017b489c789976daa7f
    Image:         docker.io/istio/proxyv2:1.16.1
    Image ID:      docker-pullable://istio/proxyv2@sha256:a861ee2ce3693ef85bbf0f96e715dde6f3fbd1546333d348993cc123a00a0290
    Port:          15090/TCP
    Host Port:     0/TCP
    Args:
      proxy
      sidecar
      --domain
      $(POD_NAMESPACE).svc.cluster.local
      --proxyLogLevel=warning
      --proxyComponentLogLevel=misc:error
      --log_output_level=default:info
      --concurrency
      2
    State:          Running
      Started:      Wed, 11 Jan 2023 23:16:55 +0800
```

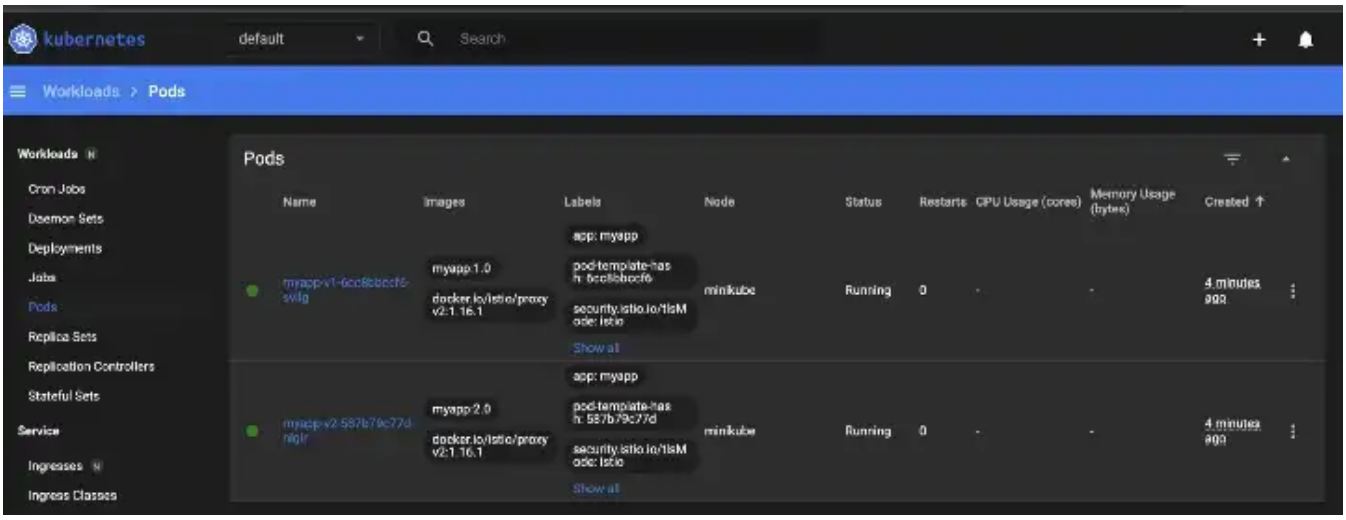
docker containers in pod

- You can use minikube dashboard to check all the service, pods, deployments and etc.

```
minikube dashboard
```



services



pods

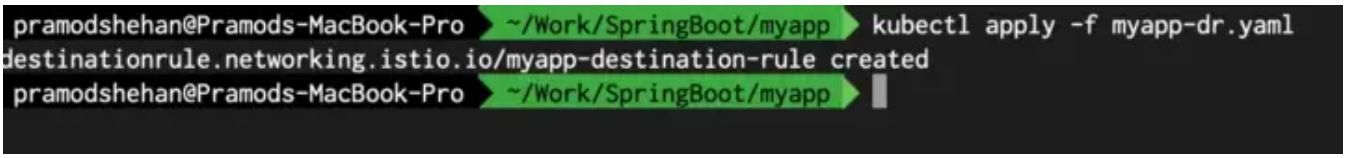
2. Now we should deploy destination rule.

- These rules specify configuration for load balancing, connection pool size from the sidecar, and outlier detection settings to detect and evict unhealthy hosts from the load balancing pool.
- Version specific policies can be specified by defining a named `subset`.
- Here we have two versions for myapp(v1 and v2). So we should define these two versions as two subsets.

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: DestinationRule
metadata:
  name: myapp-destination-rule
spec:
  host: myapp
  trafficPolicy:
    loadBalancer:
      simple: ROUND_ROBIN
  subsets:
    - name: v1
      labels:
        version: v1
    - name: v2
      labels:
        version: v2
#     trafficPolicy:
#       loadBalancer:
#         simple: ROUND_ROBIN
```

myapp-destination-rule.yaml hosted with ❤ by **GitHub** **view raw**

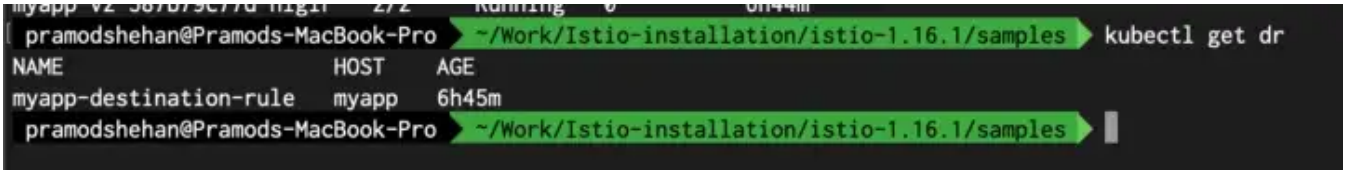
```
kubectl apply -f myapp-dr.yaml
```



deploy destination rule

- Check destination rules.

```
kubectl get dr
```



- There are 6 different load balancing policies. We can use load balancing policy for subset level and service level.

LoadBalancerSettings.SimpleLB

Standard load balancing algorithms that require no tuning.

Name	Description
UNSPECIFIED	No load balancing algorithm has been specified by the user. Istio will select an appropriate default.
RANDOM	The random load balancer selects a random healthy host. The random load balancer generally performs better than round robin if no health checking policy is configured.
PASSTHROUGH	This option will forward the connection to the original IP address requested by the caller without doing any form of load balancing. This option must be used with care. It is meant for advanced use cases. Refer to Original Destination load balancer in Envoy for further details.
ROUND_ROBIN	A basic round robin load balancing policy. This is generally unsafe for many scenarios (e.g. when enpoint weighting is used) as it can overburden endpoints. In general, prefer to use LEAST_REQUEST as a drop-in replacement for ROUND_ROBIN.
LEAST_REQUEST	The least request load balancer spreads load across endpoints, favoring endpoints with the least outstanding requests. This is generally safer and outperforms ROUND_ROBIN in nearly all cases. Prefer to use LEAST_REQUEST as a drop-in replacement for ROUND_ROBIN.
LEAST_CONN	Deprecated. Use LEAST_REQUEST instead.

3. Deploy Gateway and Virtual Services.

VirtualService

- VirtualService defines a set of traffic routing rules with matching criteria.
- If the traffic is matched, then it is sent to a named destination service (or subset/version of it) defined in the registry.

Example -

If uri is **“api/v1/hello”**, it is sent all the traffic to **myapp-v1 subset** and **myapp-v2.** Before deploying this one, we should deploy destination rules because we define all the subsets in the destination rule.

```
        - match:
        - uri:
            exact: /api/v1/hello
```

```
    route:
      - destination:
          host: myapp
          port:
            number: 8080
          subset: v1
        weight: 75
      - destination:
          host: myapp
          port:
            number: 8080
          subset: v2
        weight: 25
```

- For **traffic shifting**, we are using **weight**. According to above example, we are routing 25% traffic to myapp-v2 and 75% traffic to myapp-v1.

Gateway

- Gateway describes a load balance operating at the edge of the mesh receiving incoming or outgoing HTTP/TCP connections.
- We can expose set of ports in Gateway definition which use the type of protocol.

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: Gateway
metadata:
  name: myapp-gateway
spec:
  selector:
    istio: ingressgateway # use istio default controller
  servers:
    - port:
        number: 80
        name: http
        protocol: HTTP
      hosts:
        - "*"
---
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: myapp
spec:
  hosts:
    - "*"
  gateways:
    - myapp-gateway
  http:
    - match:
        - uri:
            exact: /api/v1/hello
      route:
        - destination:
            host: myapp
            port:
              number: 8080
            subset: v1
          weight: 75
        - destination:
            host: myapp
            port:
              number: 8080
            subset: v2
          weight: 25
```

myapp-gateway.yaml hosted with ❤ by GitHub view raw

```
kubectl apply -f myapp-gateway.yaml
```

```
pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp kubectl apply -f myapp-gateway.yaml
gateway.networking.istio.io/myapp-gateway created
virtualservice.networking.istio.io/myapp created
pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp
```

- Check virtual services and gateways.

```
kubectl get gw
kubectl get vs
```

```
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples kubectl get gw
NAME            AGE
myapp-gateway   6h50m
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples kubectl get vs
NAME    GATEWAYS            HOSTS   AGE
myapp   ["myapp-gateway"]   ["*"]   6h50m
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples
```

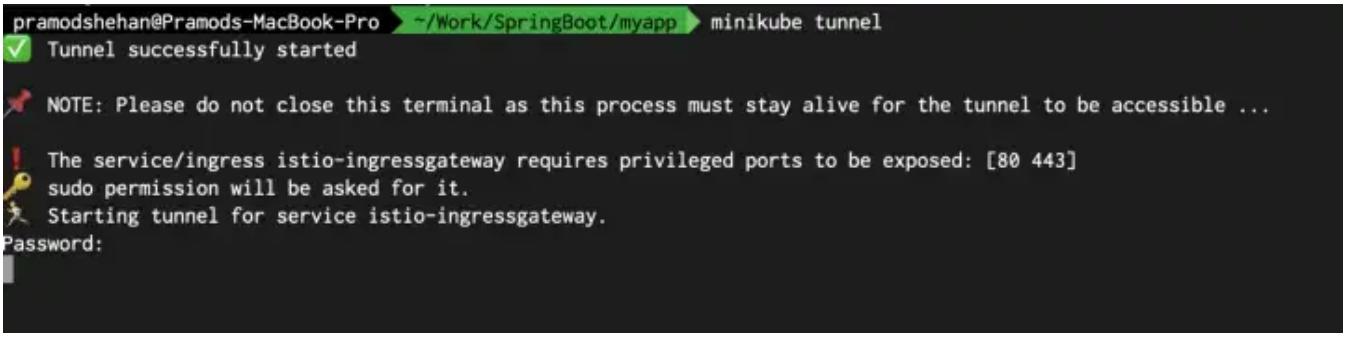
After deployment we check the Istio errors using below command.

```
istioctl analyze
```

4. Start minikube tunnel

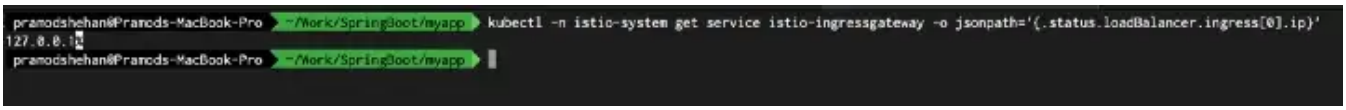
Minikube tunnel that sends traffic to your Istio Ingress Gateway. This will provide an external load balancer, `EXTERNAL-IP`, for `service/istio-ingressgateway`.

```
minikube tunnel
```



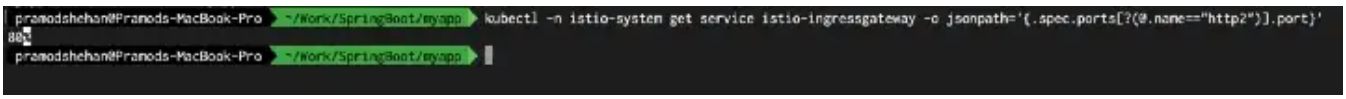
- Check the external IP of ingress gateway load balancer.

```
kubectl -n istio-system get service istio-ingressgateway
 -o jsonpath='{.status.loadBalancer.ingress[0].ip}'
```

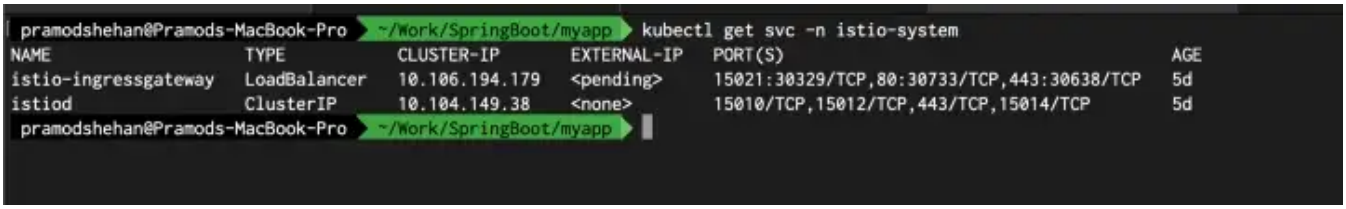


- Check the external http2 port of ingress gateway load balancer.

```
kubectl -n istio-system get service istio-ingressgateway
-o jsonpath='{.spec.ports[?(@.name=="http2")].port}'
```



- These are the istio-system services which running in minikube after installed istio.



5. Testing

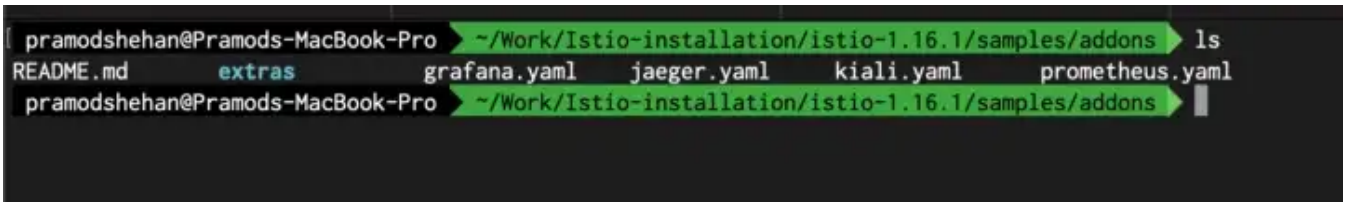
```
curl http://kubectl -n istio-system get service istio-ingressgateway
 -o jsonpath='{.status.loadBalancer.ingress[0].ip}':kubectl -n istio-system get
-o jsonpath='{.spec.ports[?(@.name=="http2")].port}'/api/v1/hello

curl http://127.0.0.1/api/v1/hello
```

- Here you can see, we have two different output for same url.

Kiali Console

- Kiali is a console for Istio service mesh. Kiali can be quickly installed as an Istio add-on, or trusted as a part of your production environment.
- There are several addons for Istio.



- Deploy Kiali, prometheus using '**kubectl apply -f addons**'.

```
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples kubectl apply -f addons
serviceaccount/grafana created
configmap/grafana created
service/grafana created
deployment.apps/grafana created
configmap/istio-grafana-dashboards created
configmap/istio-services-grafana-dashboards created
deployment.apps/jaeger created
service/tracing created
service/zipkin created
service/jaeger-collector created
serviceaccount/kiali created
configmap/kiali created
clusterrole.rbac.authorization.k8s.io/kiali-viewer created
clusterrole.rbac.authorization.k8s.io/kiali created
clusterrolebinding.rbac.authorization.k8s.io/kiali created
role.rbac.authorization.k8s.io/kiali-controlplane created
rolebinding.rbac.authorization.k8s.io/kiali-controlplane created
service/kiali created
deployment.apps/kiali created
serviceaccount/prometheus created
configmap/prometheus created
clusterrole.rbac.authorization.k8s.io/prometheus created
clusterrolebinding.rbac.authorization.k8s.io/prometheus created
service/prometheus created
deployment.apps/prometheus created
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples
```

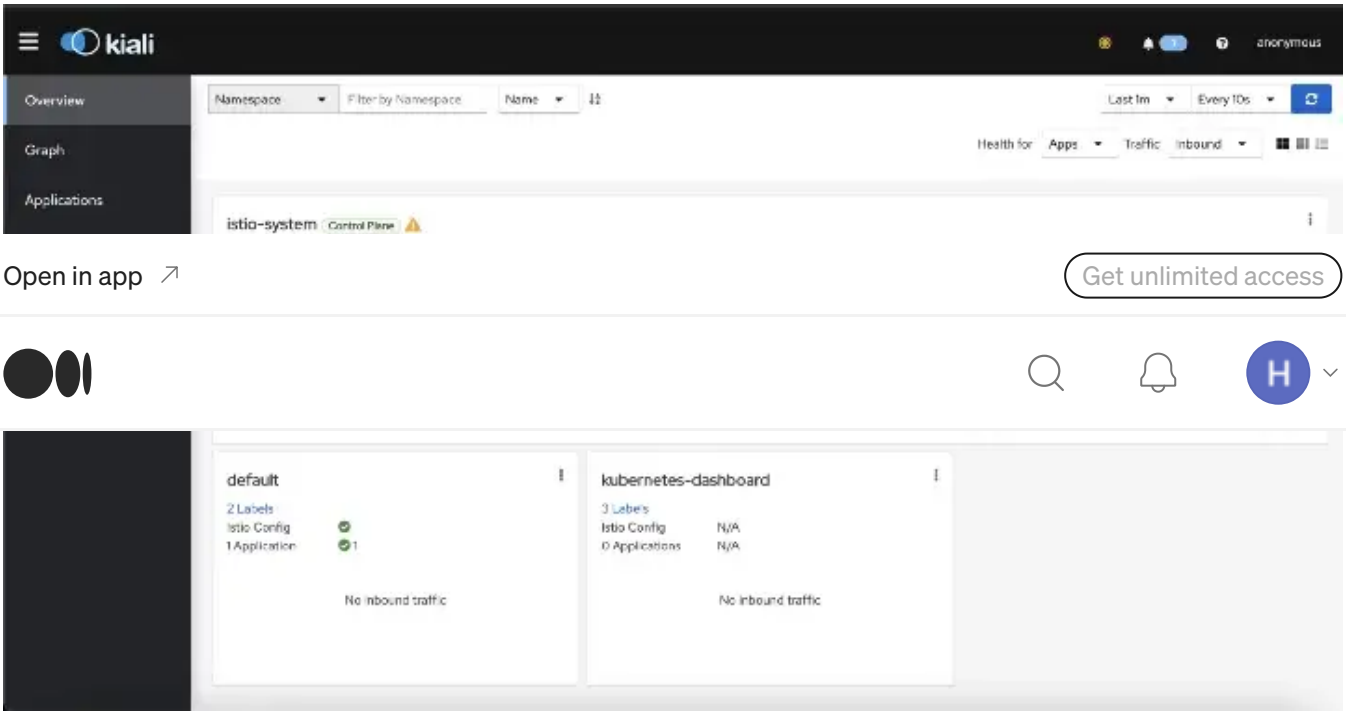
```
deployment.apps/prometheus created
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples kubectl get svc -n istio-system
NAME                   TYPE           CLUSTER-IP       EXTERNAL-IP   PORT(S)                                      AGE
grafana                ClusterIP      10.103.84.114    <none>        3000/TCP                                     60s
istio-ingressgateway   LoadBalancer   10.106.194.179   127.0.0.1     15021:30329/TCP,80:30733/TCP,443:30638/TCP   5d
istiod                 ClusterIP      10.104.149.38    <none>        15010/TCP,15012/TCP,443/TCP,15014/TCP        5d
jaeger-collector       ClusterIP      10.104.58.102    <none>        14268/TCP,14250/TCP,9411/TCP                 60s
kiali                  ClusterIP      10.101.90.253    <none>        20001/TCP,9090/TCP                           60s
prometheus             ClusterIP      10.100.161.92    <none>        9090/TCP                                     59s
tracing                ClusterIP      10.105.106.116   <none>        80/TCP,16685/TCP                             60s
zipkin                 ClusterIP      10.103.24.74     <none>        9411/TCP                                     60s
pramodshehan@Pramods-MacBook-Pro ~/Work/Istio-installation/istio-1.16.1/samples
```

- Open Kiali dashboard using below command.

```
istioctl dashboard kiali
```

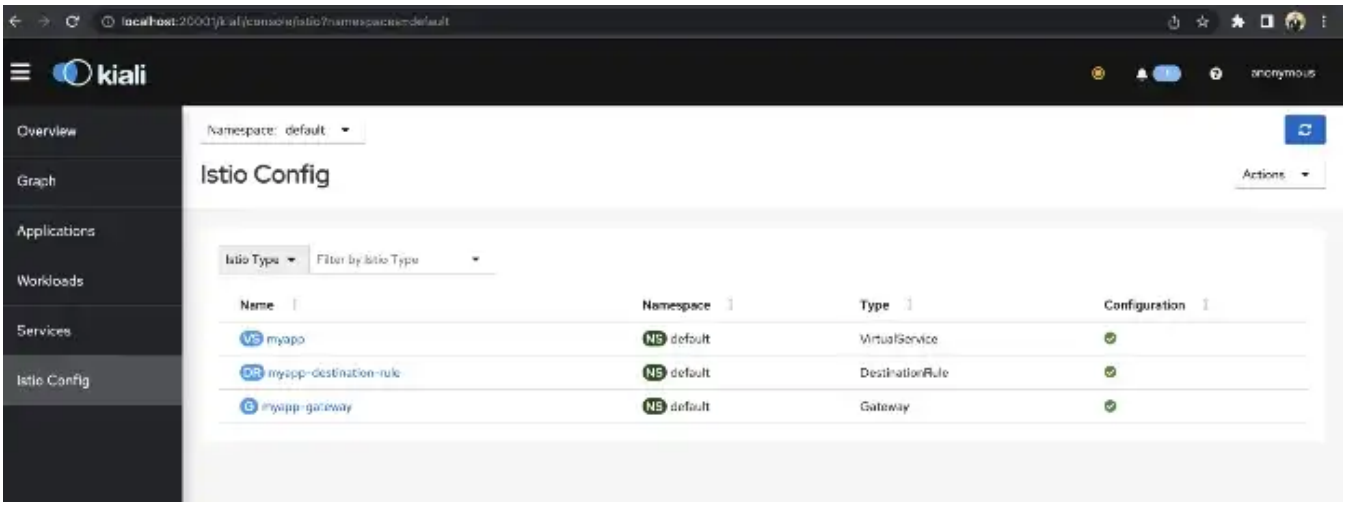
```
Error: no Kiali pods found
pramodshehan@Pramods-MacBook-Pro ~/Work/SpringBoot/myapp istioctl dashboard kiali

http://localhost:20001/kiali
```

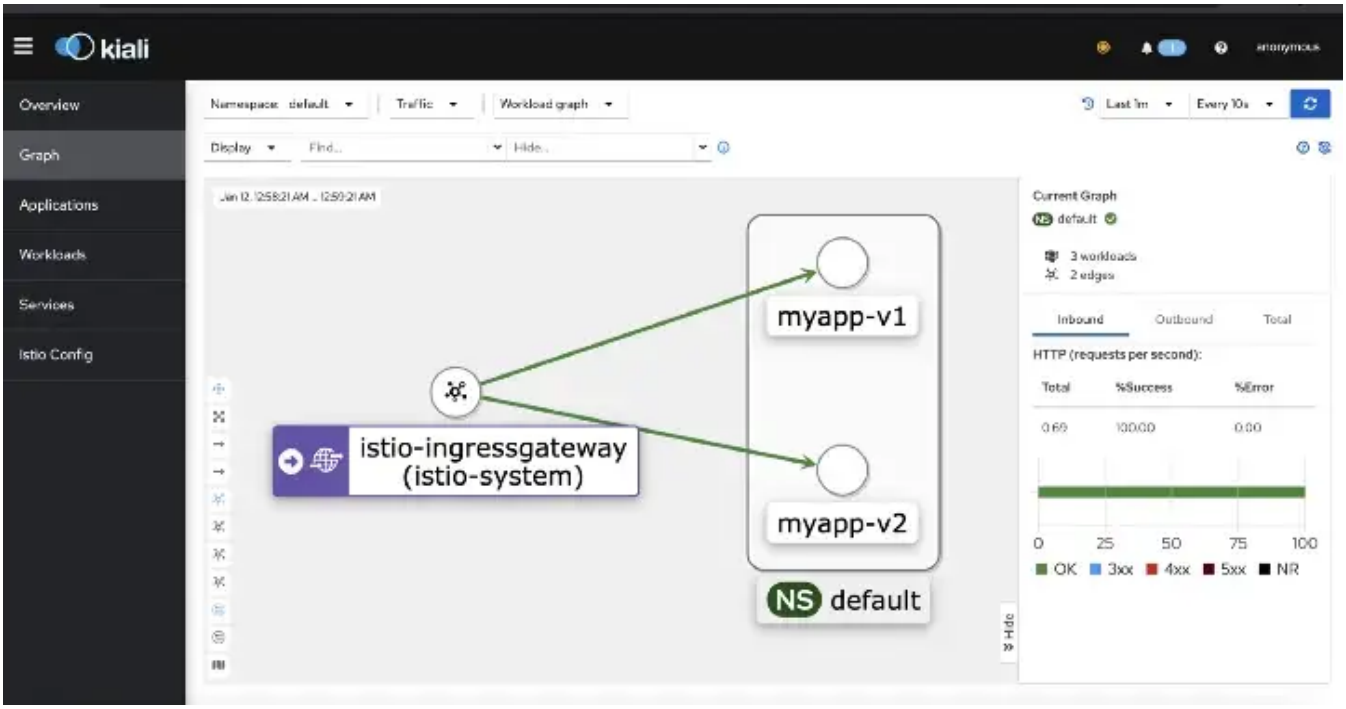


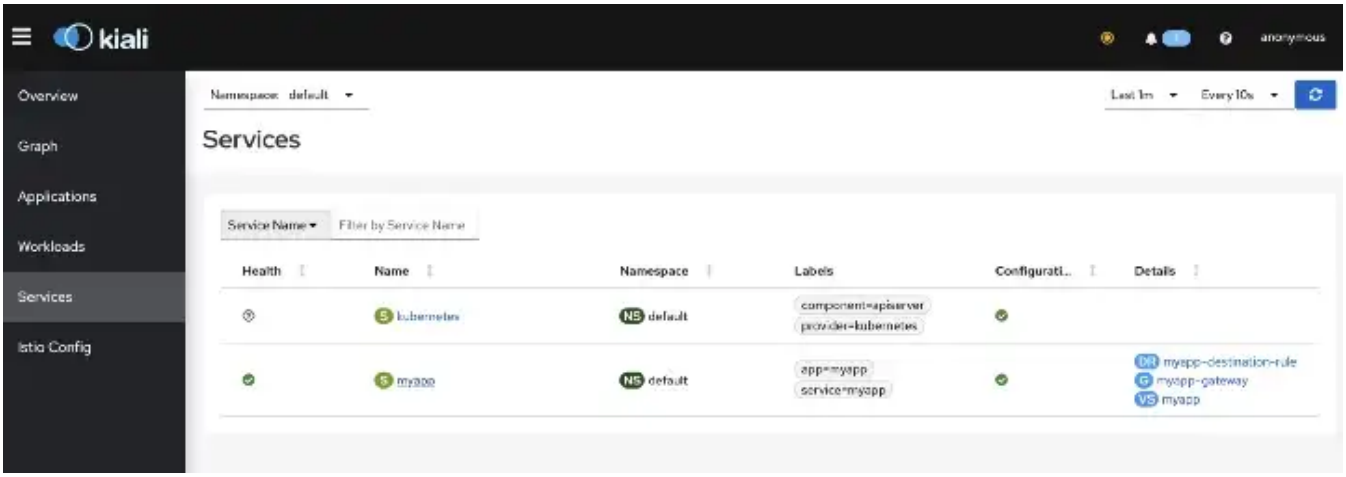
Kiali dashboard

- We can view all the deployment yaml file here which we used for services, deployments, virtual services and etc.



- This is how istio-ingressgateway is routing data to myapp-v1 and myapp-v2

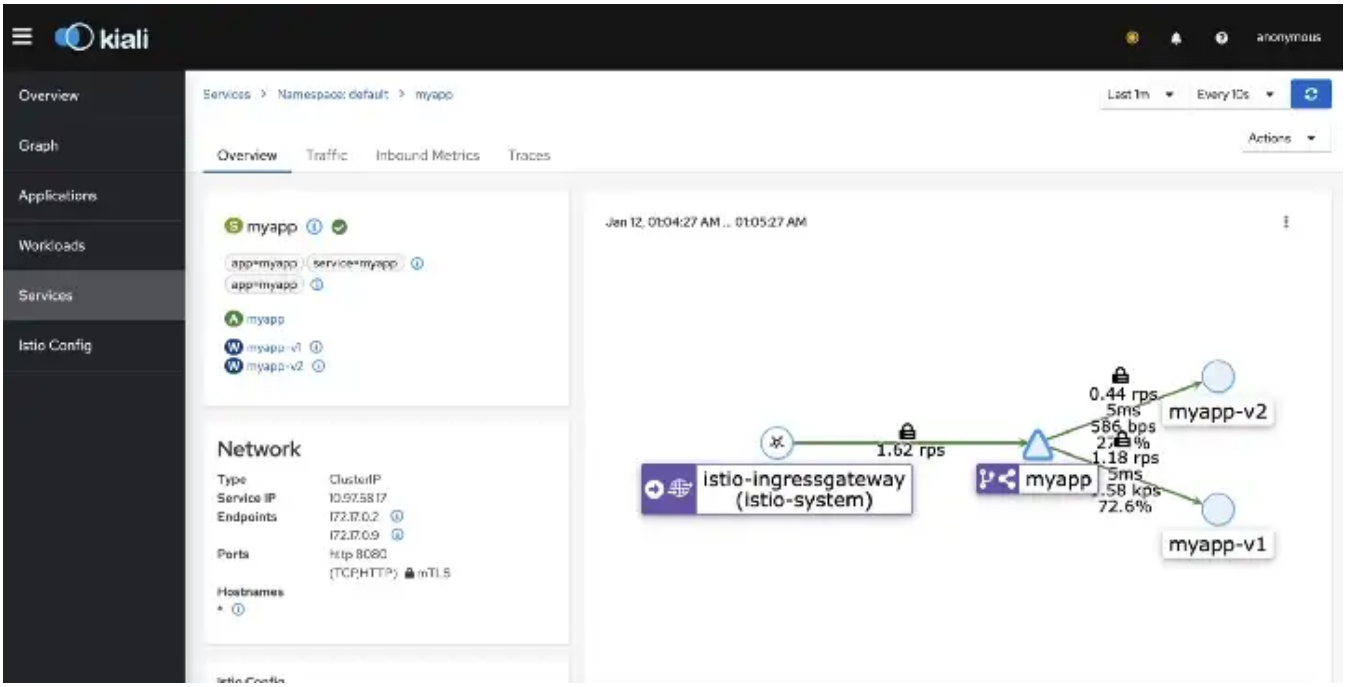




- Send some traffic to the application and check the Kiali dashboard.

```
for ((i=1;i<=100;i++)); do  sleep 0.5;  curl -v --header
"Connection: keep-alive" "http://127.0.0.1/api/v1/hello"; done
```

- Here you can see, traffic shifting has been worked according to our definition. Traffic has been routed to myapp-v1 around 72.6. for myapp-v2, it is around 27.4



github — https://github.com/pramodShehan5/istio-traffic-shifting-demo

References

https://istio.io/latest/docs/setup/getting-started/

Istio Service Mesh Microservices Minikube Kubernetes