

Lab 7 Report

Course: Cloud_Computing

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GitHub Repo: [yangzheng.github.io](https://github.com/yangzheng/yangzheng.github.io) — Repository for personal website project using GitHub Pages

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1. Objectives

Deploy and configure Istio service mesh on a Kubernetes cluster.

Install Kubernetes Gateway API CRDs and deploy the Bookinfo sample application.

Expose the application to external traffic via Istio Gateway and access the service.

Explore Istio telemetry tools including Kiali, Prometheus, Grafana, and Jaeger dashboards.

Document the full process with screenshots and detailed observations.

2. Environment & Prerequisites

Operating System: windows11

Minikube Version: minikube version: v1.37.0

Kubectl Version: Client Version: v1.34.0; Kustomize Version: v5.7.1; Server Version: v1.34.0

Istio Version: v1.28.0

Driver: docker

Hardware: ≥ 2 CPUs, ≥ 4 GB RAM, ≥ 30 GB disk space

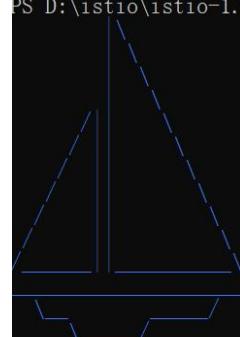
Prerequisites: Running Kubernetes cluster (Minikube), curl utility installed, internet connectivity for downloading Istio and related images

3. Lab Steps & Observations

3.1 Download and Install Istio

```
Commands: curl -L https://istio.io/downloadIstio | sh -; cd istio-1.28.0; export PATH=$PWD/bin:$PATH; istioctl install -f samples/bookinfo/demo-profile-no-gateways.yaml -y; kubectl label namespace default istio-injection=enabled
```

Screenshots:

```
PS D:\istio\istio-1.27.3> istioctl install -f samples/bookinfo/demo-profile-no-gateways.yaml -y

✓ Istio core installed ✅
✓ Istiod installed ✅
✓ Installation complete ✅
```

Observations: Istio installation completed successfully with core components and Istiod deployed. The default namespace is labeled to enable automatic sidecar injection, ensuring future deployments include Istio Envoy proxies.

3.2 Install Kubernetes Gateway API CRDs

Commands: kubectl get crd gateways.gateway.networking.k8s.io &> /dev/null || { kubectl kustomize "github.com/kubernetes-sigs/gateway-api/config/crd?ref=v1.4.0" | kubectl apply -f -; }

Screenshots:

```
PS D:\istio\istio-1.27.3> kubectl label namespace default istio-injection=enabled
namespace/default labeled

PS D:\istio\istio-1.27.3> kubectl apply -f D:/istio/istio-1.27.3/standard-install.yaml
Warning: unrecognized format "int64"
customresourcedefinition.apirextensions.k8s.io/gatewayclasses.gateway.networking.k8s.io created
Warning: unrecognized format "int32"
customresourcedefinition.apirextensions.k8s.io/gateways.gateway.networking.k8s.io created
customresourcedefinition.apirextensions.k8s.io/grpcroutes.gateway.networking.k8s.io created
customresourcedefinition.apirextensions.k8s.io/httproutes.gateway.networking.k8s.io created
customresourcedefinition.apirextensions.k8s.io/referencegrants.gateway.networking.k8s.io created
```

Observations: Kubernetes Gateway API CRDs were installed successfully as they were not present by default in the cluster. This step enables the use of Gateway API for traffic management in Istio.

3.3 Deploy Bookinfo Sample Application

Commands: kubectl apply -f samples/bookinfo/platform/kube/bookinfo.yaml; kubectl get services; kubectl get pods; kubectl exec "\$(kubectl get pod -l app=ratings -o jsonpath='{.items[0].metadata.name}') -- curl -sS productpage:9080/productpage | grep -o "<title>.*</title>"

Screenshots:

```
c:\> the path 'samples/bookinfo/platform/kube/bookinfo.yaml' does not exist.
PS D:\istio\istio-1.27.3> kubectl apply -f samples/bookinfo/platform/kube/bookinfo.yaml
service/details created
serviceaccount/bookinfo-details created
deployment.apps/details-v1 created
service/ratings created
serviceaccount/bookinfo-ratings created
deployment.apps/ratings-v1 created
service/reviews created
serviceaccount/bookinfo-reviews created
deployment.apps/reviews-v1 created
deployment.apps/reviews-v2 created
deployment.apps/reviews-v3 created
service/productpage created
serviceaccount/bookinfo-productpage created
deployment.apps/productpage-v1 created
```

```
PS D:\istio\istio-1.27.3> kubectl get pods
NAME          READY   STATUS    RESTARTS   AGE
details-v1-695657544f-nrxfd   2/2     Running   0          4m21s
productpage-v1-5f7c4cc496-czmvb 2/2     Running   0          4m21s
ratings-v1-6d68dbd97-h52zj    2/2     Running   0          32s
reviews-v1-79f468d546-f8cj1   2/2     Running   0          4m21s
reviews-v2-6f57955665-4tgsw   2/2     Running   0          4m21s
reviews-v3-65dd664b48-5jkw7   2/2     Running   0          4m21s
PS D:\istio\istio-1.27.3> kubectl get services
NAME        TYPE        CLUSTER-IP      EXTERNAL-IP    PORT(S)        AGE
details     ClusterIP   10.100.28.41   <none>        9080/TCP     4m38s
kubernetes  ClusterIP   10.96.0.1       <none>        443/TCP      46h
productpage ClusterIP   10.98.137.199  <none>        9080/TCP     4m37s
ratings     ClusterIP   10.107.13.204  <none>        9080/TCP     4m38s
reviews     ClusterIP   10.111.103.206 <none>        9080/TCP     4m38s
```

Observations: All Bookinfo services (details, ratings, reviews, productpage) and corresponding deployments were created successfully. Each pod shows 2/2 ready status, indicating the Istio sidecar proxy was injected automatically. The curl command verified the application is running within the cluster with the expected title.

3.4 Expose Application via Istio Gateway

Commands: `kubectl apply -f samples/bookinfo/gateway-api/bookinfo-gateway.yaml;` `kubectl annotate gateway bookinfo-gateway networking.istio.io/service-type=ClusterIP --namespace=default;` `kubectl get gateway;` `kubectl port-forward svc/bookinfo-gateway-istio 8080:80`

Screenshots:

```
PS D:\istio\istio-1.27.3> kubectl get gateway
NAME        CLASS      ADDRESS           PROGRAMMED   AGE
bookinfo-gateway  istio     bookinfo-gateway-istio.default.svc.cluster.local  True        43s
PS D:\istio\istio-1.27.3> kubectl apply -f samples/bookinfo/gateway-api/bookinfo-gateway.yaml
gateway.gateway.networking.k8s.io/bookinfo-gateway created
httproute.gateway.networking.k8s.io/bookinfo created
PS D:\istio\istio-1.27.3> kubectl annotate gateway bookinfo-gateway networking.istio.io/service-type=ClusterIP --namespace=default
>>
>>
gateway.gateway.networking.k8s.io/bookinfo-gateway annotated
```

Observations: The Bookinfo Gateway and HTTP route were created successfully, with the gateway status showing "PROGRAMMED: True". Annotating the gateway set the service type to ClusterIP, eliminating the need for an external load balancer. Port forwarding to the gateway service established a local connection to the cluster.

3.5 Access the Bookinfo Application

Commands: [No additional commands beyond port-forward; access via browser at <http://localhost:8080/productpage>]

Screenshots:

```
C:\Users\zy>kubectl port-forward svc/bookinfo-gateway-istio 8080:80
Forwarding from 127.0.0.1:8080 -> 80
Forwarding from [::1]:8080 -> 80
```

Observations: The application was accessible via the local port 8080, displaying the full Bookinfo interface including book summary, details, and reviews. Refreshing the page rotated reviews across different versions of the reviews service, demonstrating Istio's traffic distribution capabilities.

3.6 Explore Istio Telemetry Dashboards

Commands: kubectl apply -f samples/addons/kiali.yaml; kubectl rollout status deployment/kiali -n istio-system; istioctl dashboard kiali; for i in \$(seq 1 100); do curl -s -o /dev/null "http://localhost:8080/productpage"; done

Screenshots:

```
D:\istio\istio-1.27.3>kubectl apply -f samples/addons/kiali.yaml
serviceaccount/kiali created
configmap/kiali created
clusterrole.rbac.authorization.k8s.io/kiali created
clusterrolebinding.rbac.authorization.k8s.io/kiali created
service/kiali created
deployment.apps/kiali created

D:\istio\istio-1.27.3>kubectl rollout status deployment/kiali -n istio-system
Waiting for deployment "kiali" rollout to finish: 0 of 1 updated replicas are available.
deployment "kiali" successfully rolled out

D:\istio\istio-1.27.3>istioctl dashboard kiali
http://localhost:20001/kiali
```

The screenshot shows the Kiali dashboard interface. On the left, there is a sidebar with navigation links: Overview, Traffic Graph, Applications, Workloads, Services, Istio Config, and Mesh. The 'Overview' link is currently selected. The main area displays three cards representing namespaces: 'default', 'istio-system', and 'kubernetes-dashboard'. Each card provides basic information: 'default' has 2 labels, 1 istio config, and 0 applications; 'istio-system' has 1 label, 1 istio config, and N/A applications; 'kubernetes-dashboard' has 3 labels, 1 istio config, and 0 applications. Below each card, it says 'Namespace metrics are not available'. At the top right of the dashboard, there are several status indicators and a user profile labeled 'anonymous'.

Observations: Kiali and associated telemetry tools (Prometheus, Grafana, Jaeger) were deployed successfully. The Kiali dashboard visualized the service mesh topology, showing relationships

between Bookinfo services. Sending 100 requests generated trace data, which was visible in the dashboard, with 100% success rate for HTTP traffic.

4. Summary

What went well: Smooth Istio installation and configuration, successful automatic sidecar injection, seamless exposure of the Bookinfo application via Istio Gateway, and clear visualization of the service mesh through Kiali.

Challenges: Ensuring sufficient RAM for running both the Kubernetes cluster and Istio components, troubleshooting port forwarding conflicts, and waiting for trace data to appear in Kiali

Key Takeaways: Understanding the role of Istio as a service mesh for traffic management and observability, the importance of sidecar proxies for intercepting and managing service-to-service communication, how Gateway API enables controlled external access to mesh services, and the value of telemetry tools for monitoring mesh health and traffic flow.