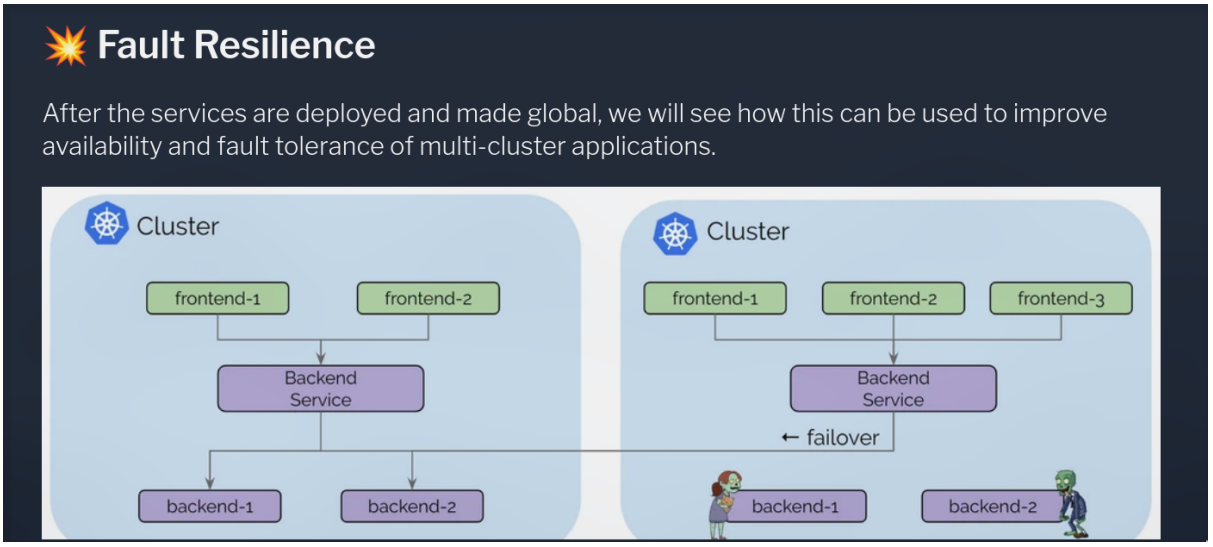
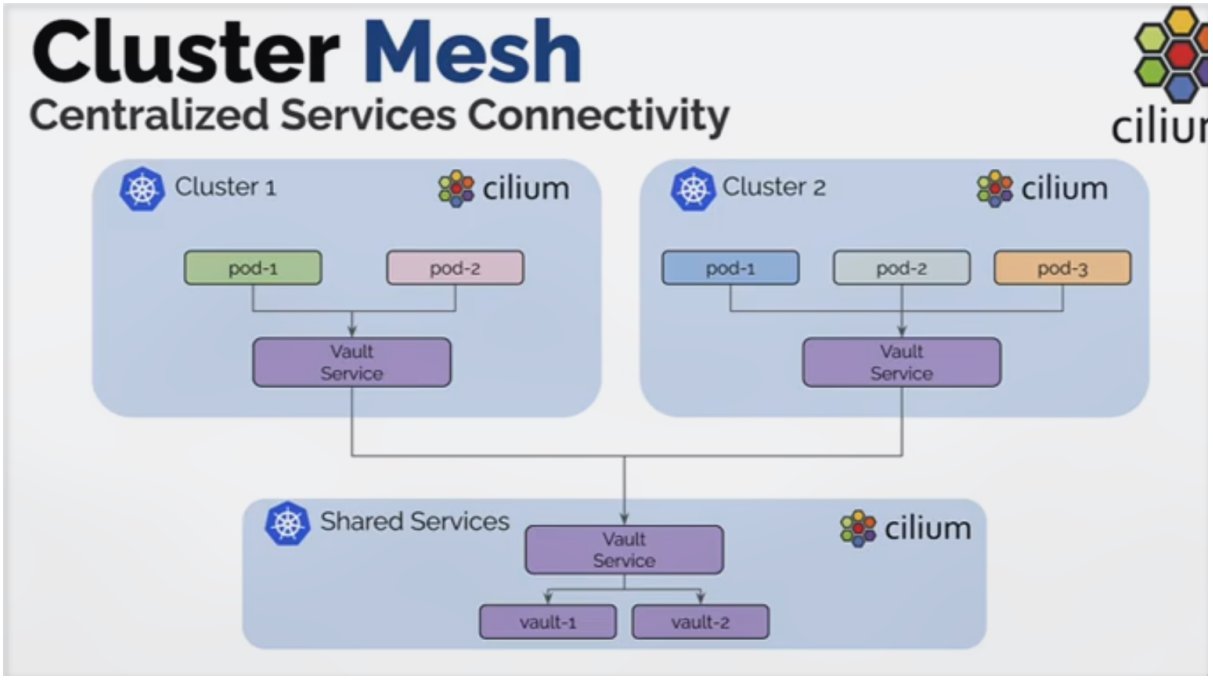
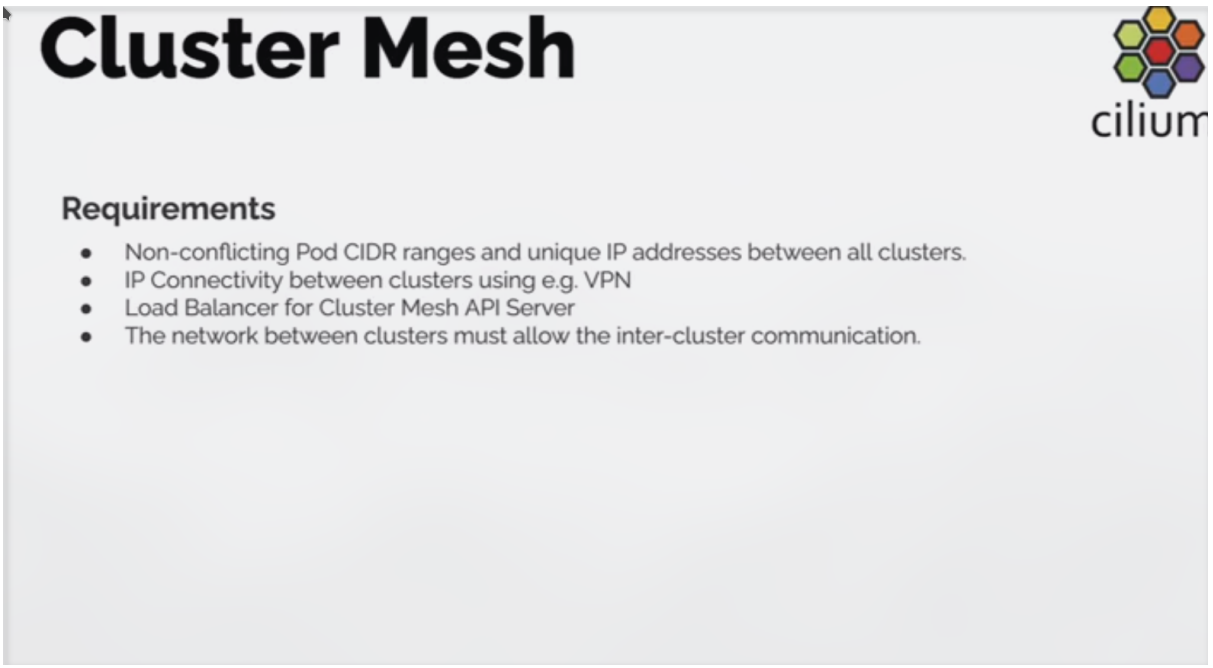
Installing the clusters







In this lab, we will create two Kind clusters and mesh them using Cilium.

We'll have two requirements for these clusters:

1. disable default CNI so we can easily install Cilium
2. use disjoint pods and services subnets

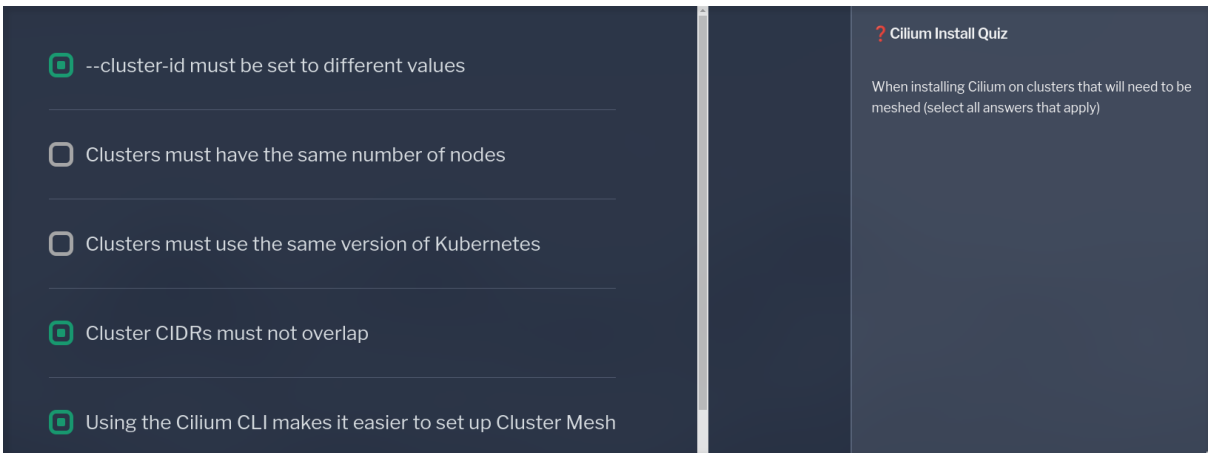
```yaml
cat kind_koornacht.yaml
---
apiVersion: kind.x-k8s.io/v1alpha4
kind: Cluster
networking:
  disableDefaultCNI: true
  podSubnet: 10.1.0.0/16
  serviceSubnet: 172.20.1.0/24
nodes:
- role: control-plane
  extraPortMappings:
  # localhost.run proxy
  - containerPort: 32042
    hostPort: 32042
  # Hubble relay
  - containerPort: 31234
    hostPort: 31234
  # Hubble UI
  - containerPort: 31235
    hostPort: 31235
- role: worker
- role: worker
```

```bash
cilium install --cluster-name abcd --cluster-id 1 --ipam kubernetes
cilium hubble enable
cilium status
```

```bash
cat kind_tion.yaml
---
apiVersion: kind.x-k8s.io/v1alpha4
kind: Cluster
networking:
  disableDefaultCNI: true
  podSubnet: 10.2.0.0/16
  serviceSubnet: 172.20.2.0/24
nodes:
- role: control-plane
- role: worker
- role: worker
```

This Tion cluster will also feature one control-plane node and 2 worker nodes, but it will use 10.2.0.0/16 for the Pod network, and 172.20.2.0/24 for the Services.

cilium install --cluster-name tion --cluster-id 2 --ipam kubernetes
cilium status

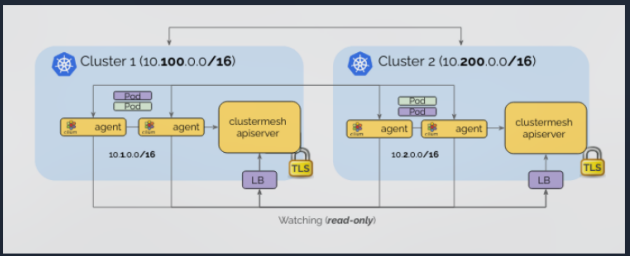


Cluster mesh adding

🏛️ Cluster Mesh Architecture

When activating Cluster Mesh on Cilium clusters, a new Control Plane is deployed to manage the mesh for this cluster, along with its etcd key-value store.

Agents of other clusters can then access this Cluster Mesh Control Plane in read-only mode, allowing them to access metadata about the cluster, such as Service names and corresponding IPs.



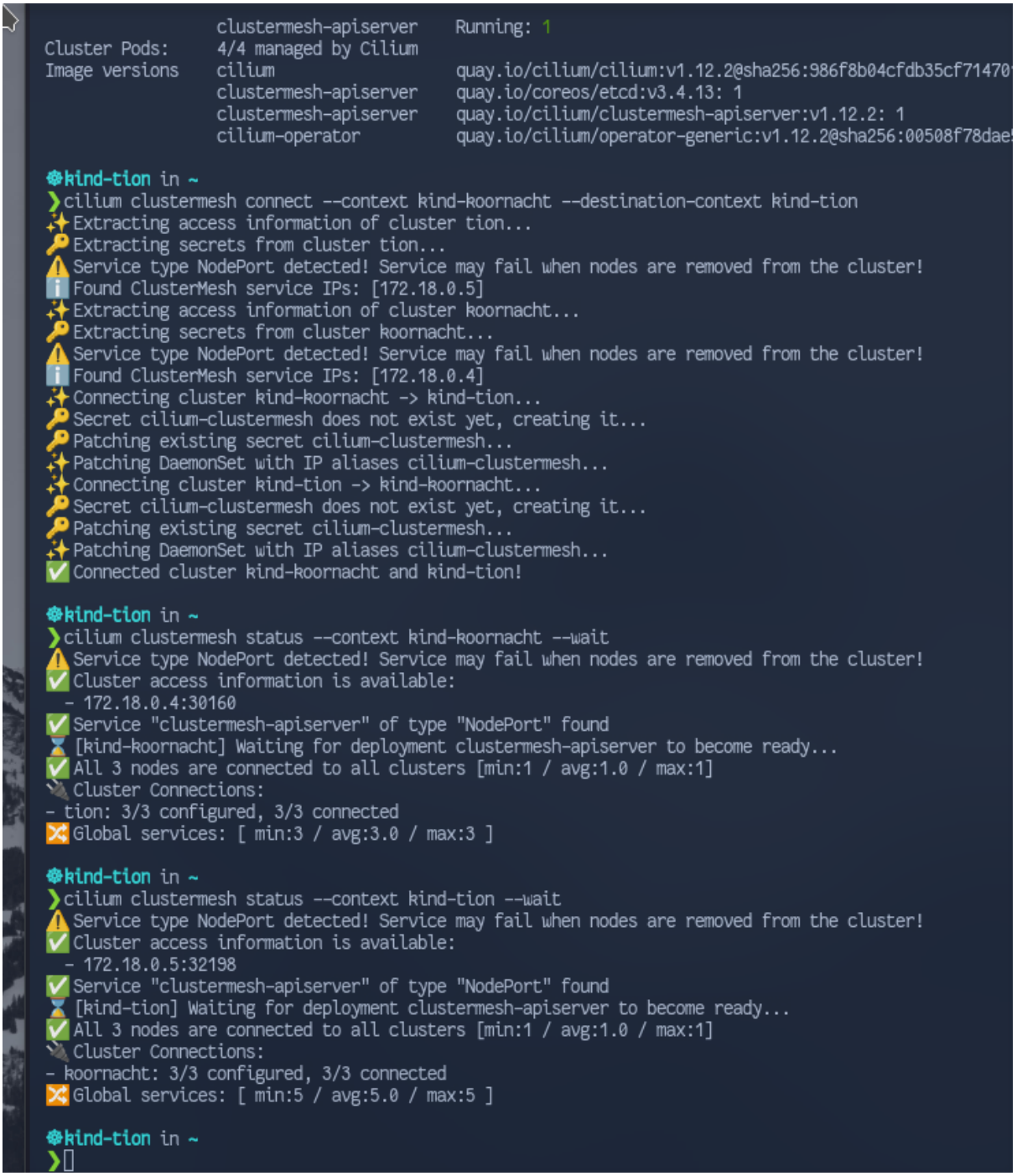

```bash
cilium clustermesh enable --context kind-koornacht --service-type NodePort
cilium clustermesh enable --context kind-tion --service-type NodePort

cilium clustermesh status --context kind-koornacht --wait
cilium clustermesh status --context kind-tion --wait


cilium clustermesh connect --context kind-koornacht --destination-context kind-tion
cilium clustermesh status --context kind-koornacht --wait
cilium clustermesh status --context kind-tion --wait
```

❓ Meshing Clusters Quiz

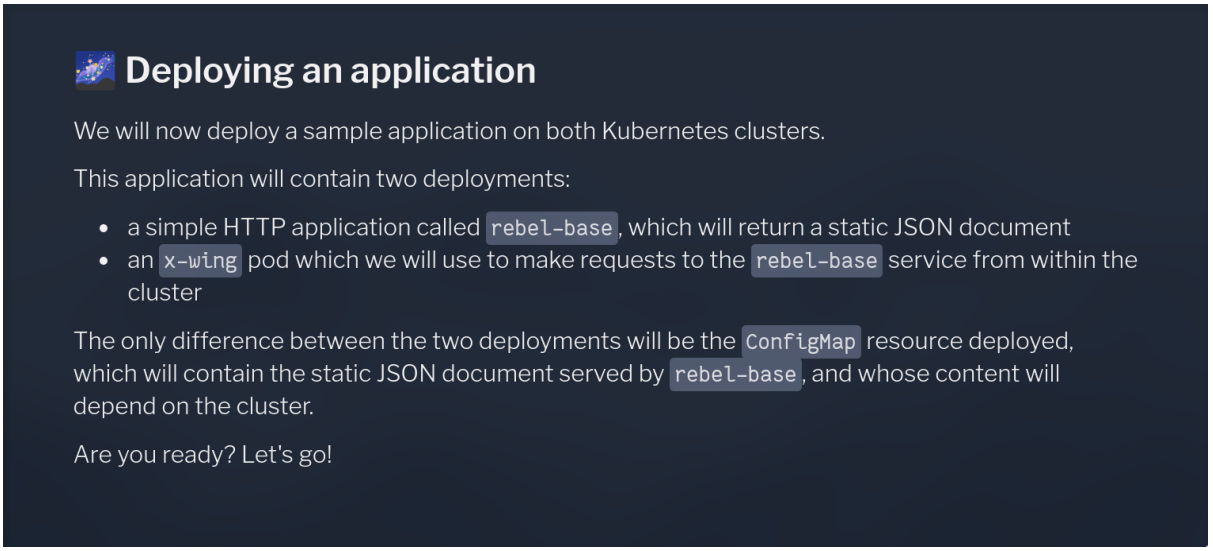
When meshing Kubernetes clusters (select all answers that apply)

- [x] Clustermesh needs to be enabled on both clusters
- [ ] It is recommended to use a `NodePort` setup for production
- [x] Clustermesh status can be checked using the Cilium CLI
- [ ] The clustermesh connect command must be issued on both clusters

Multiple answers can be checked as correct.


clustermesh-apiserver Running: 1
Cluster Pods: 4/4 managed by Cilium
Image versions cilium quay.io/cilium/cilium:v1.12.2@sha256:986f8b04cfdb35cf71470
clustermesh-apiserver quay.io/coreos/etcd:v3.4.13: 1
clustermesh-apiserver quay.io/cilium/clustermesh-apiserver:v1.12.2: 1
cilium-operator quay.io/cilium/operator-generic:v1.12.2@sha256:00508f78dae
kind-tion in ~
cilium clustermesh connect --context kind-koornacht --destination-context kind-tion
Extracting access information of cluster tion...
Extracting secrets from cluster tion...
Service type NodePort detected! Service may fail when nodes are removed from the cluster!
Found ClusterMesh service IPs: [172.18.0.5]
Extracting access information of cluster koornacht...
Extracting secrets from cluster koornacht...
Service type NodePort detected! Service may fail when nodes are removed from the cluster!
Found ClusterMesh service IPs: [172.18.0.4]
Connecting cluster kind-koornacht -> kind-tion...
Secret cilium-clustermesh does not exist yet, creating it...
Patching existing secret cilium-clustermesh...
Patching DaemonSet with IP aliases cilium-clustermesh...
Connecting cluster kind-tion -> kind-koornacht...
Secret cilium-clustermesh does not exist yet, creating it...
Patching existing secret cilium-clustermesh...
Patching DaemonSet with IP aliases cilium-clustermesh...
Connected cluster kind-koornacht and kind-tion!
kind-tion in ~
cilium clustermesh status --context kind-koornacht --wait
Service type NodePort detected! Service may fail when nodes are removed from the cluster!
Cluster access information is available:
- 172.18.0.4:30160
Service "clustermesh-apiserver" of type "NodePort" found
[kind-koornacht] Waiting for deployment clustermesh-apiserver to become ready...
All 3 nodes are connected to all clusters [min:1 / avg:1.0 / max:1]
Cluster Connections:
- tion: 3/3 configured, 3/3 connected
Global services: [min:3 / avg:3.0 / max:3]
kind-tion in ~
cilium clustermesh status --context kind-tion --wait
Service type NodePort detected! Service may fail when nodes are removed from the cluster!
Cluster access information is available:
- 172.18.0.5:32198
Service "clustermesh-apiserver" of type "NodePort" found
[kind-tion] Waiting for deployment clustermesh-apiserver to become ready...
All 3 nodes are connected to all clusters [min:1 / avg:1.0 / max:1]
Cluster Connections:
- koornacht: 3/3 configured, 3/3 connected
Global services: [min:5 / avg:5.0 / max:5]
kind-tion in ~

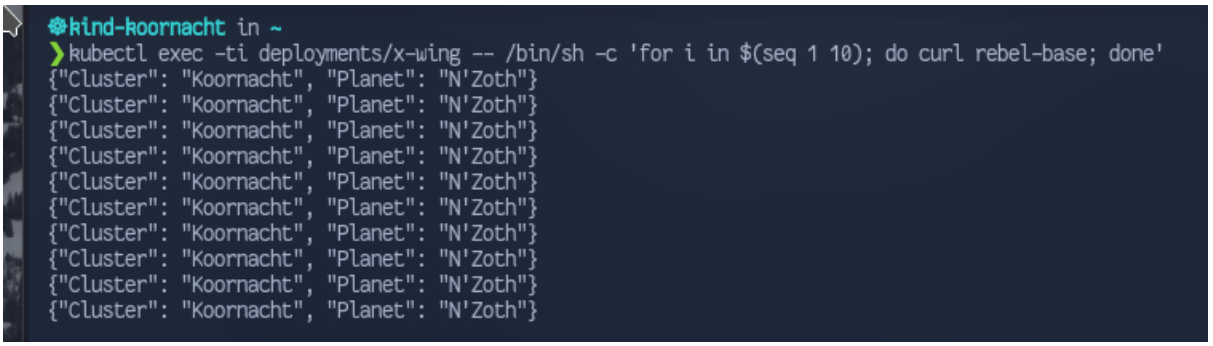
Deploy the applications




```yaml
**kubectl config use kind-koornacht**
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: rebel-base
spec:
  selector:
    matchLabels:
      name: rebel-base
  replicas: 2
  template:
    metadata:
      labels:
        name: rebel-base
    spec:
      containers:
      - name: rebel-base
        image: docker.io/nginx:1.15.8
        volumeMounts:
          - name: html
            mountPath: /usr/share/nginx/html/
        livenessProbe:
          httpGet:
            path: /
            port: 80
          periodSeconds: 1
        readinessProbe:
          httpGet:
```

```
            path: /
            port: 80
      volumes:
        - name: html
          configMap:
            name: rebel-base-response
            items:
              - key: message
                path: index.html
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: x-wing
spec:
  selector:
    matchLabels:
      name: x-wing
  replicas: 2
  template:
    metadata:
      labels:
        name: x-wing
    spec:
      containers:
      - name: x-wing-container
        image: docker.io/cilium/json-mock:1.2
        livenessProbe:
          exec:
            command:
            - curl
            - -sS
            - -o
            - /dev/null
            - localhost
        readinessProbe:
          exec:
            command:
            - curl
            - -sS
            - -o
            - /dev/null
            - localhost


kubectl apply -f configmap_koornacht.yaml -o yaml
apiVersion: v1
data:
```

```
  message: |
    {"Cluster": "Koornacht", "Planet": "N'Zoth"}
kind: ConfigMap
metadata:
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: |
      {"apiVersion":"v1","data":{"message":"{\"Cluster\": \"Koornacht\", \"Planet\": \"N'Zoth\"}\n"},"kind":"ConfigMap","metadata":{"annotations":{},"name":"rebel-base-response","namespace":"default"}}




---
apiVersion: v1
kind: Service
metadata:
  name: rebel-base
spec:
  type: ClusterIP
  ports:
  - port: 80
  selector:
    name: rebel-base
```



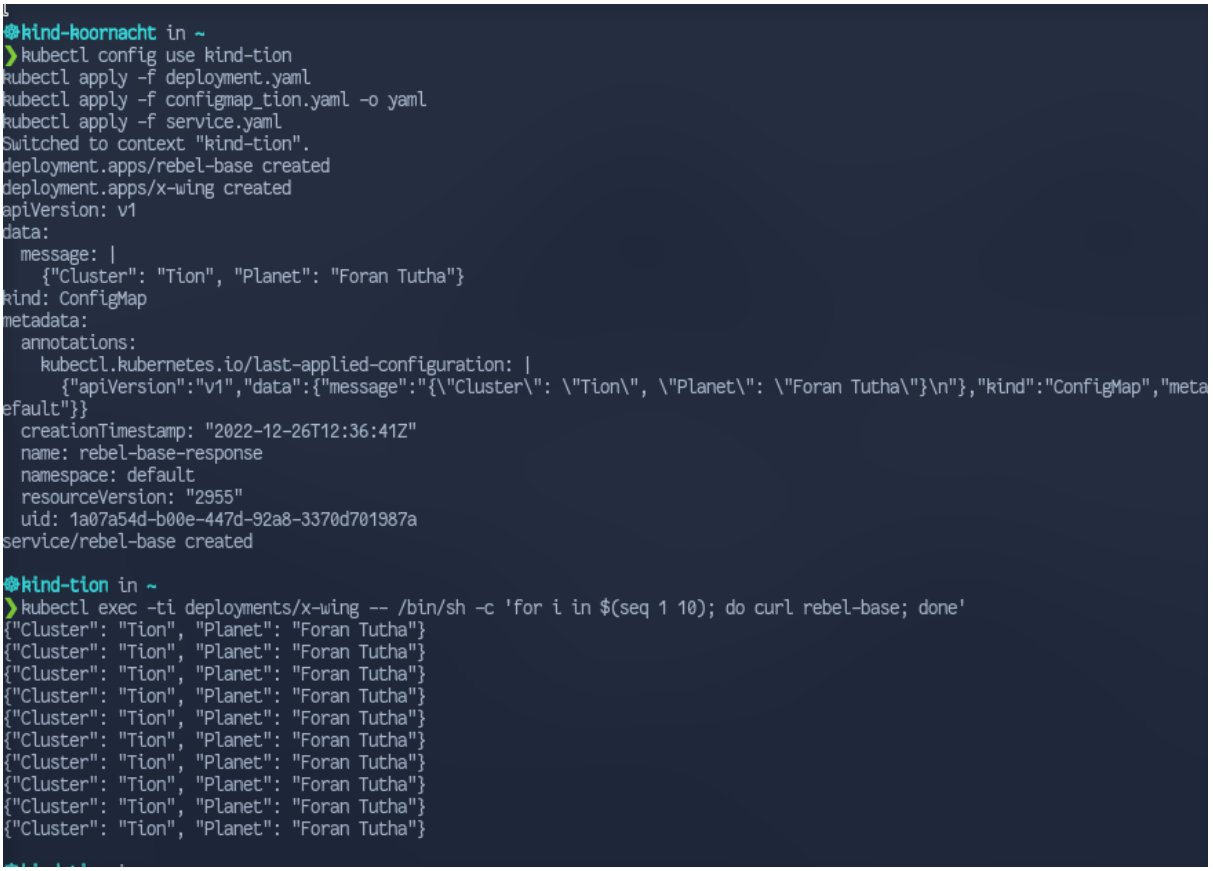

```
```

kubectl config use kind-tion

```
apiVersion: v1
data:
  message: |
    {"Cluster": "Tion", "Planet": "Foran Tutha"}
kind: ConfigMap
metadata:
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: |
```

{"apiVersion":"v1","data":{"message":"{\"Cluster\": \"Tion\", \"Planet\": \"Foran Tutha\"}\n"},"kind":"ConfigMap","metadata":{"annotations":{},"name":"rebel-base-response","namespace":"default"}}

```
```



Making services global

🌍 Making Services Global

When two or more clusters are meshed, Cilium allows you to set services as global in one or more clusters, by adding an annotation to them:

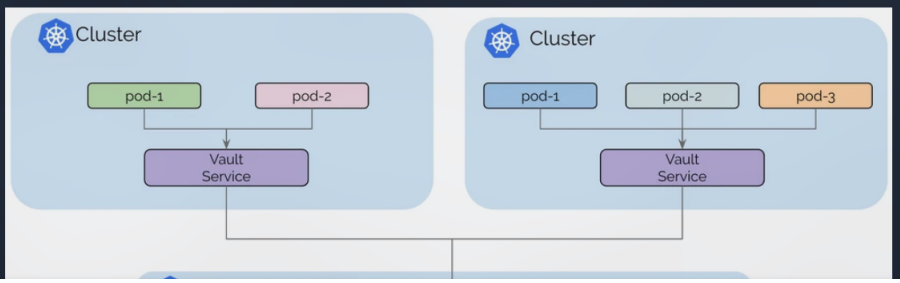
```
io.cilium/global-service: "true"
```

When this annotation is set, requests to this service will load-balance to all available services with the same name and namespace in all meshed clusters.

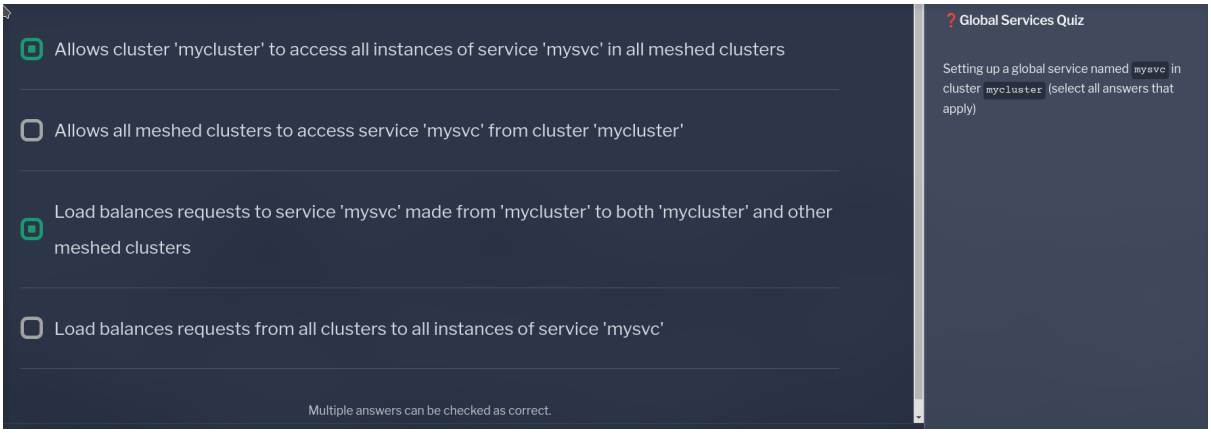
🤲 Shared services

Another use case of global services is shared services.

This is particularly usefull when sharing stateful services between multiple Kubernetes clusters. If all clusters are meshed, the stateless applications spread among multiple clusters can all access the stateful services located on a single shared cluster.



```
kind-tion in ~
❯ kubectl --context kind-koornacht annotate service rebel-base io.cilium/global-service="true"
service/rebel-base annotated

kind-tion in ~
❯ kubectl --context kind-tion exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}

kind-tion in ~
❯ kubectl --context kind-koornacht exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}

kind-tion in ~
❯ kubectl --context kind-tion annotate service rebel-base io.cilium/global-service="true"
service/rebel-base annotated

kind-tion in ~
❯ kubectl --context kind-tion exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}

kind-tion in ~
```


Allows cluster 'mycluster' to access all instances of service 'mysvc' in all meshed clusters
Allows all meshed clusters to access service 'mysvc' from cluster 'mycluster'
Load balances requests to service 'mysvc' made from 'mycluster' to both 'mycluster' and other meshed clusters
Load balances requests from all clusters to all instances of service 'mysvc'
Multiple answers can be checked as correct.
❓ Global Services Quiz
Setting up a global service named mysvc in cluster mycluster (select all answers that apply)

Global and shared service

🌎 Global vs Shared

We've seen how the `io.cilium/global-service` annotation allows for a cluster to load-balance requests to a service to all meshed clusters with the same service.

What if you want to remove the service of a specific cluster from the global service?

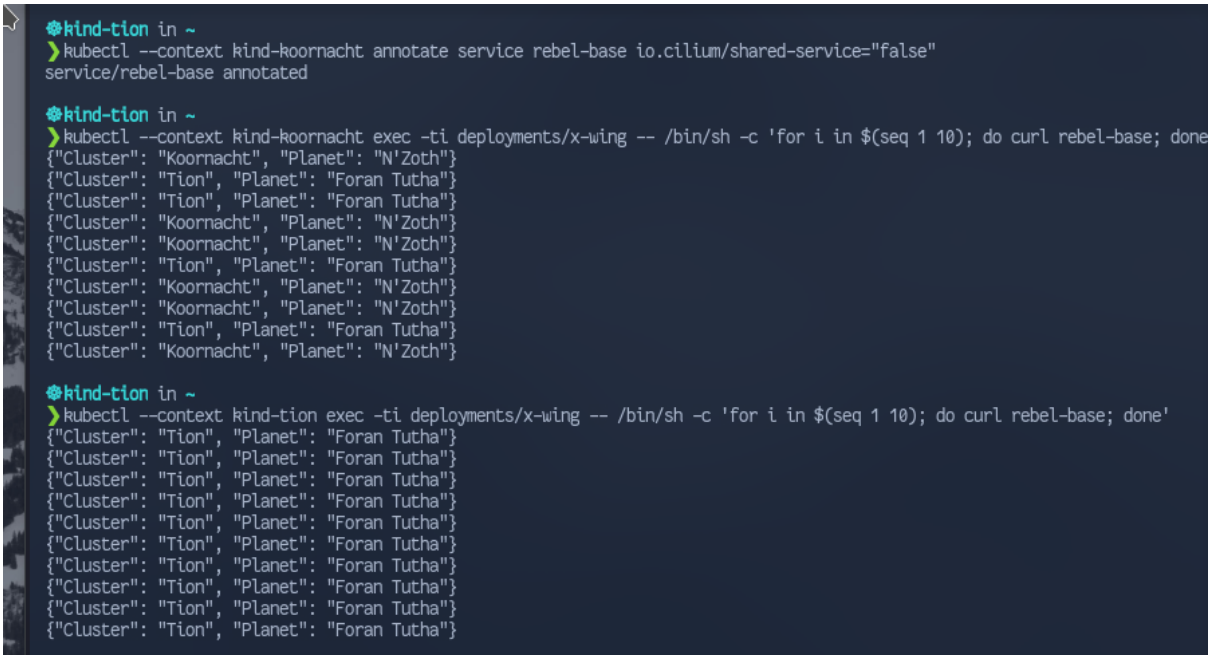
The `io.cilium/shared-service` annotation can be used for this.

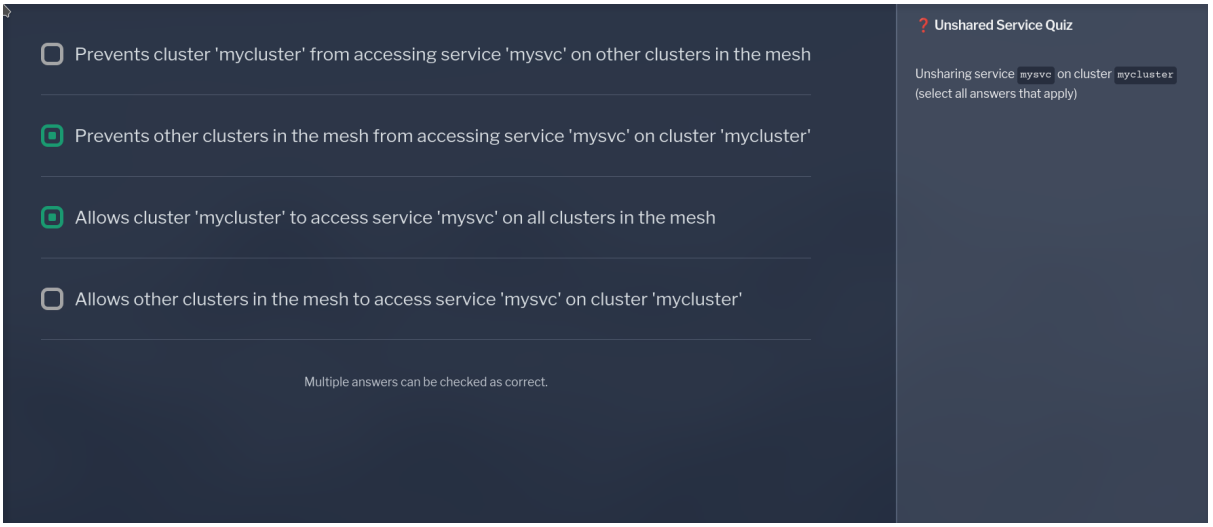
🚫 Disabling Global Service

By default, a service marked as global is considered shared as well, so the value of `io.cilium/shared-service` is `true` for all clusters when the service is marked as global in at least one cluster in the mesh.

Setting it to `false` in a cluster removes that specific service from the global service:

```
io.cilium/shared-service: "false"
```




❓ Unshared Service Quiz
Unsharing service mysvc on cluster mycluster
(select all answers that apply)
Prevents cluster 'mycluster' from accessing service 'mysvc' on other clusters in the mesh
Prevents other clusters in the mesh from accessing service 'mysvc' on cluster 'mycluster'
Allows cluster 'mycluster' to access service 'mysvc' on all clusters in the mesh
Allows other clusters in the mesh to access service 'mysvc' on cluster 'mycluster'
Multiple answers can be checked as correct.

Global services & latency

⏳ Global services & latency

Global services allow to load-balance traffic across multiple clusters.

As we have seen, this is very useful to implement a fallback policy for redundant services.

Most of the time however, it would be useful to limit latency by only using remote services when local ones are not available.

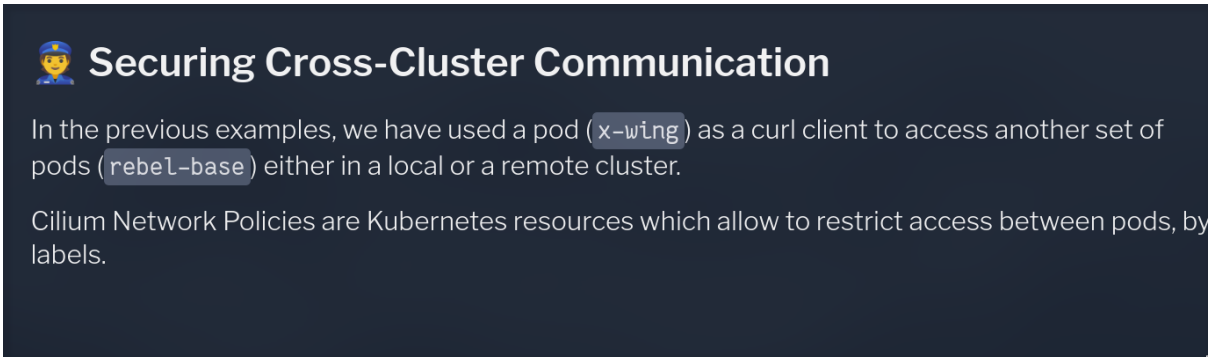
This is the objective of service affinity.

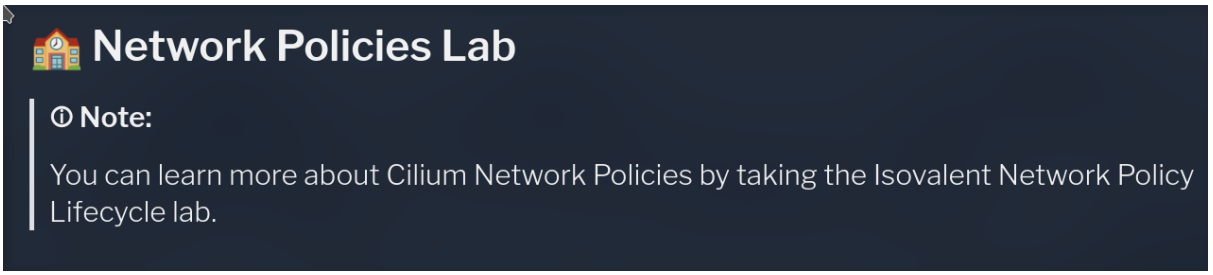
```
kind-tion in ~
❯ kubectl --context kind-koornacht annotate service rebel-base io.cilium/service-affinity=local
service/rebel-base annotated

kind-tion in ~
❯ kubectl --context kind-koornacht exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}
{"Cluster": "Koornacht", "Planet": "N'Zoth"}

kind-tion in ~
❯ kubectl --context kind-koornacht scale deployment rebel-base --replicas 0
deployment.apps/rebel-base scaled

kind-tion in ~
❯ kubectl --context kind-koornacht exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}
{"Cluster": "Tion", "Planet": "Foran Tutha"}

kind-tion in ~
❯
```

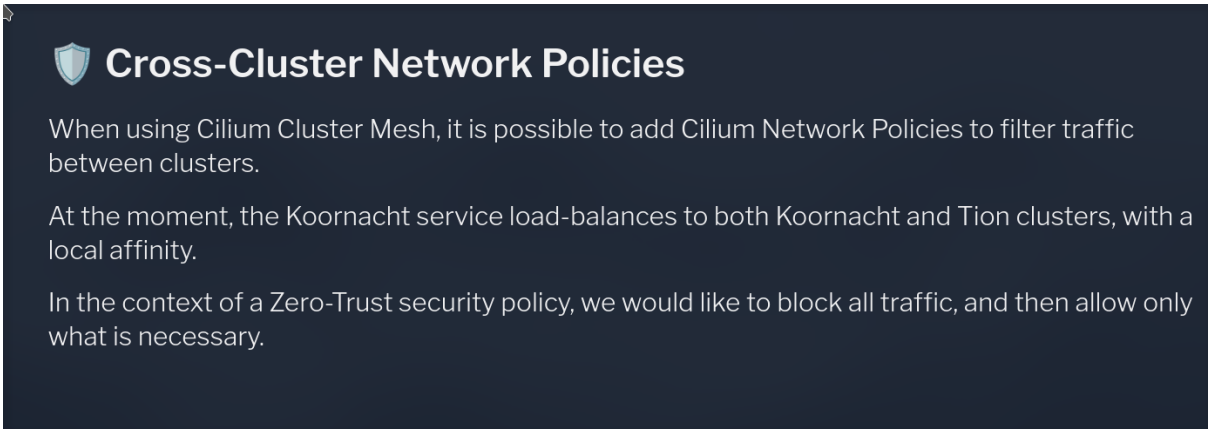
> ⓘ Note:
>
> The opposite effect can be obtained by using `remote` as the annotation value.

```
kubectl --context kind-koornacht scale deployment rebel-base --replicas 2
kubectl --context kind-koornacht rollout status deployment/rebel-base
kubectl --context kind-koornacht exec -ti deployments/x-wing -- /bin/sh -c 'for i in $(seq 1 10); do curl rebel-base; done'
```

Secure cross cluster communication

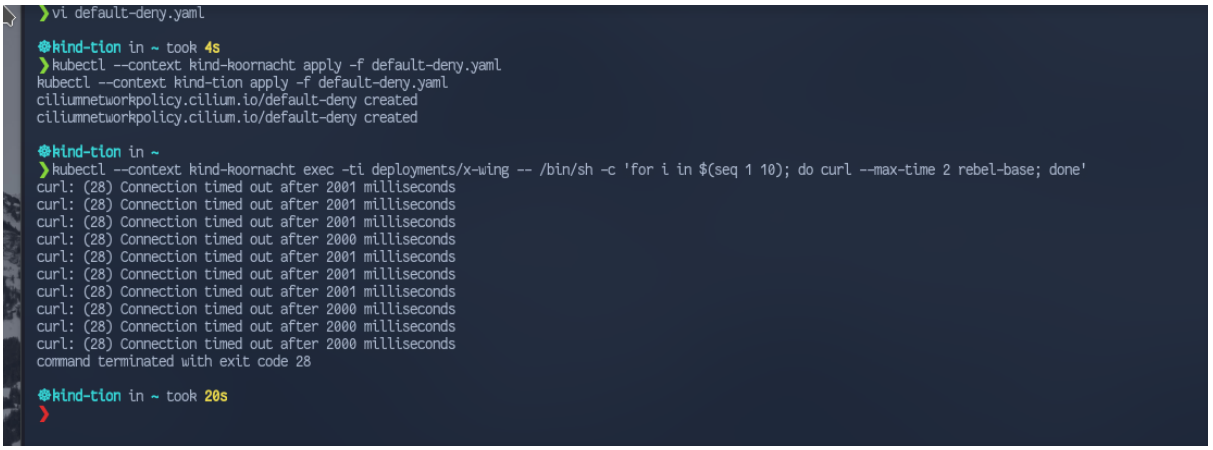


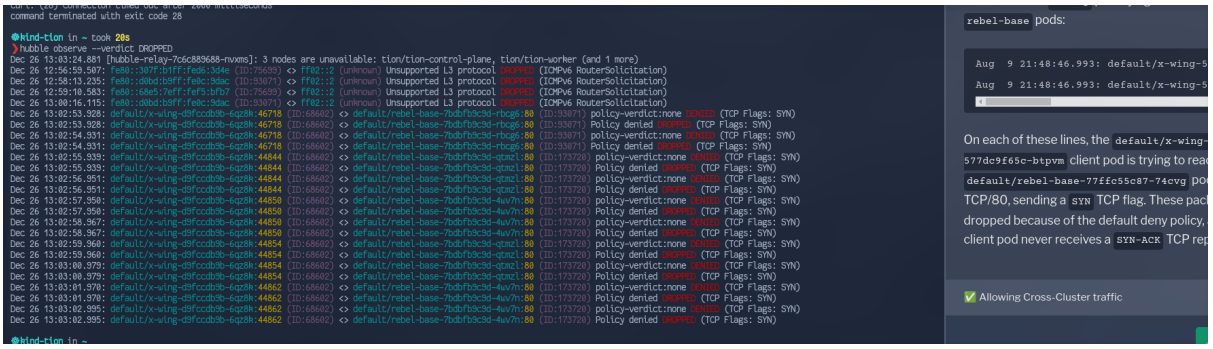





```
---
apiVersion: "cilium.io/v2"
kind: CiliumNetworkPolicy
metadata:
  name: "default-deny"
spec:
  description: "Default Deny"
  endpointSelector: {}
  ingress:
    - {}
  egress:
    - toEndpoints:
        - matchLabels:
            io.kubernetes.pod.namespace: kube-system
            k8s-app: kube-dns
      toPorts:
```

```
      - ports:
          - port: "53"
            protocol: UDP
        rules:
          dns:
            - matchPattern: "*"
```



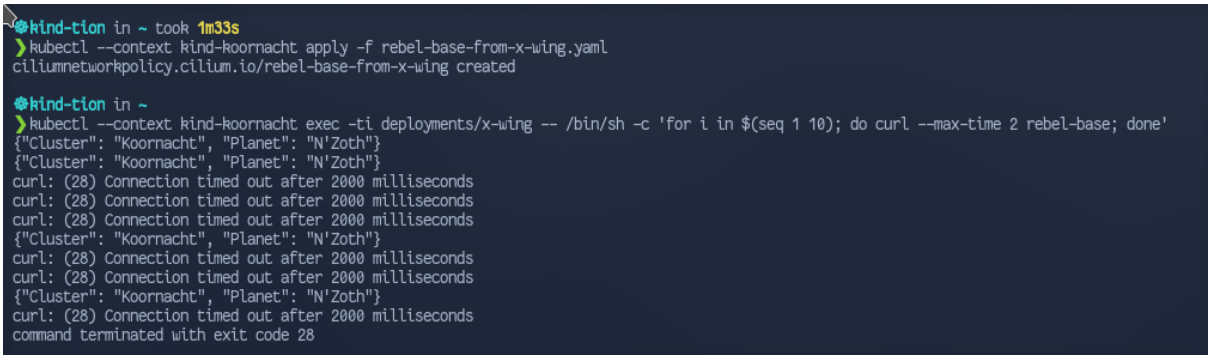



```
---
apiVersion: "cilium.io/v2"
kind: CiliumNetworkPolicy
metadata:
  name: "x-wing-to-rebel-base"
spec:
  description: "Allow x-wing in Koornacht to contact rebel-base"
  endpointSelector:
    matchLabels:
      name: x-wing
      io.cilium.k8s.policy.cluster: koornacht
  egress:
  - toEndpoints:
    - matchLabels:
        name: rebel-base
```

ur default deny policy blocks both ingress and egress connections for all pods, but the new policy we've added only allows egress connectivity. We also need to allow ingress

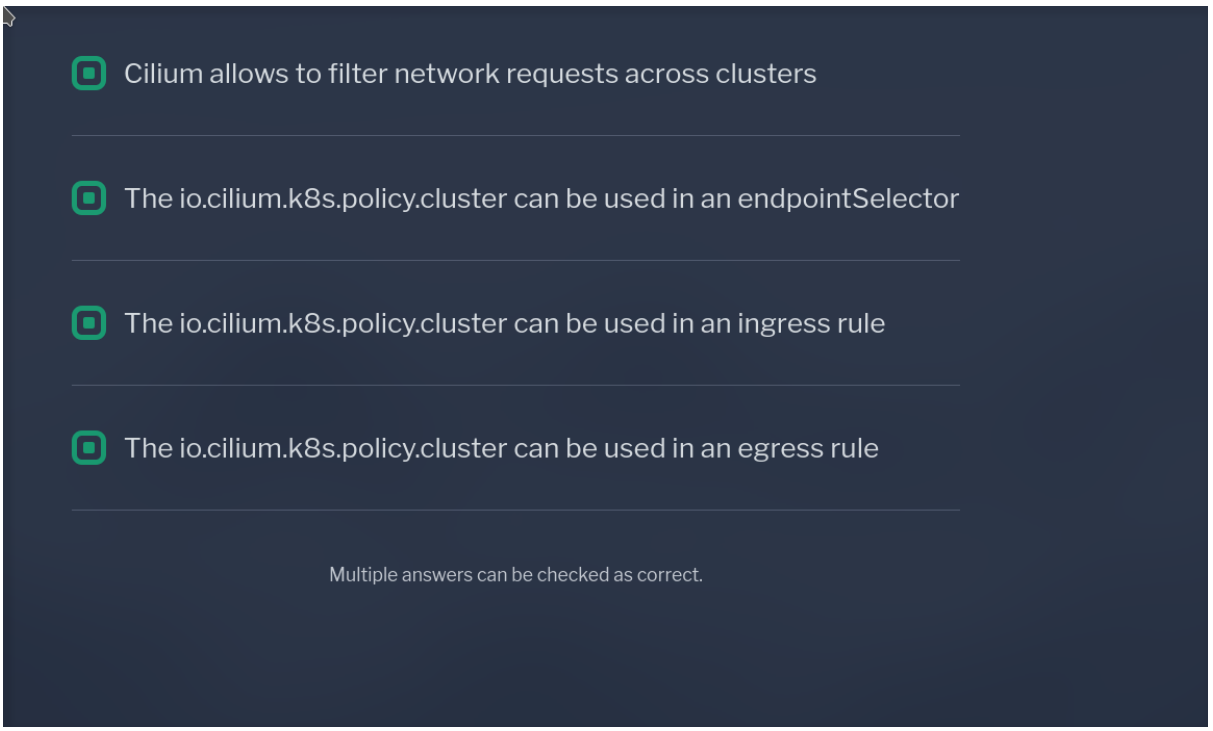
connections to reach the rebel-base pods. Let's fix this with a new CiliumNetworkPolicy resource:

```
---
apiVersion: "cilium.io/v2"
kind: CiliumNetworkPolicy
metadata:
  name: "rebel-base-from-x-wing"
spec:
  description: "Allow rebel-base to be contacted by Koornacht's x-wing"
  endpointSelector:
    matchLabels:
      name: rebel-base
  ingress:
  - fromEndpoints:
    - matchLabels:
        name: x-wing
        io.cilium.k8s.policy.cluster: koornacht
```



This is because we haven't applied any specific policies to the Tion cluster, where the default deny policy was also deployed.

We need to apply the rebel-base-from-x-wing Network Policy to the Tion cluster to allow the ingress connection:



Exam

When you want your service to be globally accessible and simultaneously not to be shared and also tries the local service first then only checks all other service in different clusters

kubectl annotate service <> io.cilium/service-affinity=”local”
kubectl annotate service <> io.cilium/global-service=”true”
kubectl annotate service <> io.cilium/shared-service=”false”