

Inside Kubernetes Ingress

KubeCon + CloudNativeCon North America 2020





Dominik Tornow

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dominik.tornow@gmail.com





<https://youtu.be/Hk77mToouEI>

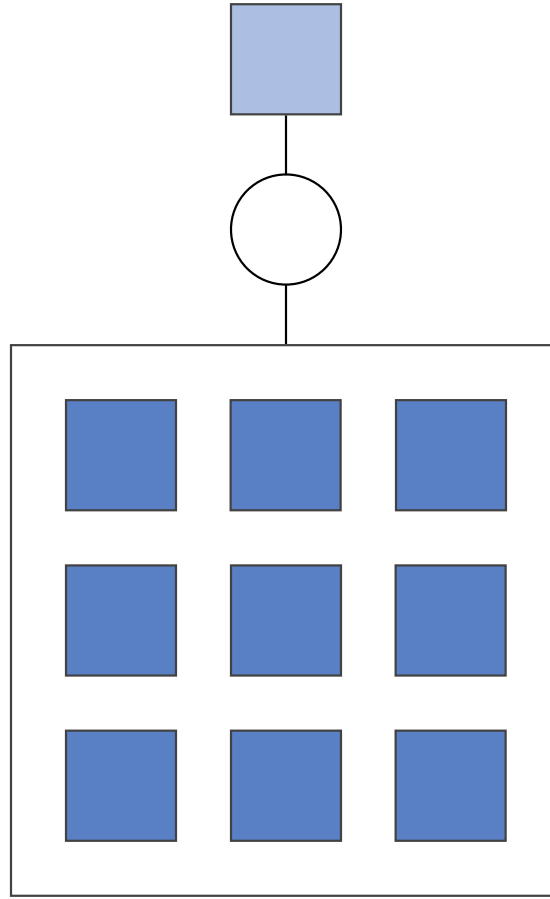
Inside Kubernetes Services

KubeCon + CloudNativeCon North America 2019

Ingress for Kubernetes

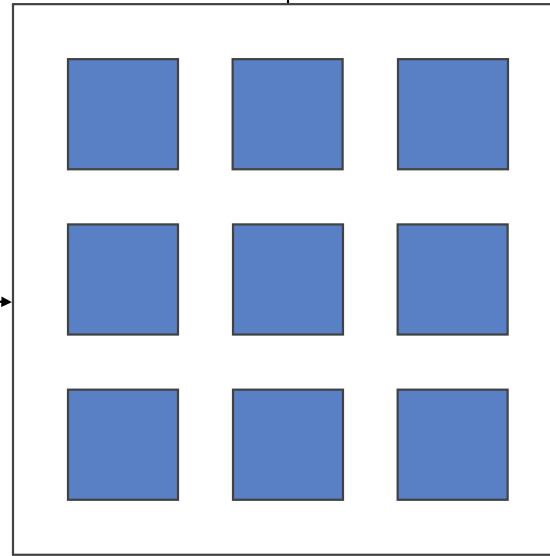
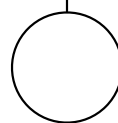
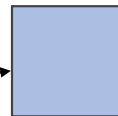
Problem





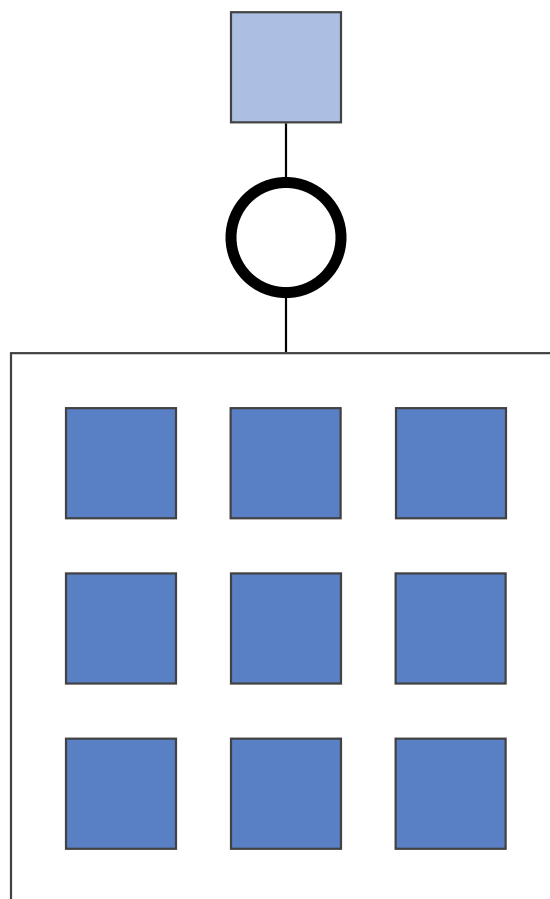
External
Everything "outside" the cluster

**Service
Consumer**



Internal
Everything "inside" the cluster

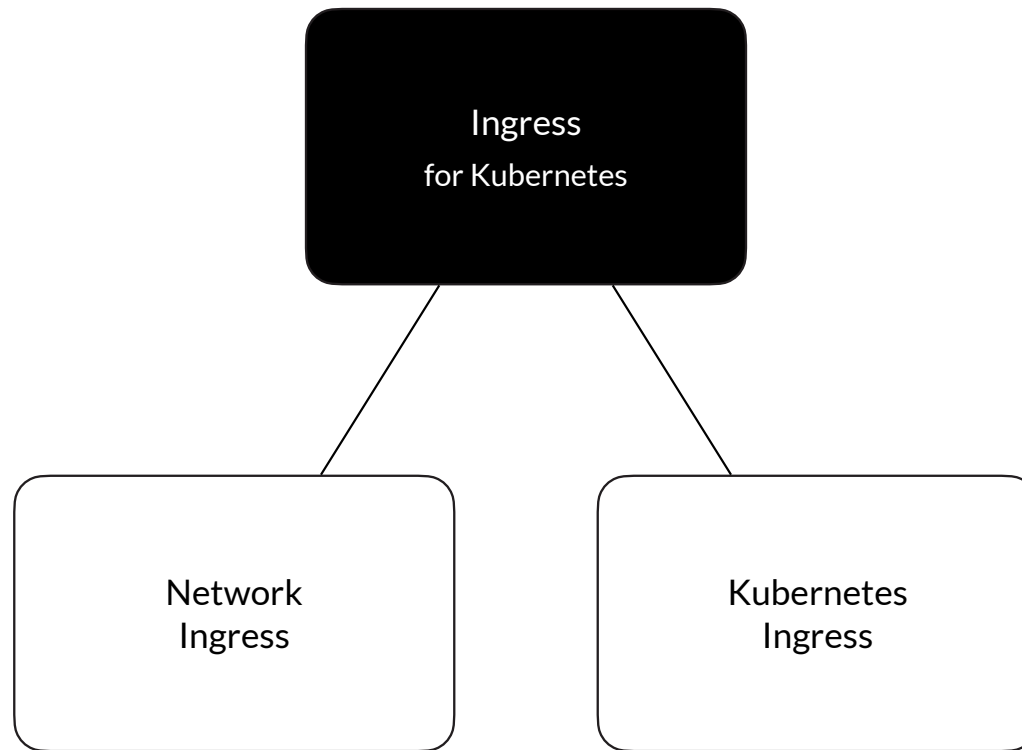
**Service
Provider**



Ingress for Kubernetes

Solution



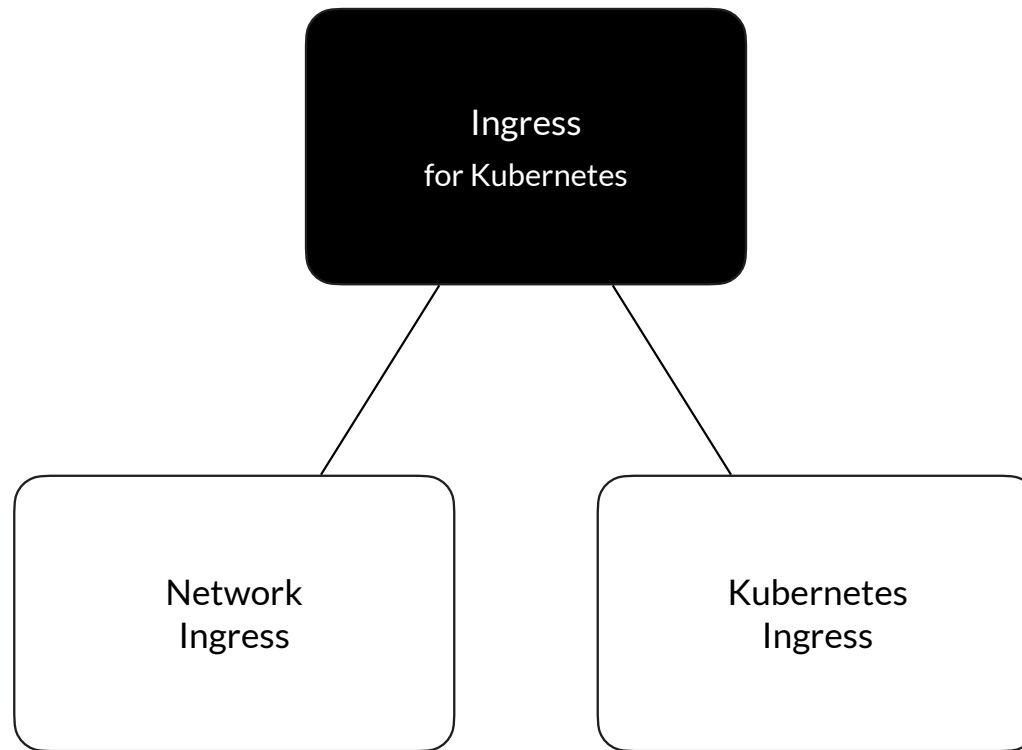


Ingress for Kubernetes

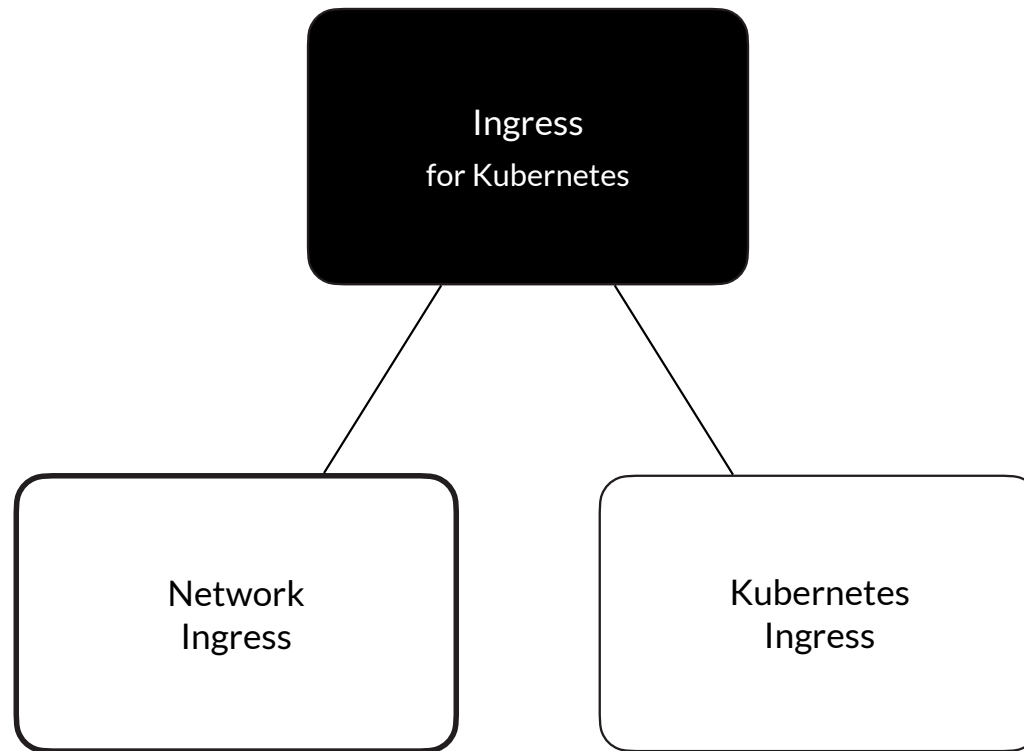
Intuition



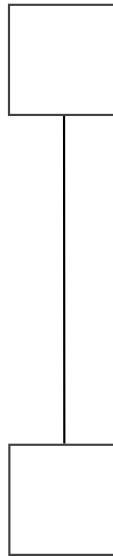
Intuition



Intuition



Network Ingress



Network Ingress

External



Internal



Network Ingress

External



Internal



Network Ingress

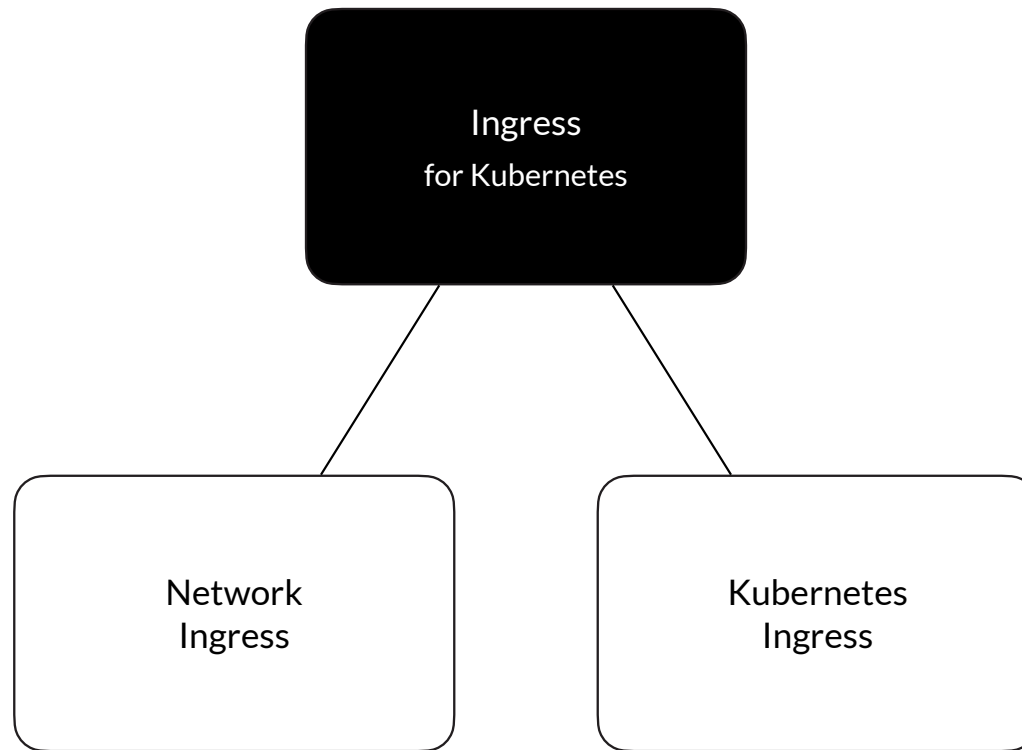
External



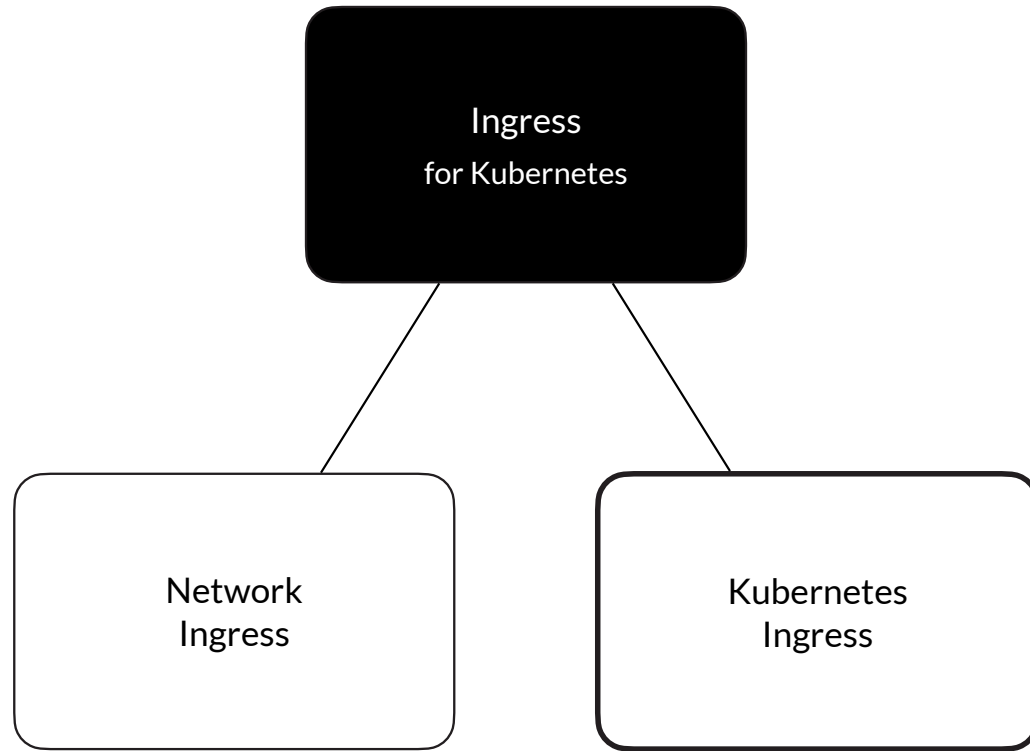
Internal



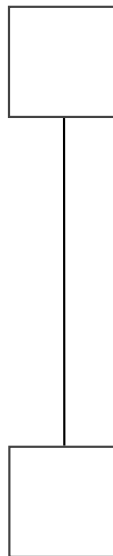
Intuition



Intuition



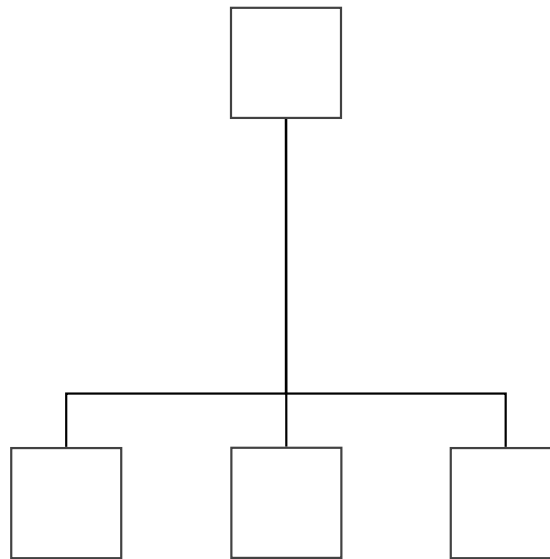
Kubernetes Ingress



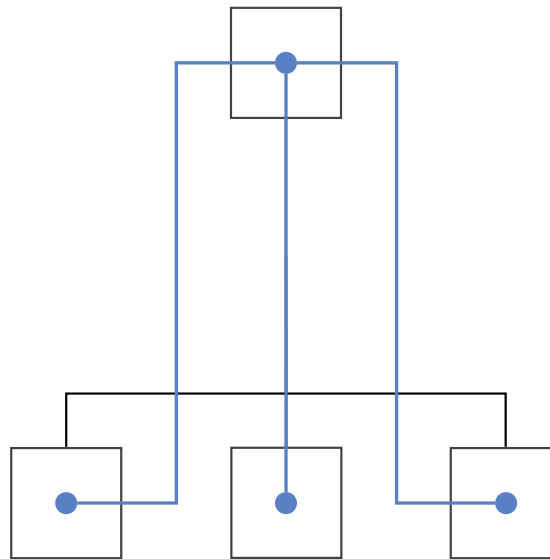
Kubernetes Ingress



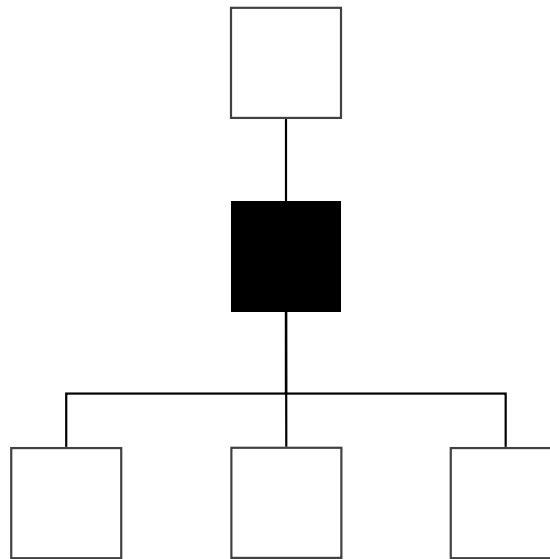
Kubernetes Ingress



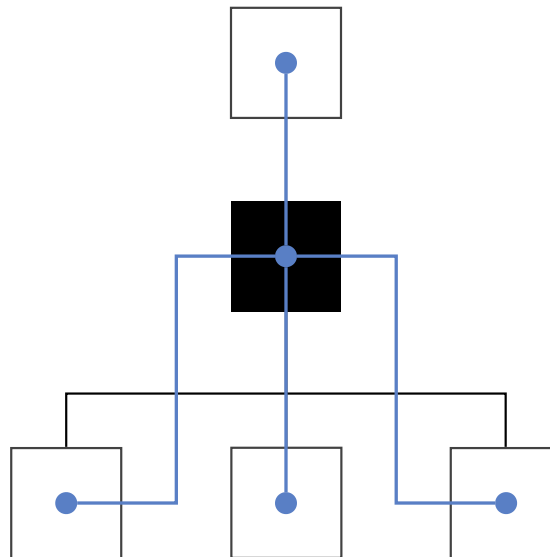
Kubernetes Ingress



Kubernetes Ingress

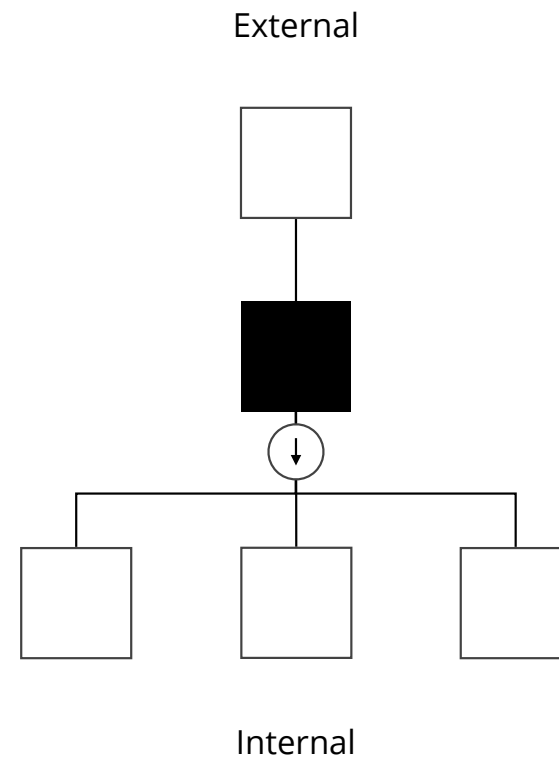
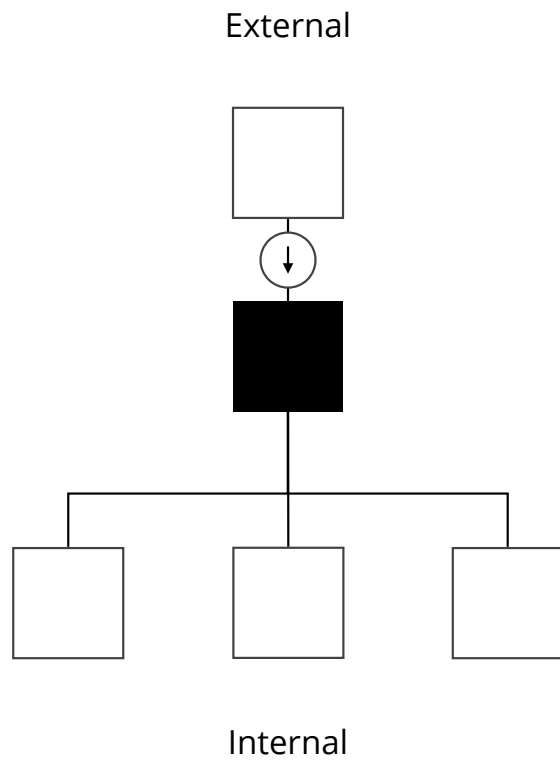


Kubernetes Ingress



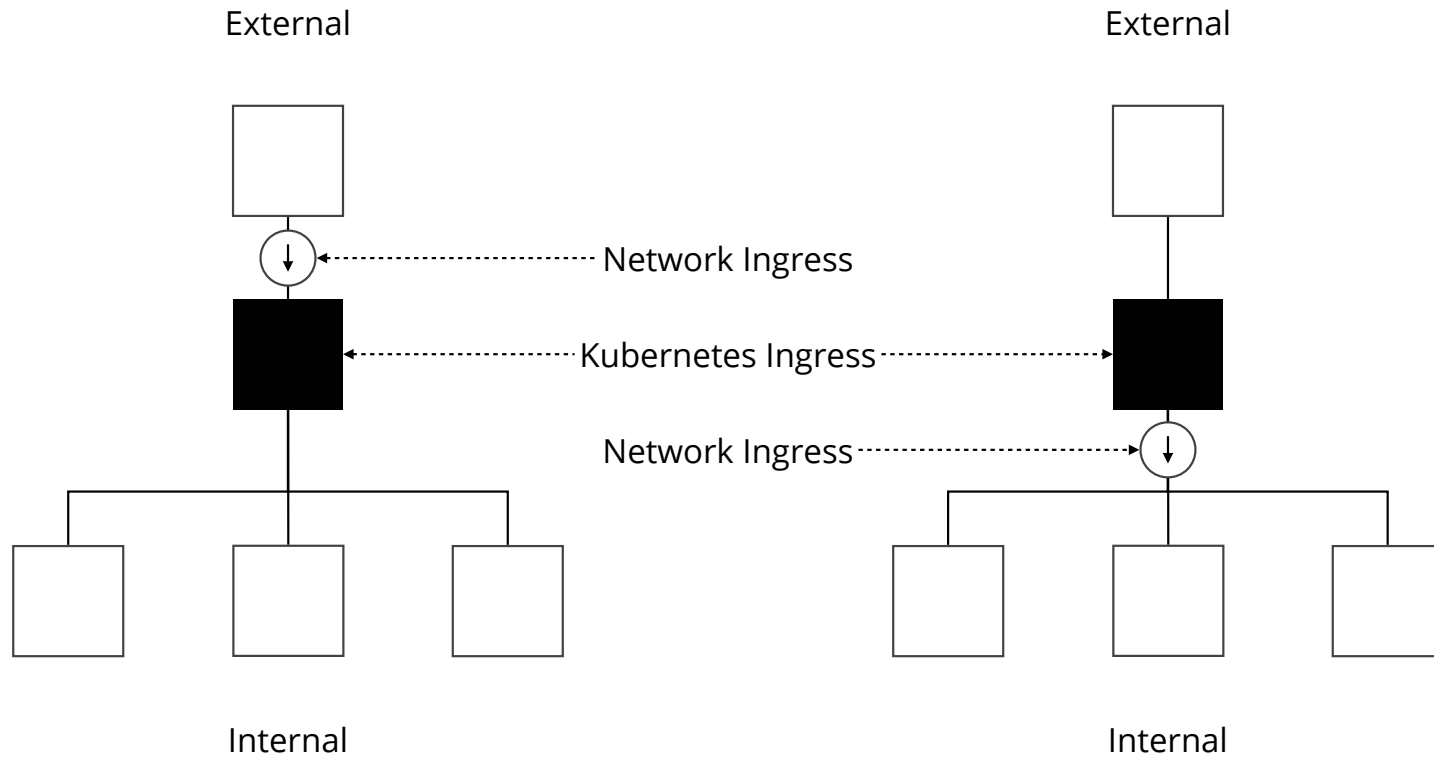
Ingress for Kubernetes

Network Ingress & Kubernetes Ingress



Ingress for Kubernetes

Network Ingress & Kubernetes Ingress

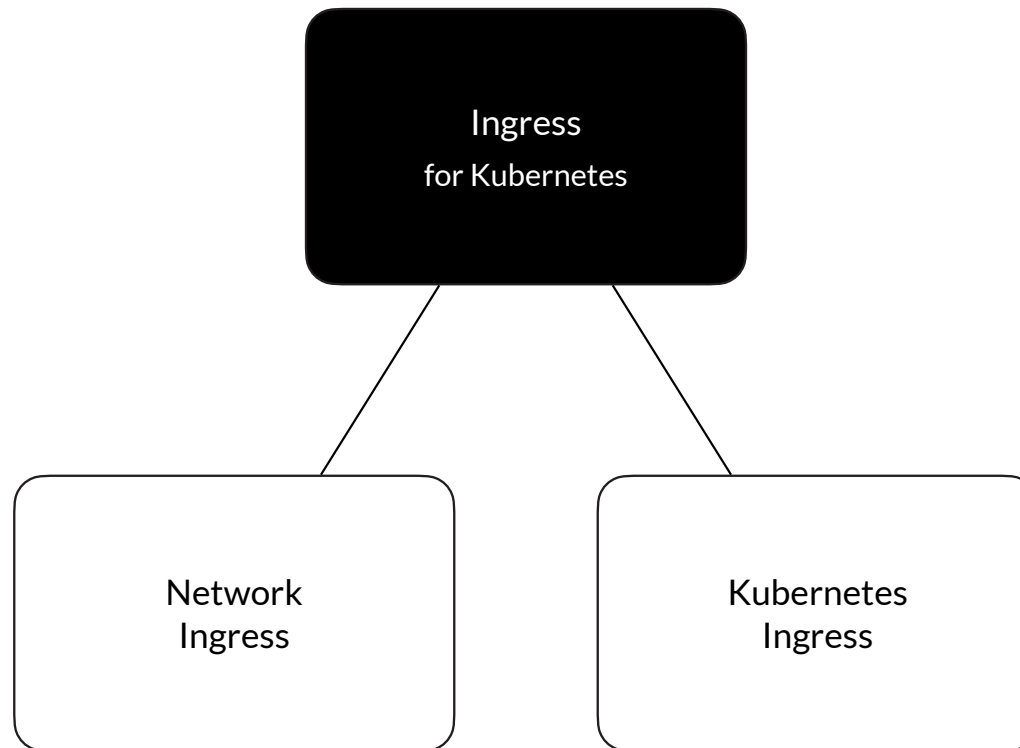


Ingress for Kubernetes

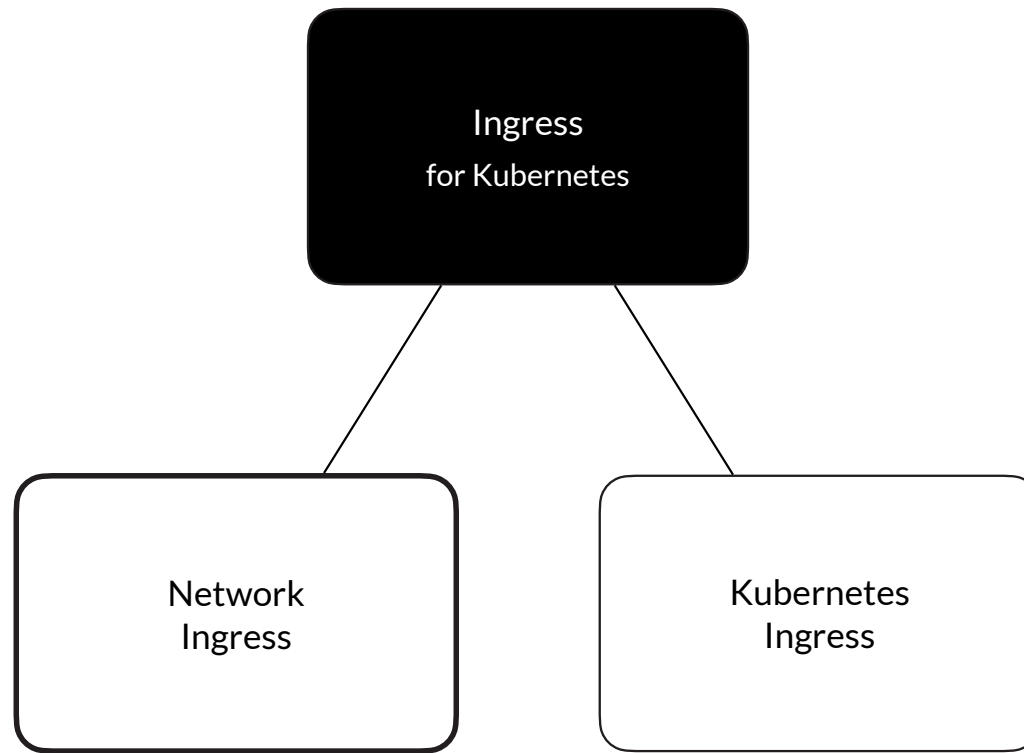
Definition

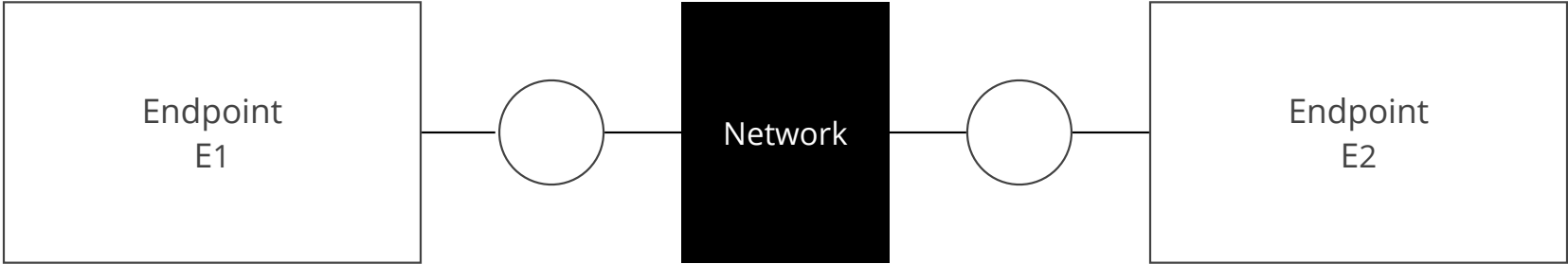


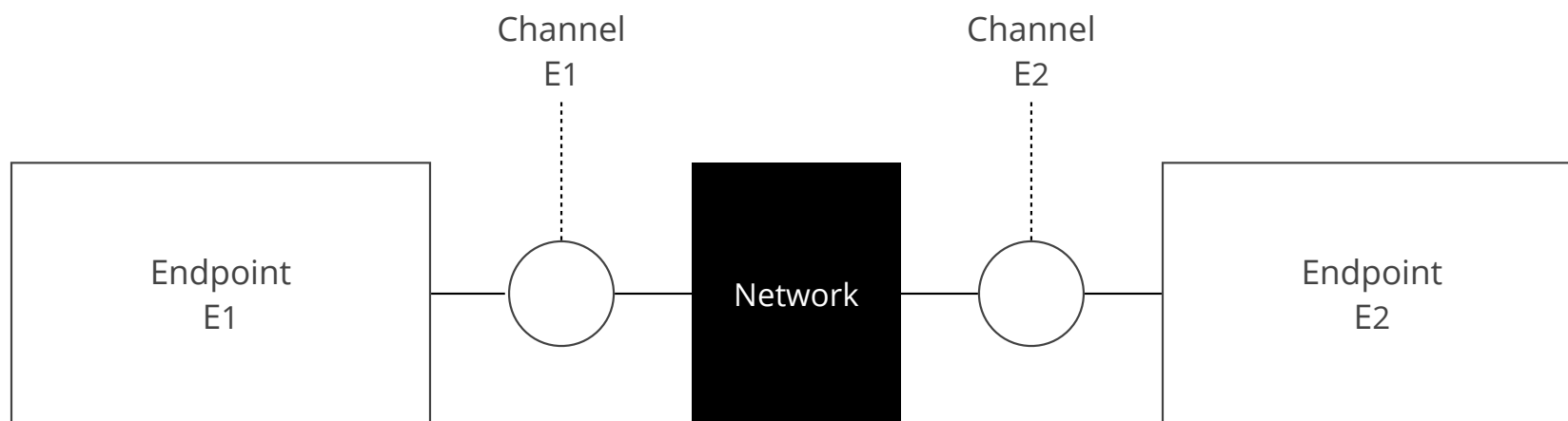
Definition

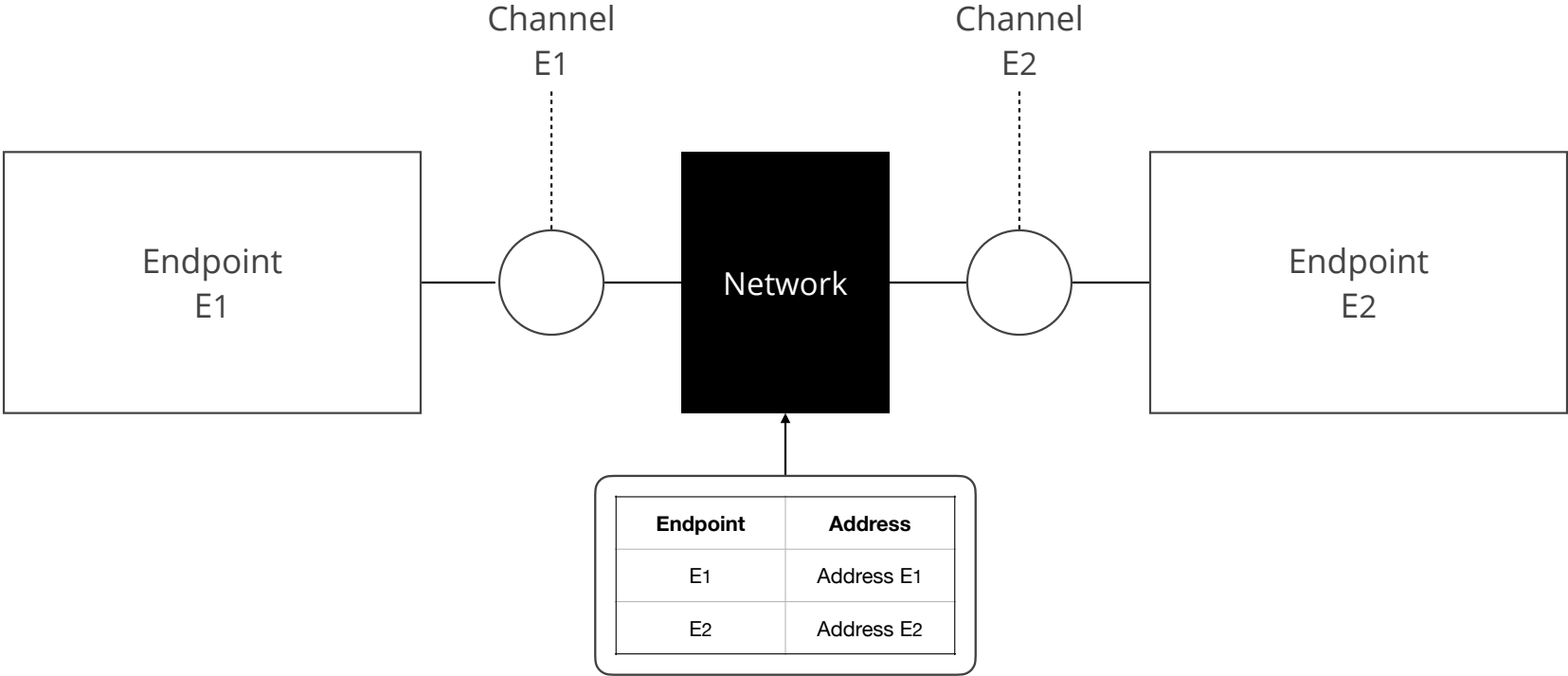


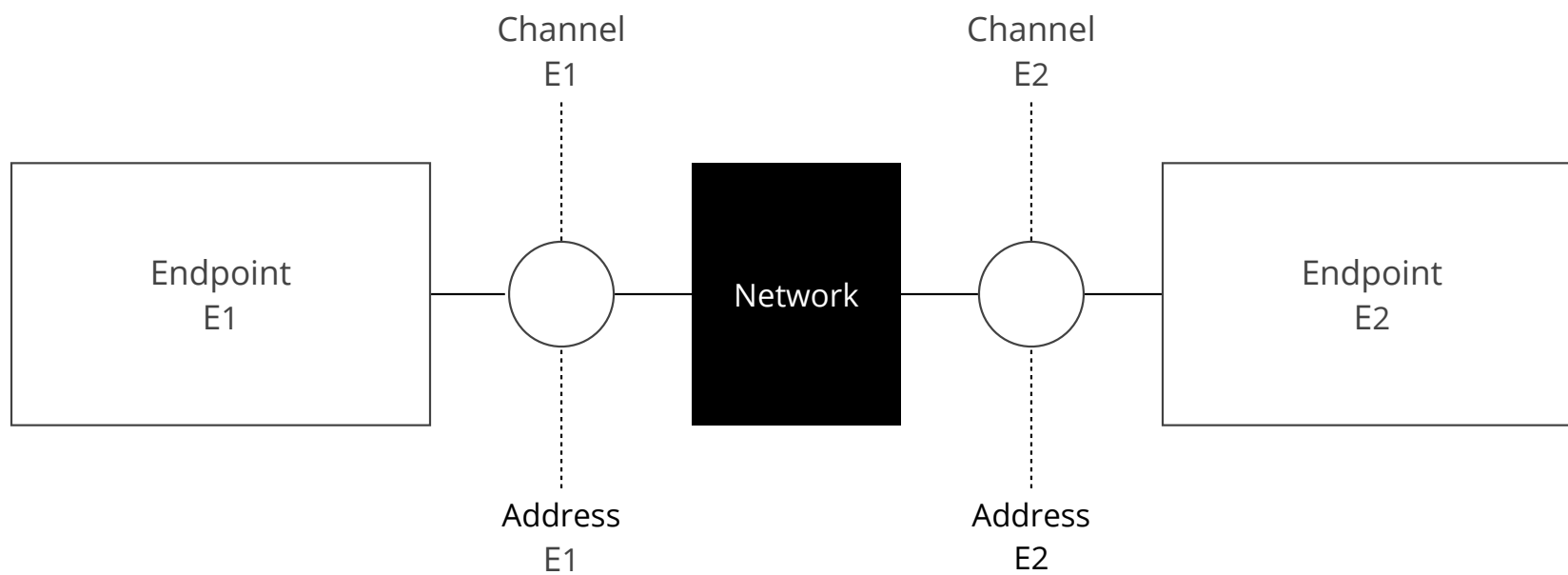
Definition

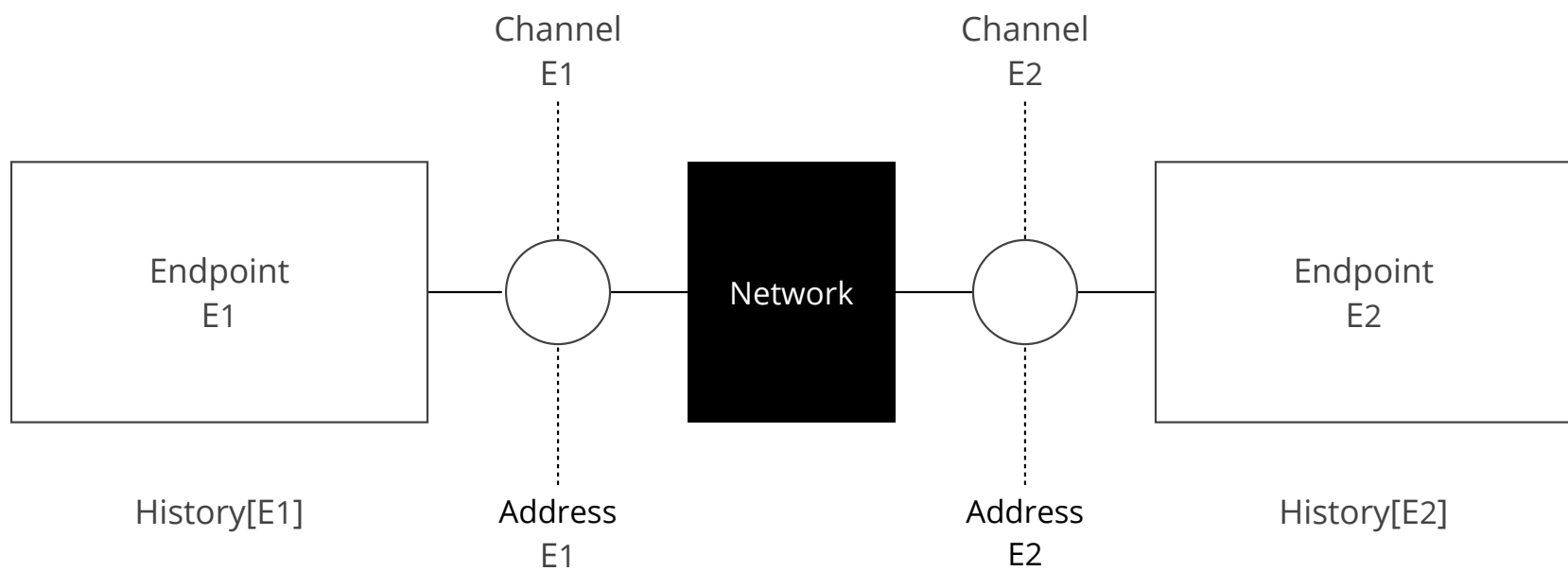


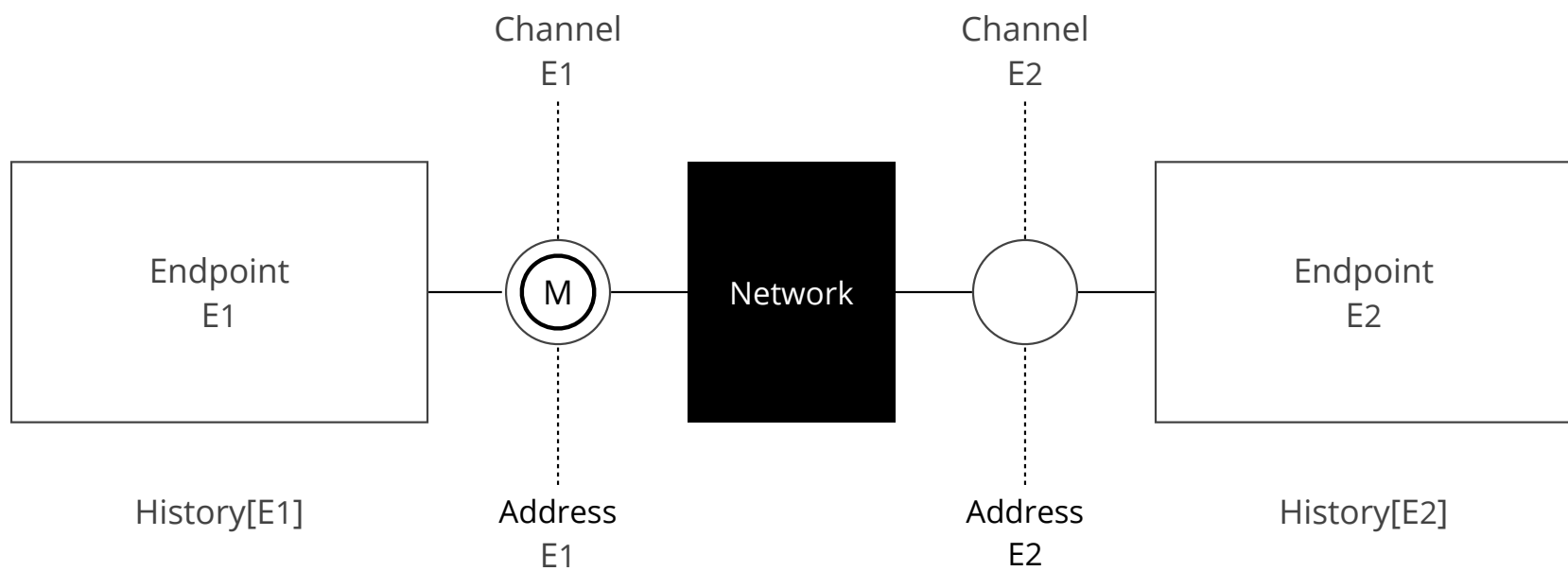


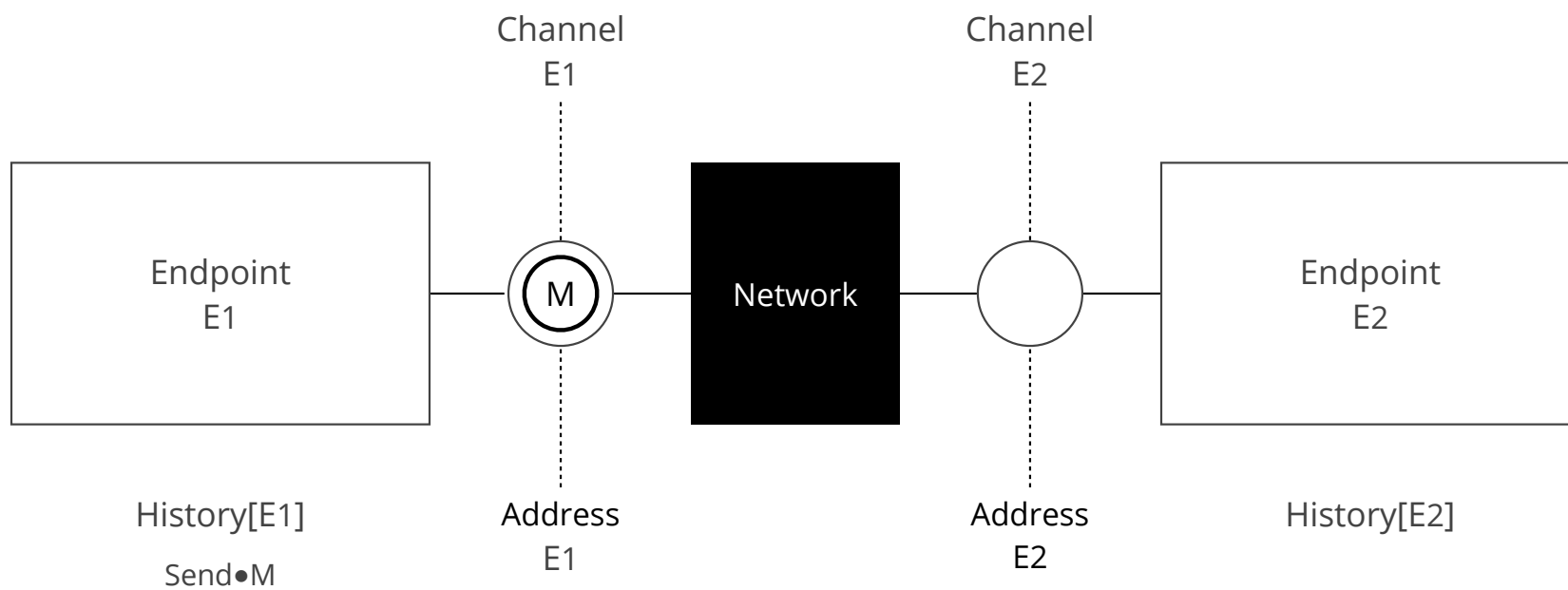


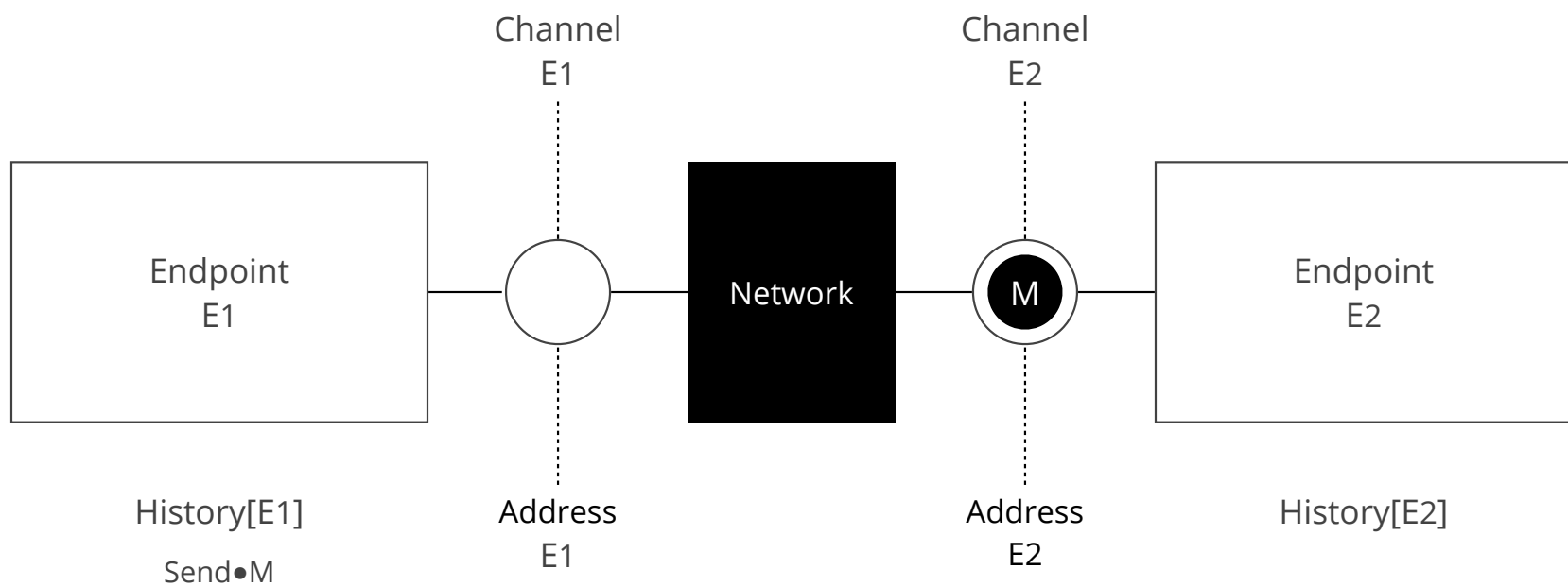


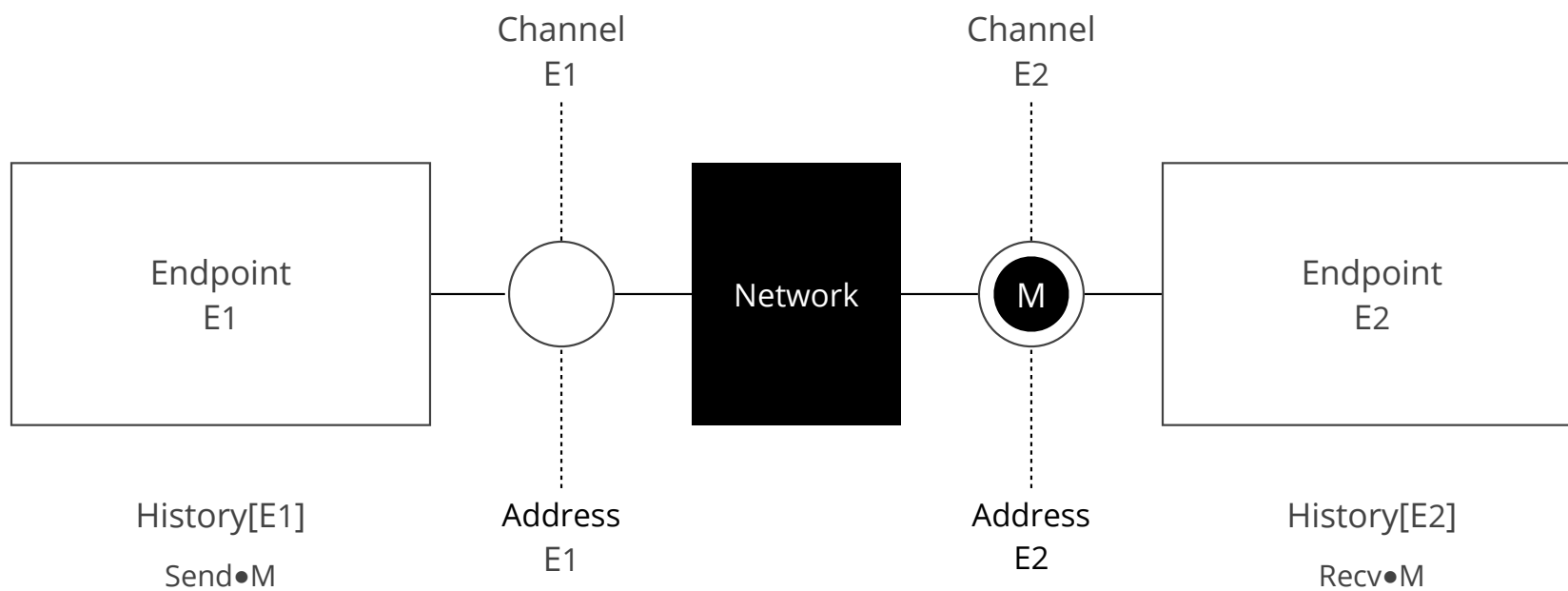




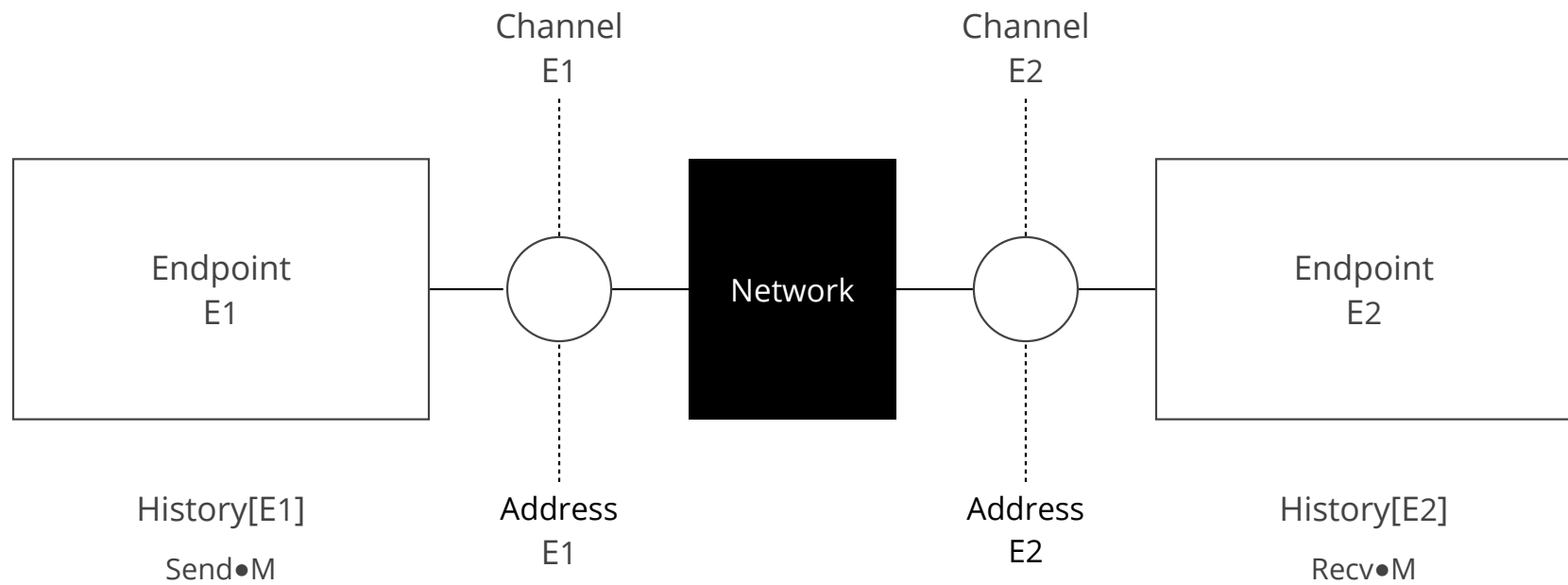




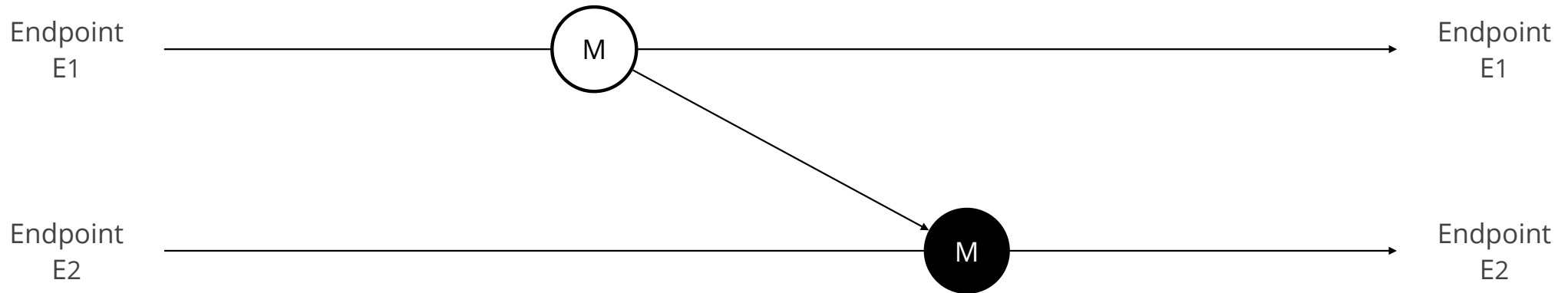




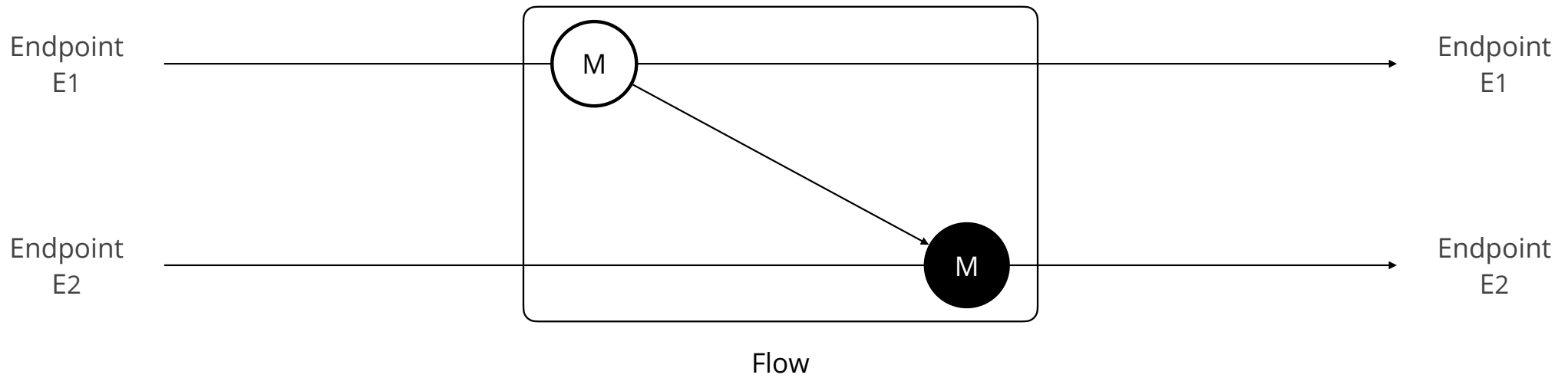
$\text{Send} \bullet M \in \text{History}[E1] \wedge \text{Recv} \bullet M \in \text{History}[E2] \implies \text{target}[\text{Send} \bullet M] = \text{address}[E2]$

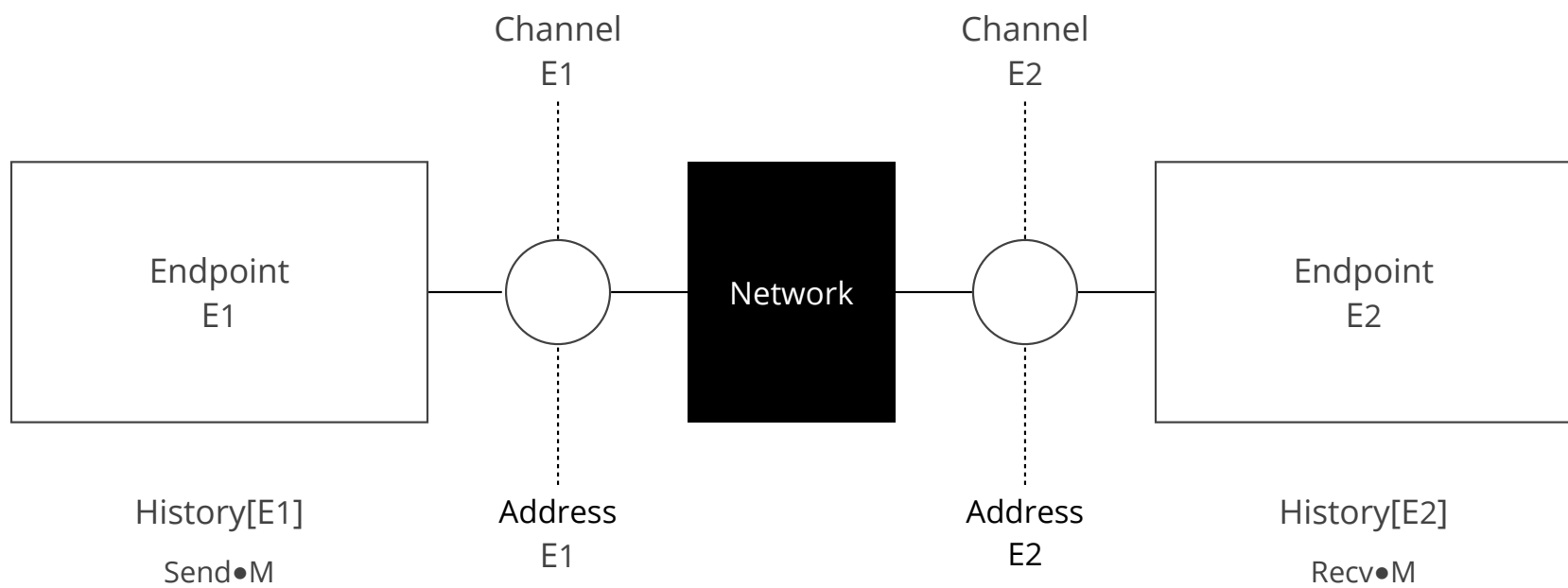


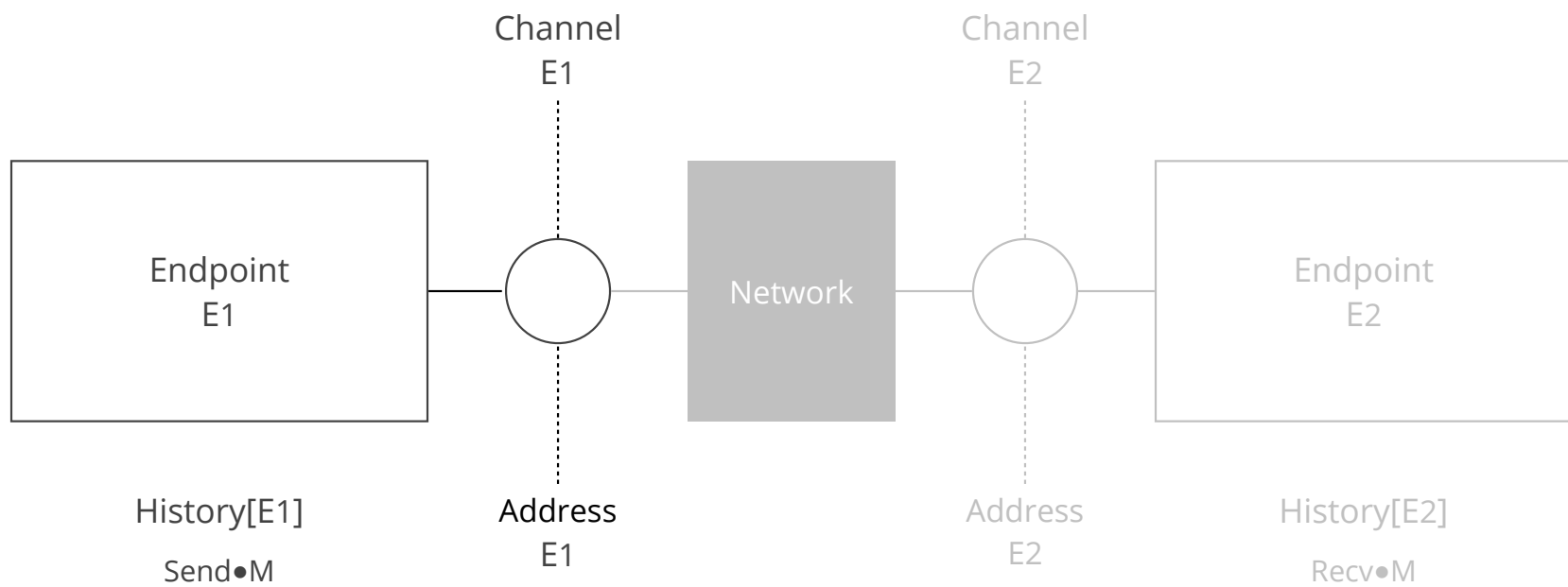
$\text{Send} \bullet M \in \text{History}[E1] \wedge \text{Recv} \bullet M \in \text{History}[E2] \implies \text{target}[\text{Send} \bullet M] = \text{address}[E2]$

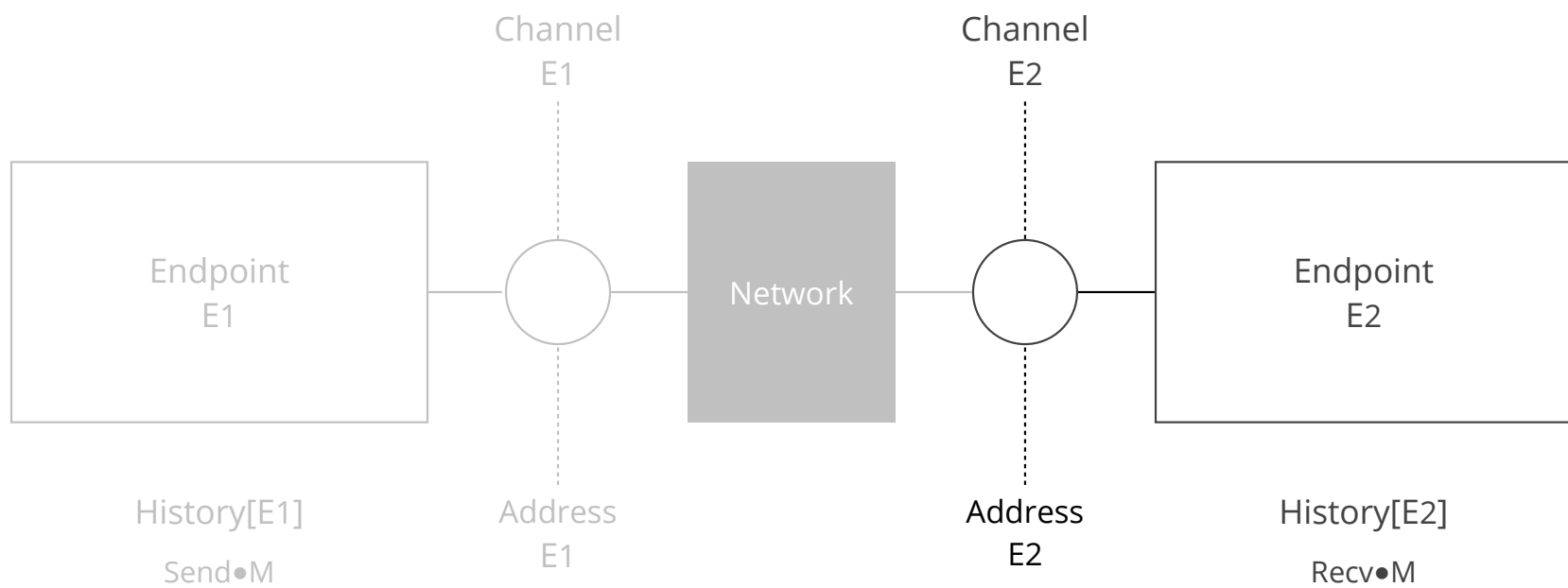


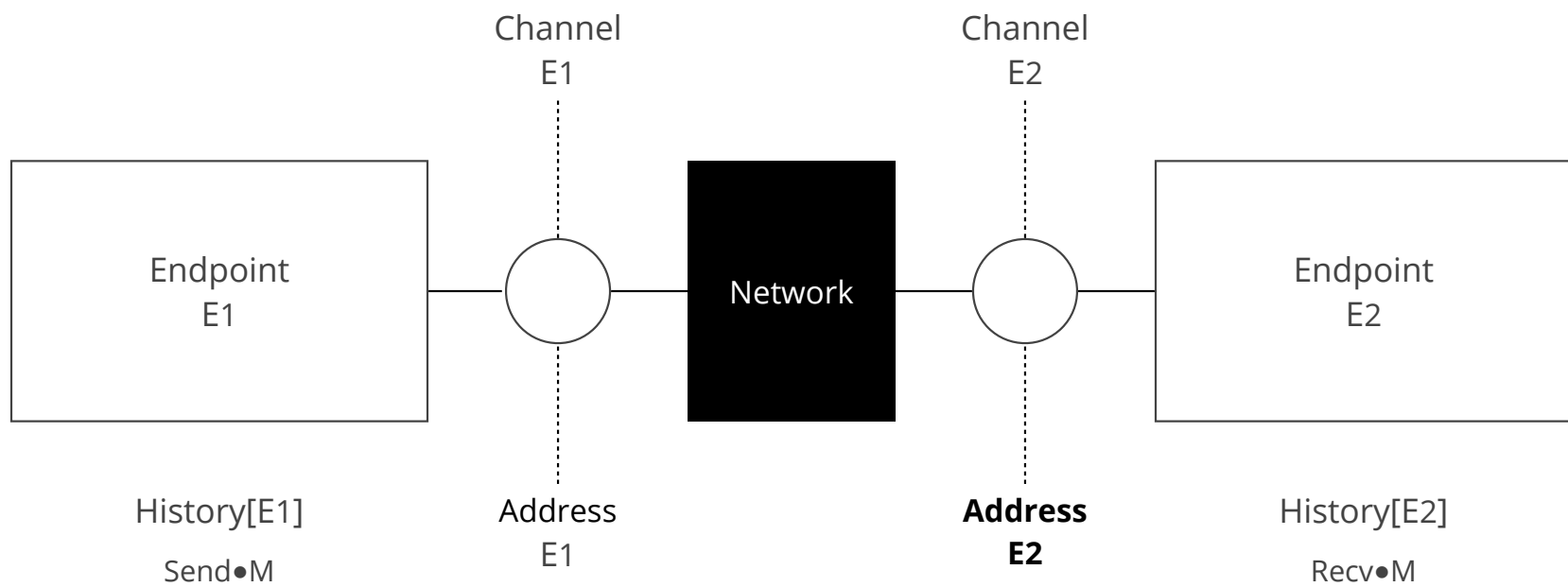
$\text{Send} \bullet M \in \text{History}[E1] \wedge \text{Recv} \bullet M \in \text{History}[E2] \implies \text{target}[\text{Send} \bullet M] = \text{address}[E2]$

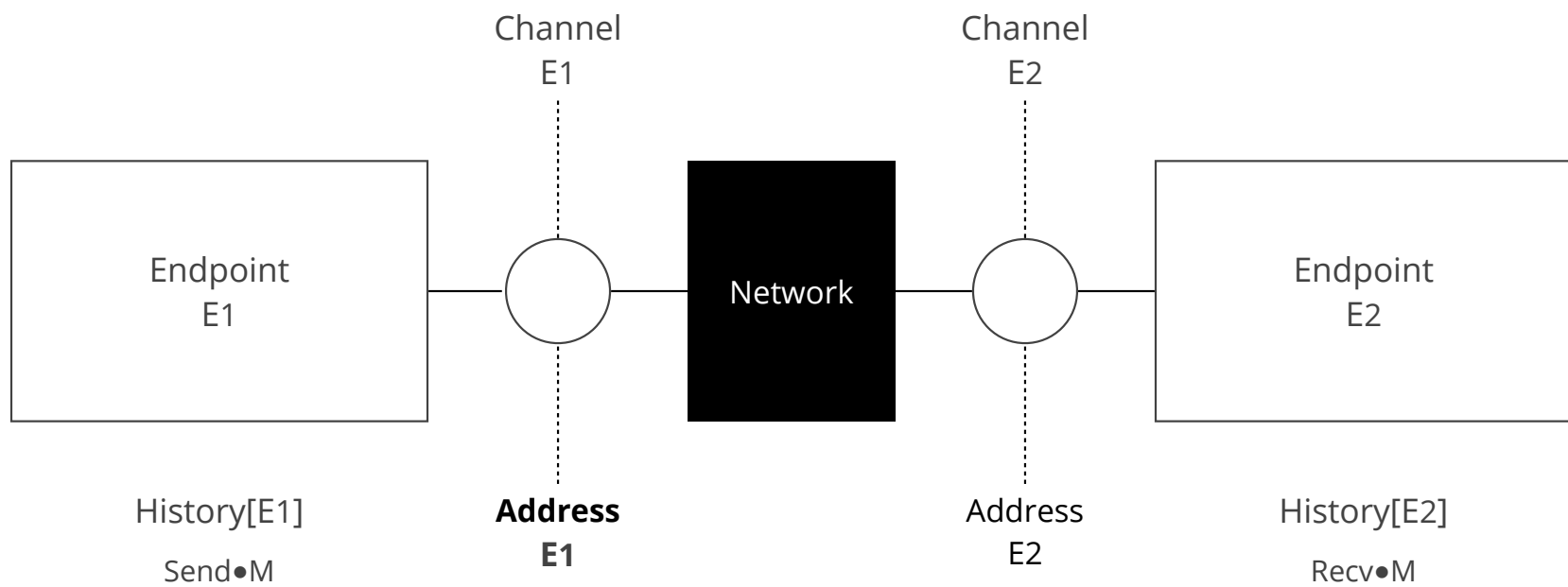


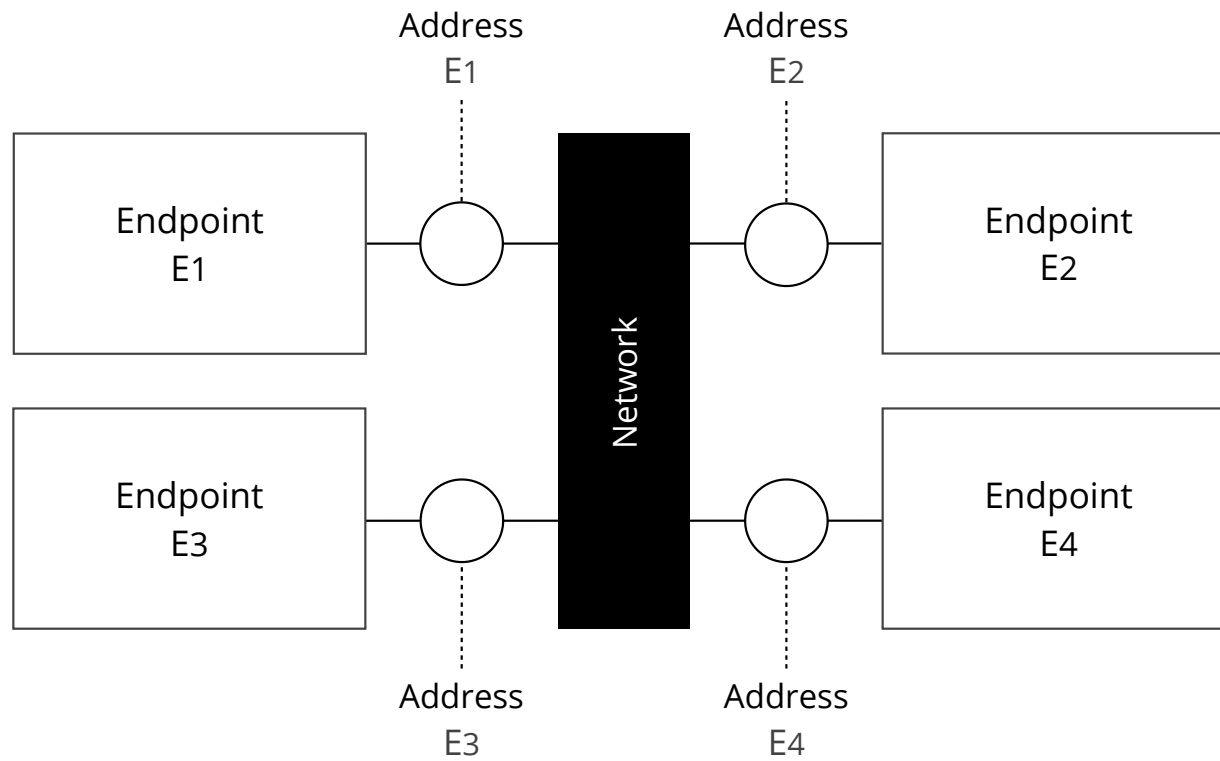


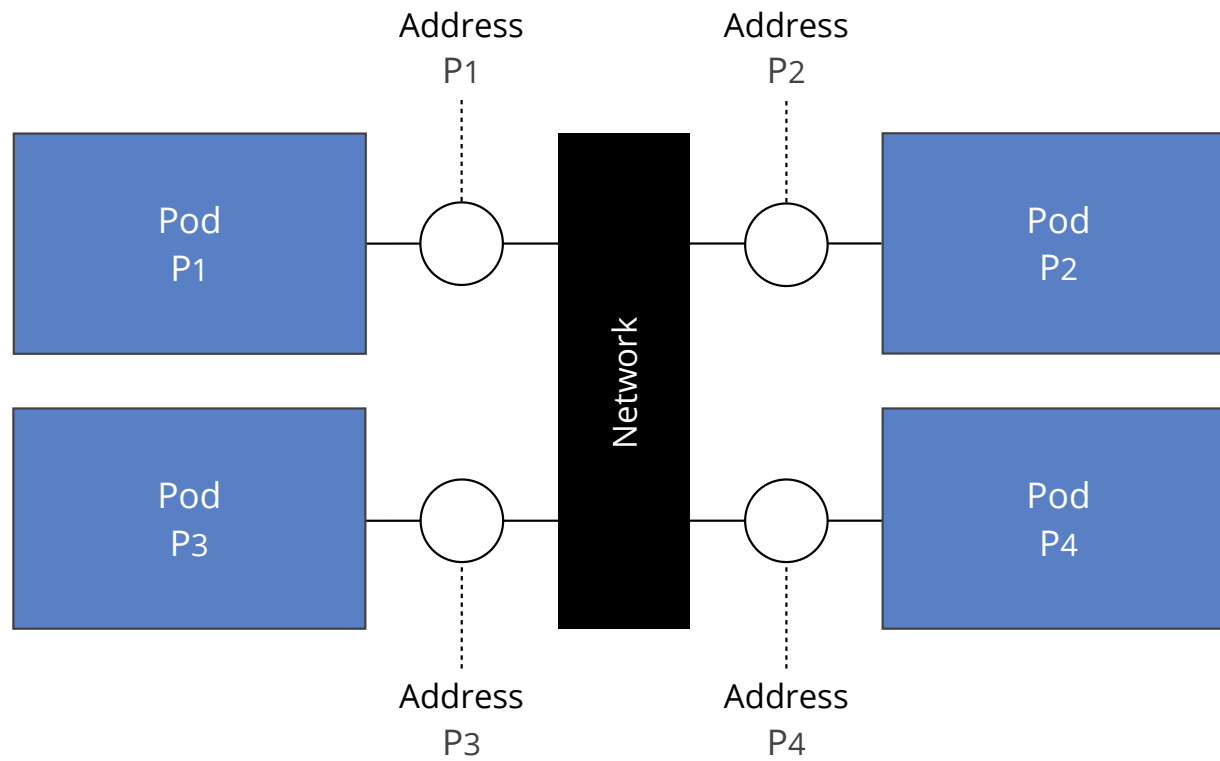


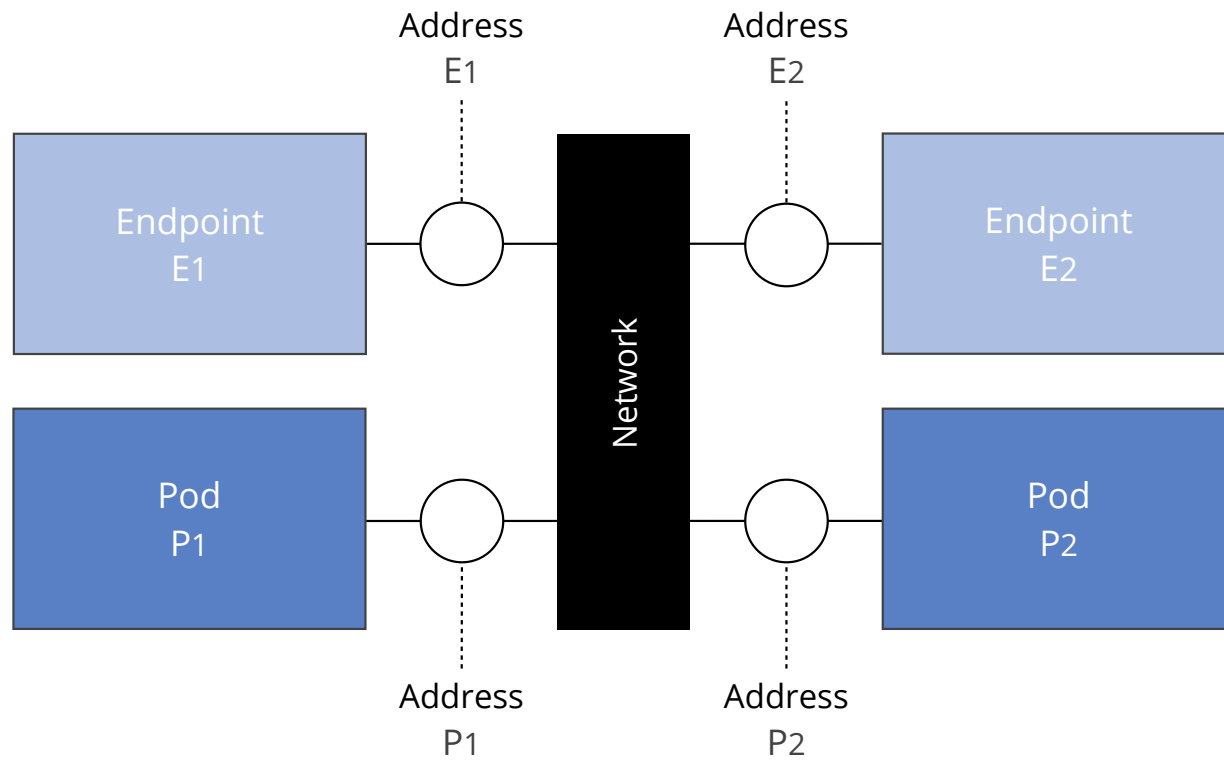


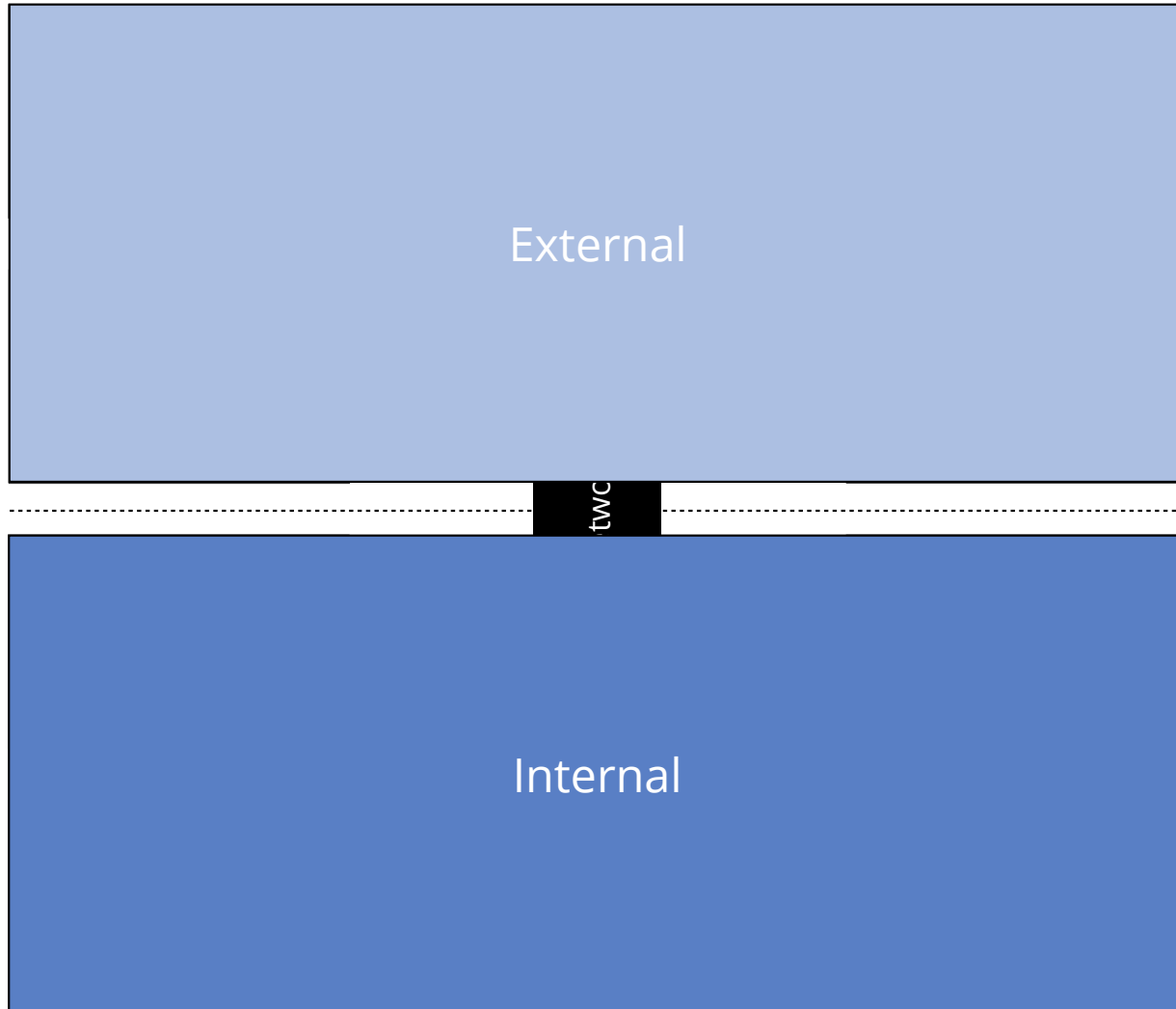




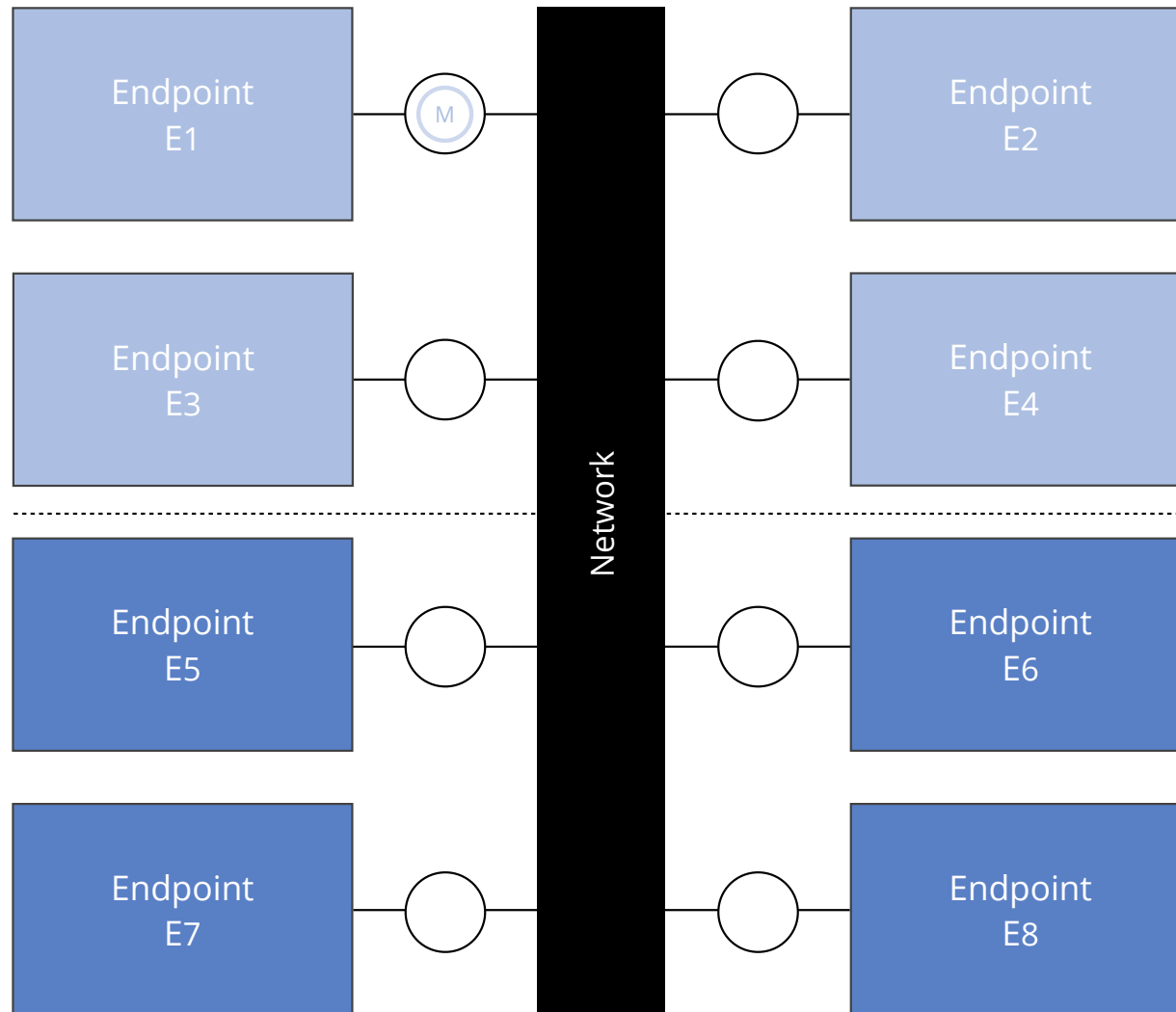


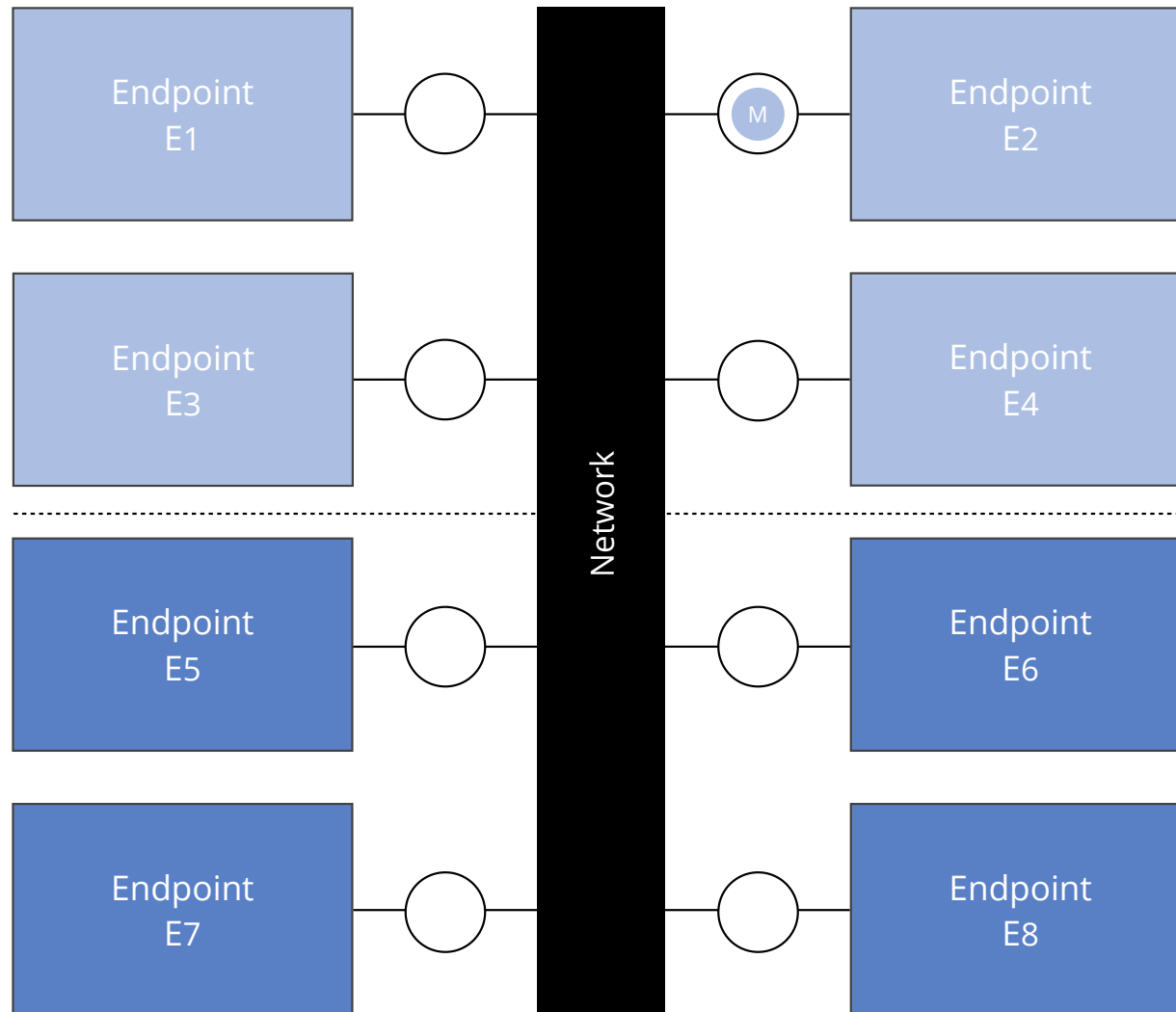


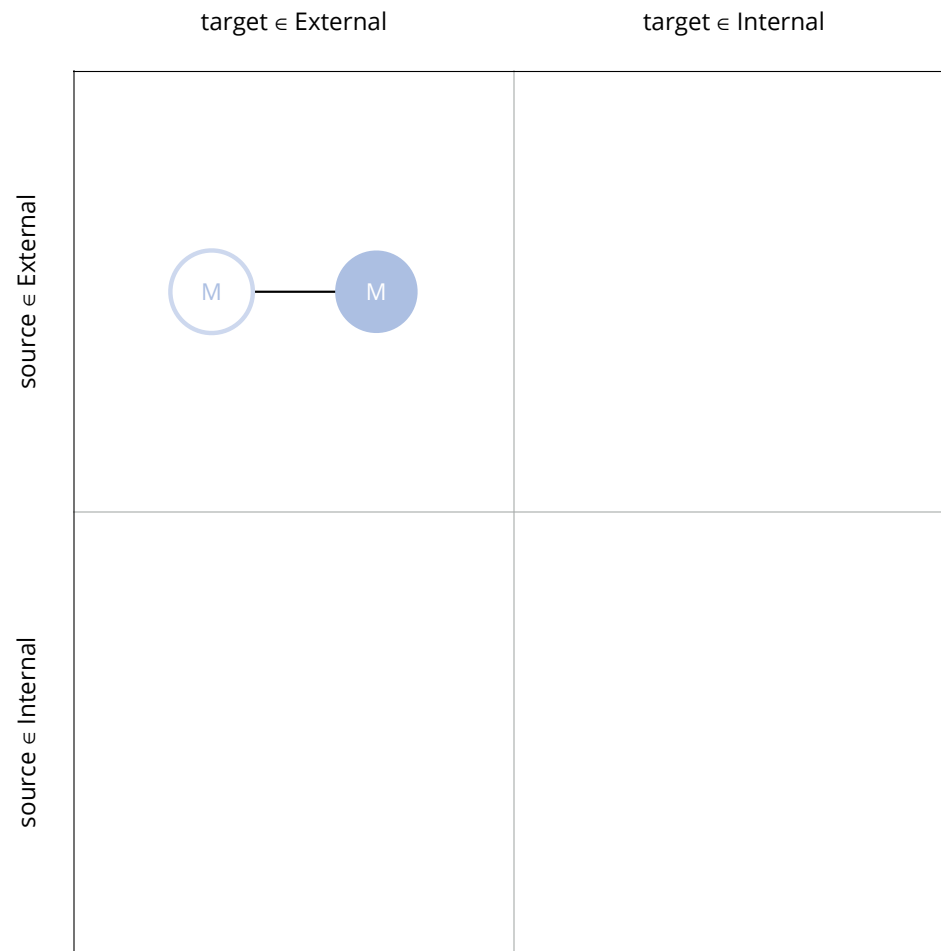


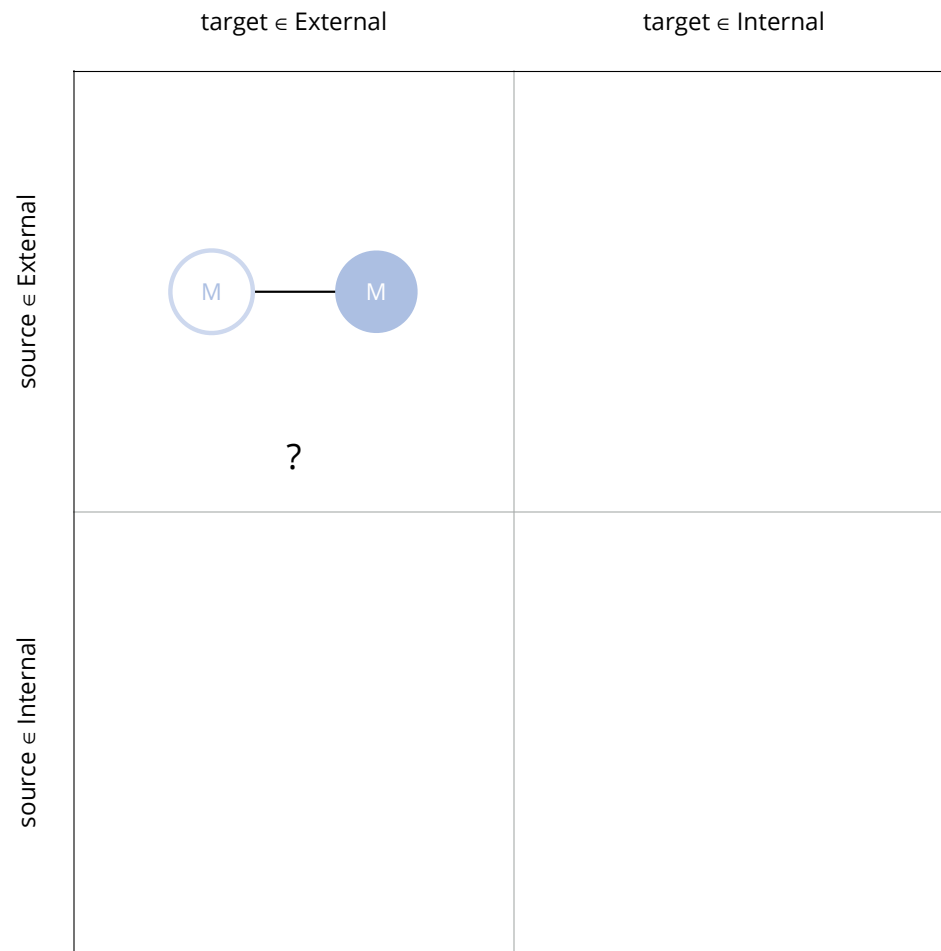


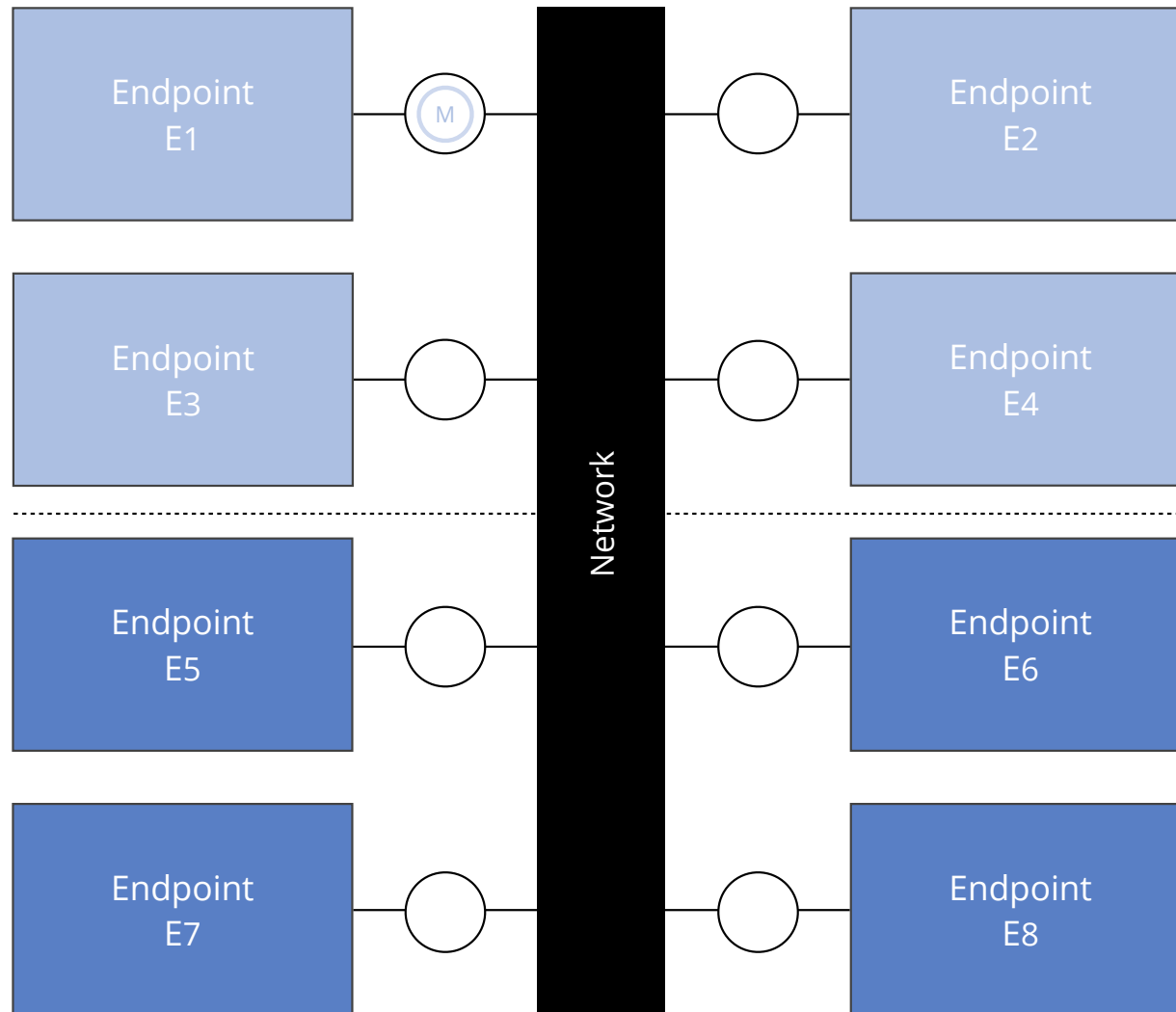
	target $\in$ External	target $\in$ Internal
source $\in$ External		
source $\in$ Internal		

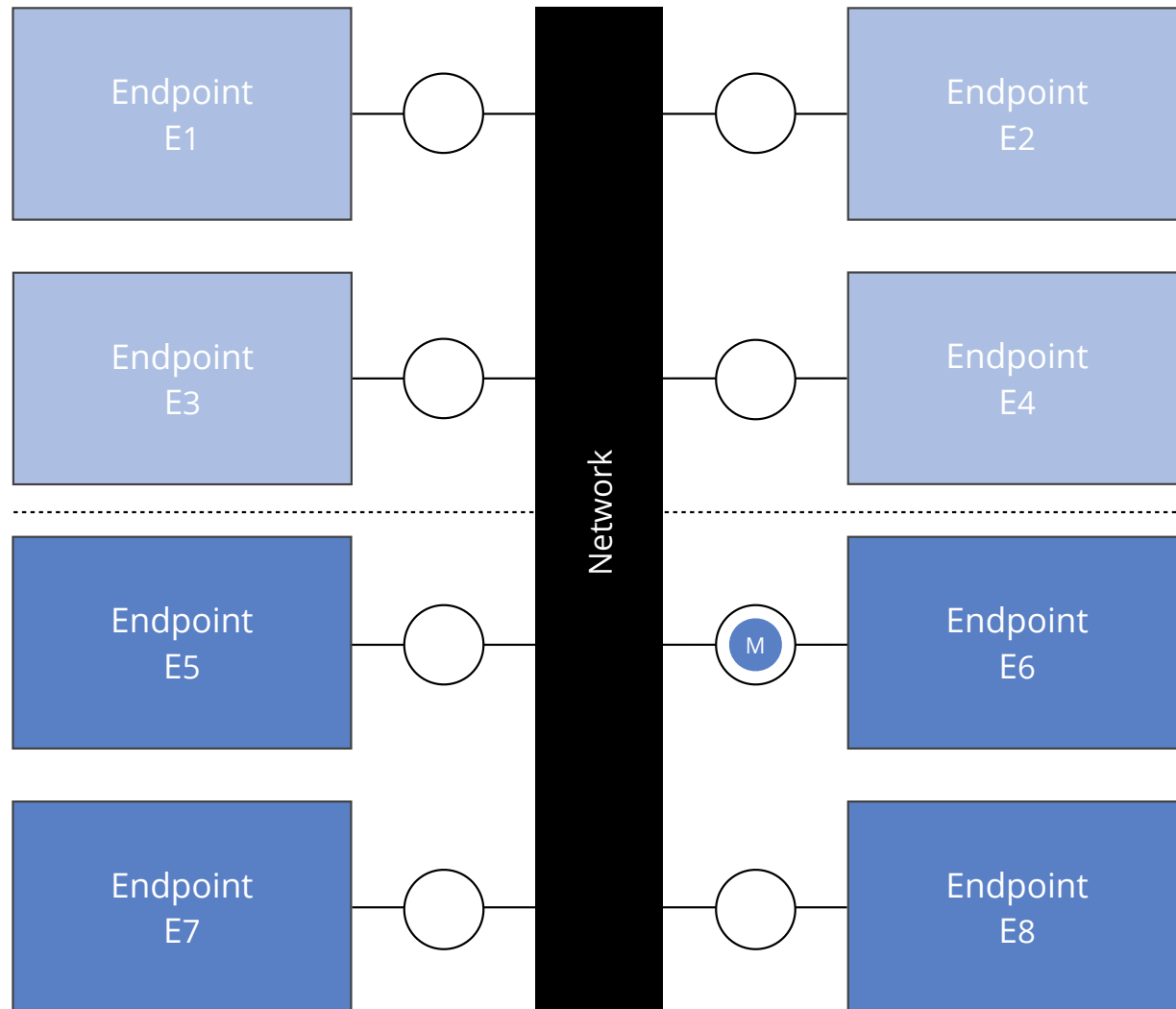


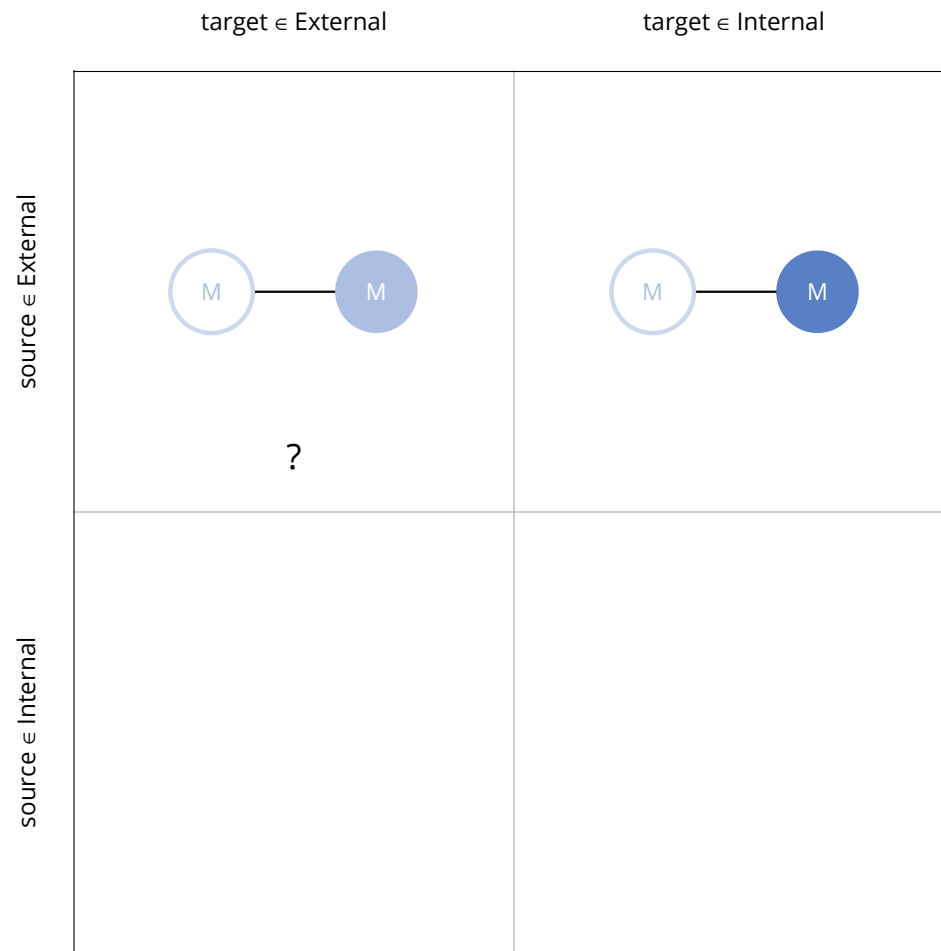


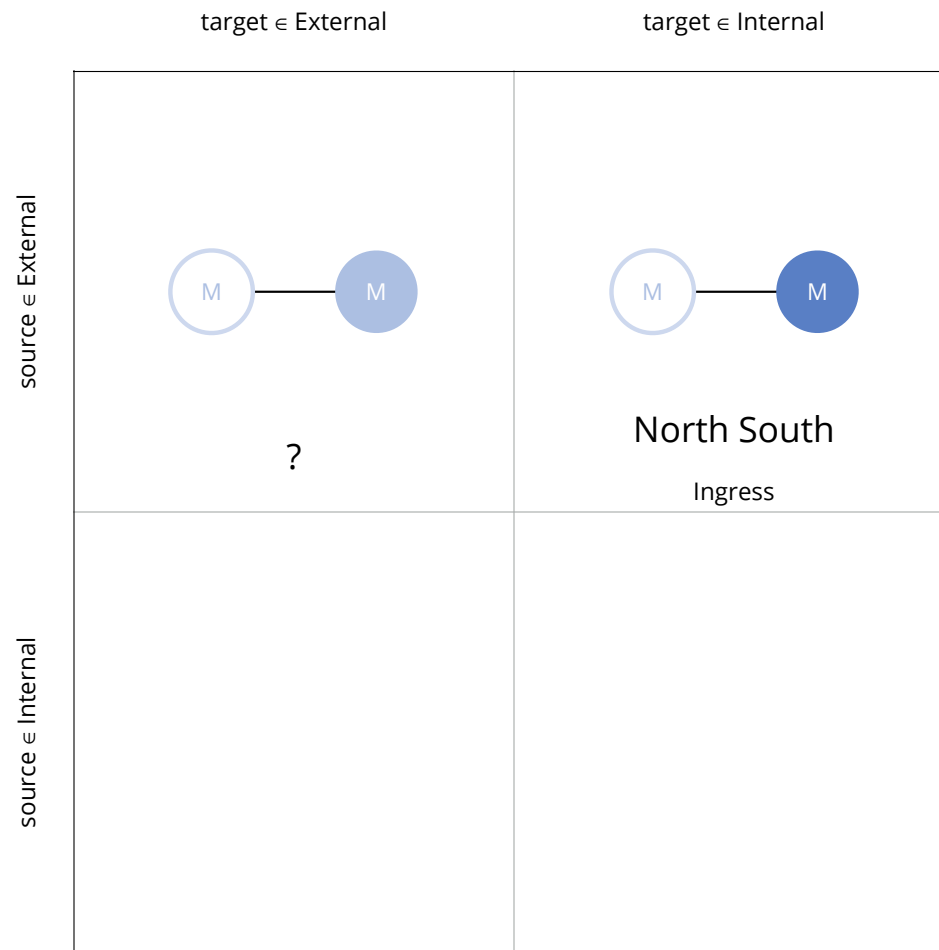


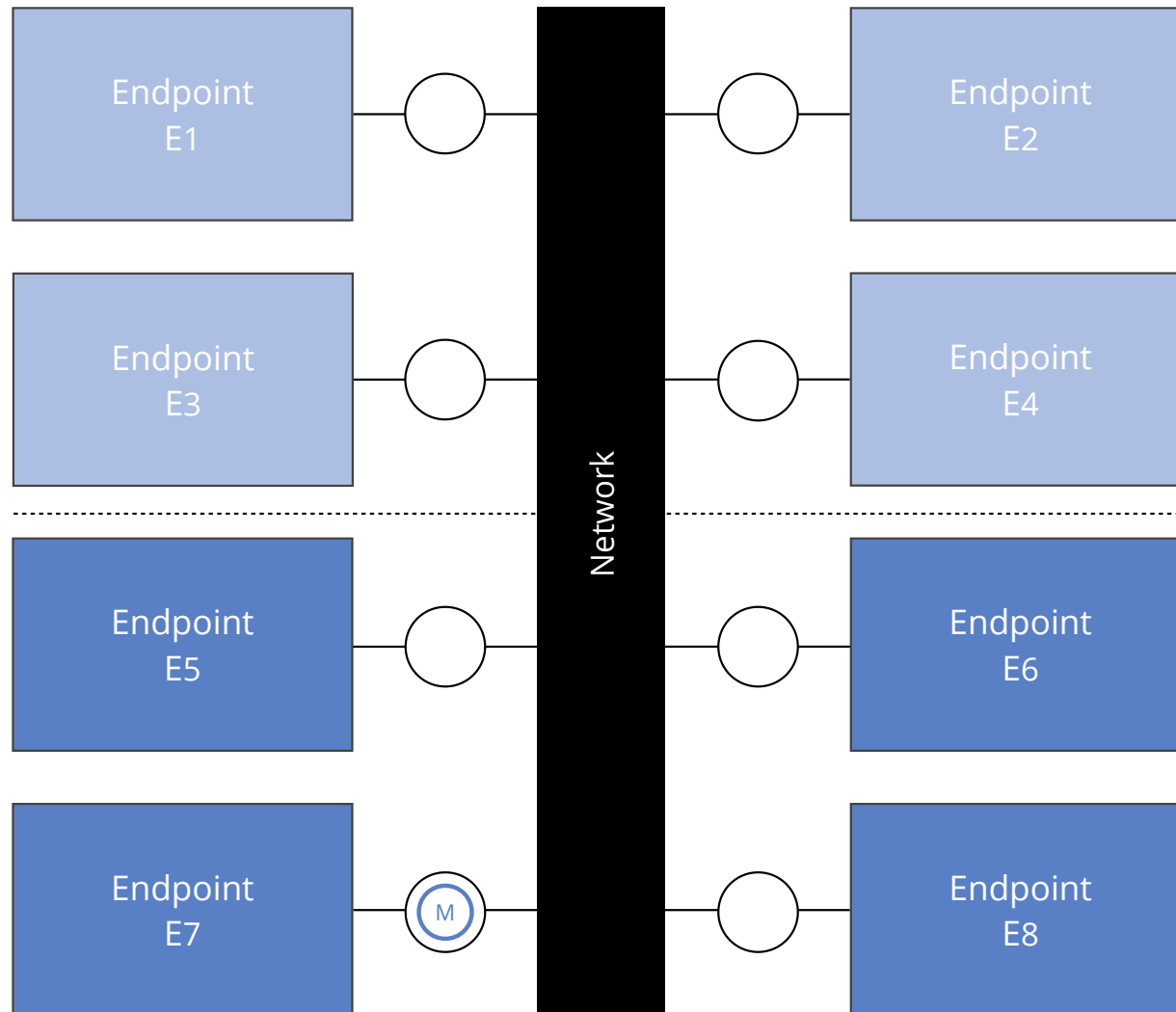


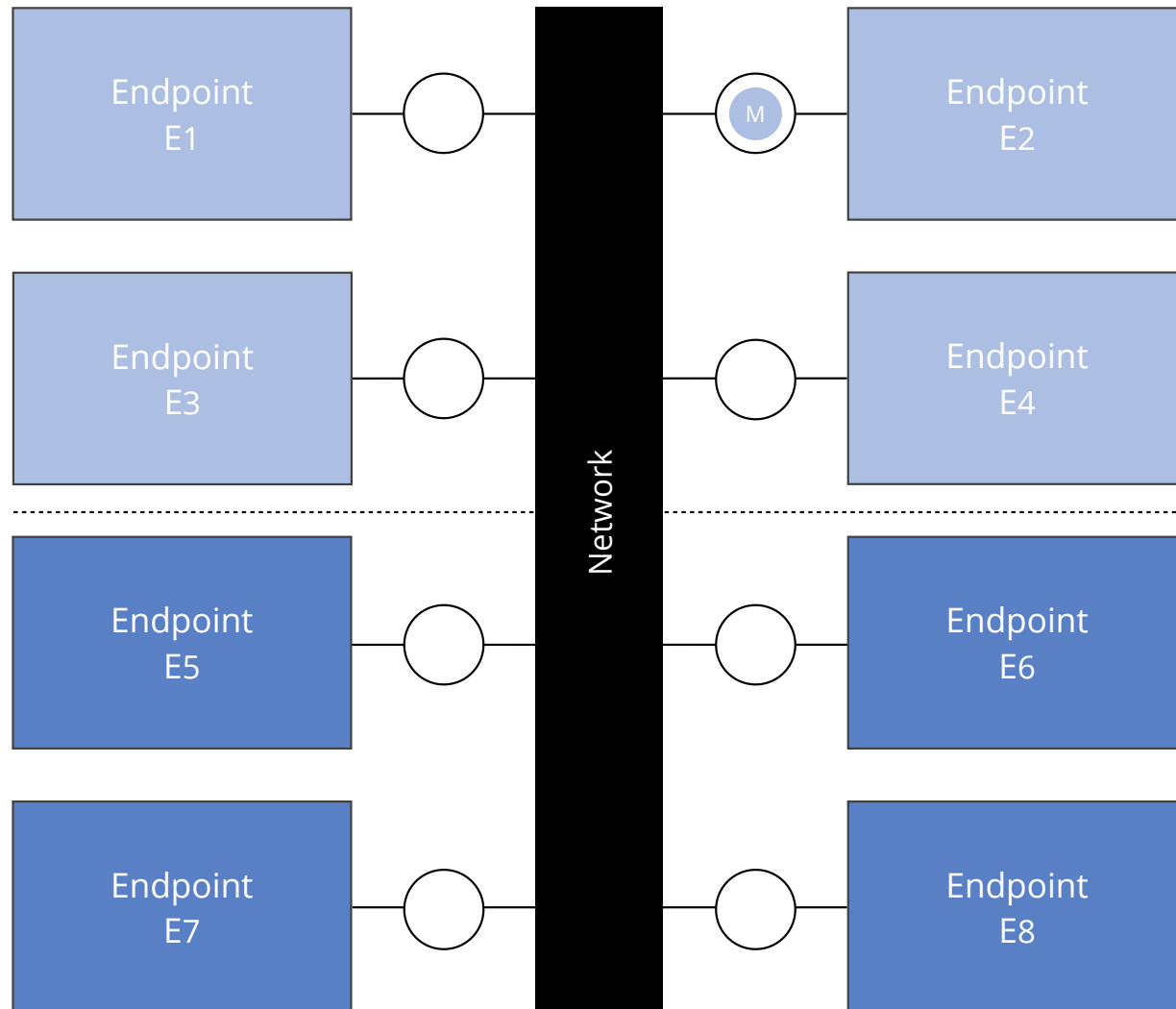


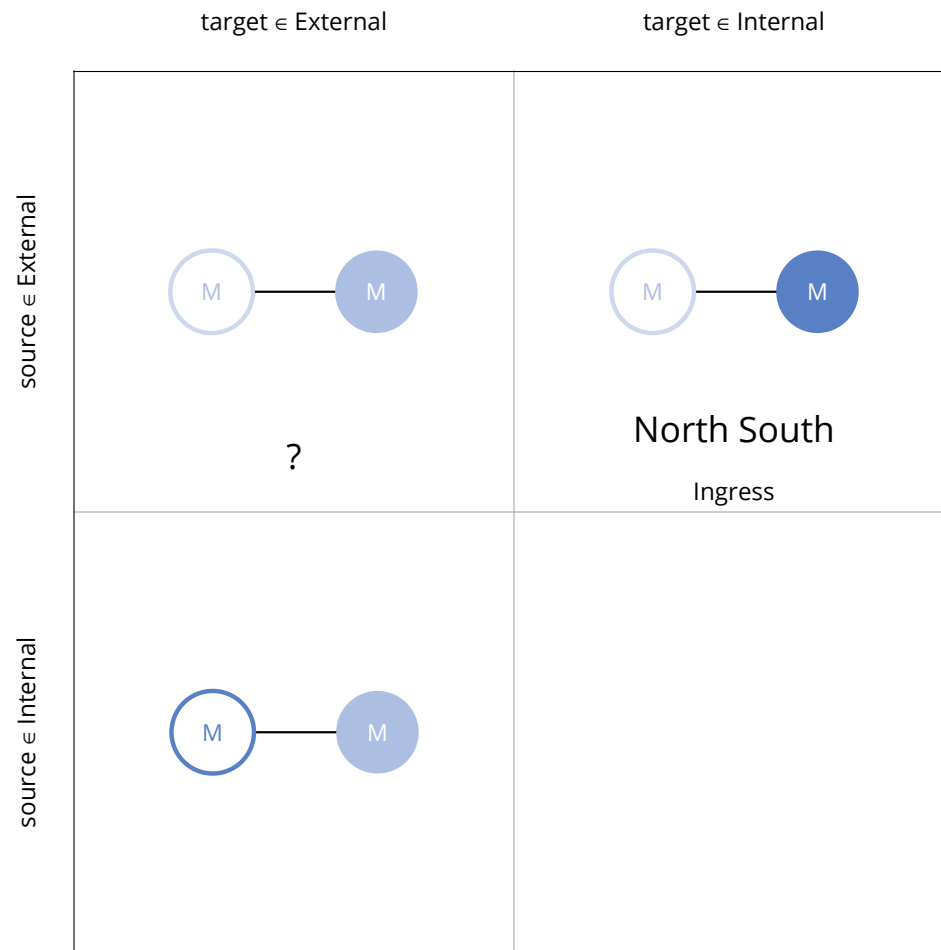


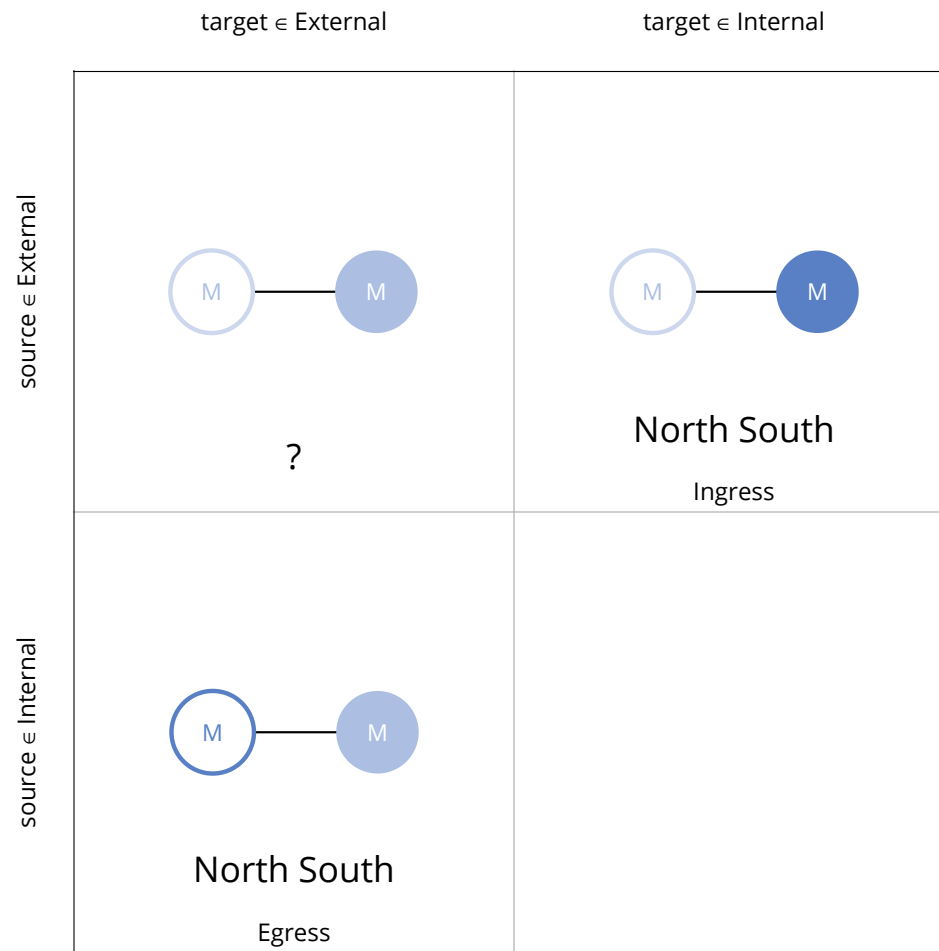


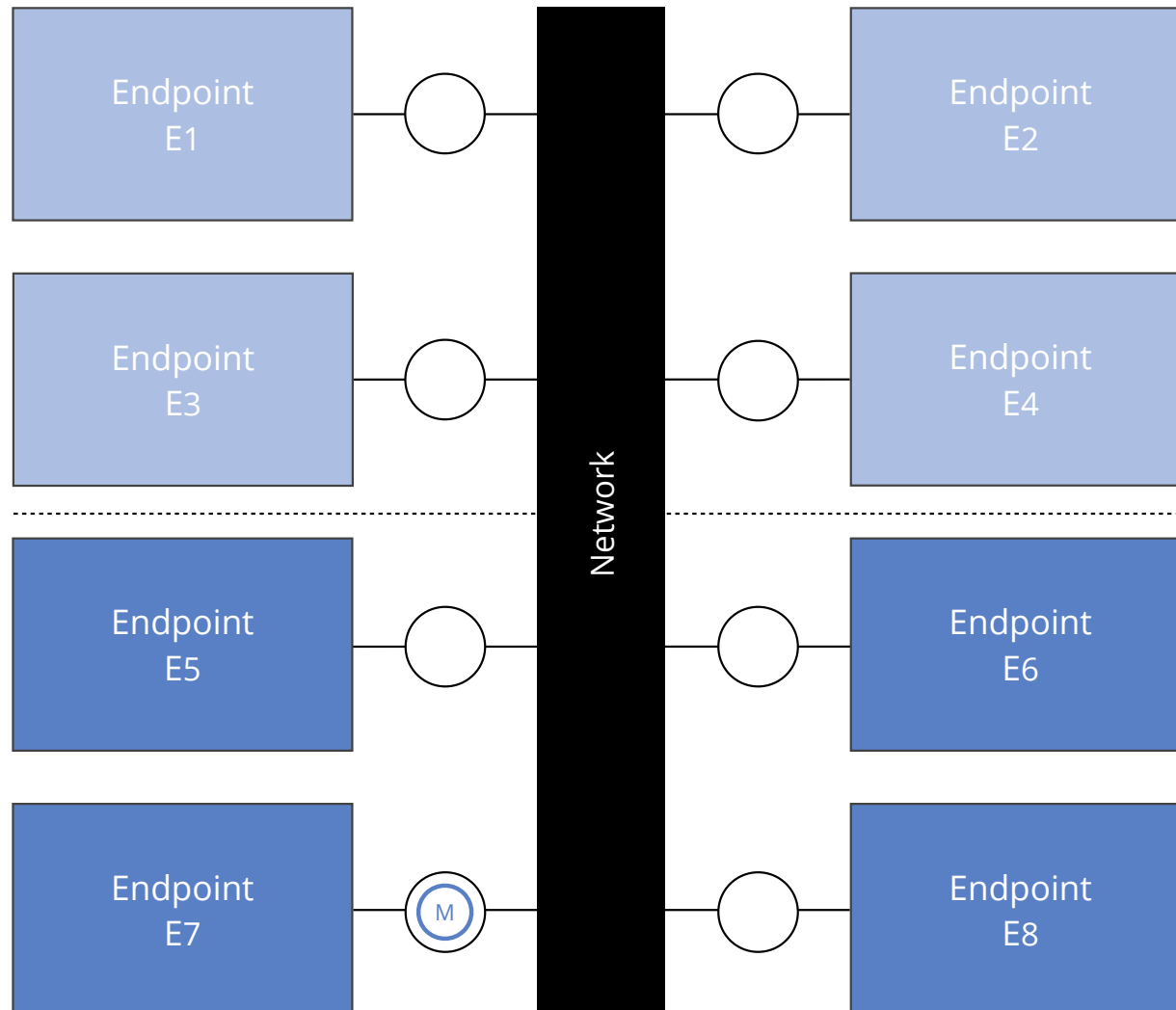


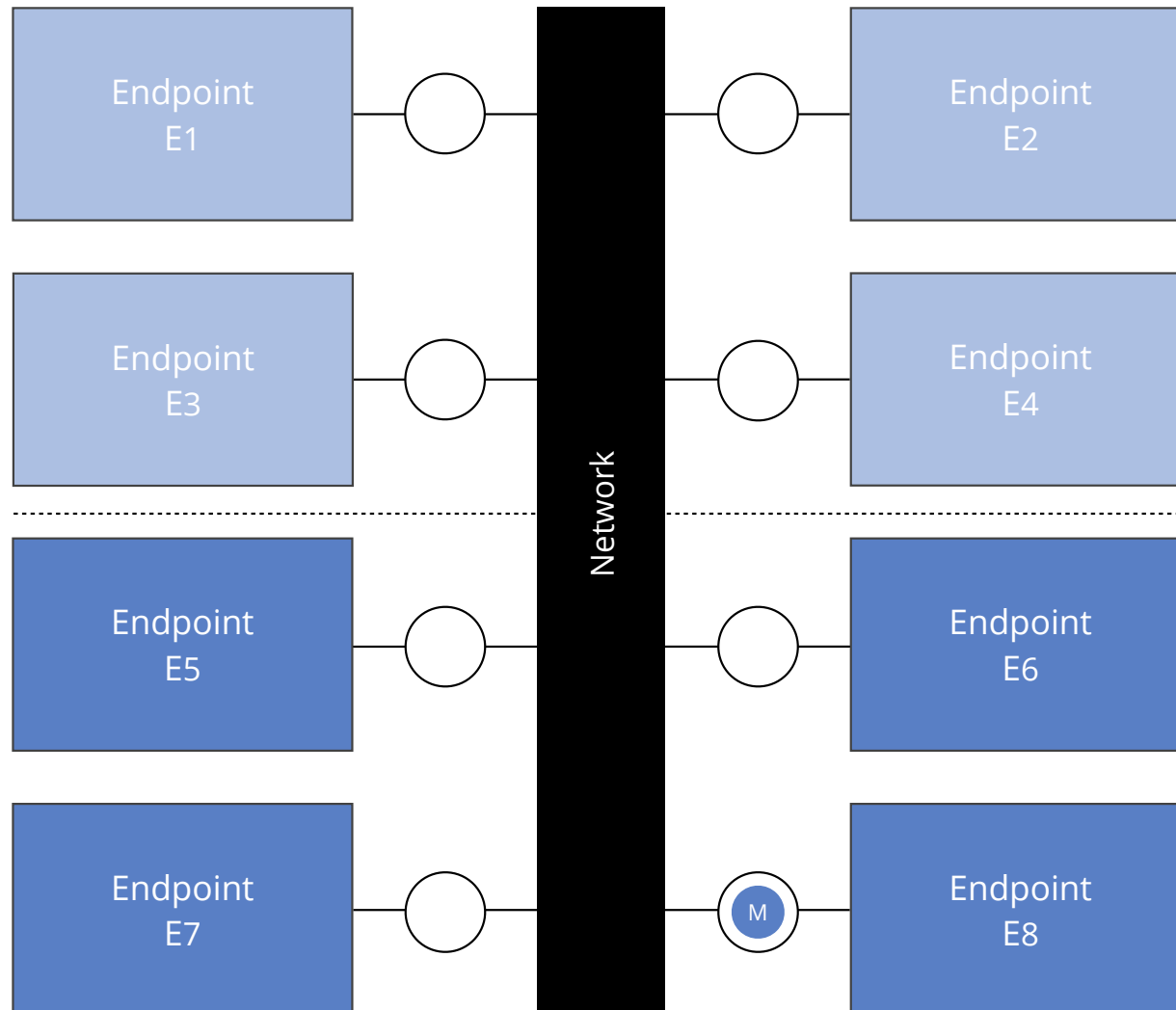


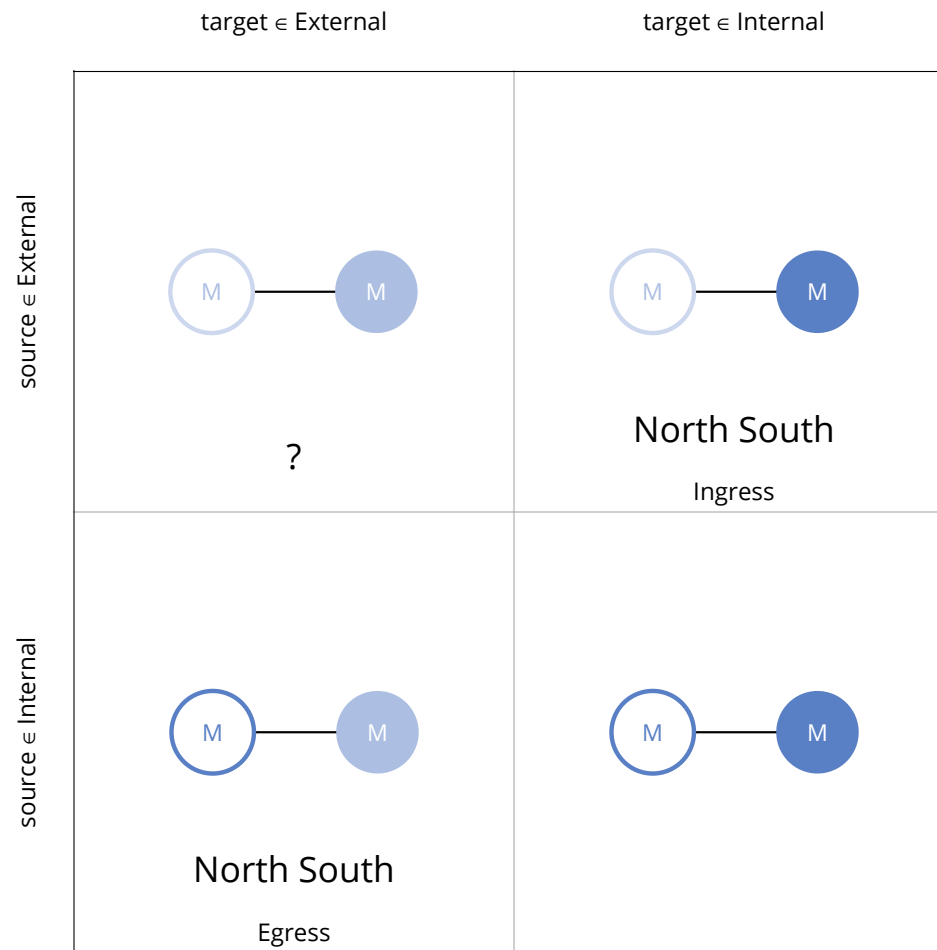


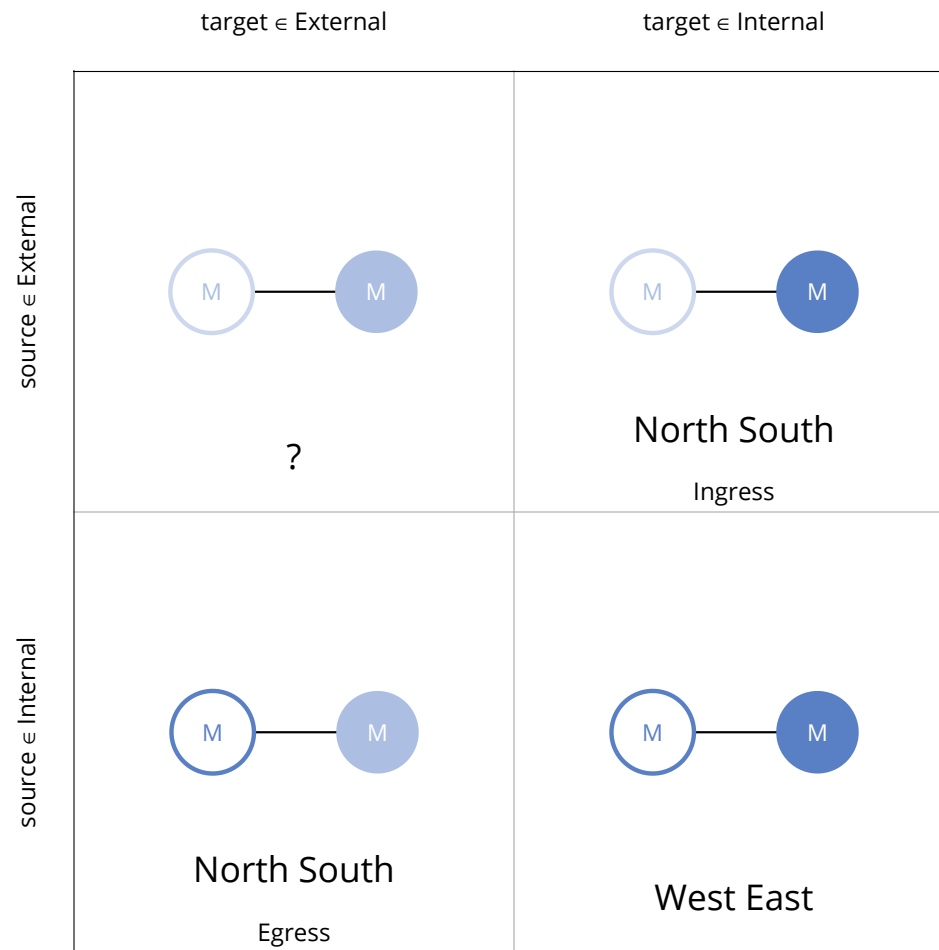










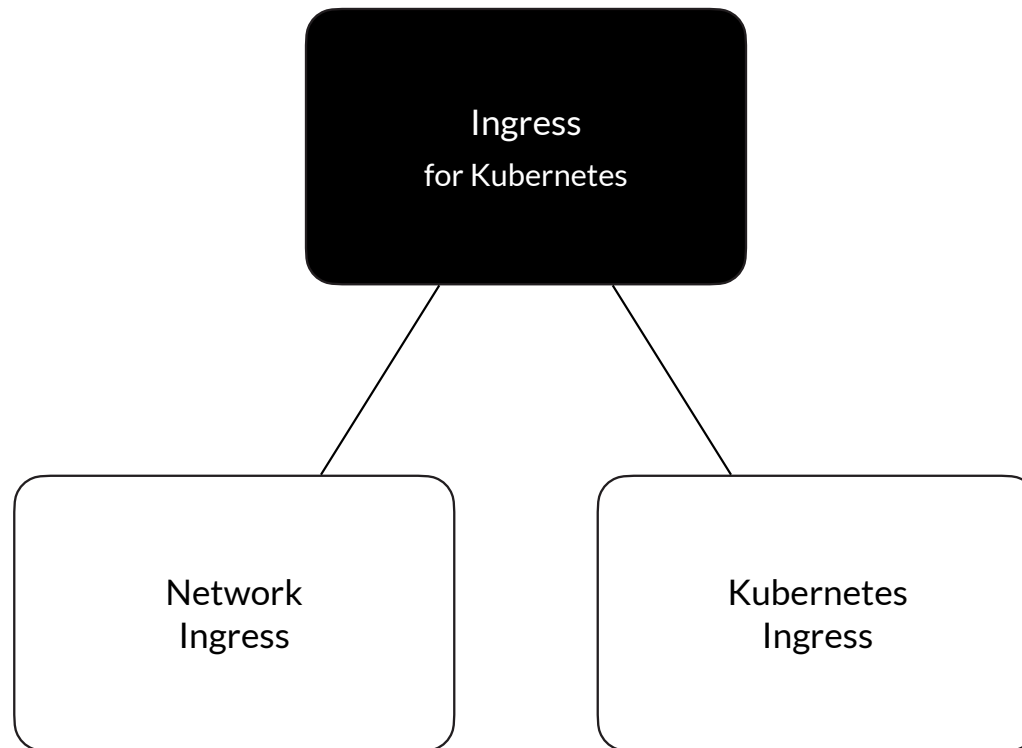


Definition

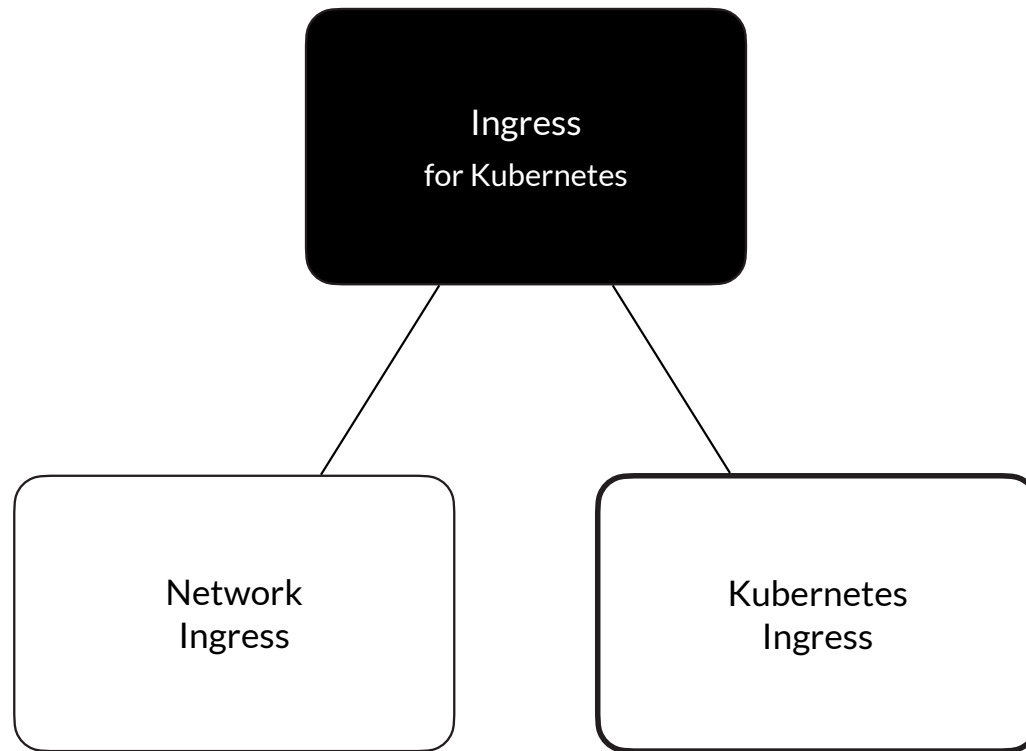
Network Ingress

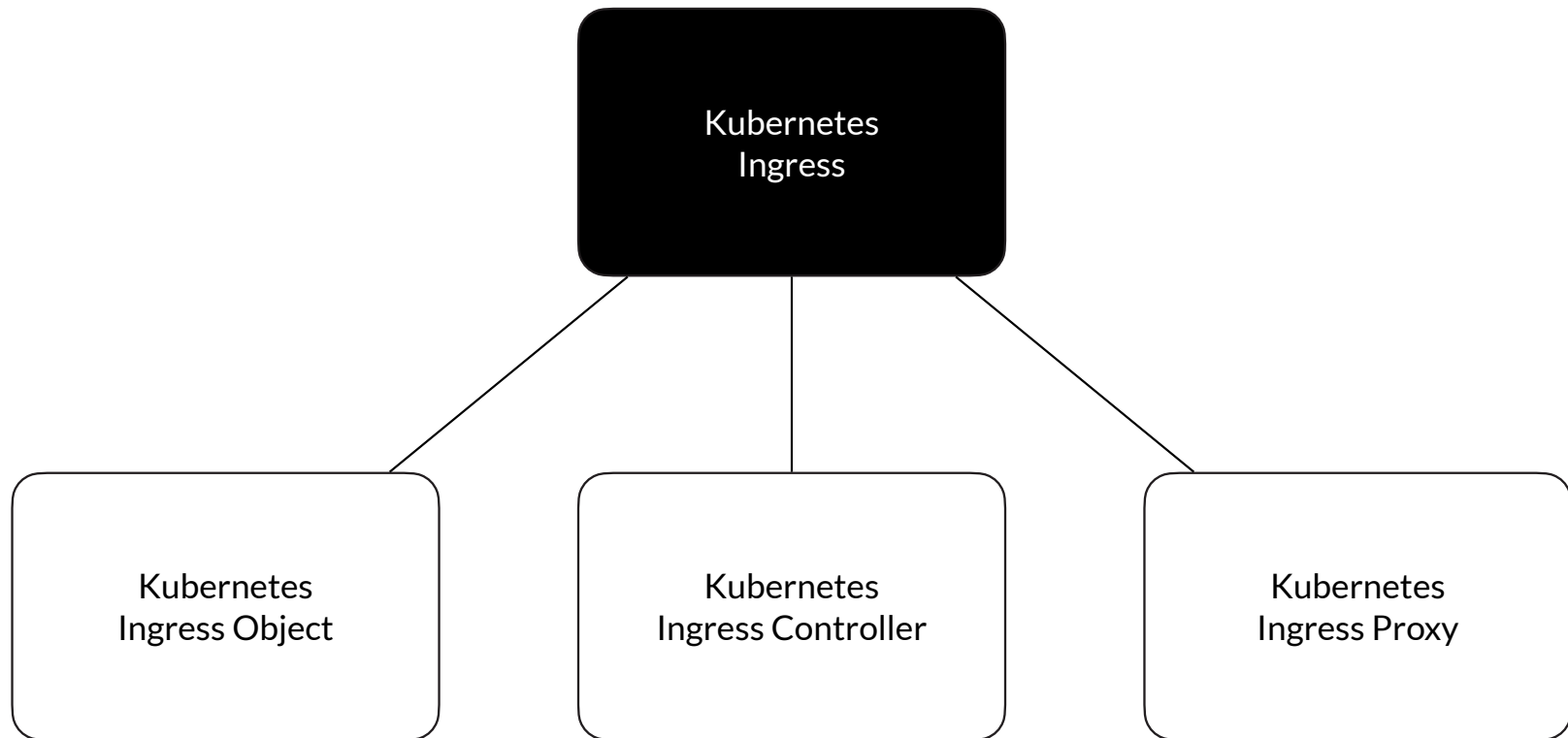
$$\{ f \in \text{Flow} \mid \text{source}[f] \notin \text{Cluster} \wedge \text{target}[f] \in \text{Cluster} \}$$

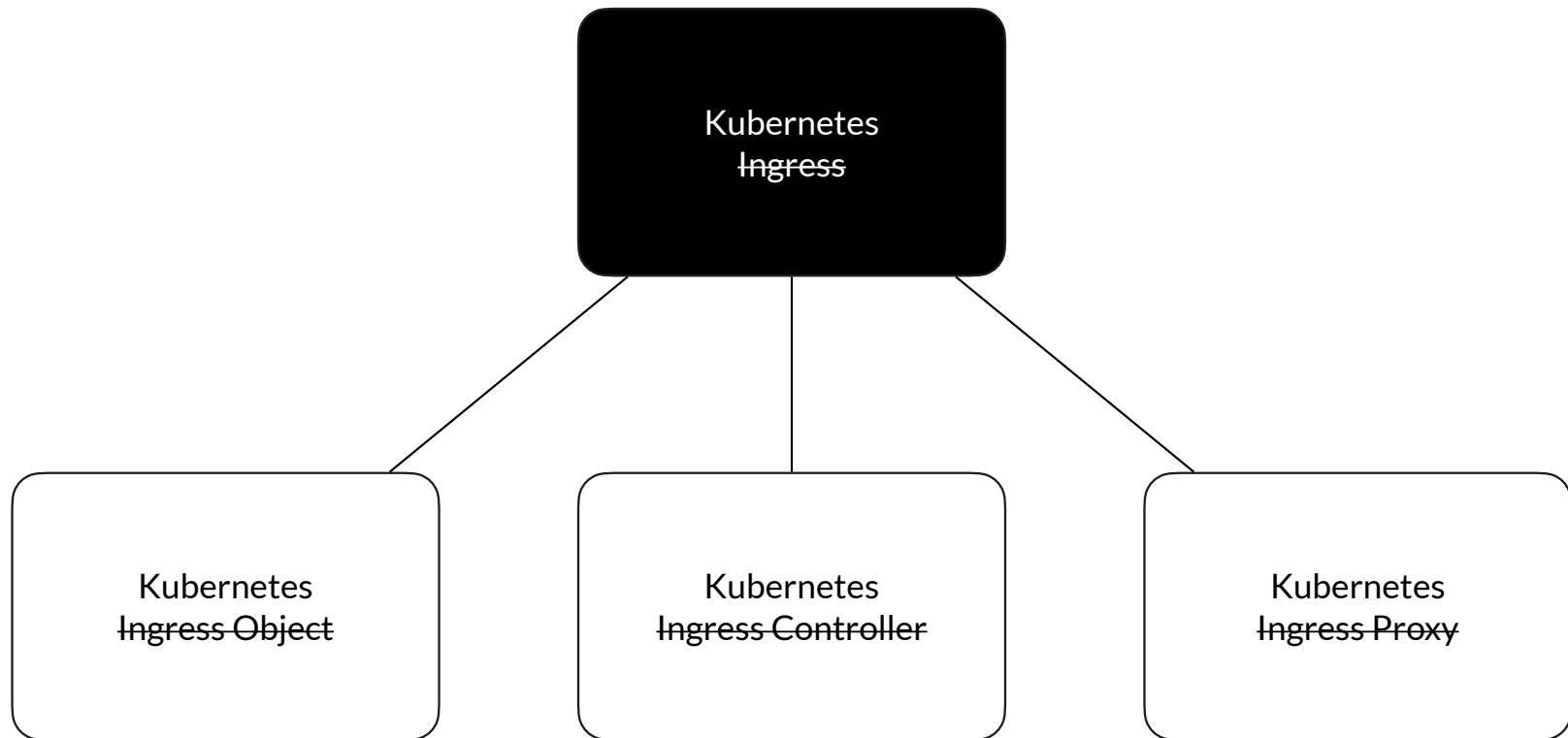
Definition

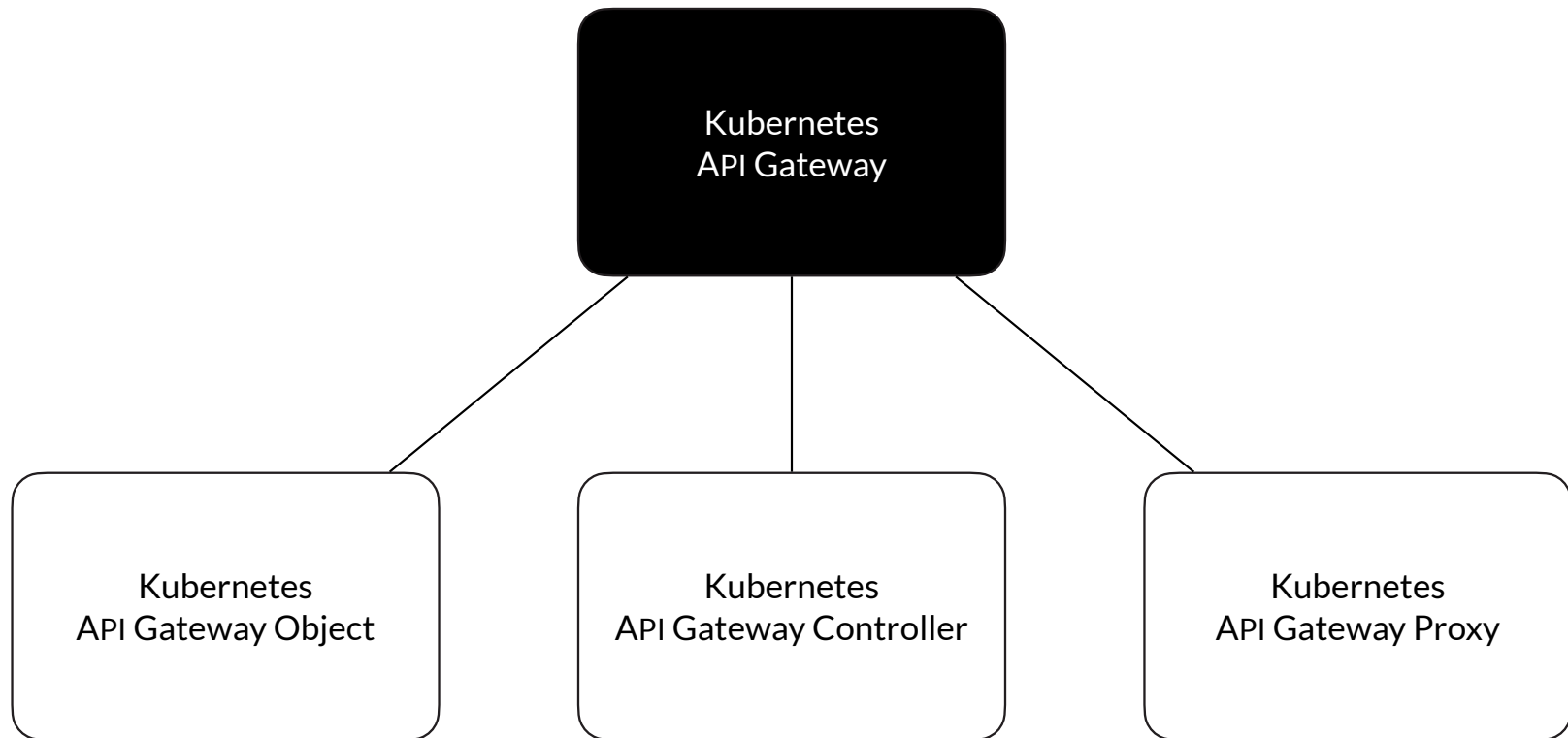


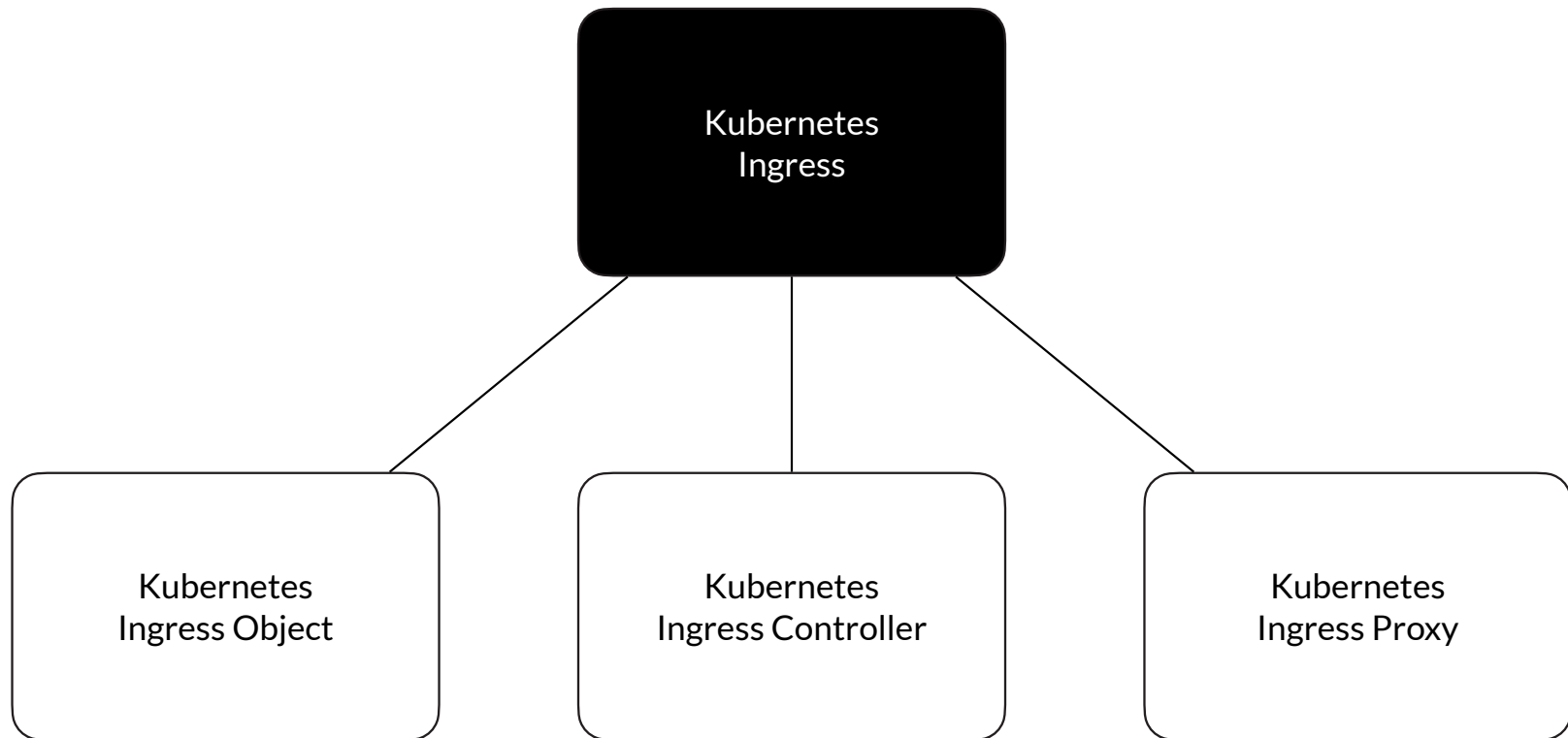
Definition

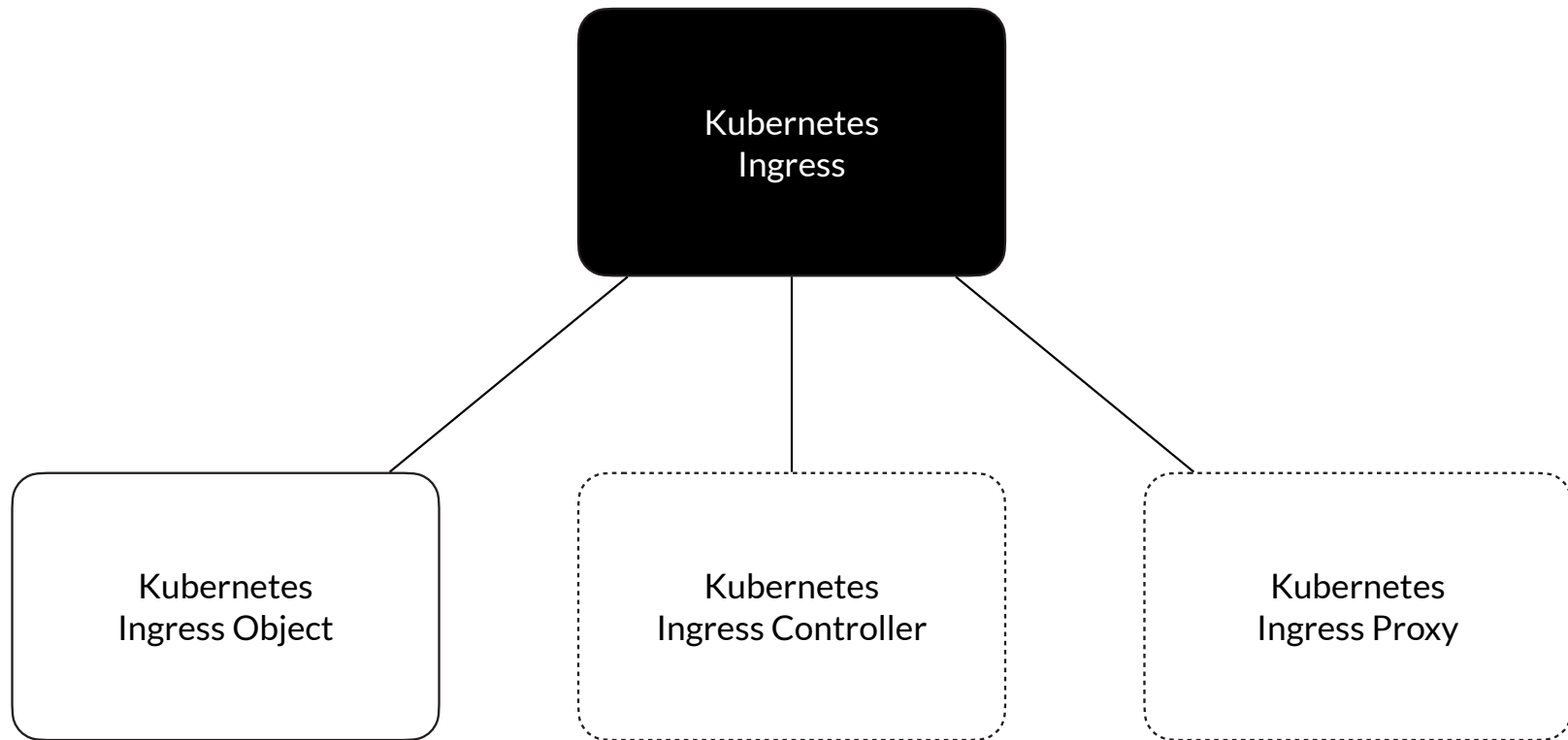


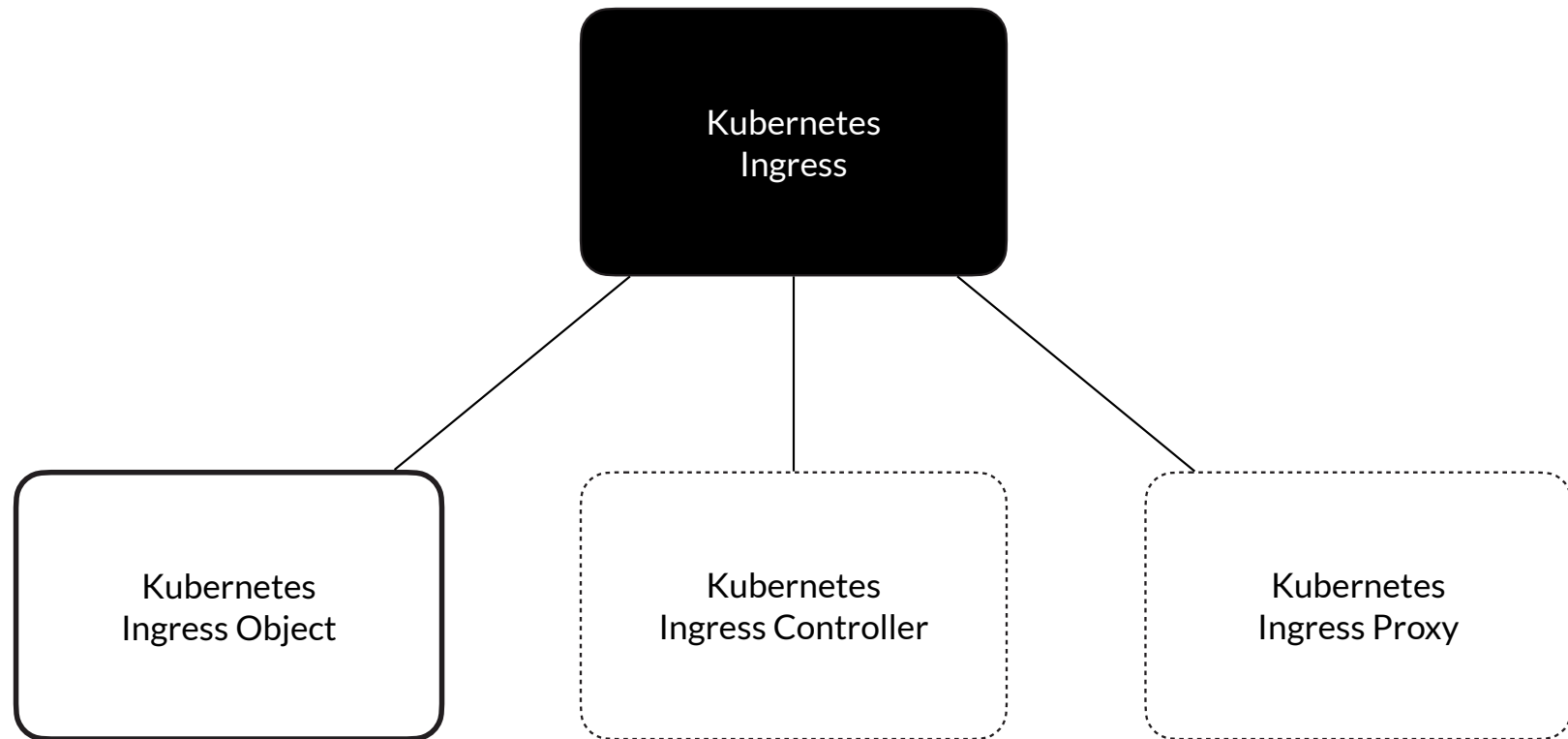












Ingress
Object

TCP/IP	Source IP	Source Port	Target IP	Target Port	TCP/IP
HTTP	Method		Path		HTTP
	Host Header				
	Body				

TCP/IP	Source IP	Source Port	Target IP	Target Port	TCP/IP
HTTP	Method		Path		HTTP
	Host Header				
	Body				

TCP/IP	Source IP	Source Port	Target IP	Target Port	TCP/IP
HTTP	Method		Path		HTTP
	Host Header				
	Body				


```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: foobar
spec:
  rules:
  - host: foo.org
    http:
      paths:
      - path: /a
        backend:
          service:
            name: foo-a
            port:
              number: 8080
      - path: /b
        backend:
          service:
            name: foo-b
            port:
              number: 8181
  - host: bar.org
    http:
      paths:
      - path: /a
        backend:
          service:
            name: bar-a
            port:
              number: 9090
      - path: /b
        backend:
          service:
            name: bar-b
            port:
              number: 9191
```

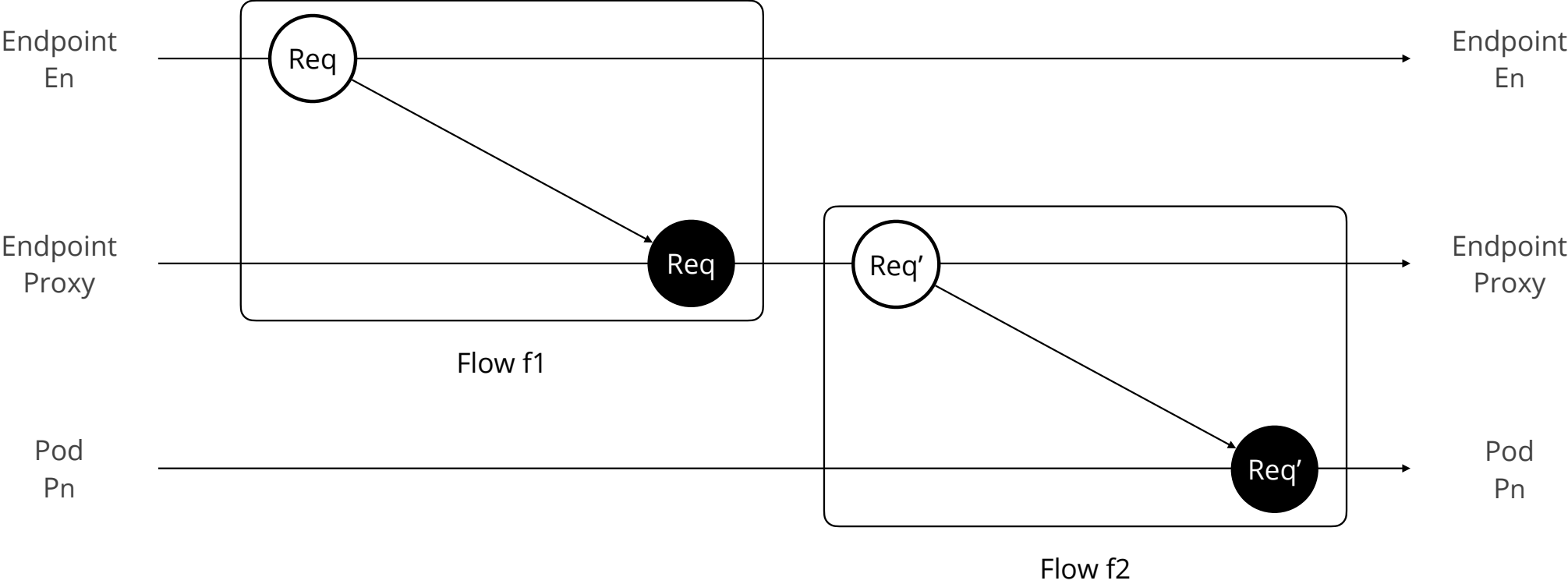
Rule	Host	Path	Service
r ₁	<u>foo.org</u>	/a	foo-a:8080
r ₂	<u>foo.org</u>	/b	foo-b:8181
r ₃	<u>bar.org</u>	/a	bar-a:9090
r ₄	<u>bar.org</u>	/b	bar-b:9191

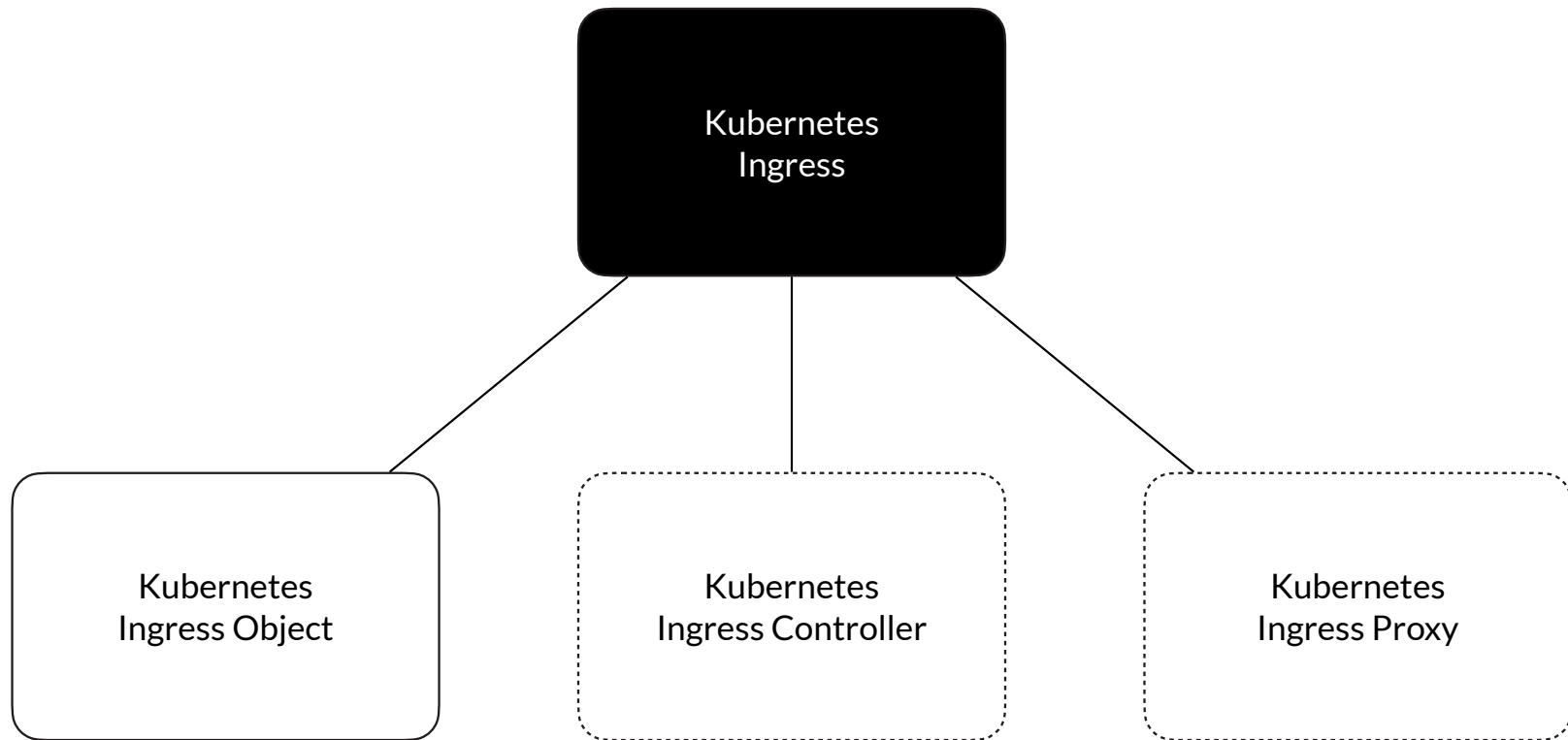
```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: foobar
spec:
  rules:
    - host: foo.org
      http:
        paths:
          - path: /a
            backend:
              service:
                name: foo-a
                port:
                  number: 8080
          - path: /b
            backend:
              service:
                name: foo-b
                port:
                  number: 8181
    - host: bar.org
      http:
        paths:
          - path: /a
            backend:
              service:
                name: bar-a
                port:
                  number: 9090
          - path: /b
            backend:
              service:
                name: bar-b
                port:
                  number: 9191
```

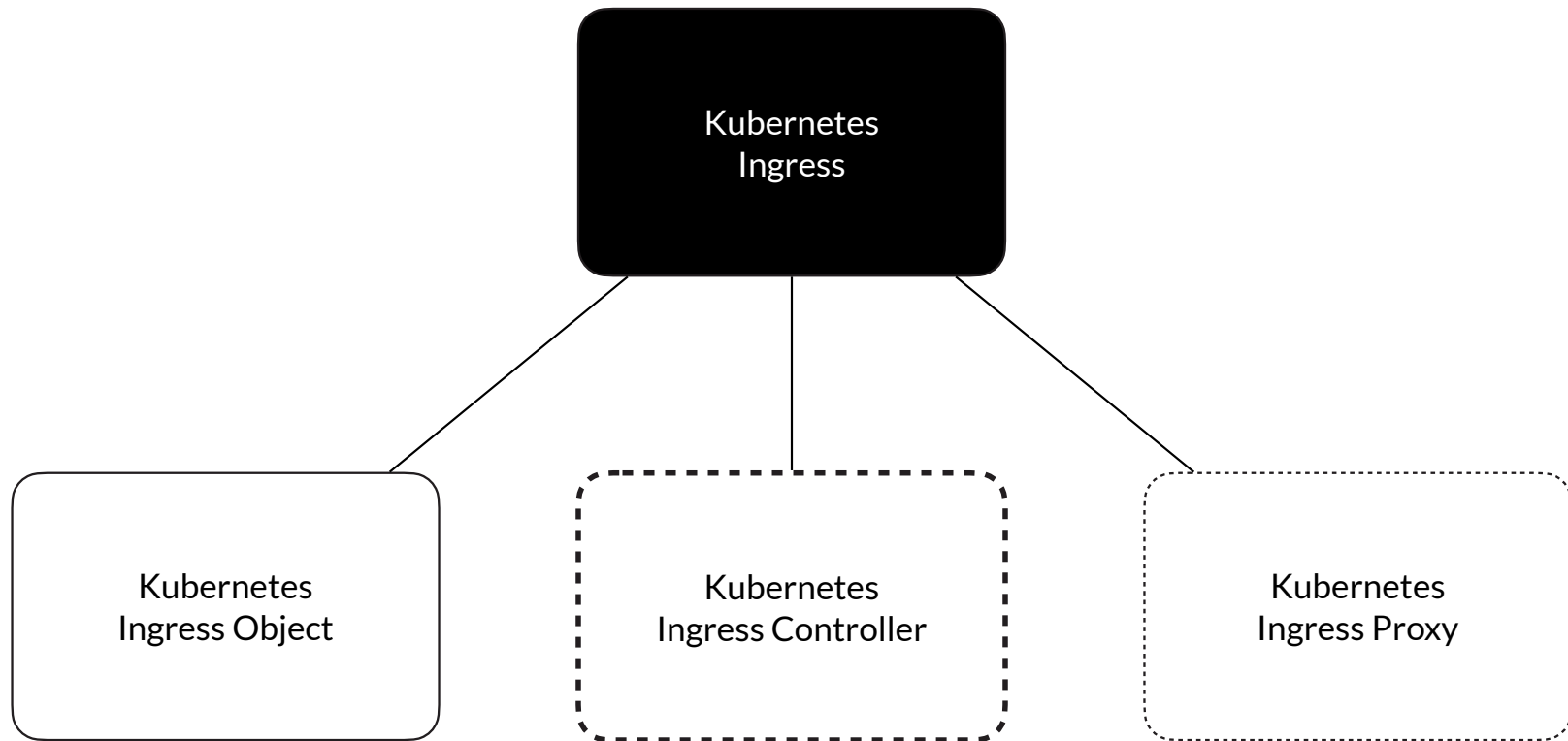
Rule	Host	Path	Service
r ₁	foo.org	/a	foo-a:8080
r ₂	foo.org	/b	foo-b:8181
r ₃	bar.org	/a	bar-a:9090
r ₄	bar.org	/b	bar-b:9191

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: foobar
spec:
  rules:
    - host: foo.org
      http:
        paths:
          - path: /a
            backend:
              service:
                name: foo-a
                port:
                  number: 8080
          - path: /b
            backend:
              service:
                name: foo-b
                port:
                  number: 8181
    - host: bar.org
      http:
        paths:
          - path: /a
            backend:
              service:
                name: bar-a
                port:
                  number: 9090
          - path: /b
            backend:
              service:
                name: bar-b
                port:
                  number: 9191
```

Rule	Host	Path	Service
r ₁	<u>foo.org</u>	/a	foo-a:8080
r ₂	<u>foo.org</u>	/b	foo-b:8181
r ₃	<u>bar.org</u>	/a	bar-a:9090
r ₄	<u>bar.org</u>	/b	bar-b:9191







Control Plane

Data Plane

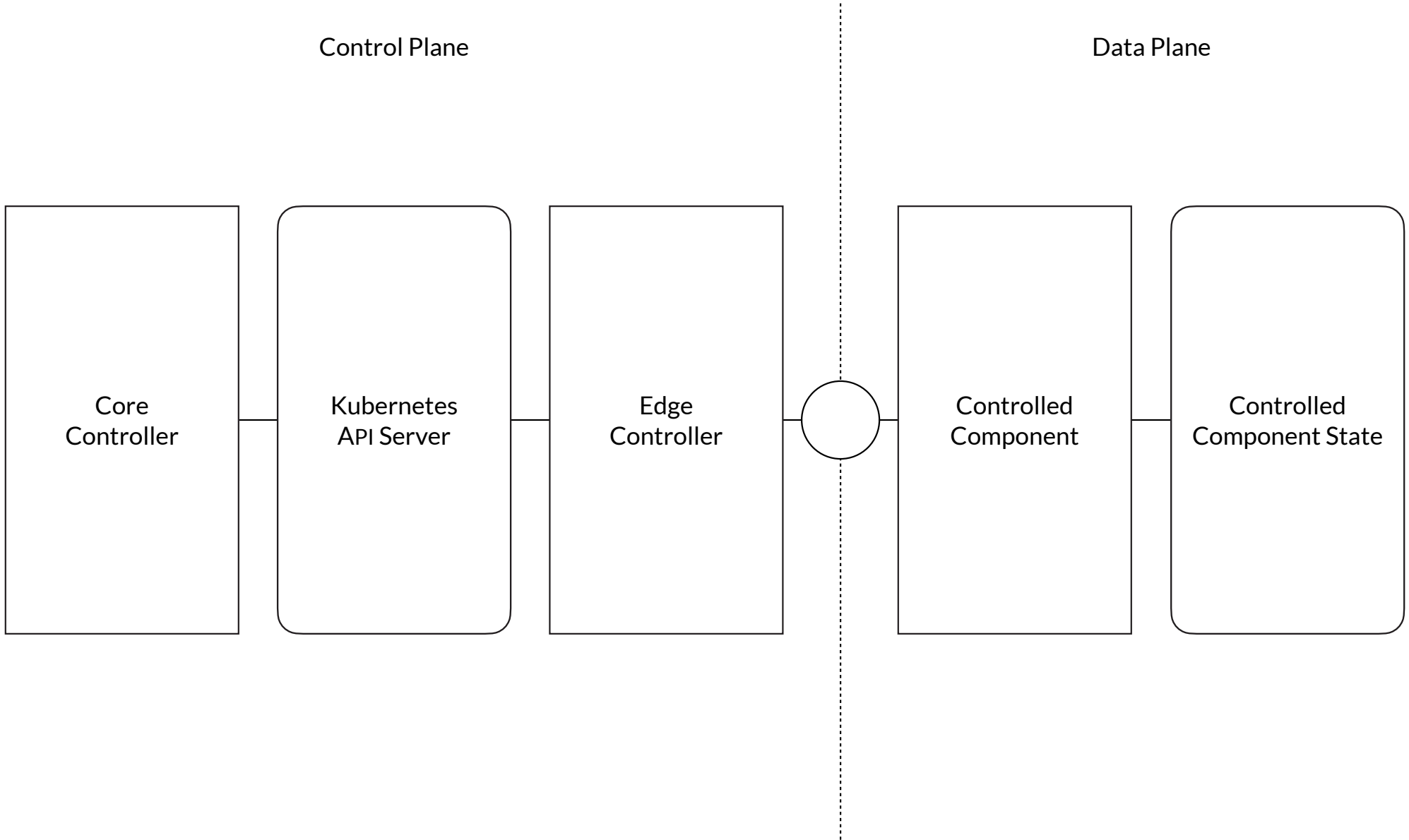
Core
Controller

Kubernetes
API Server

Edge
Controller

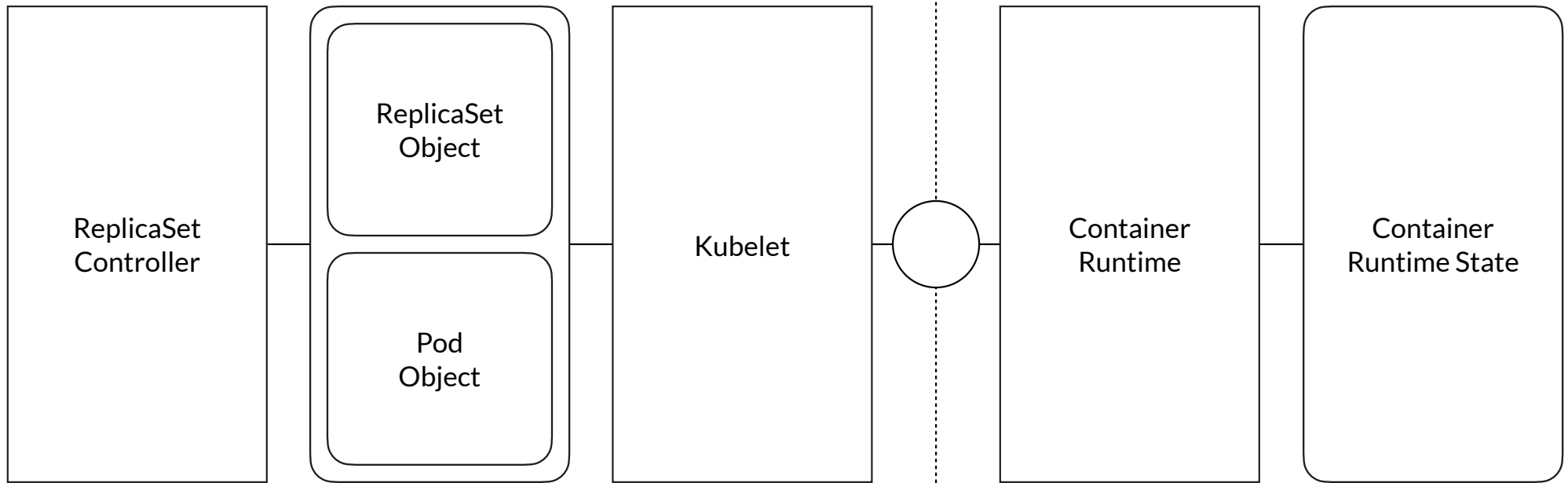
Controlled
Component

Controlled
Component State



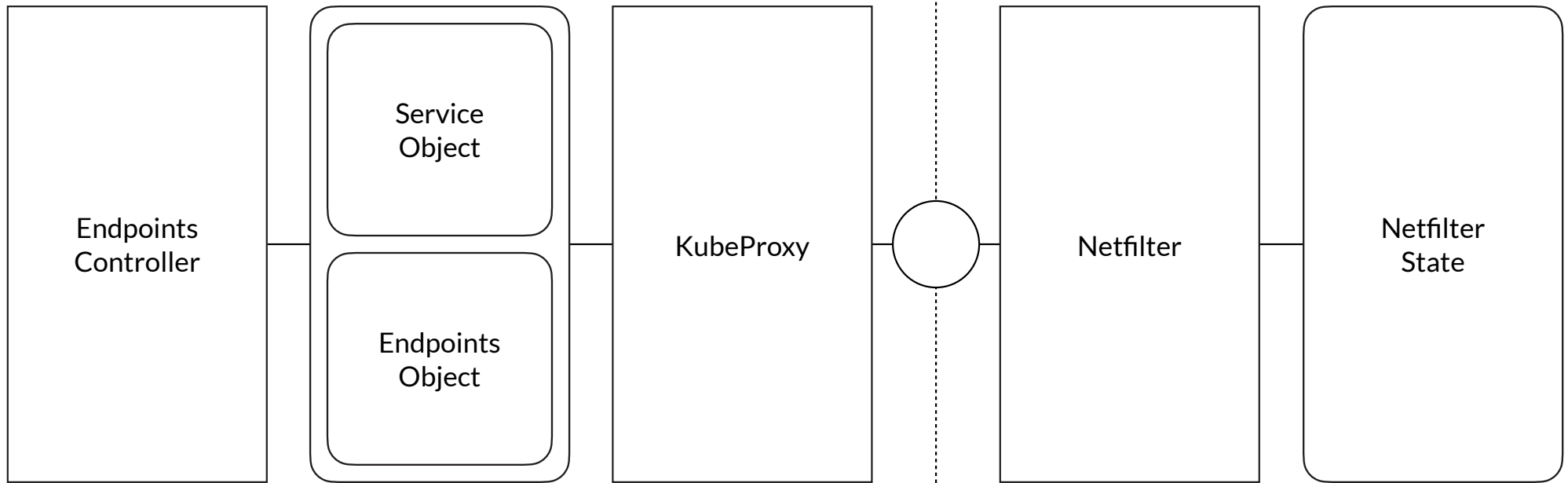
Control Plane

Data Plane



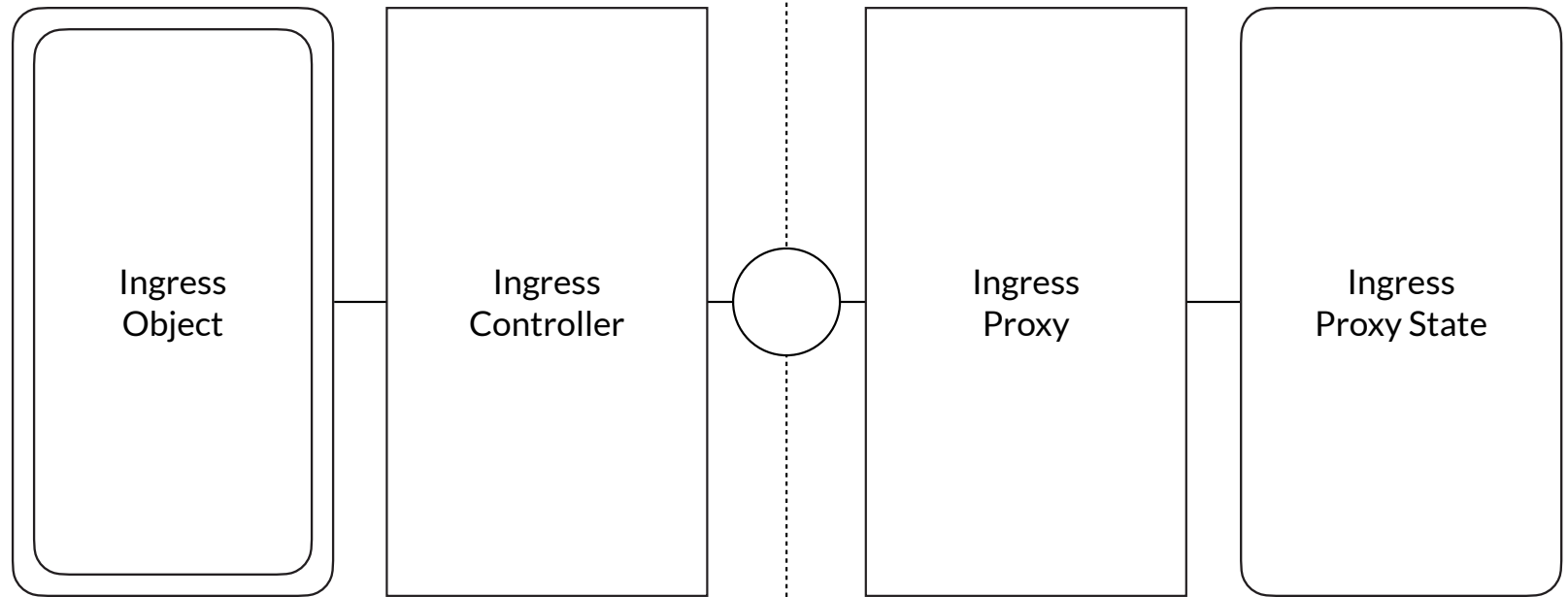
Control Plane

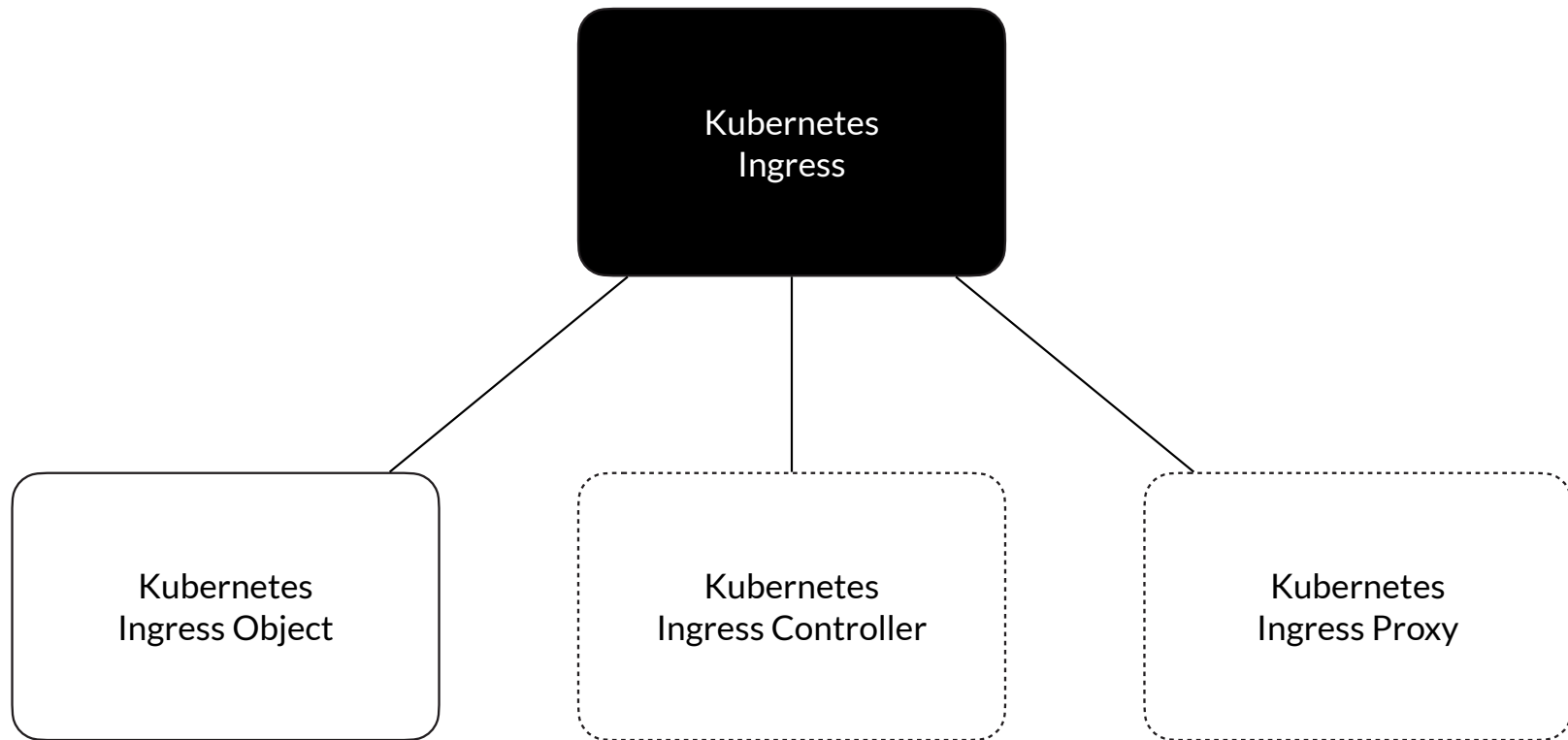
Data Plane

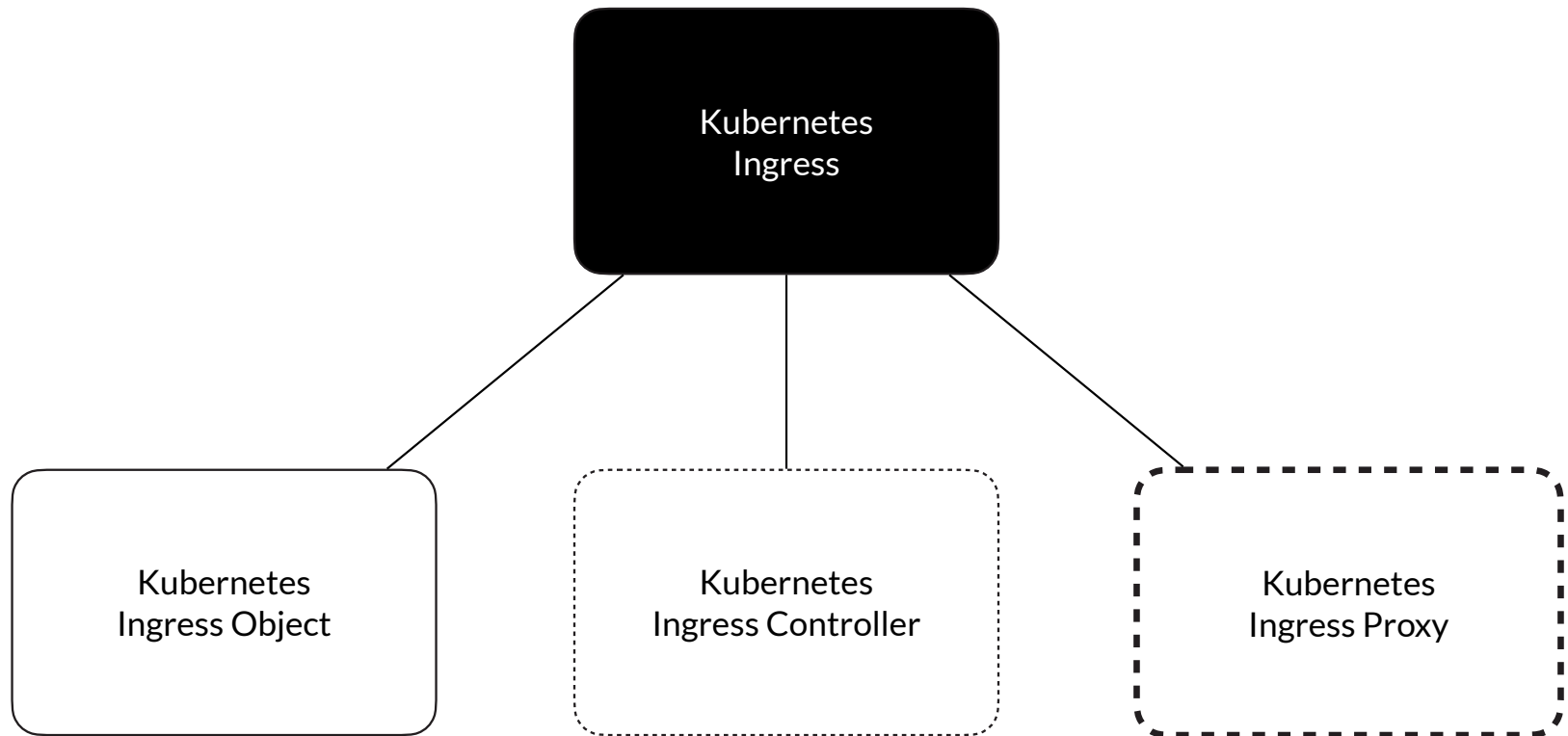


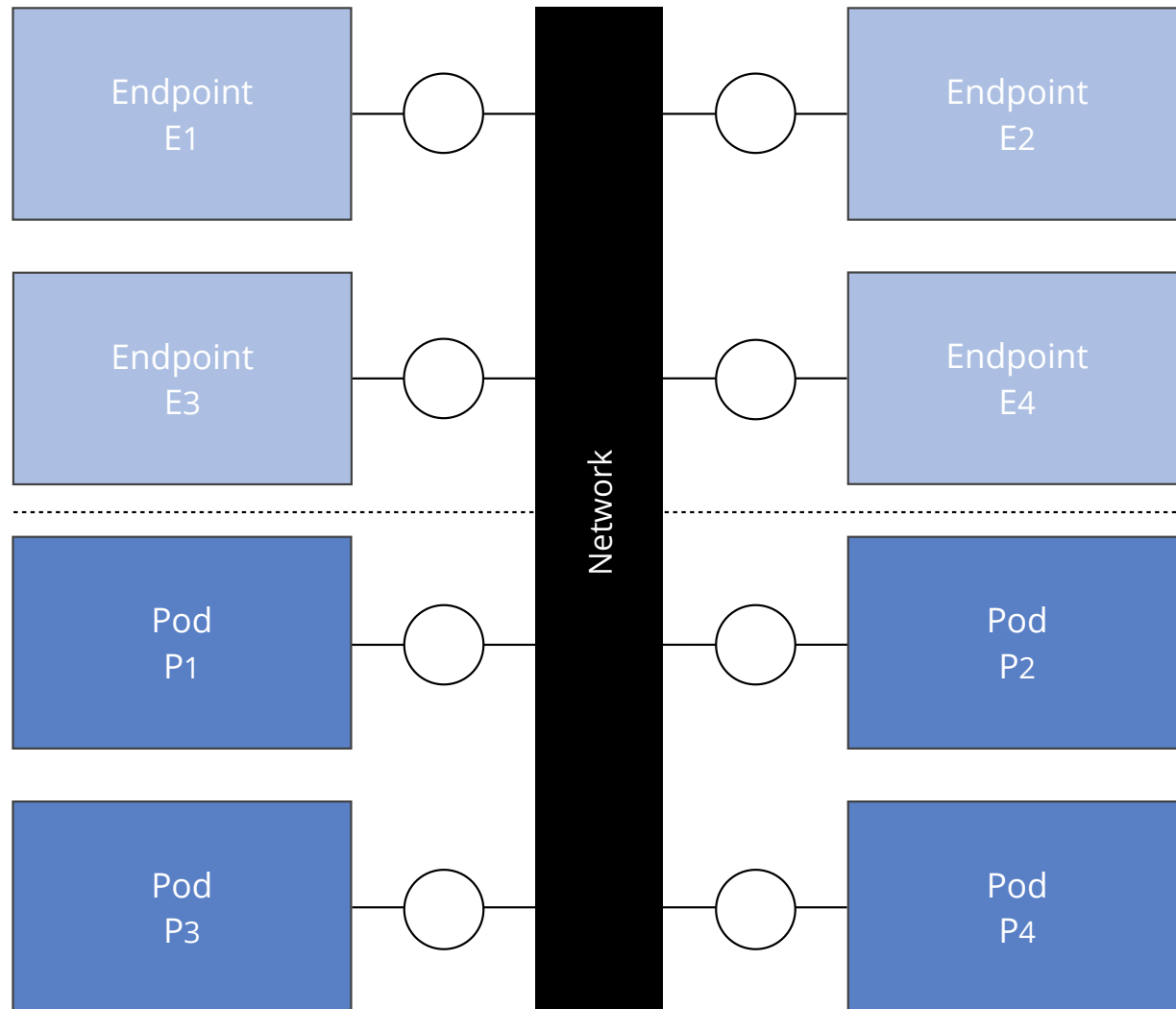
Control Plane

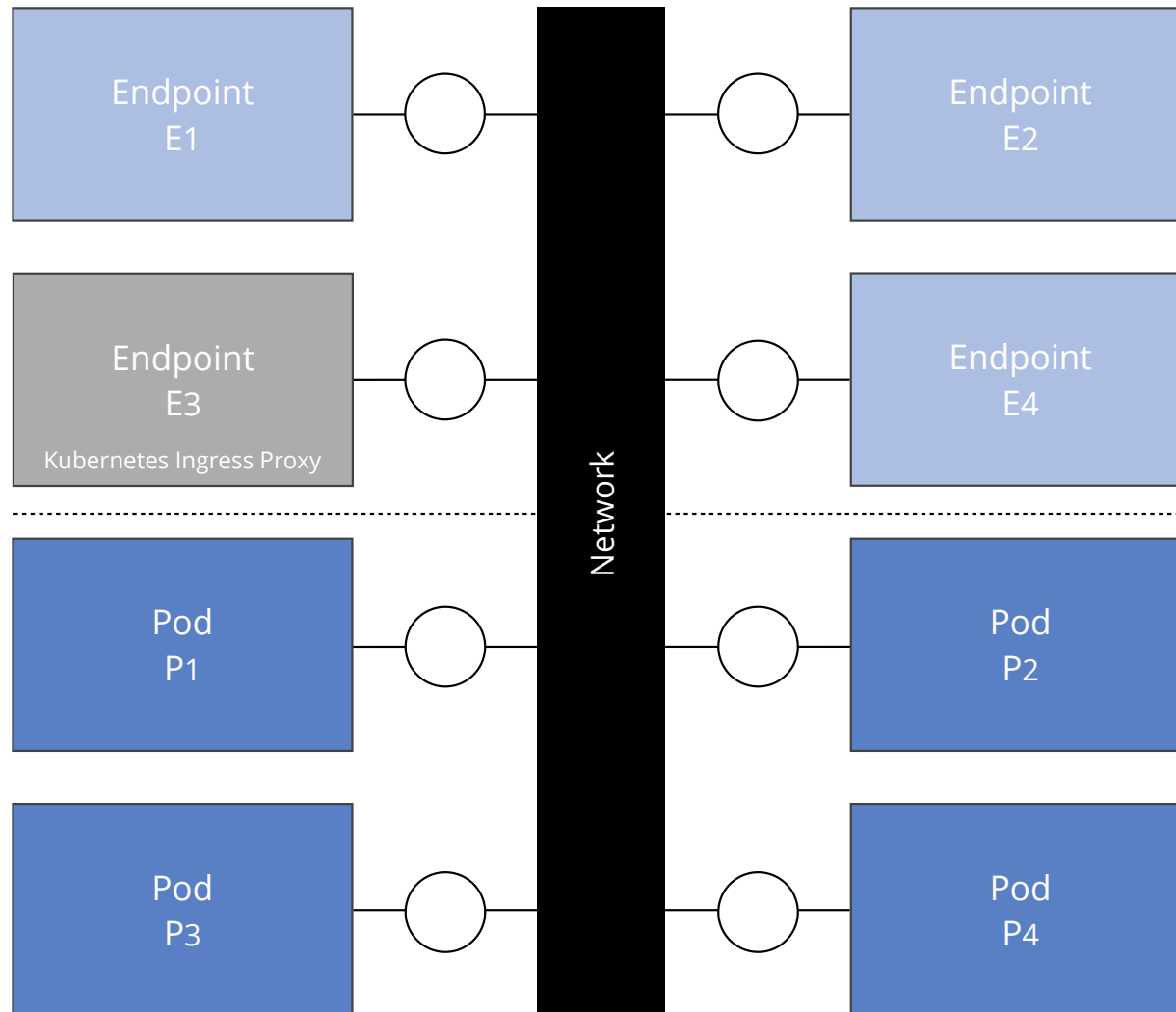
Data Plane

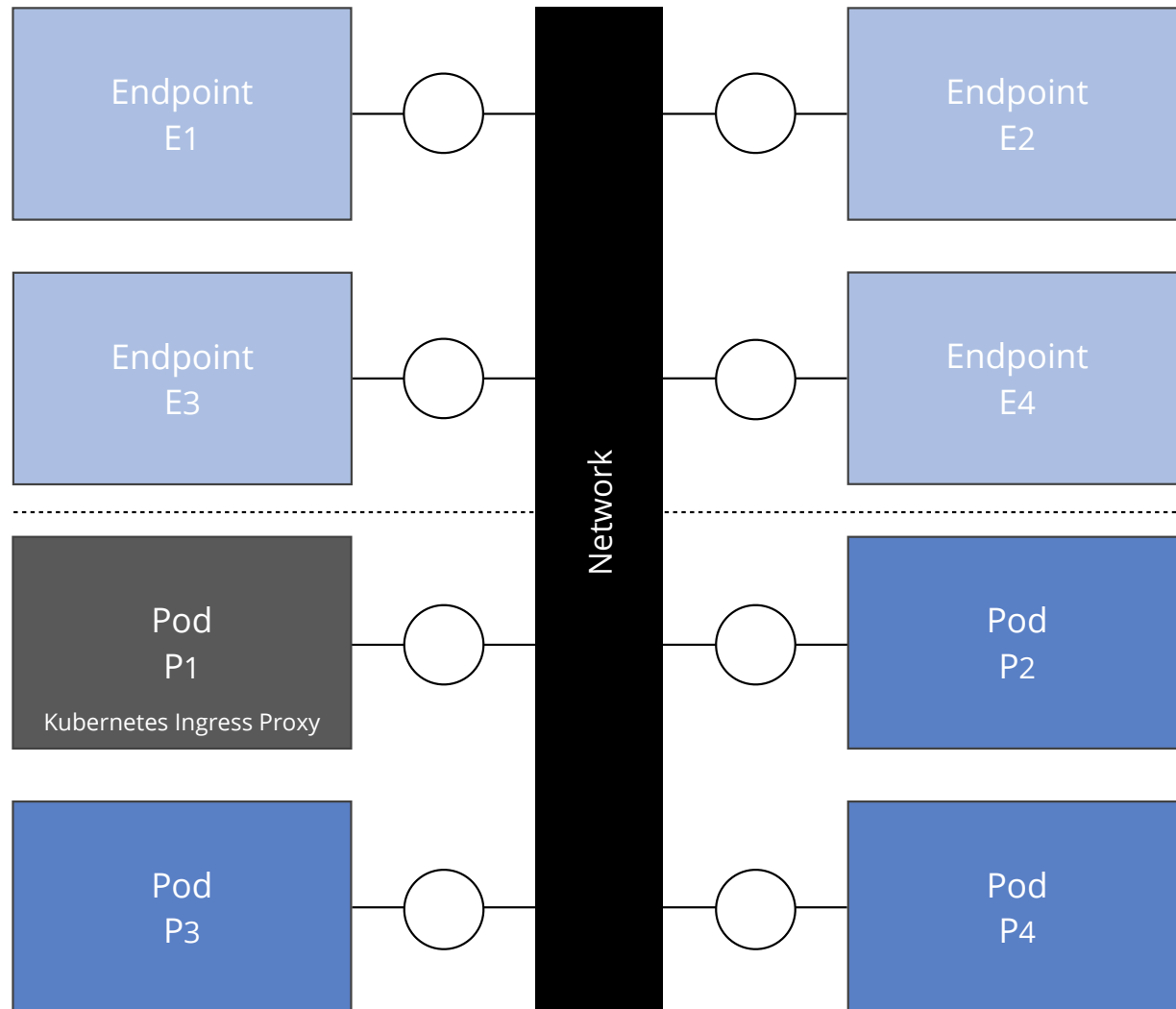


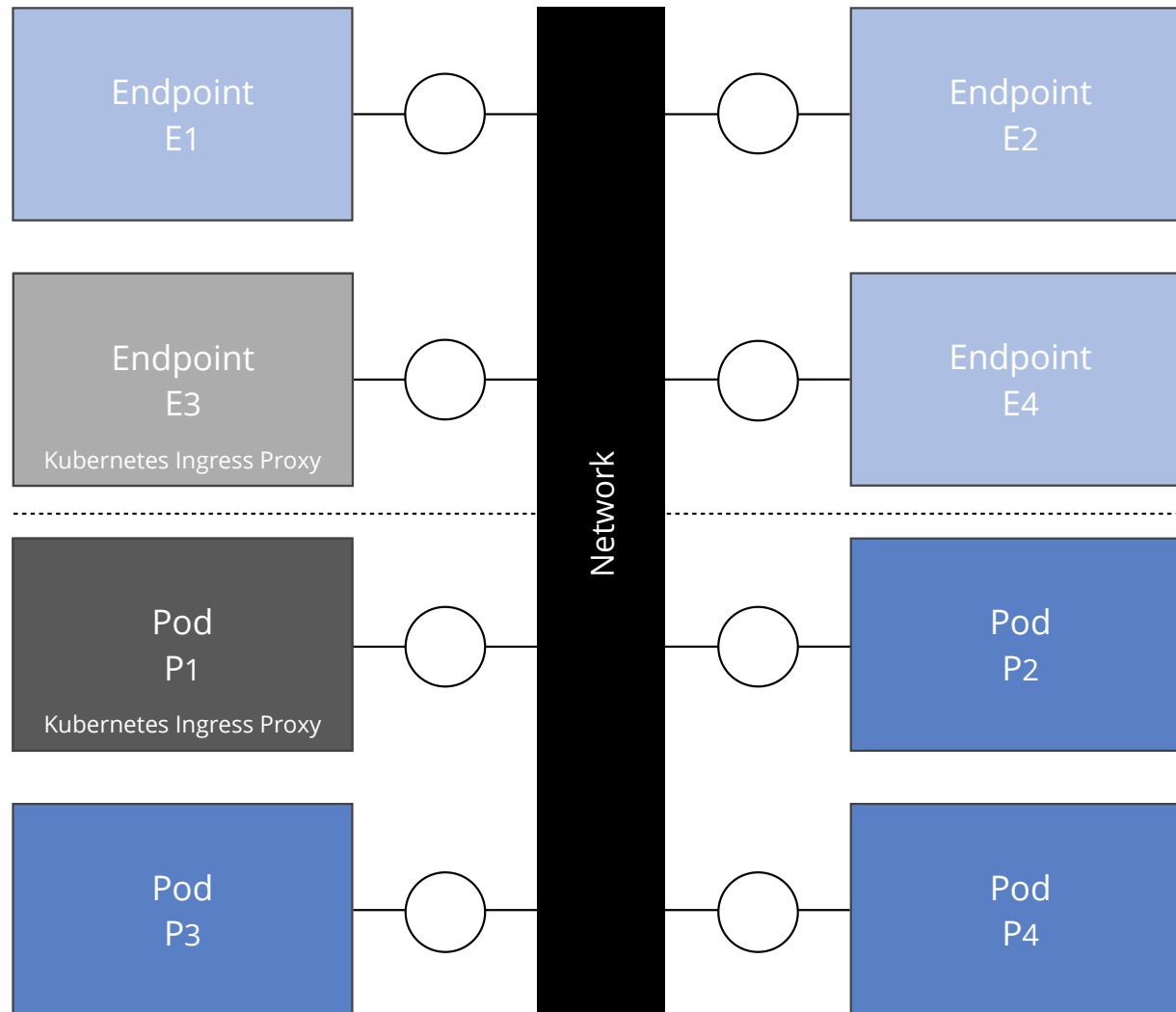












Definition

Kubernetes Ingress

$\{ f1 \times f2 \in \text{Flow} \times \text{Flow} \mid \text{target}[f1] = \text{Proxy} \wedge \text{target}[f2] = \text{Pod} \wedge \exists r \in \text{Rules}[\text{Proxy}]: \text{Req}_{f1} \vdash \text{conditions}[r] \wedge \text{Pod} \vdash \text{target}[r] \}$



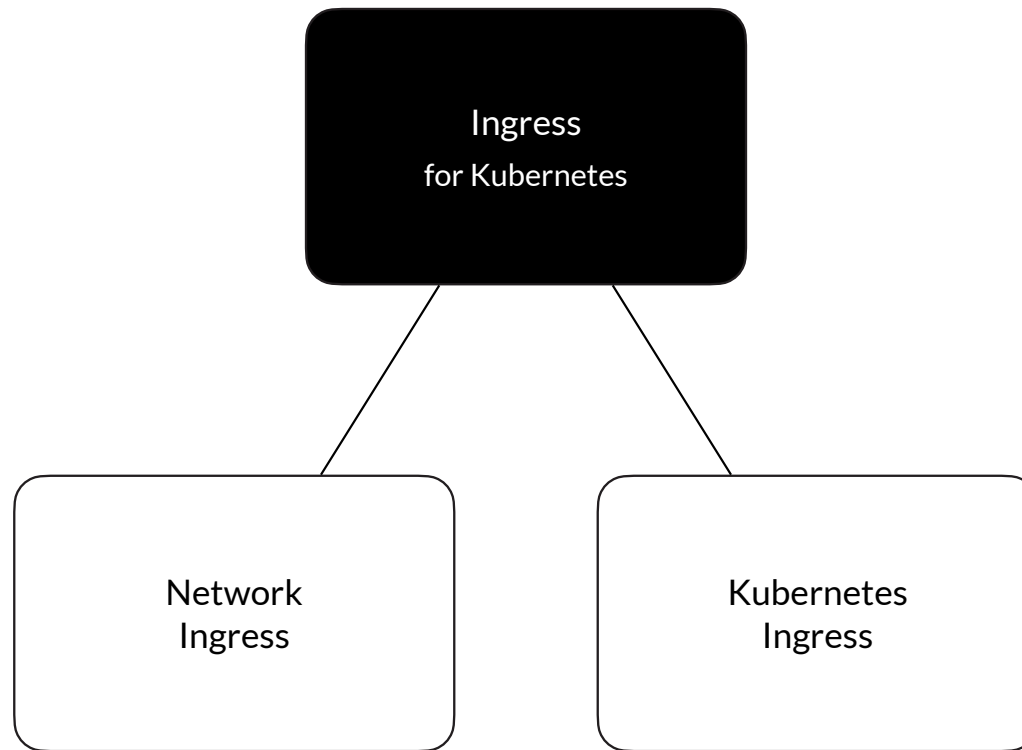
Definition

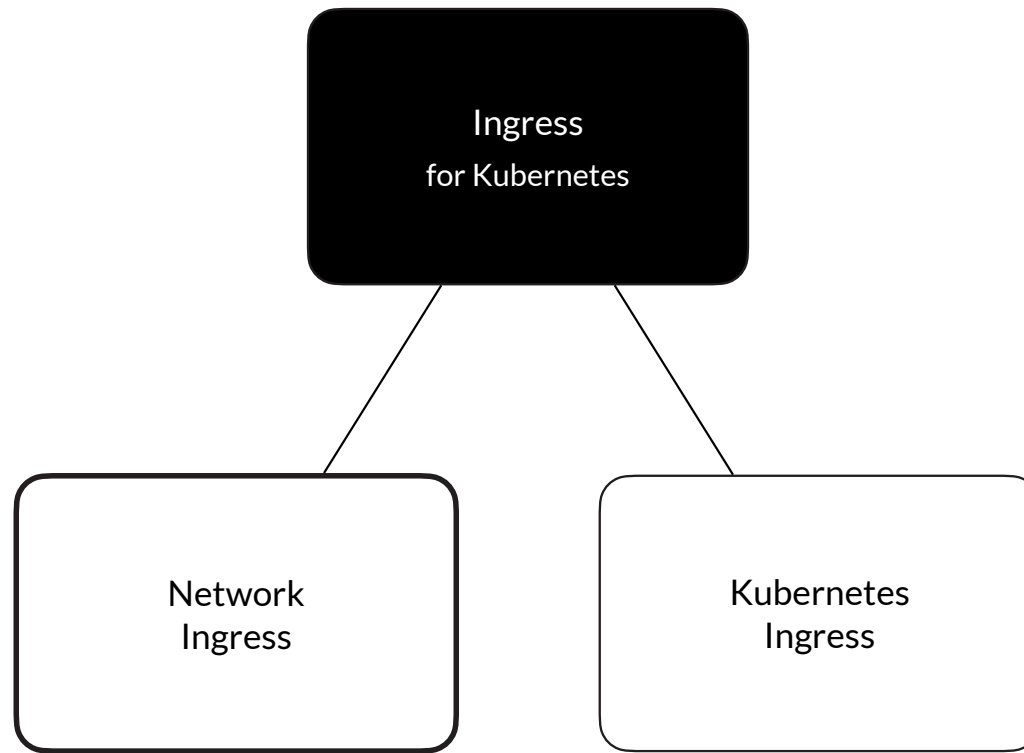
Ingress for Kubernetes

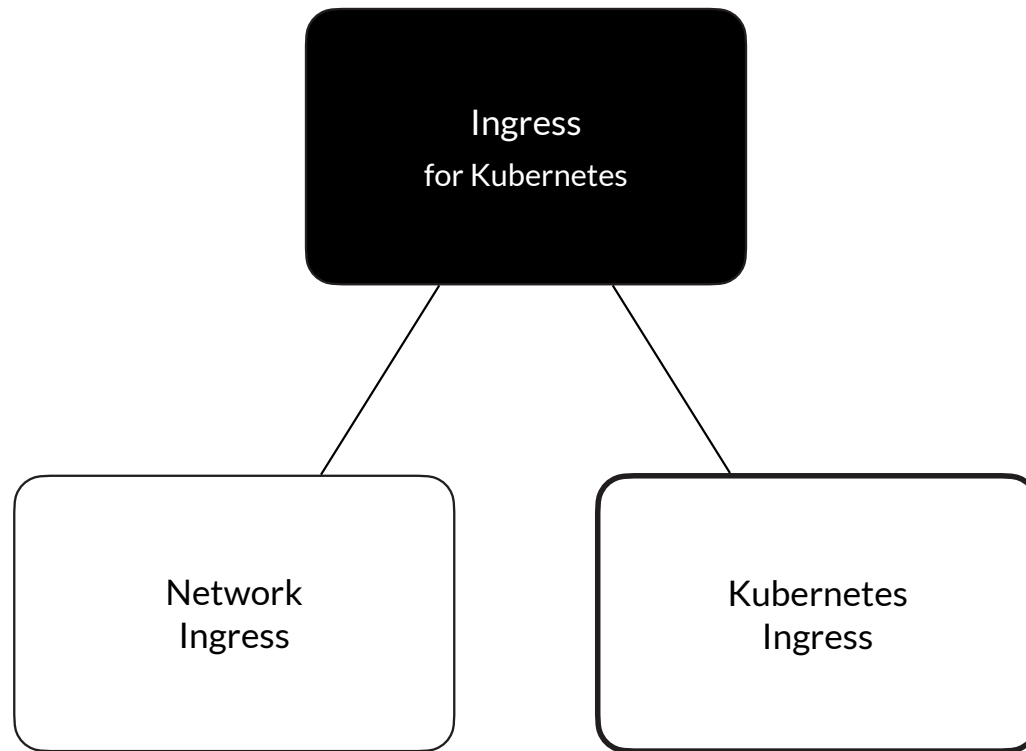
$\{ f1 \times f2 \in \text{Flow} \times \text{Flow} \mid \text{source}[f1] \notin \text{Cluster} \wedge \text{target}[f2] \in \text{Cluster} \wedge \text{target}[f1] = \text{Proxy} \wedge \text{target}[f2] = \text{Pod} \wedge \exists \dots \}$

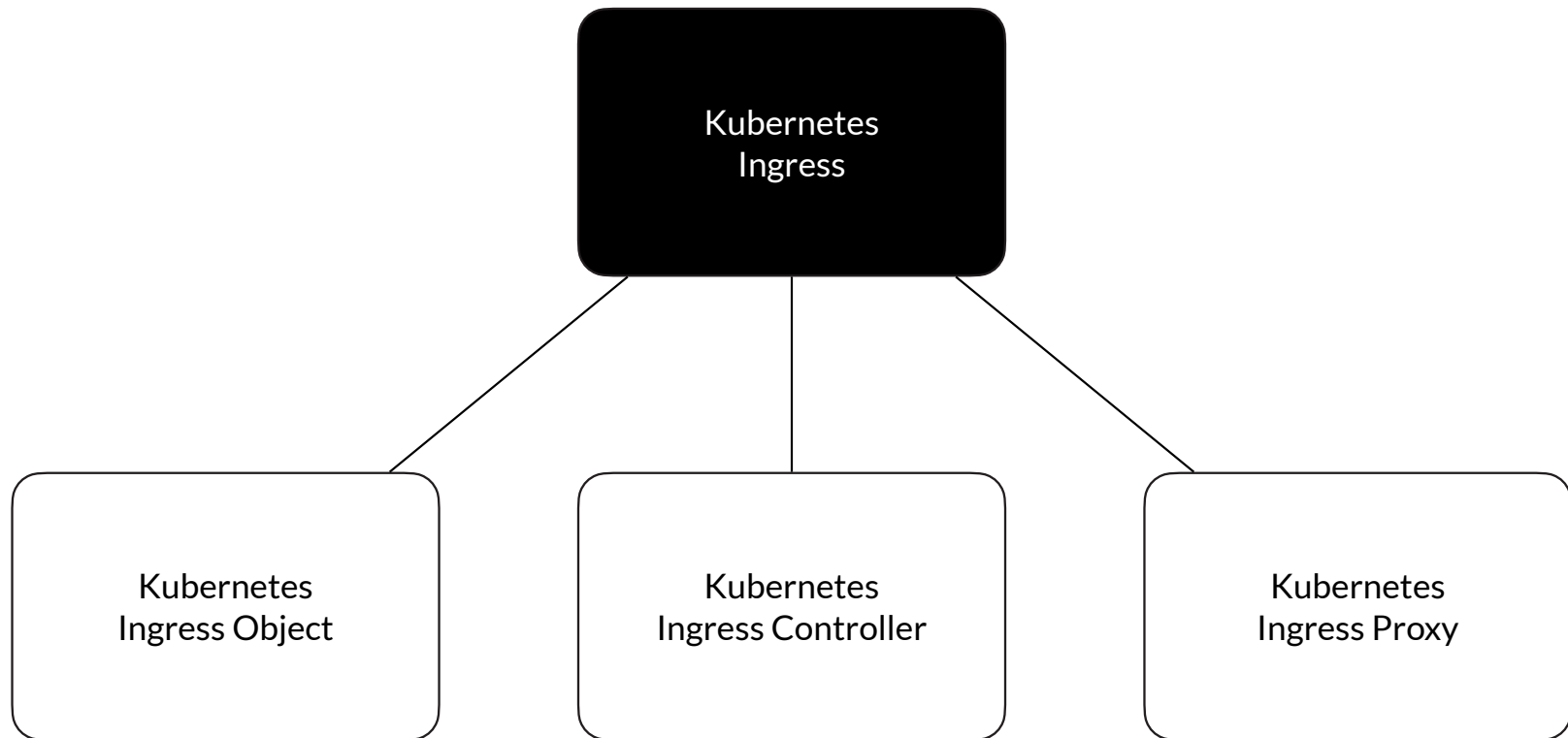


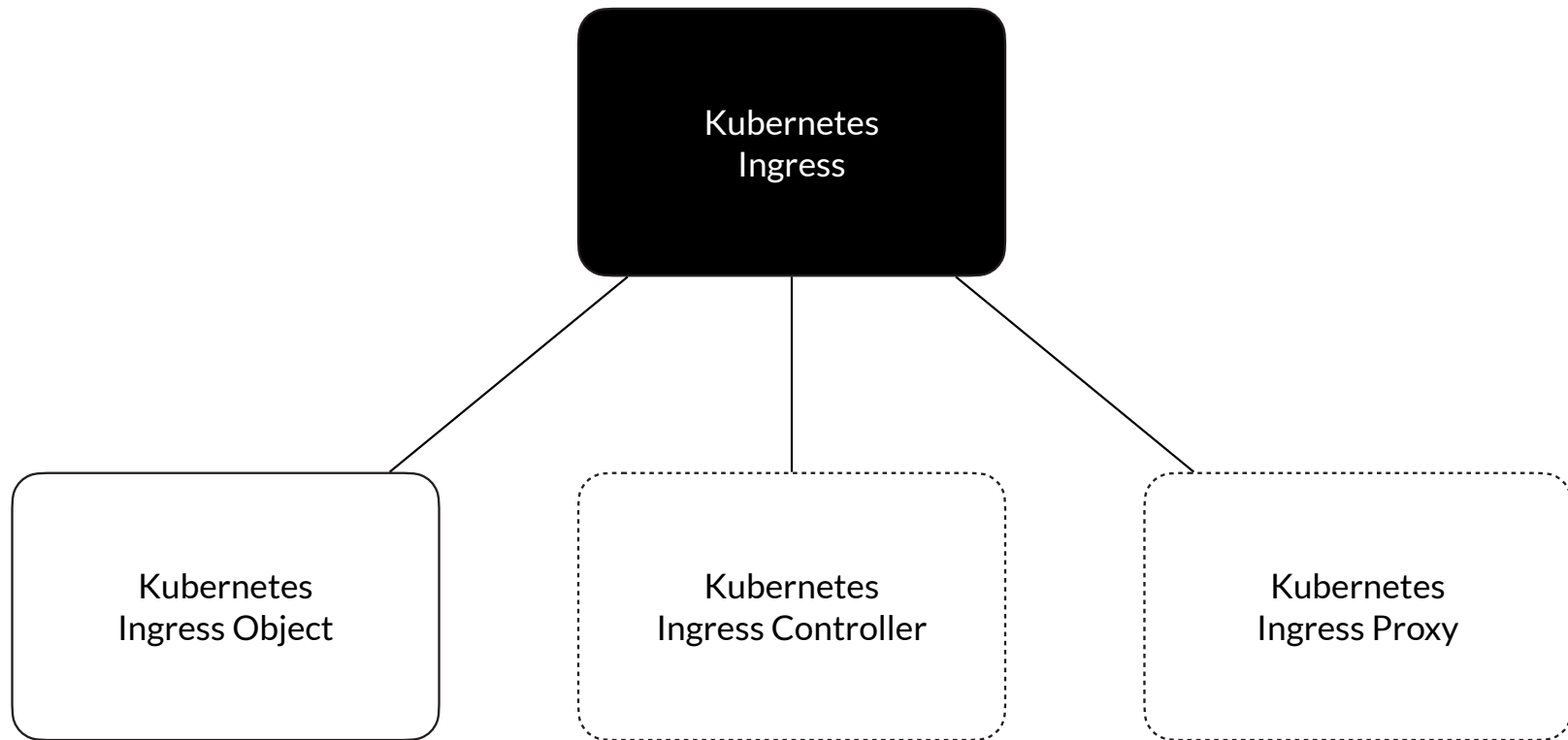
Conclusion

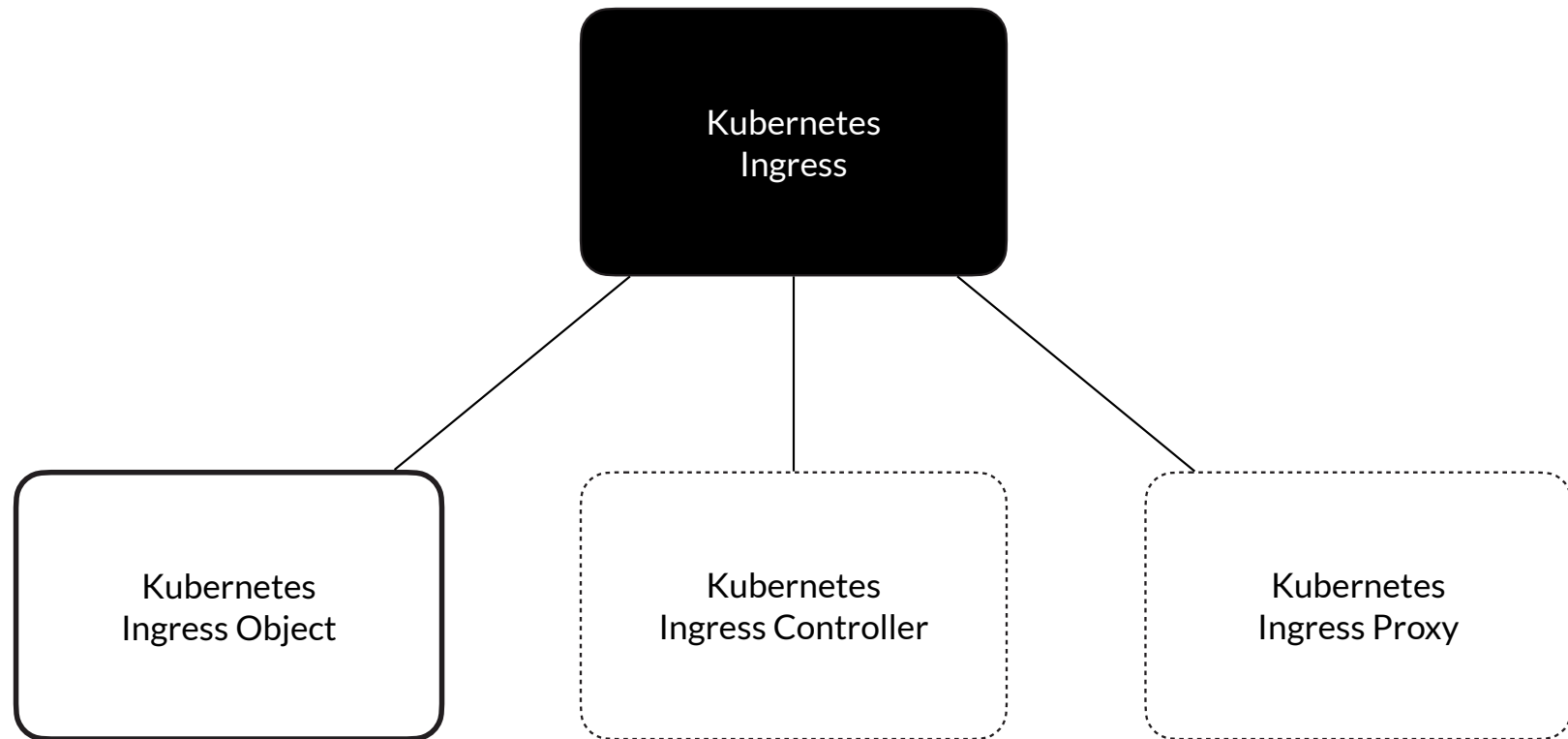


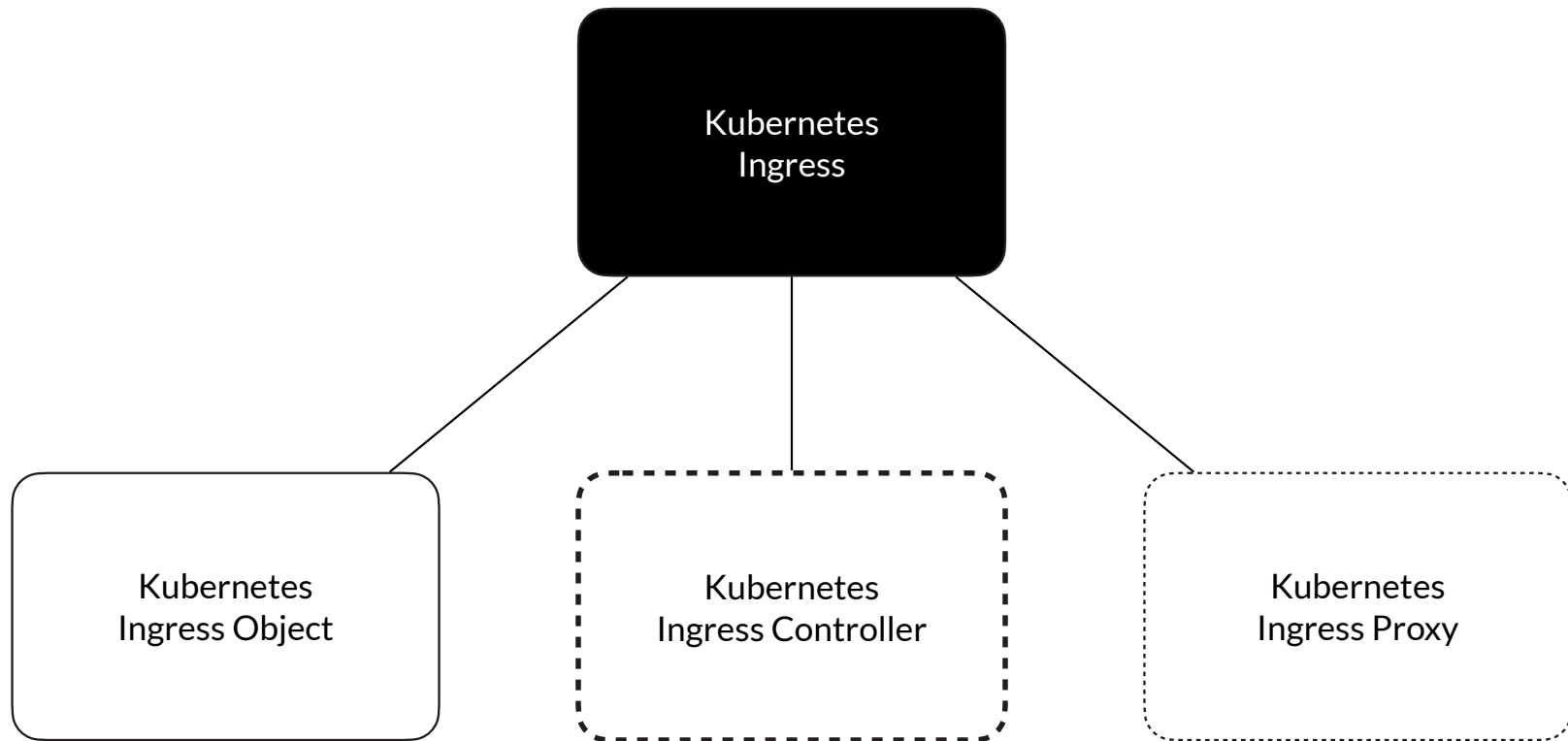


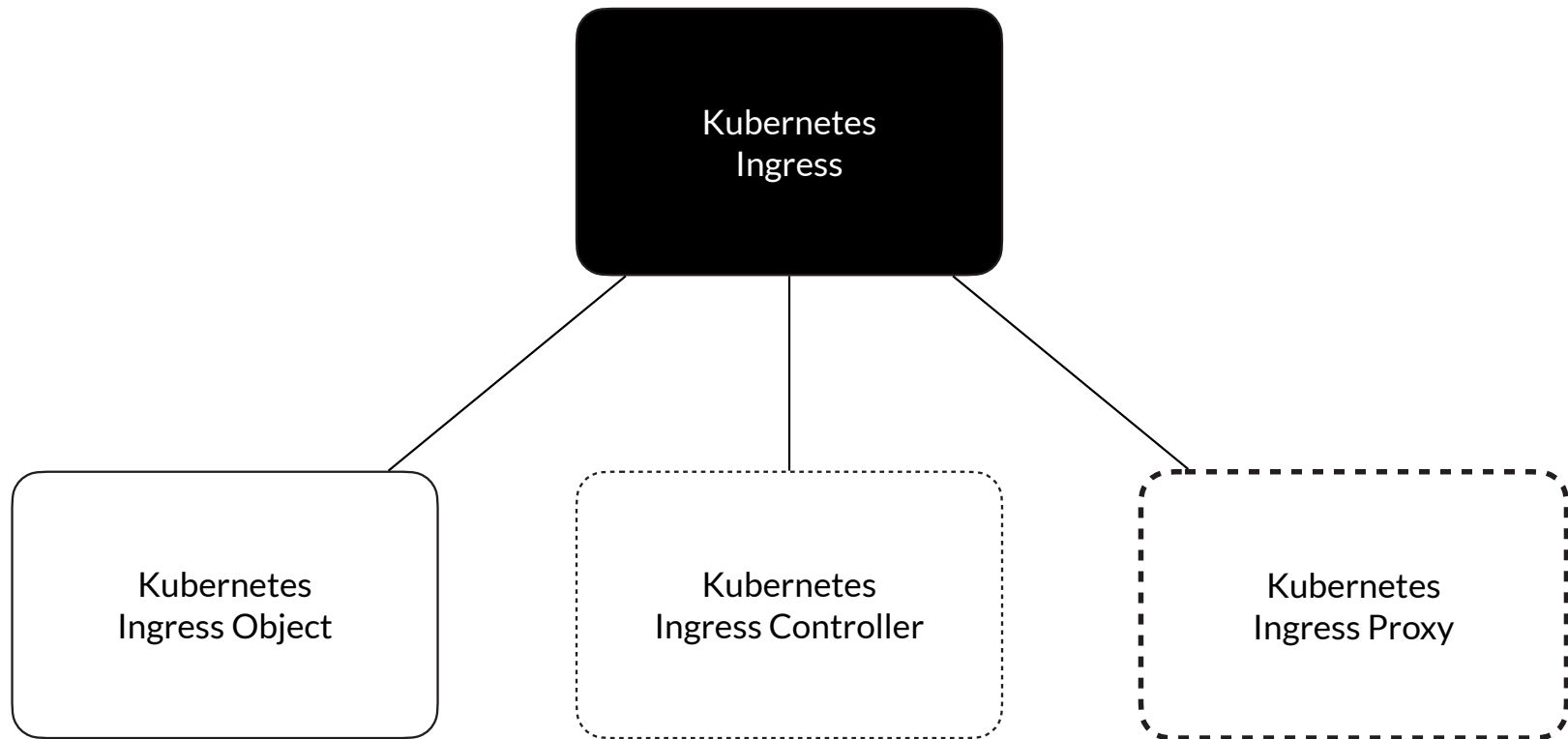












Finally ...

What is the difference between
Kubernetes Ingress and an API Gateway like the Ambassador API Gateway?



Thank You

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