CLOUDNATIVE SECURITYCON

NORTH AMERICA 2023

CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

CNI or Service Mesh?
Comparing Security Policies Across Providers

CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

Christine Kim - Google
@xtineskim

Rob Salmond - SuperOrbital
mastodon.social/@rsalmond

What we'll cover . . .

- What's a CNI? What's a Service Mesh?
- The What and How of Policy Enforcement
- Security Gotchas
- Mitigation and How the Field is Evolving
- What You Can Do

cilium

Istio

Top Ten CNCF Projects by:

Top Ten CNCF Projects by: commits

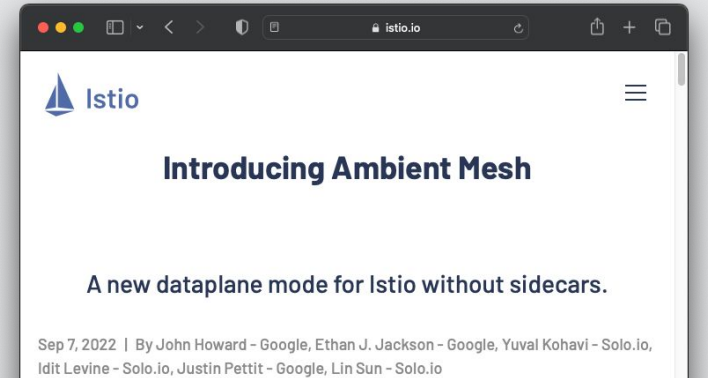
Top Ten CNCF Projects by: contributors

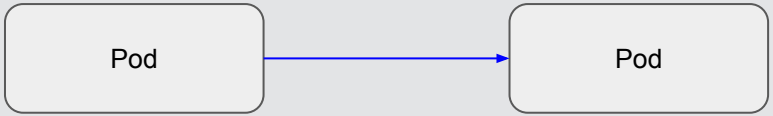
Top Ten CNCF Projects by: comments

Top Ten CNCF Projects by: issues

cilium

Istio

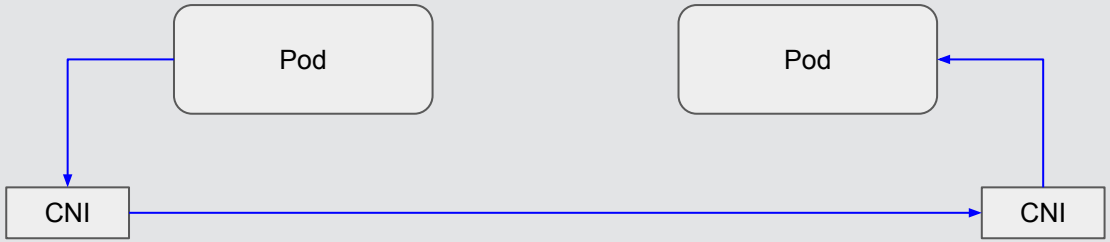




“pods can communicate with all other pods on any other node without NAT”

https://kubernetes.io/docs/concepts/services-networking/

data



data

What is CNI?

Container Network Interface

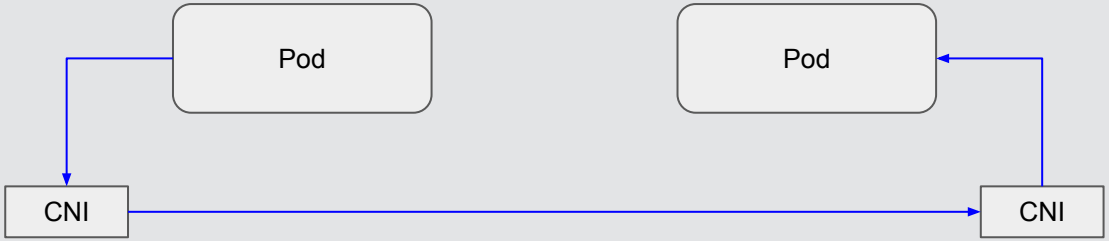
What is CNI?

Container
Network
Interface

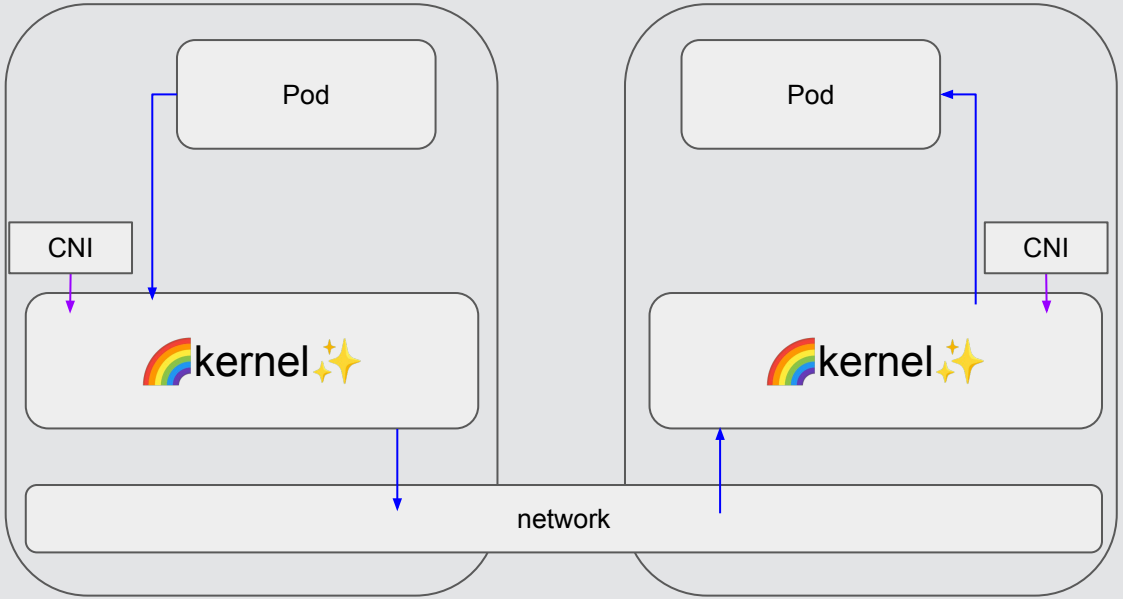
“A way to ask for changes to be made to a container’s network config.”

What kind of changes?

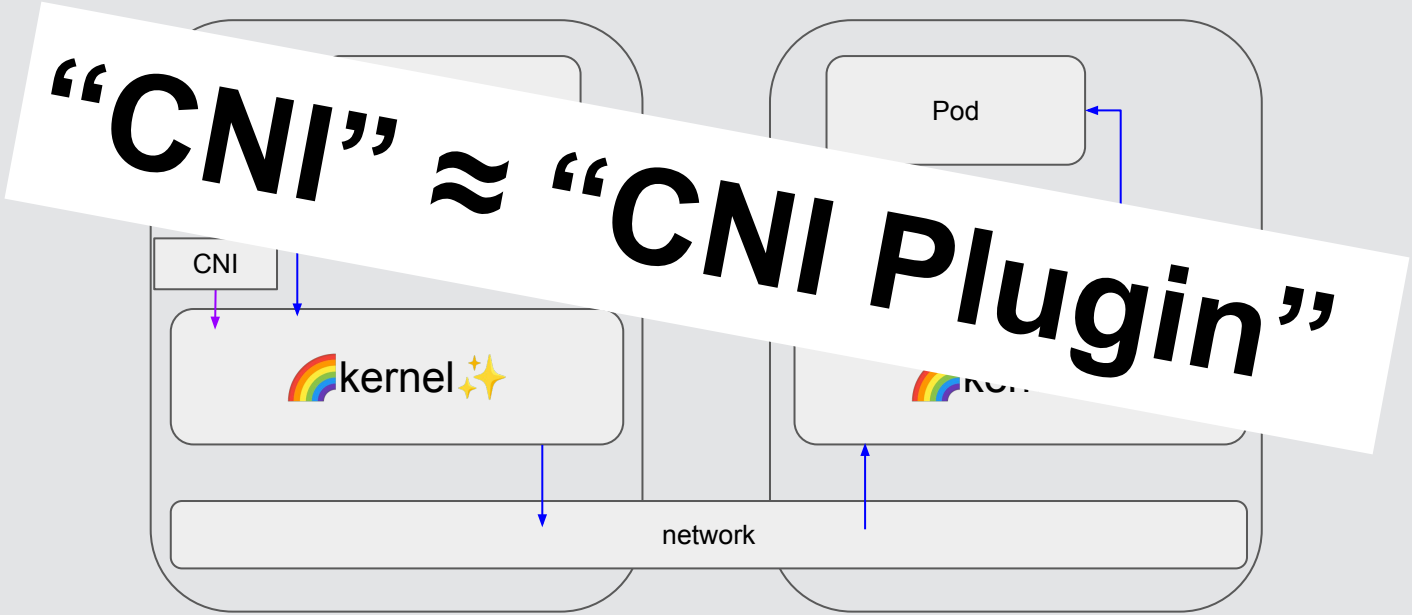
What kind of changes?



What kind of changes?



What kind of changes?



What is a CNI plugin?

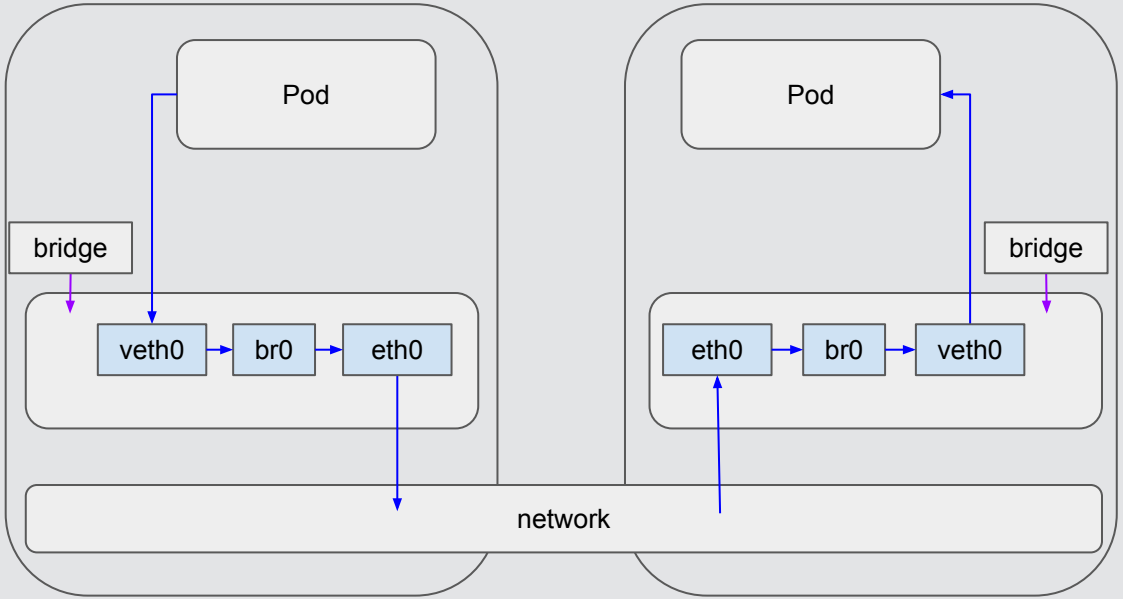
CNI ⇐ implements

What is a CNI plugin?

CNI ⇐ implements

“A thing that can make container networking changes.

bridge plugin

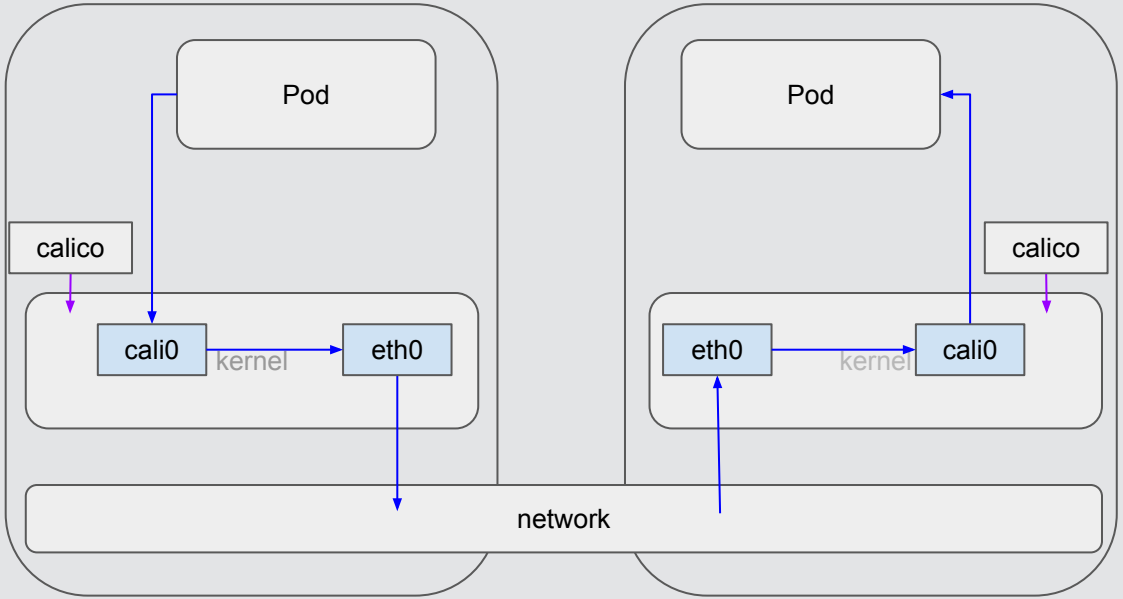


https://github.com/containernetworking/plugins

control

data

Calico plugin

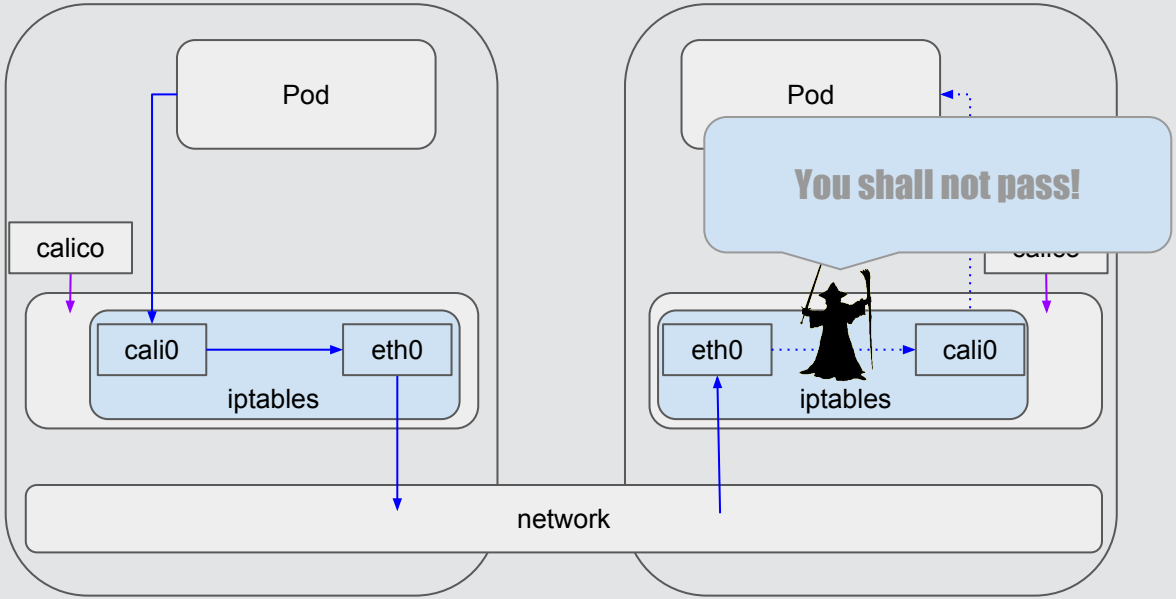


https://github.com/projectcalico/calico

control

data

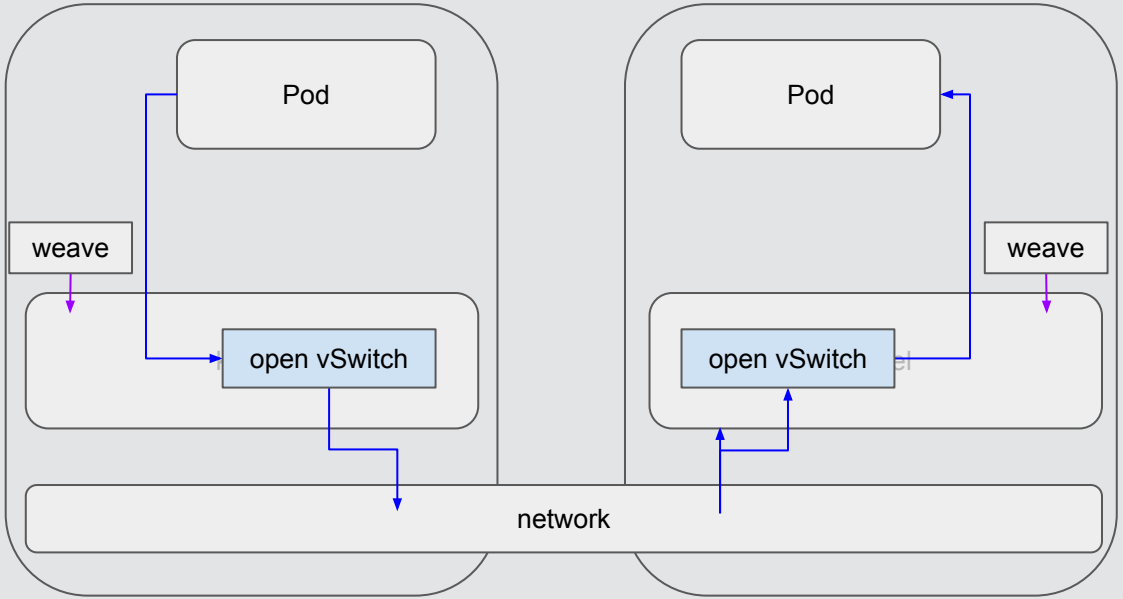
Calico plugin



https://github.com/projectcalico/calico

control
data

weave plugin

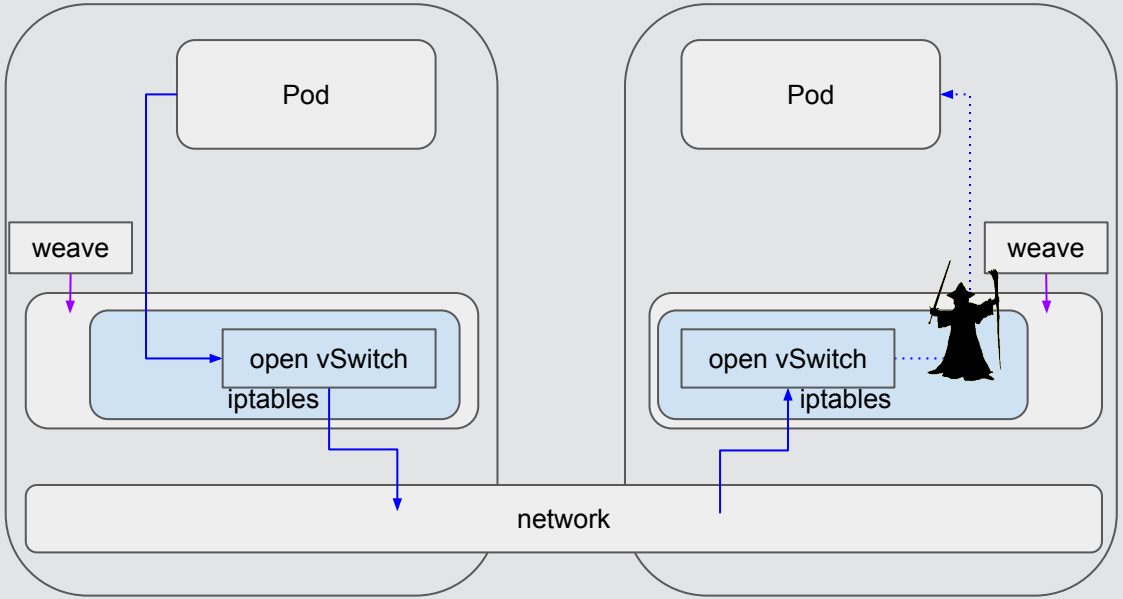


https://github.com/weaveworks/weave

control

data

weave plugin

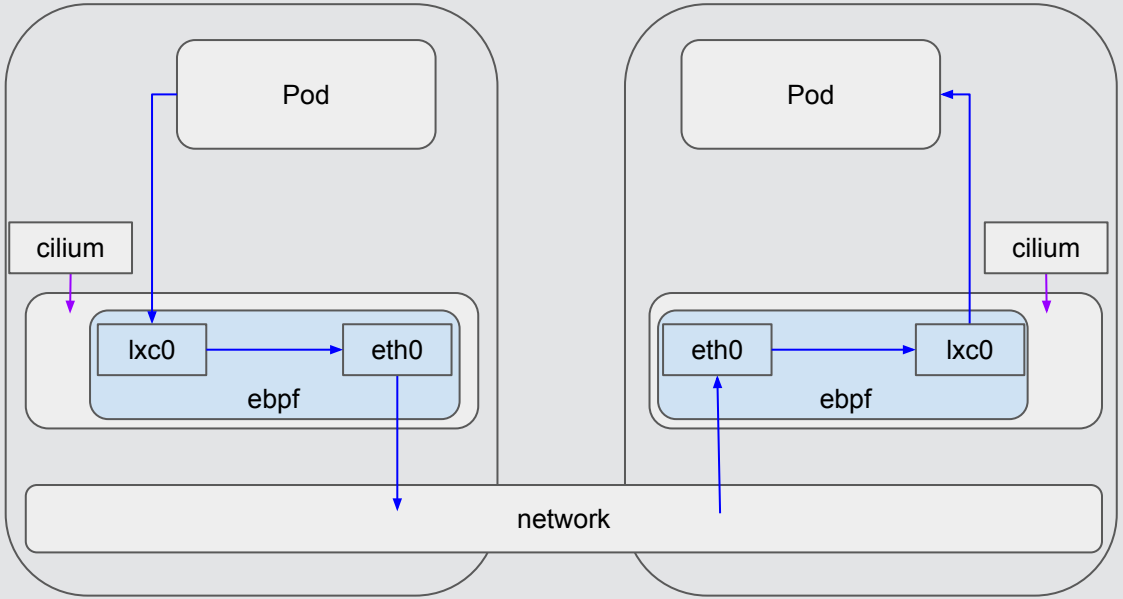


https://github.com/weaveworks/weave

control

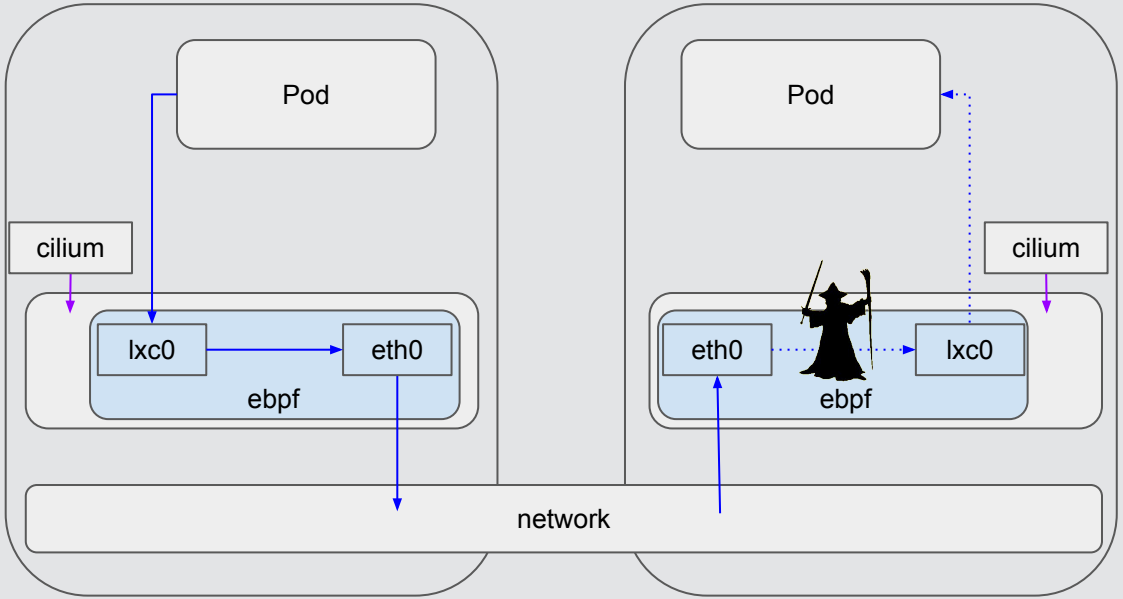
data

cilium plugin



https://github.com/cilium/cilium

cilium plugin



https://github.com/cilium/cilium

control

data

Most of the popular CNI Plugins:

Most of the popular CNI Plugins:

- Configure pod to pod networking

Most of the popular CNI Plugins:

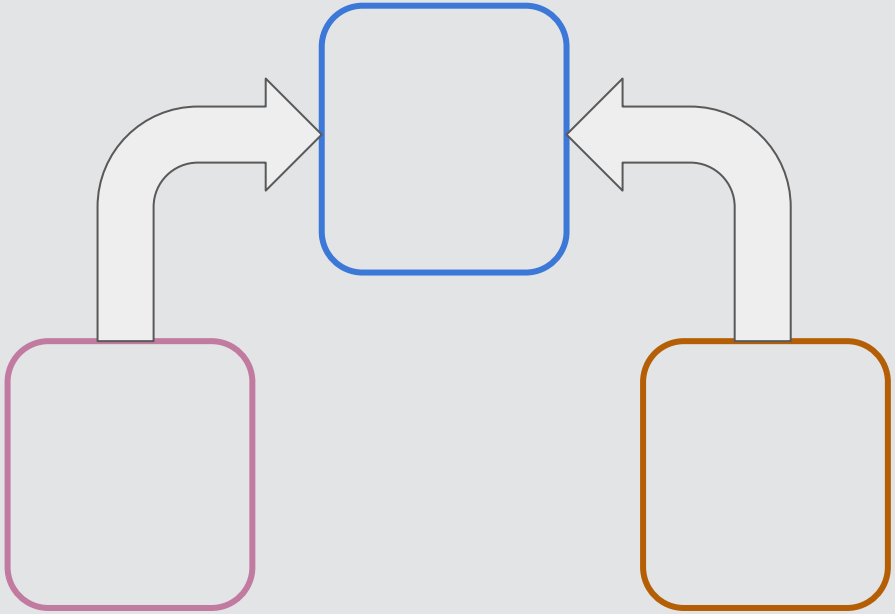
- Configure pod to pod networking
- Support NetworkPolicy enforcement

Most of the popular CNI Plugins:

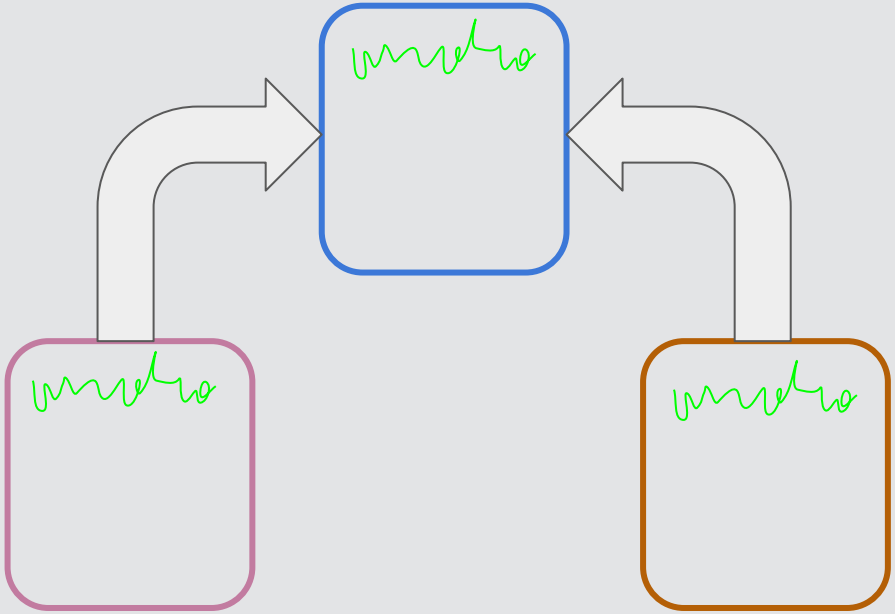
- Configure pod to pod networking
- Support NetworkPolicy enforcement
- ≈ Cloud Native software defined network

What is a Service Mesh?

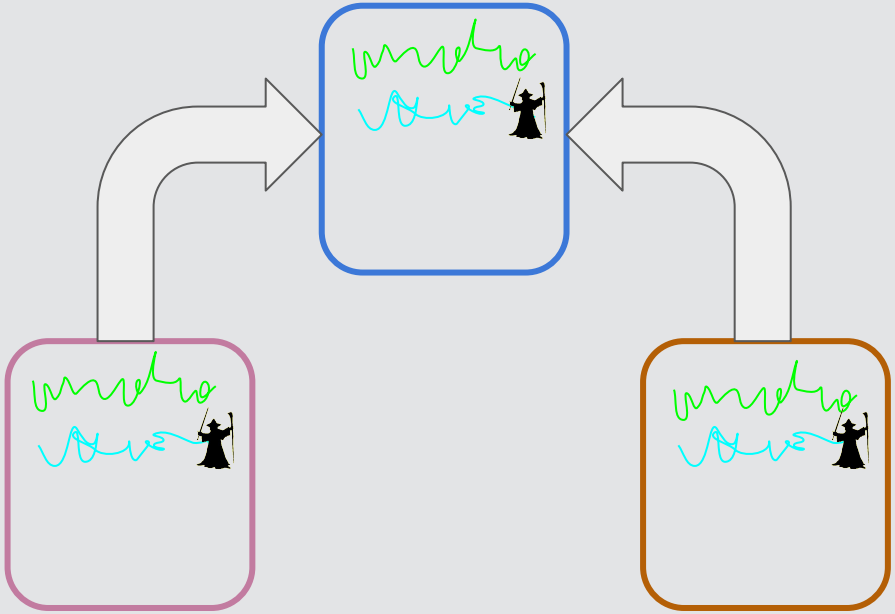
What is a Service Mesh?



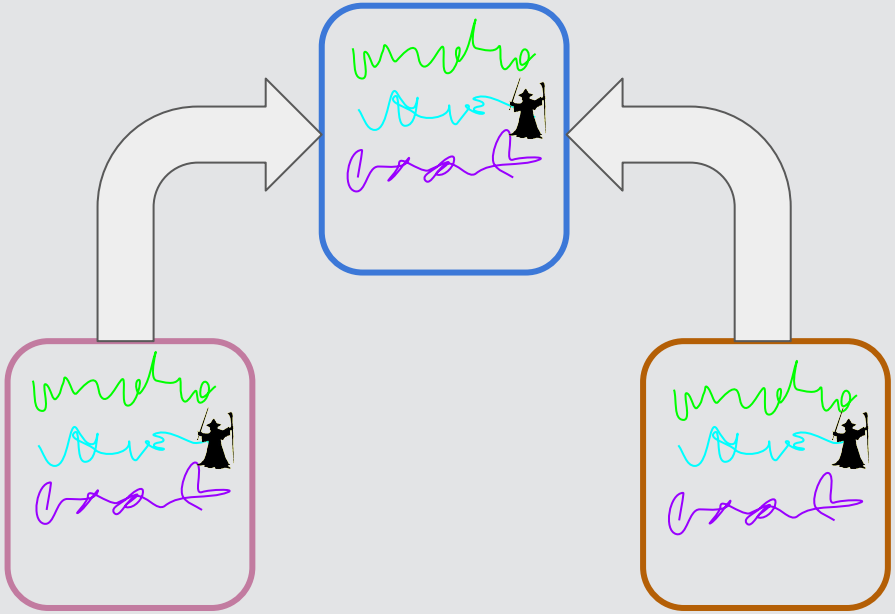
What is a Service Mesh?



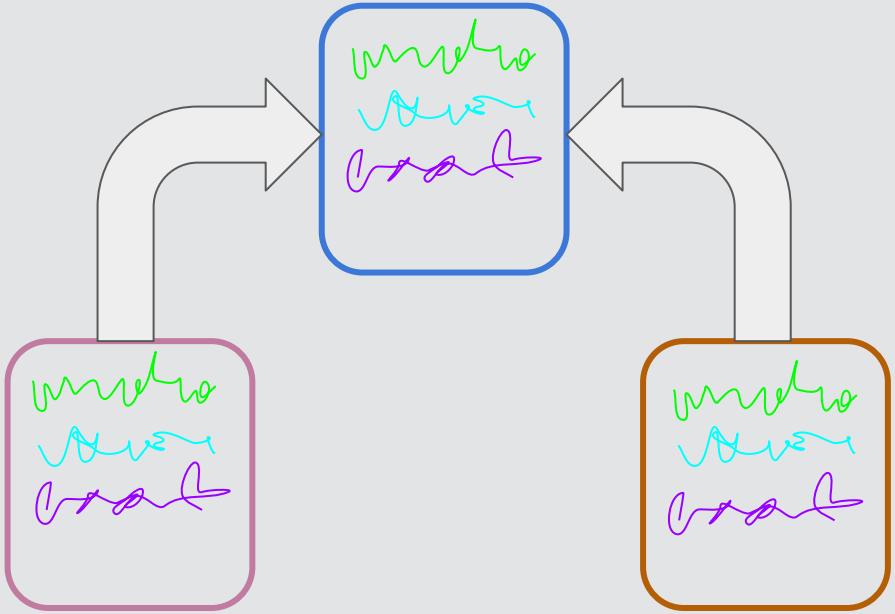
What is a Service Mesh?

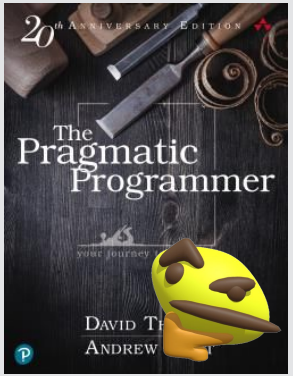


What is a Service Mesh?

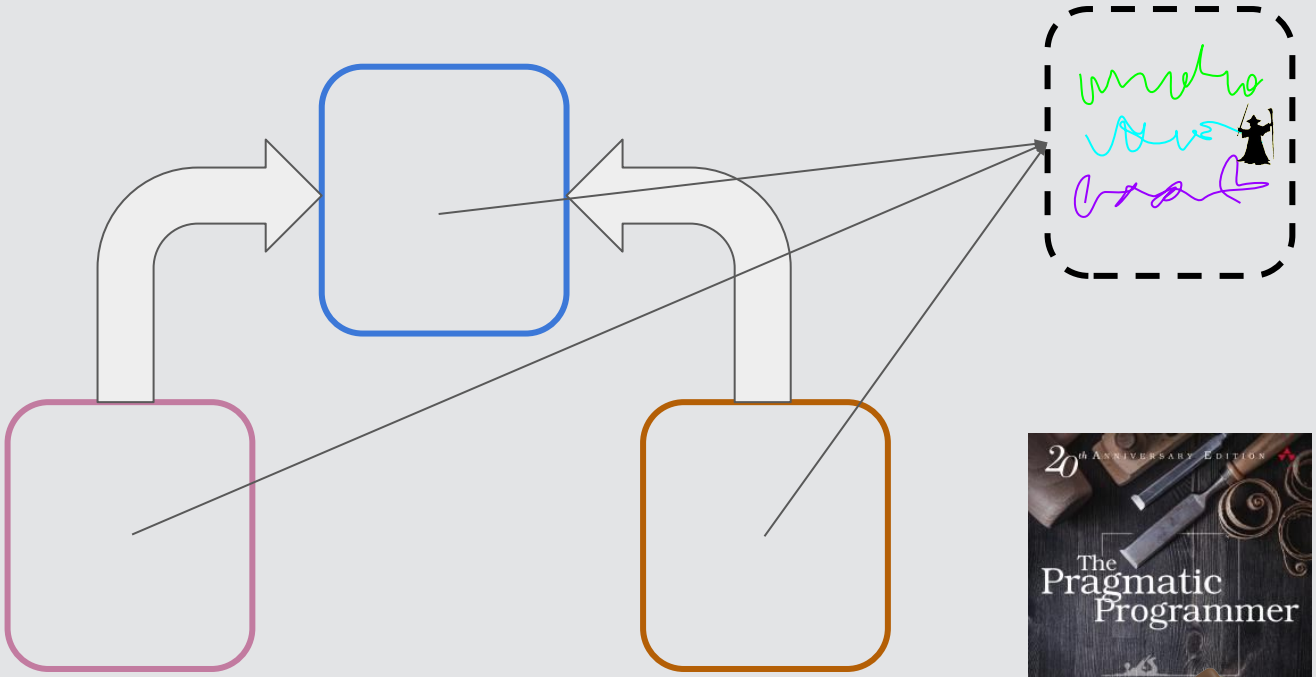


What is a Service Mesh?

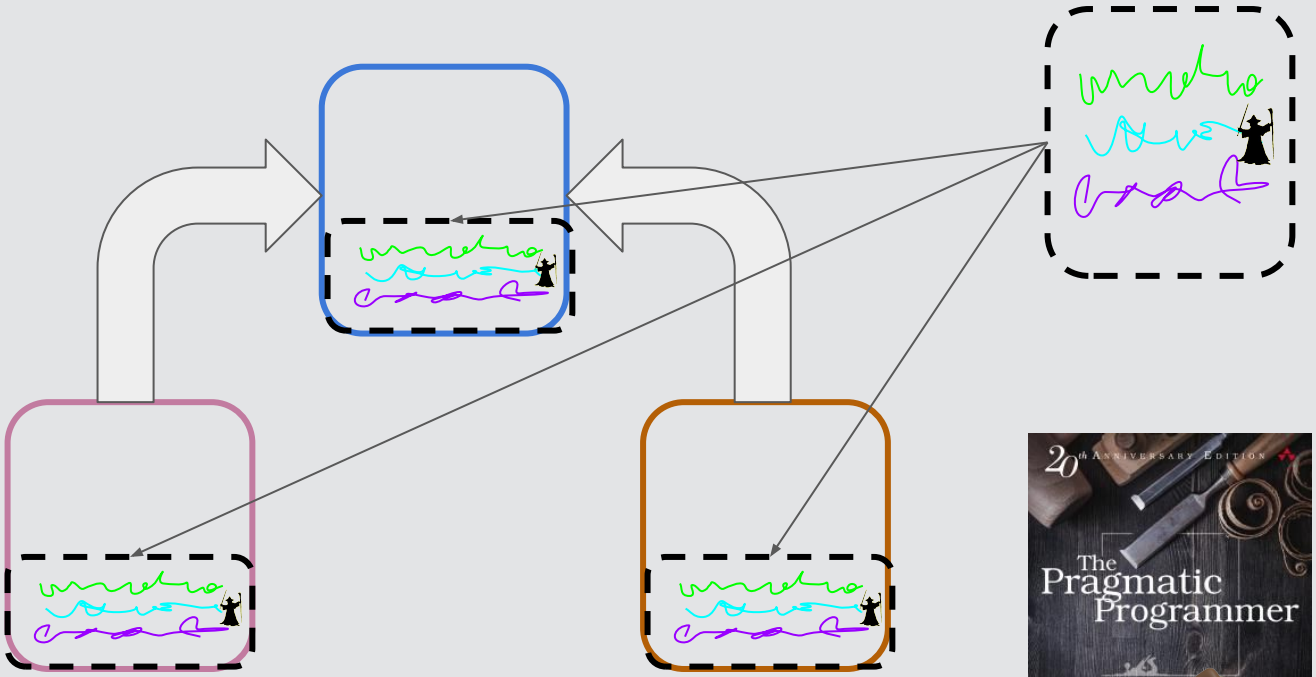




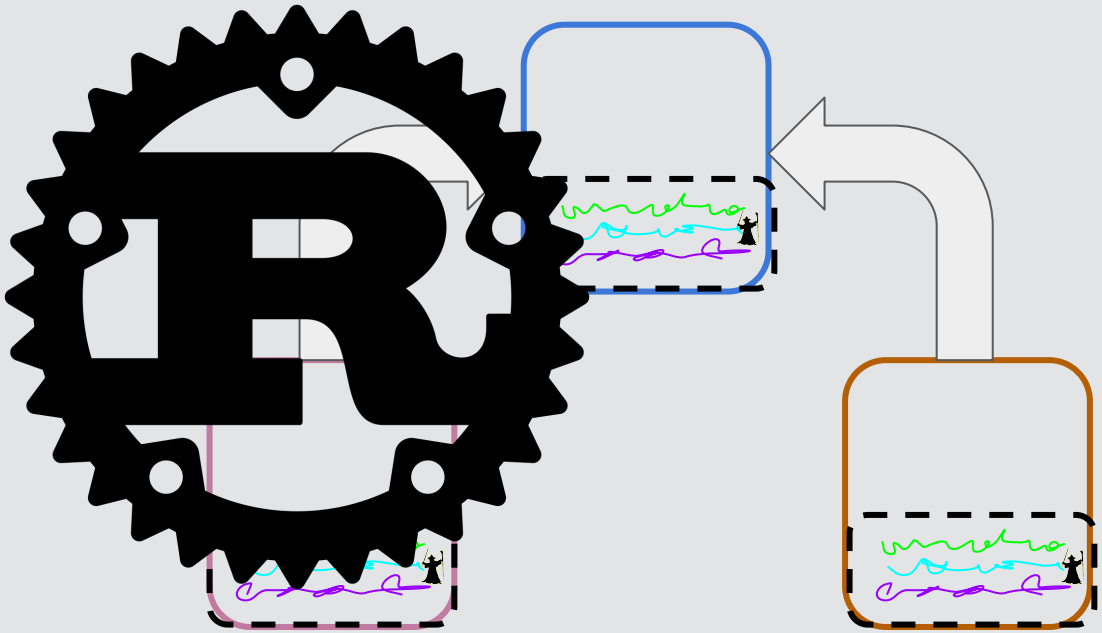
What is a Service Mesh?



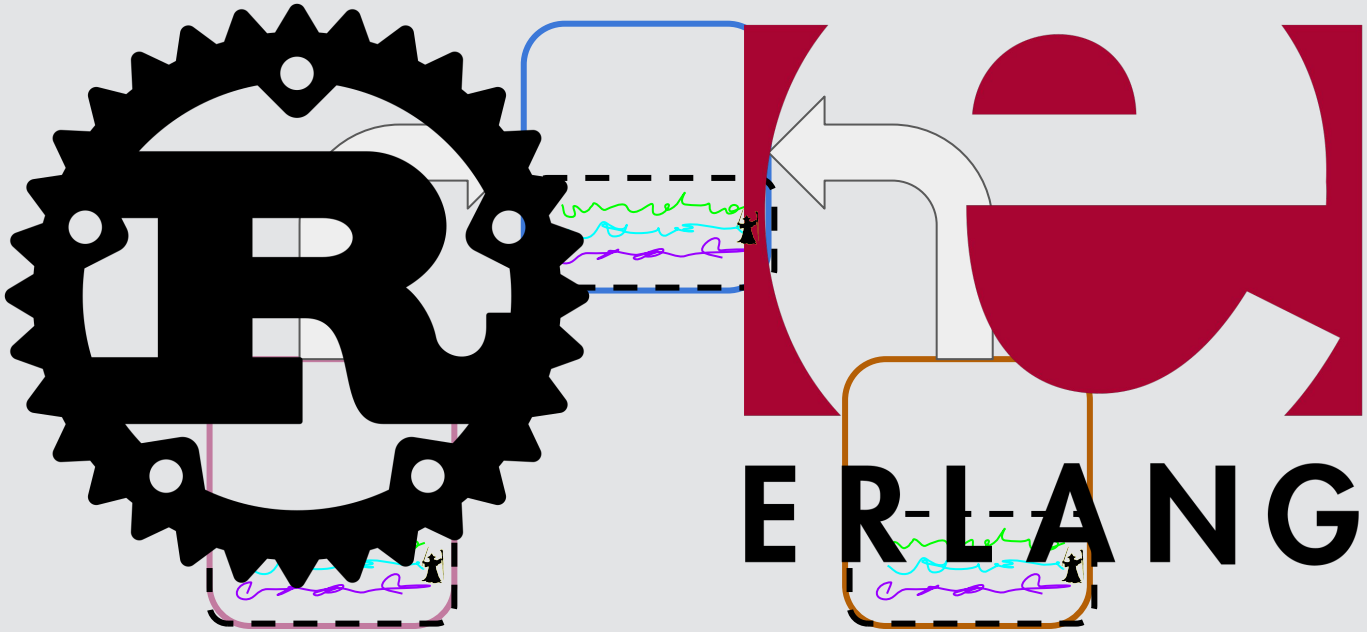
What is a Service Mesh?



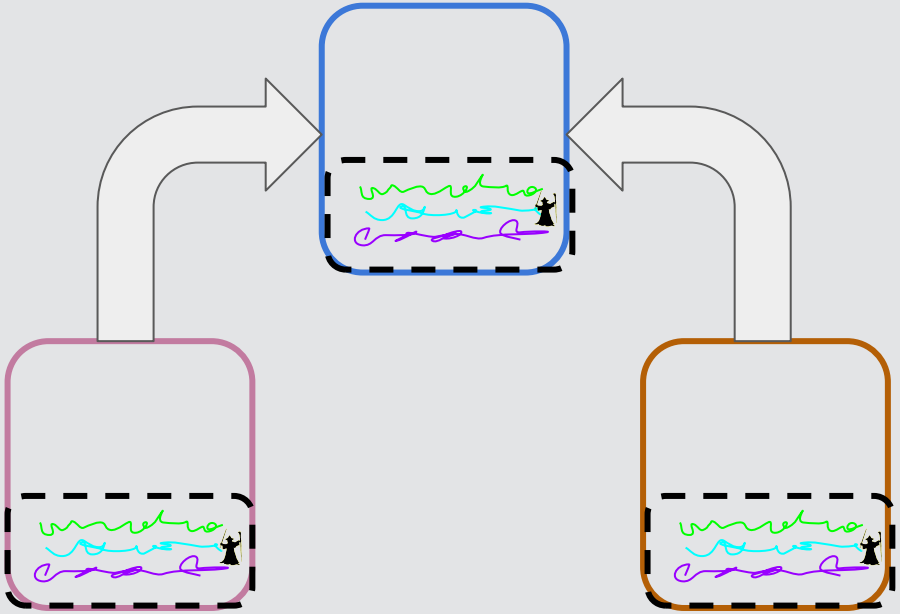
What is a Service Mesh?



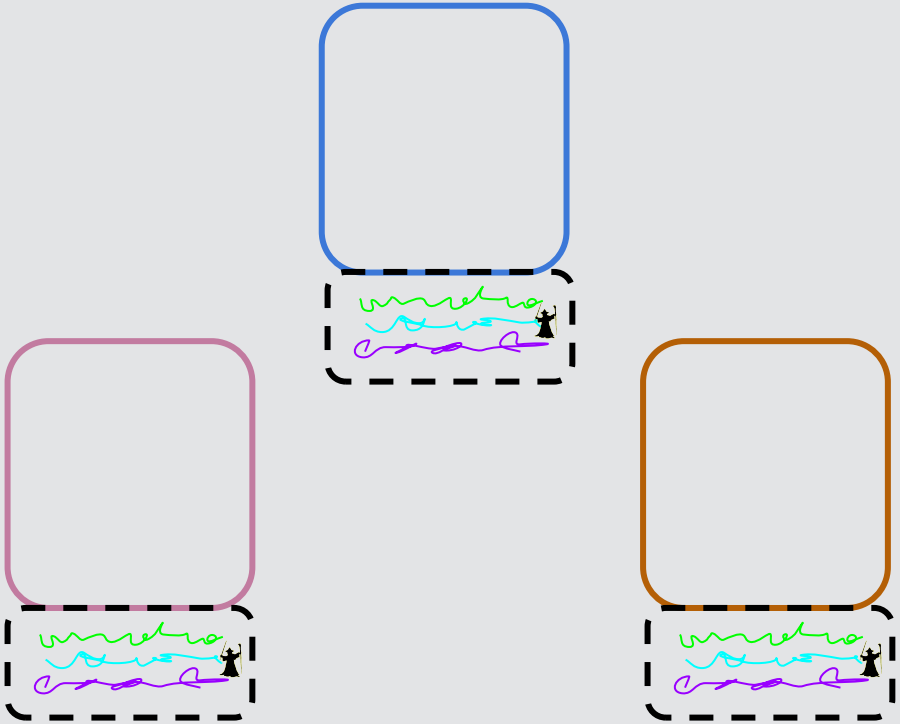
What is a Service Mesh?



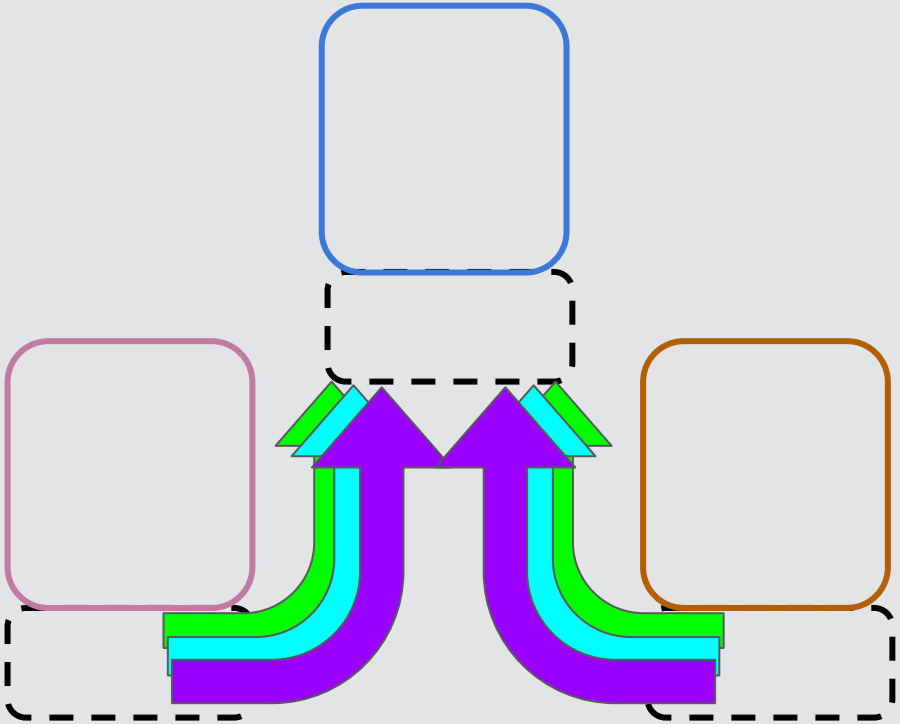
What is a Service Mesh?



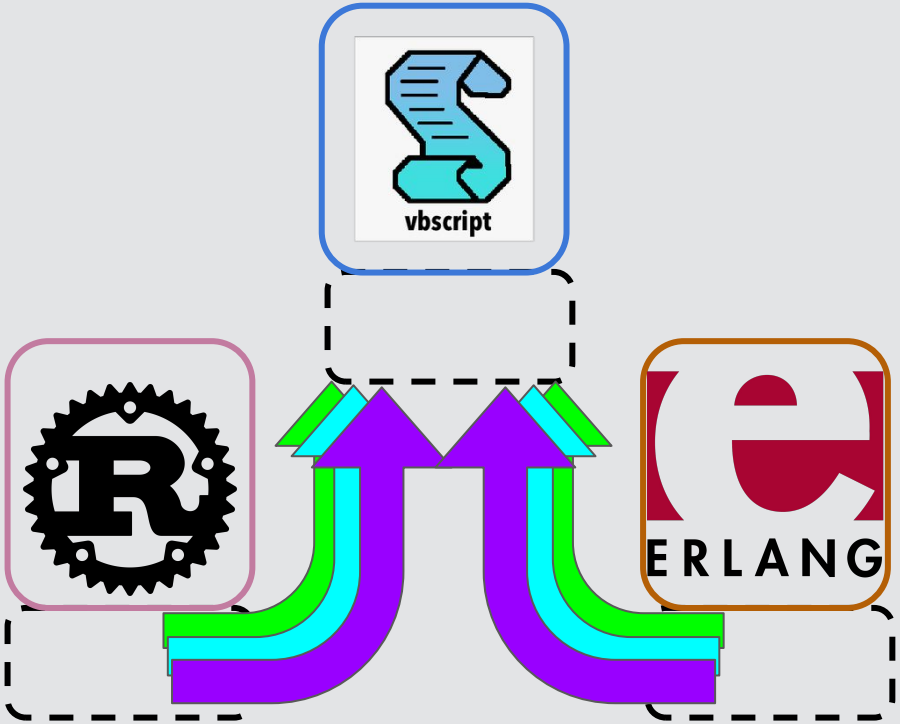
What is a Service Mesh?



What is a Service Mesh?



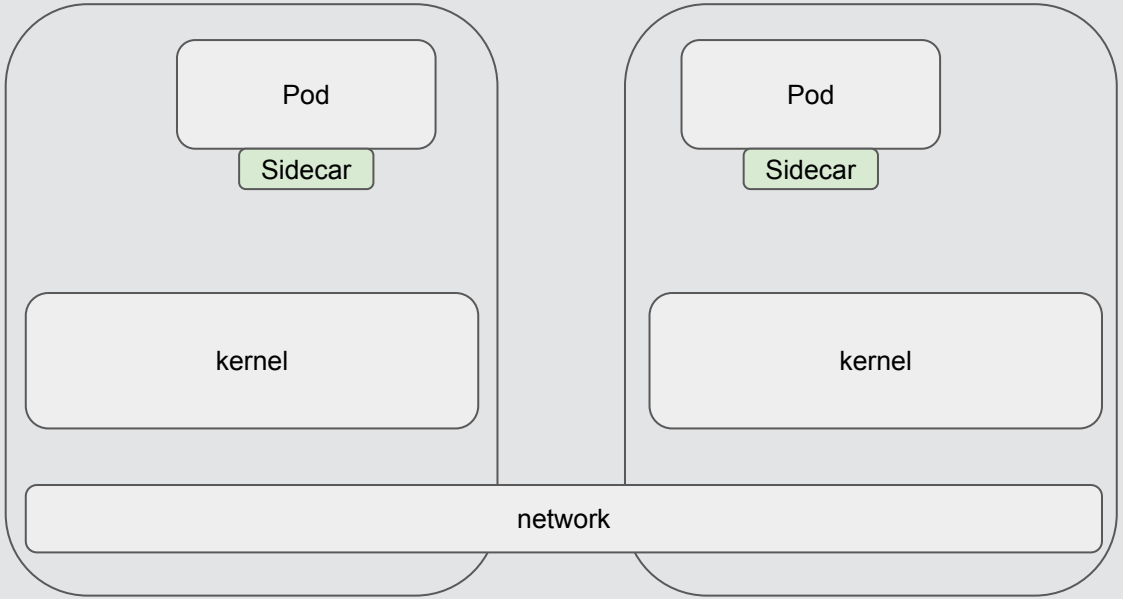
What is a Service Mesh?



The most popular Meshes offer:

- Observability
- Identity
- Encryption
- Access Control
- Load Balancing

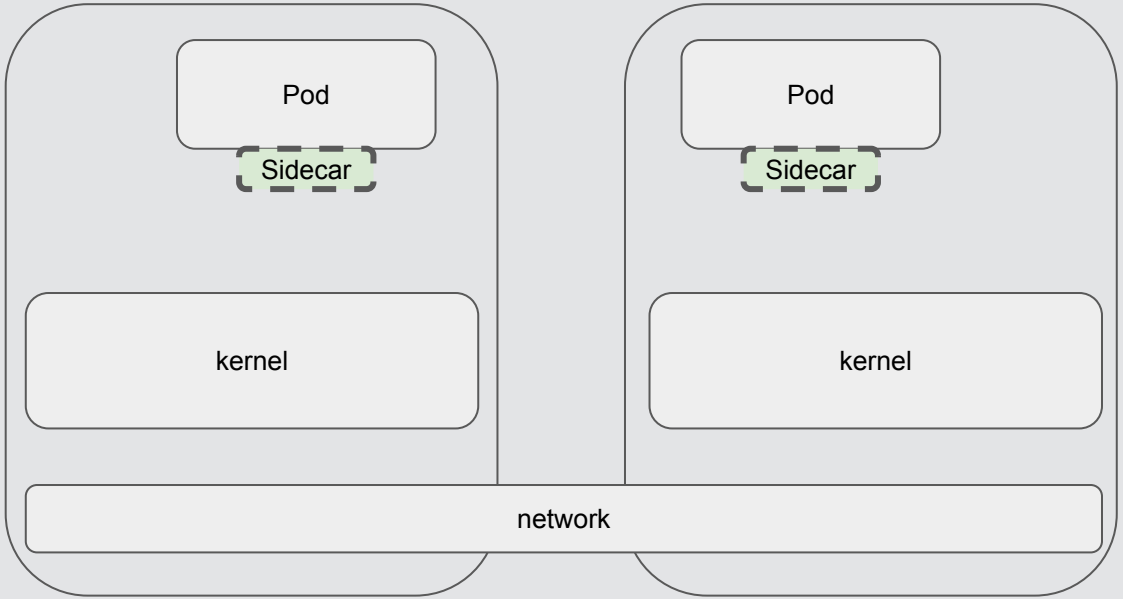
service mesh



control

data

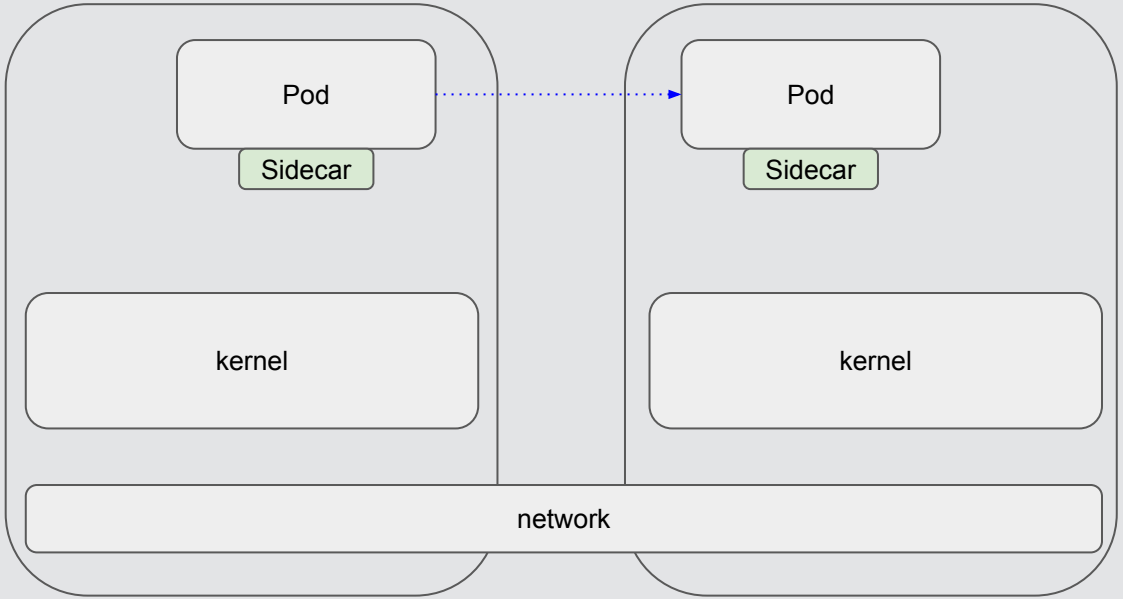
service mesh



control

data

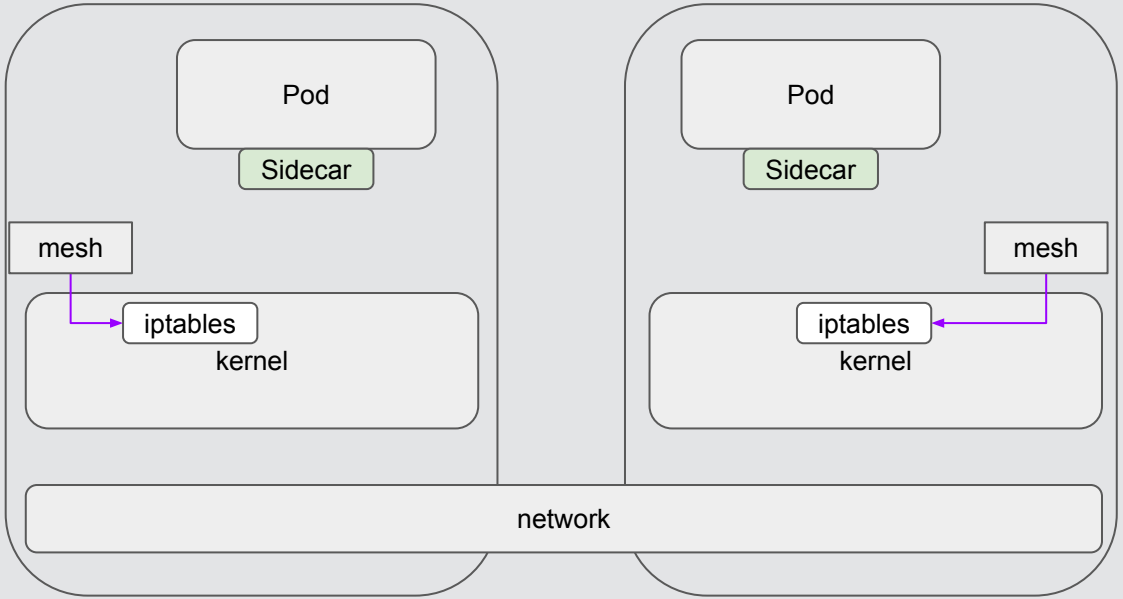
service mesh



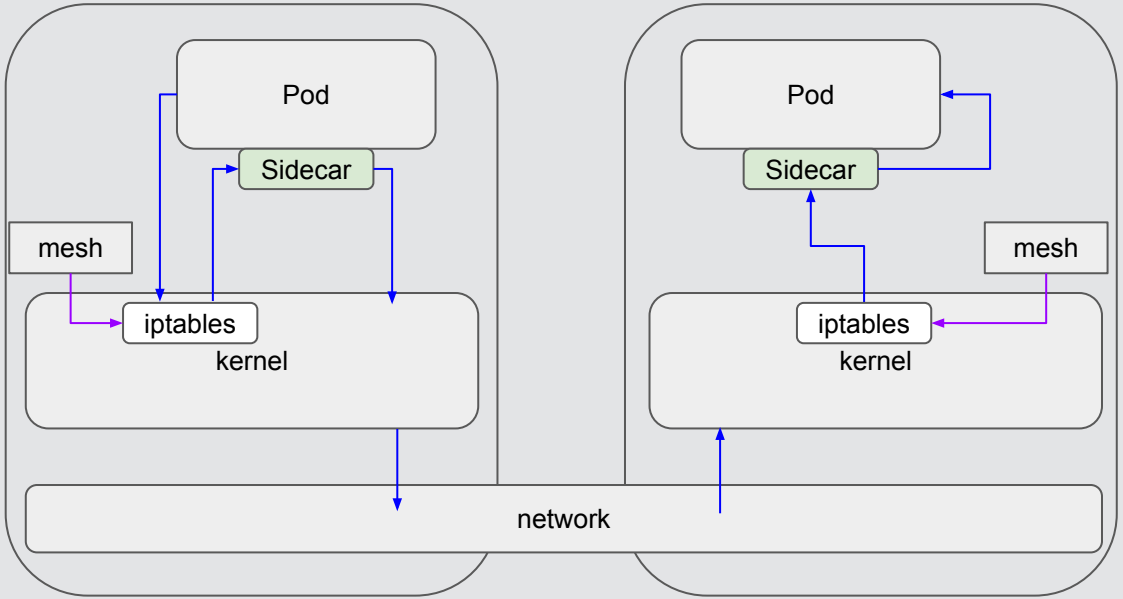
control

data

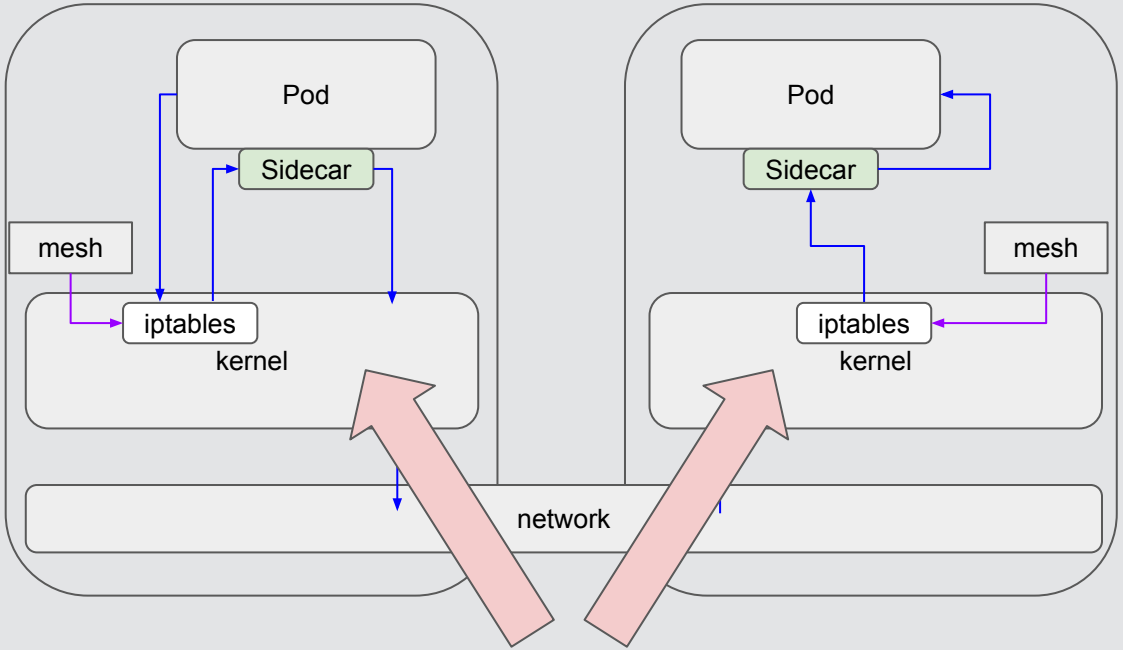
service mesh



service mesh



service mesh

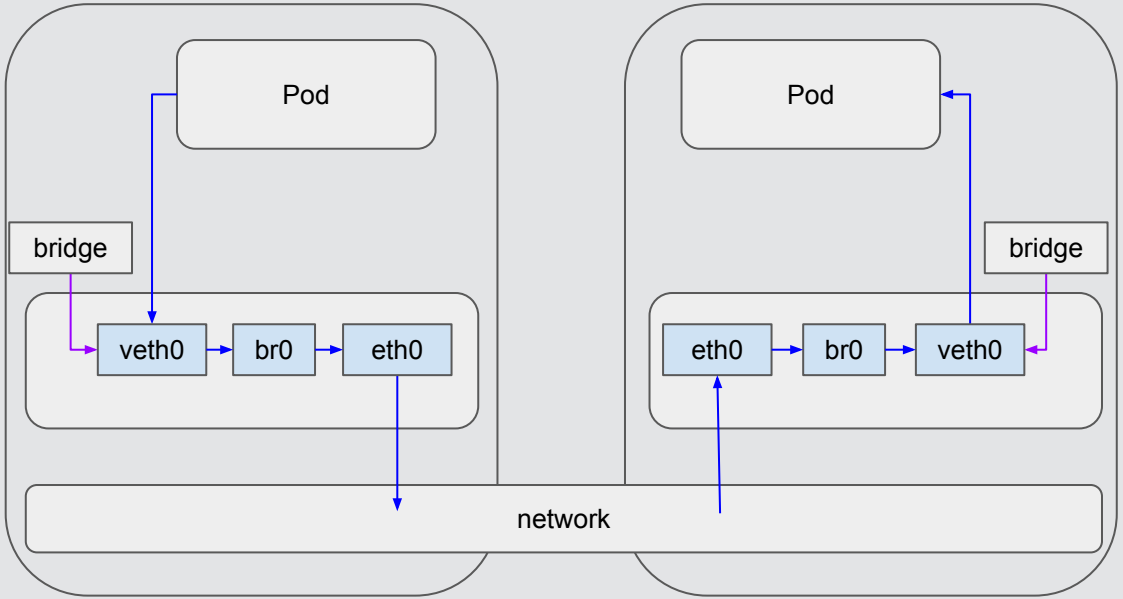


No Interfaces?

control

data

bridge plugin

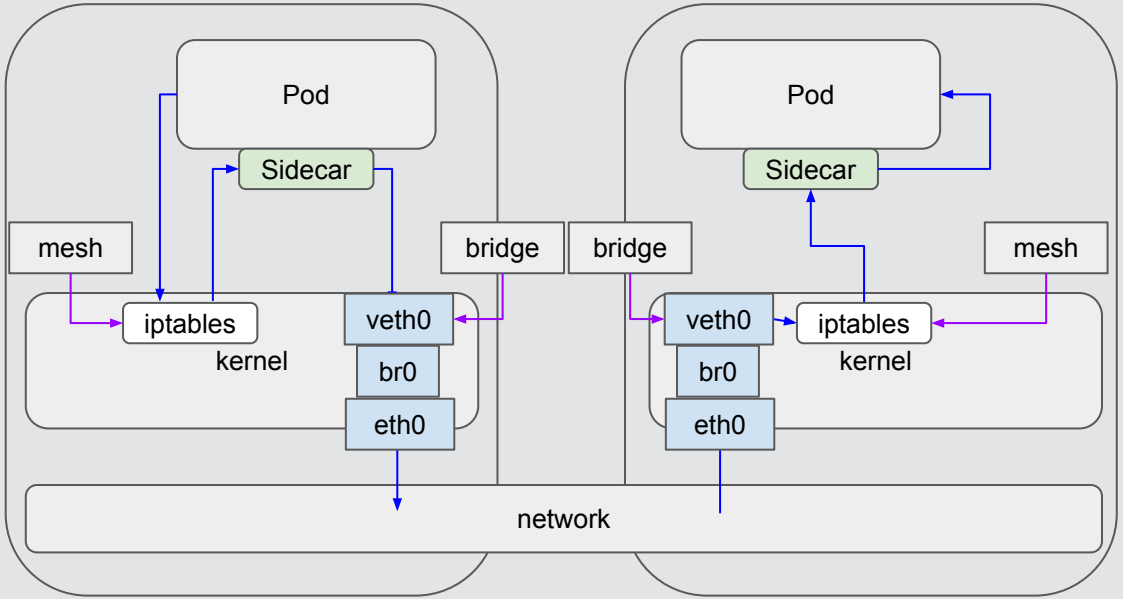


https://github.com/containernetworking/plugins

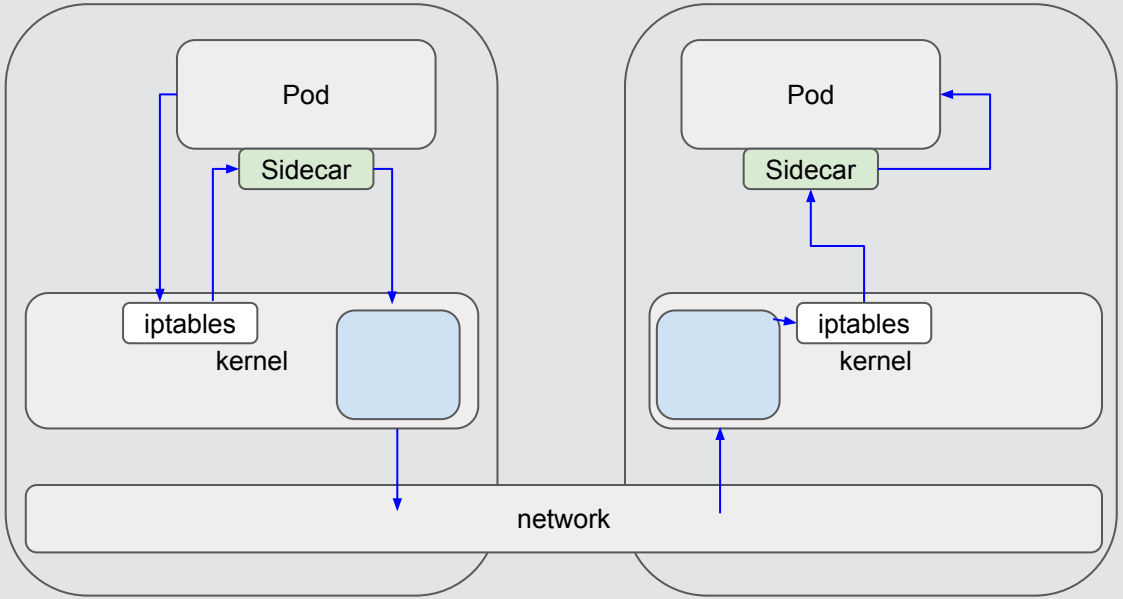
control

data

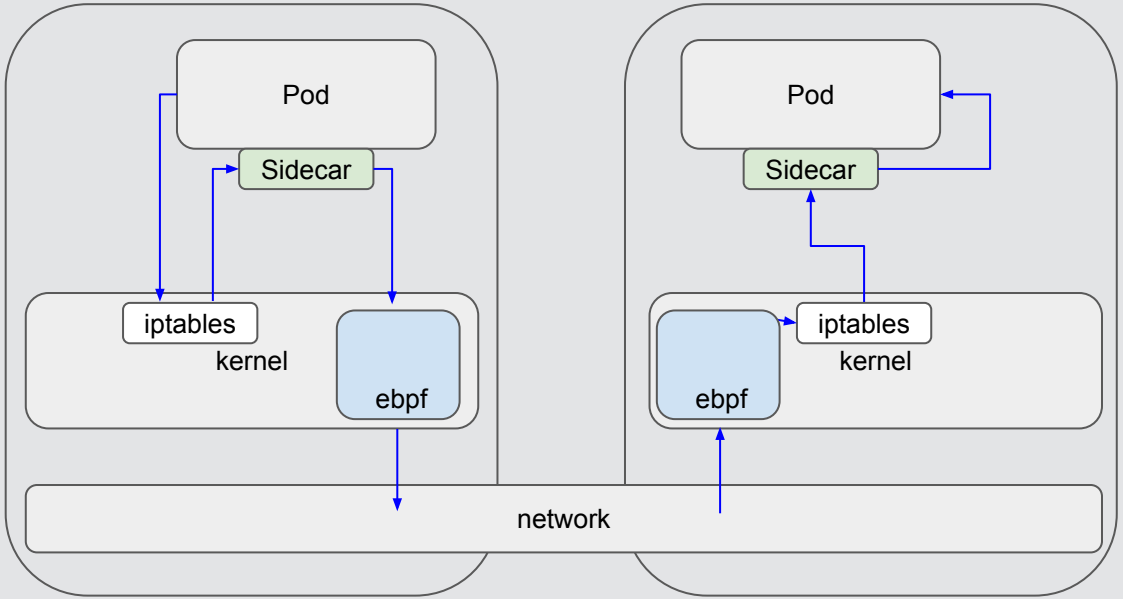
service mesh with bridge plugin



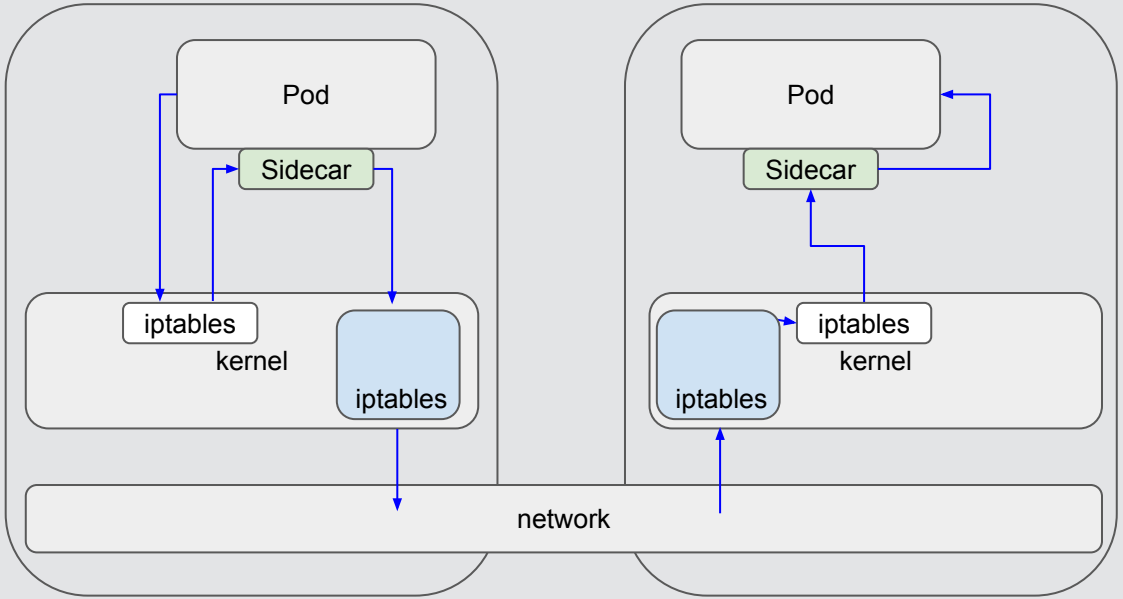
CNI + service mesh



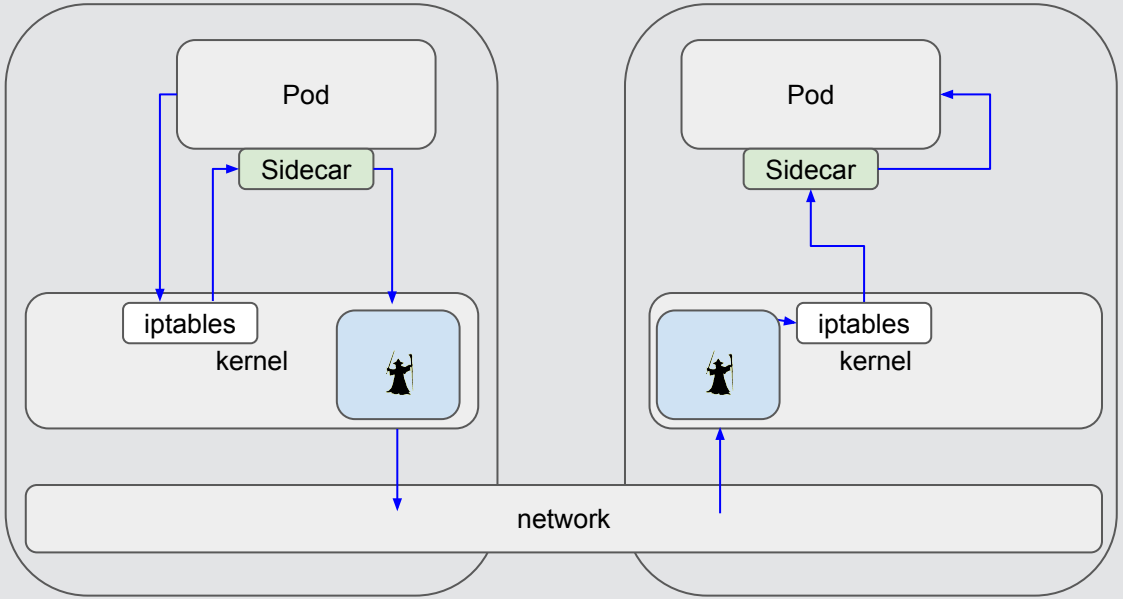
CNI + service mesh



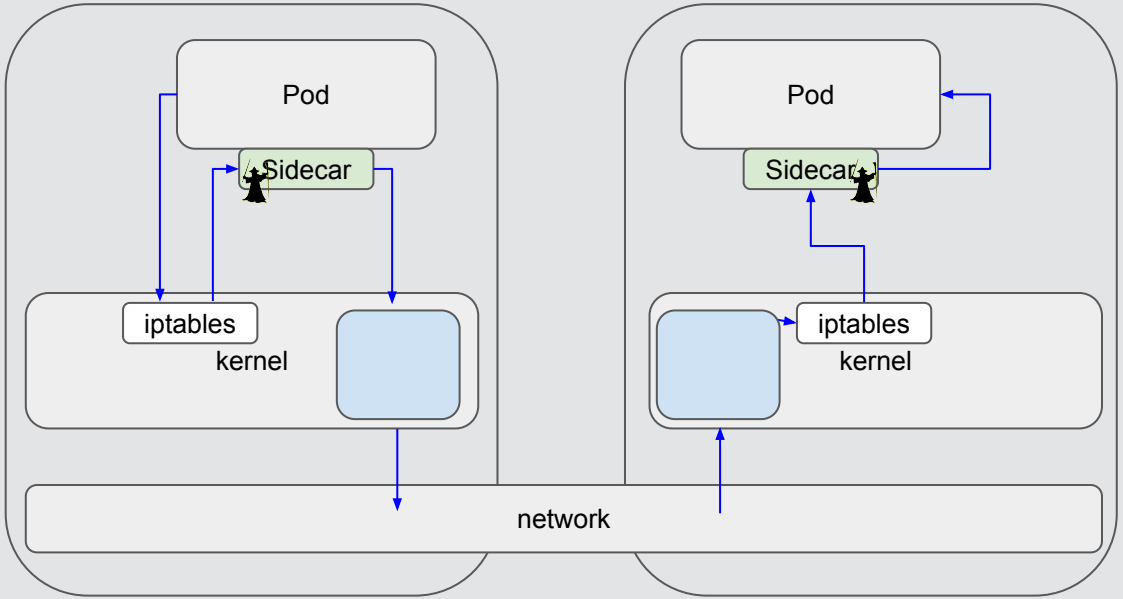
CNI + service mesh



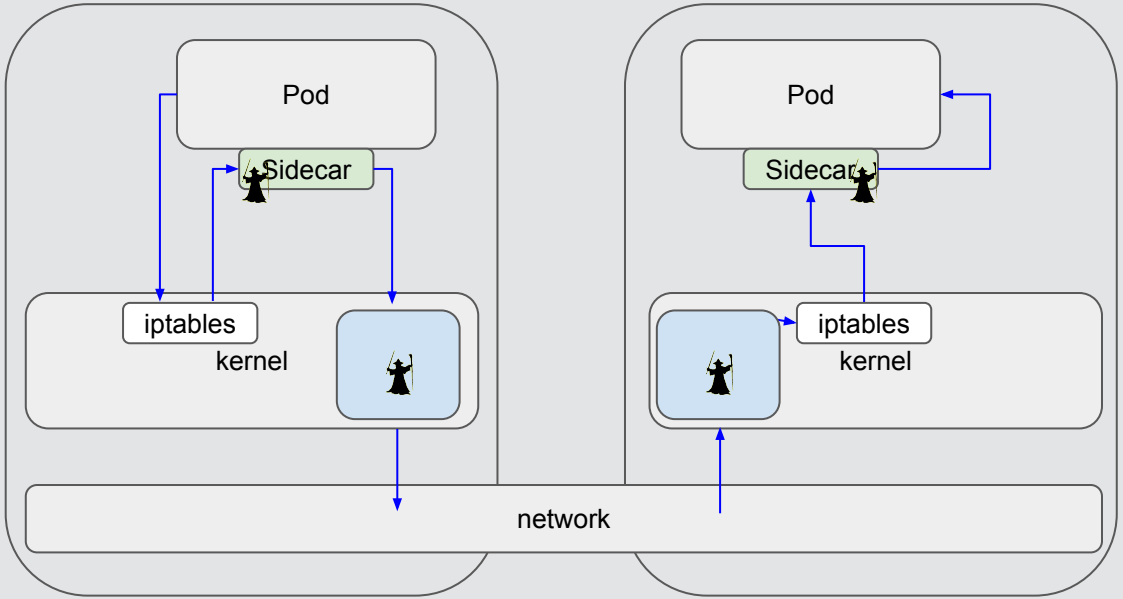
CNI + service mesh



CNI + service mesh



CNI + service mesh



CNI - what shall not pass?

CNI - ~~what shall not pass?~~
- what is enforceable?

CNI - what is enforceable?


```
$ kubectl explain networkpolicy.spec
```

- Allows you to apply policy on traffic which:
  - is going to any* IP or CIDR
  - is going to pods that match some label selector
  - is going to specific port(s)
  - is going to a specific namespace(s)

* except loopback or host traffic

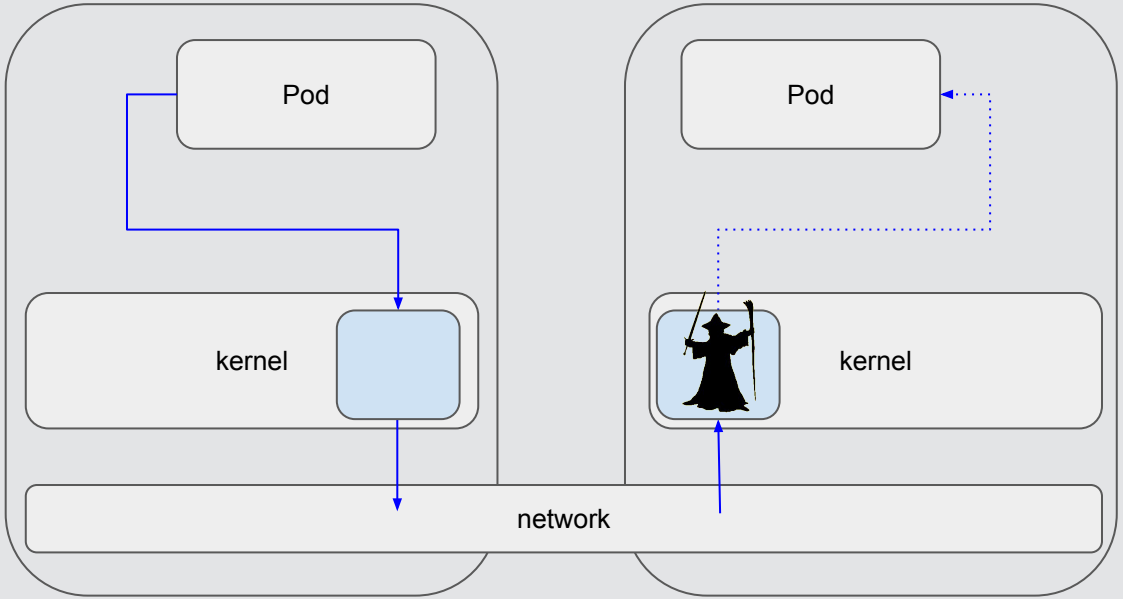
CNI - what is enforceable?


```
$ kubectl explain networkpolicy.spec
```

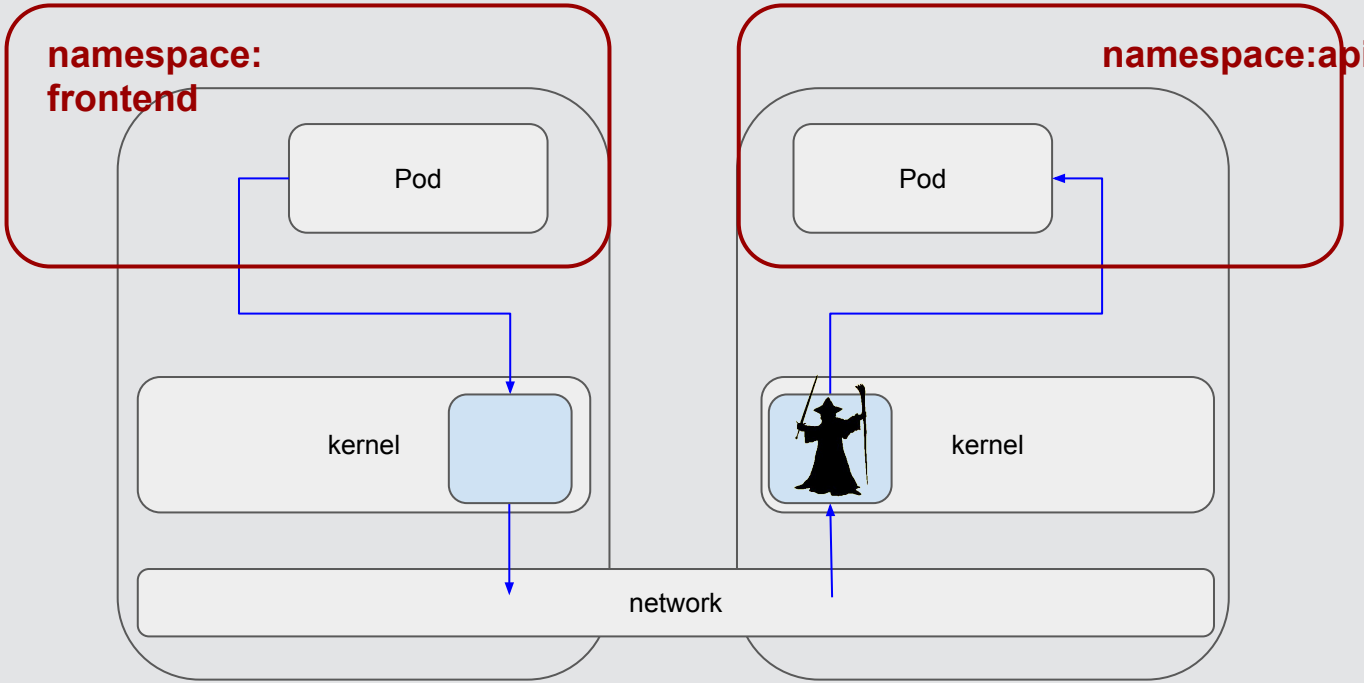
- Allows you to apply policy on traffic which:
  - is going to any* IP or CIDR
  - is going to pods that match some label selector
  - is going to specific port(s)
  - is going to a specific namespace(s)
- Allows you to conditionally block/permit traffic based on:
  - source IP or CIDR
  - source pods that match some label selector
  - source namespace

* except loopback or host traffic

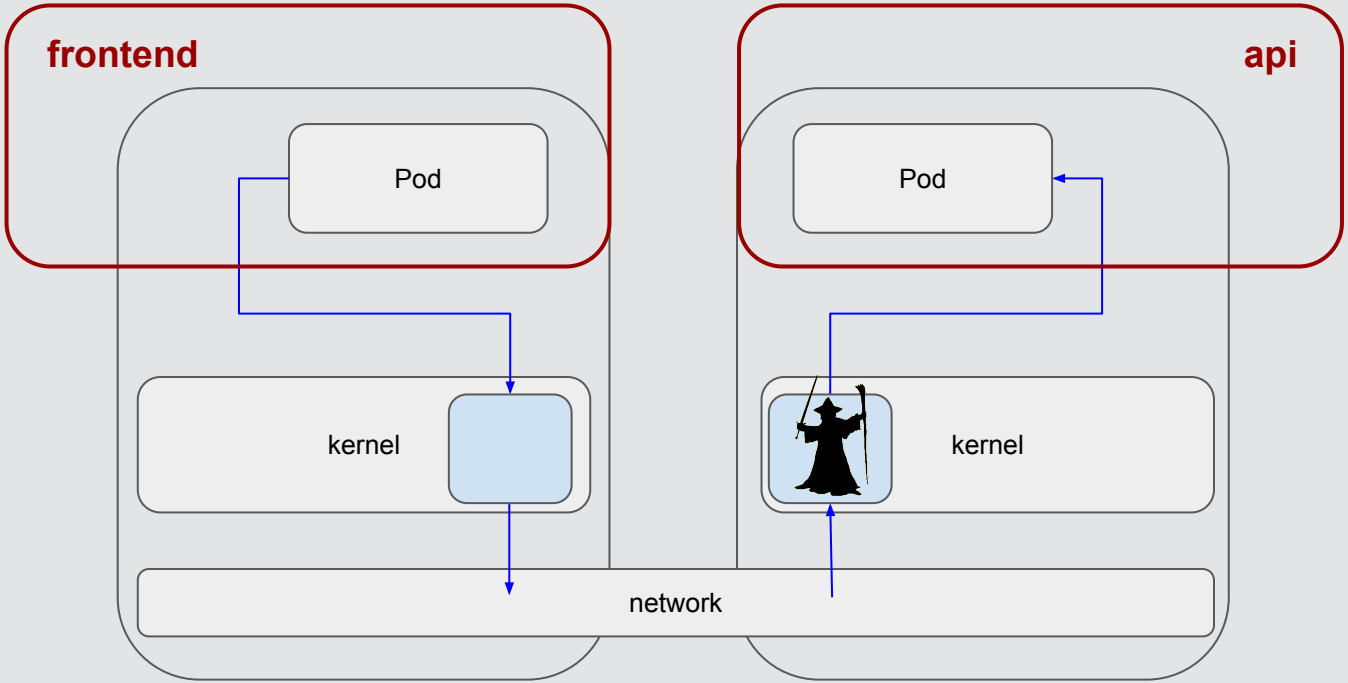
CNI - how is it enforced?



CNI - how is it enforced?

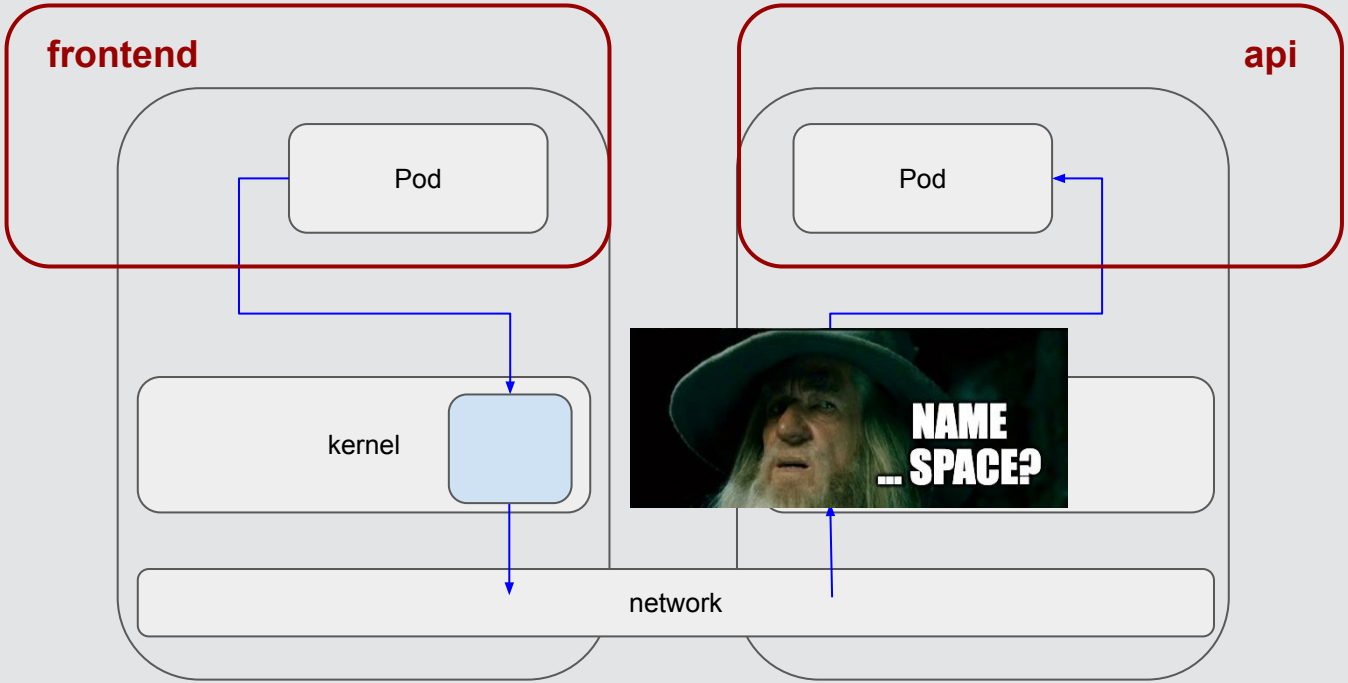


CNI - how is it enforced?



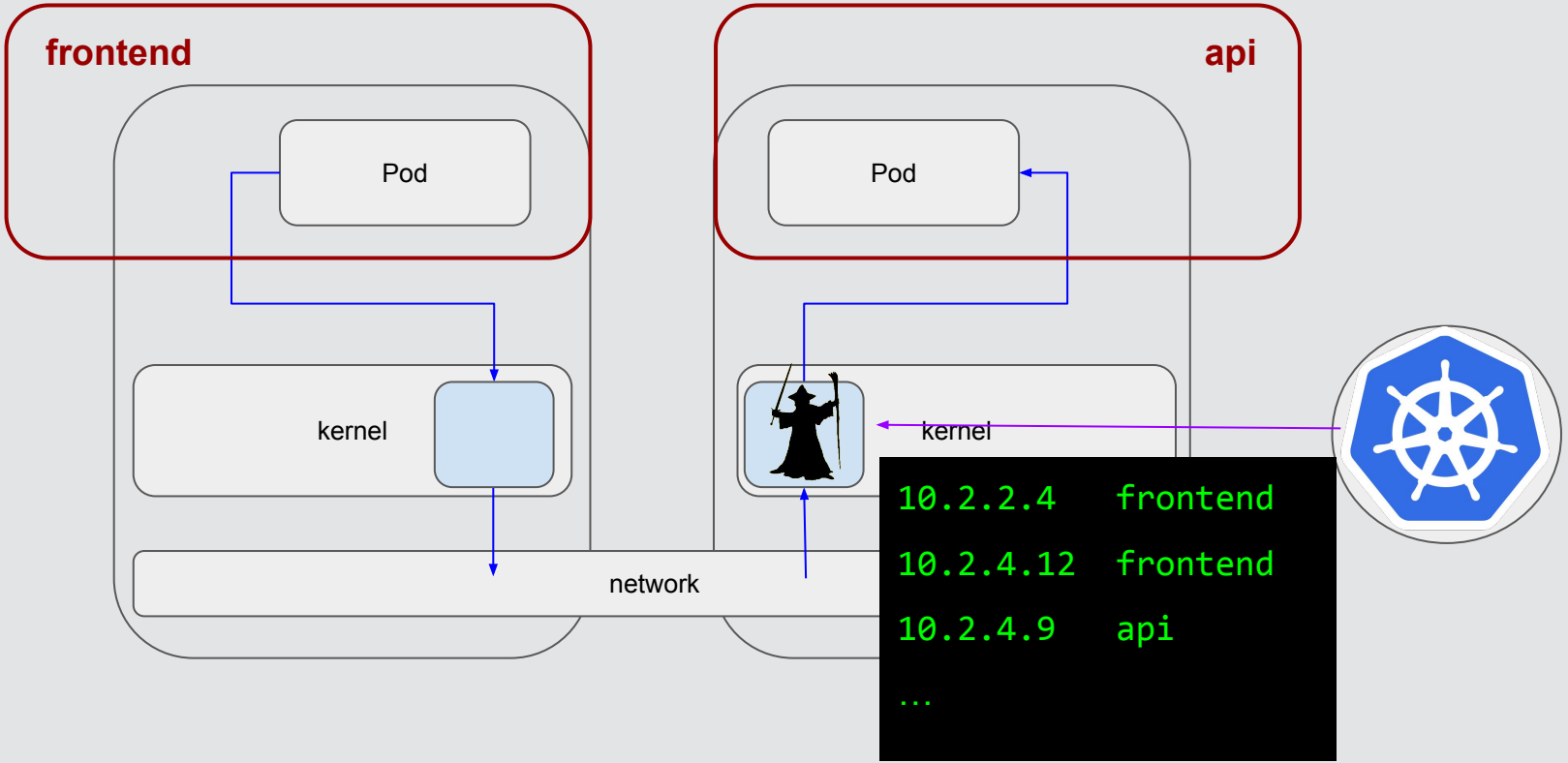

```
$ dear CNI: [pods in frontend] => [pods in api] == OK!
```

CNI - how is it enforced?

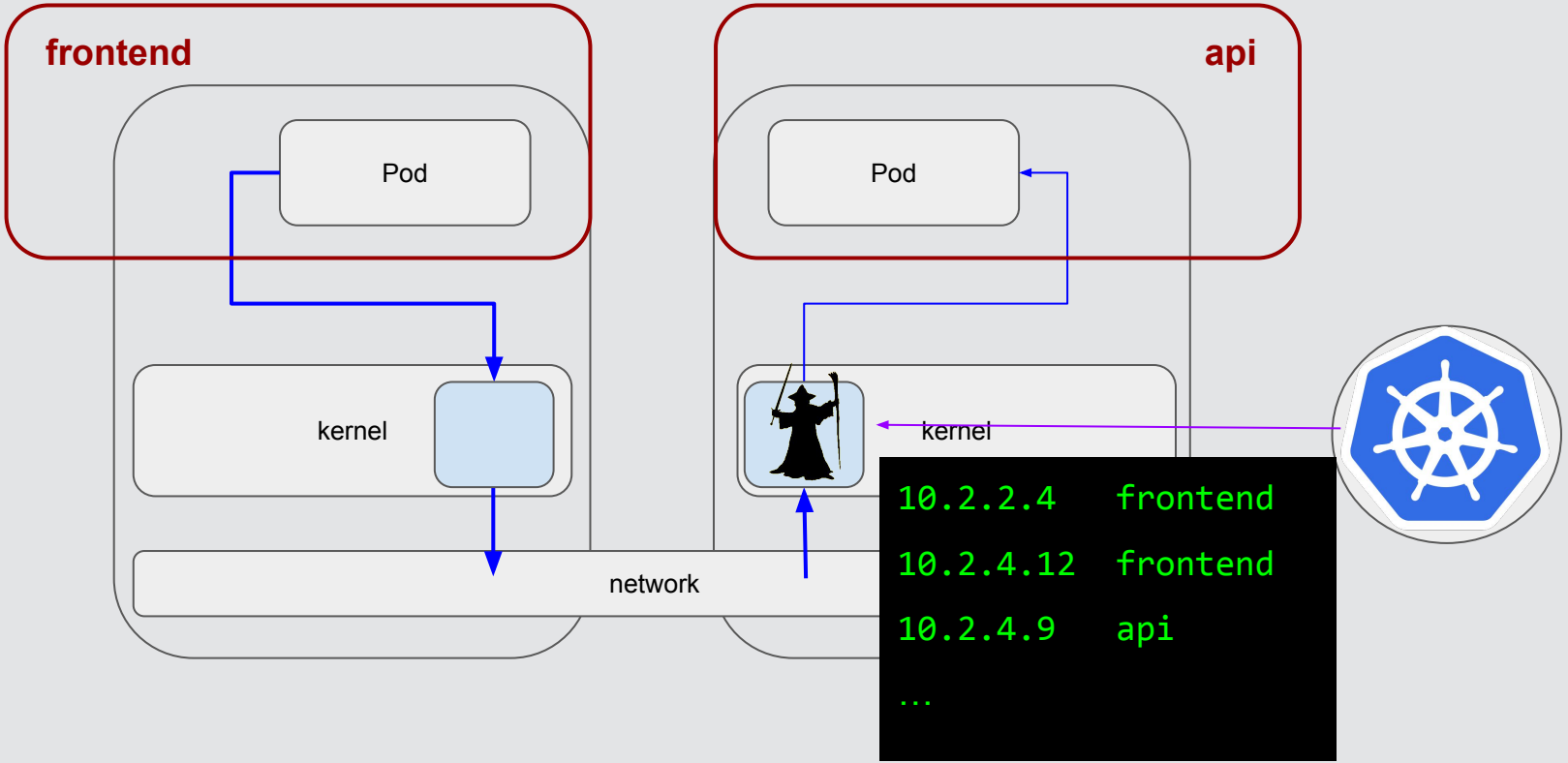



```
$ dear CNI: [pods in frontend] => [pods in api] == OK!
```

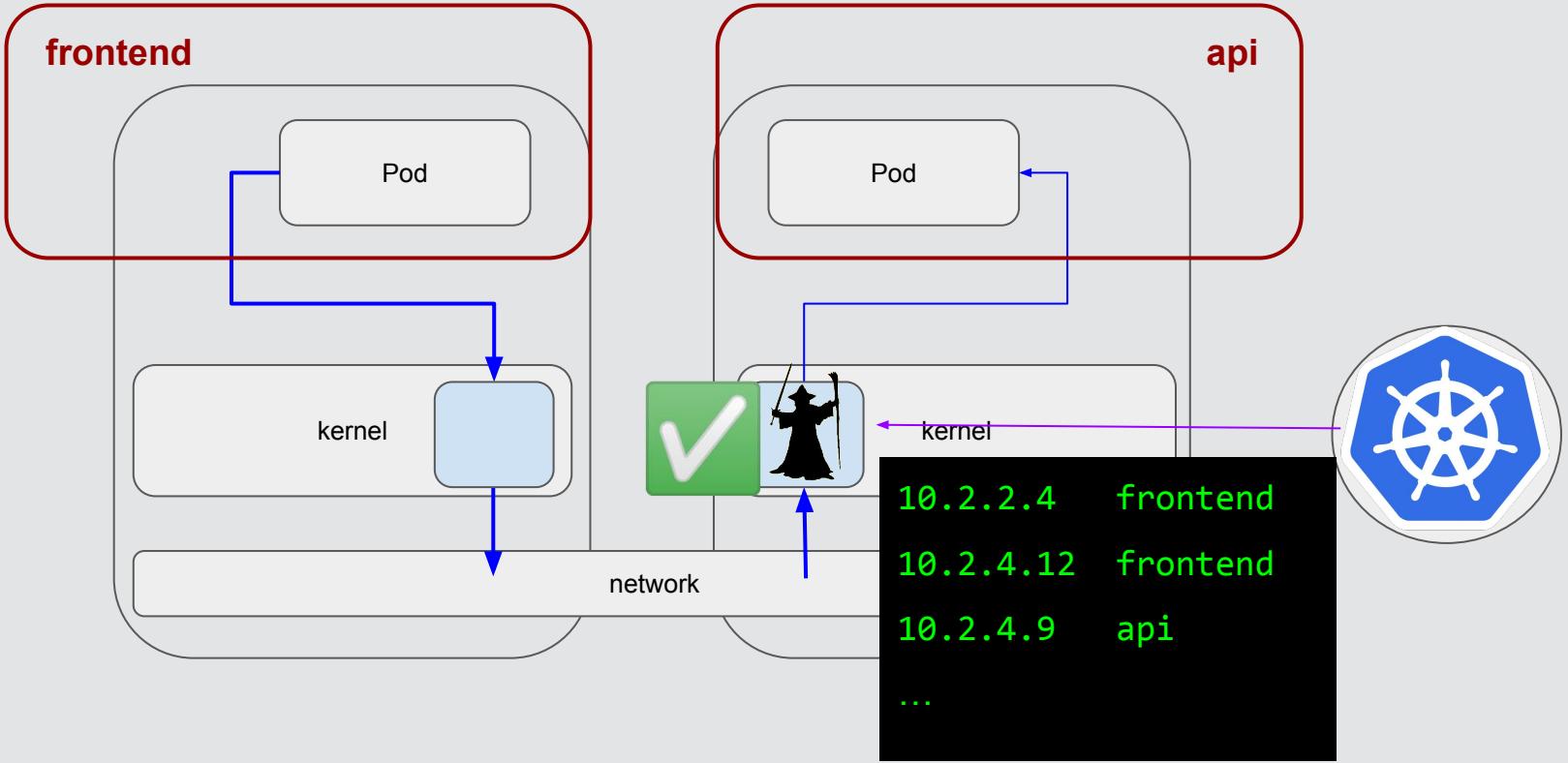
CNI - how is it enforced?



CNI - how is it enforced?



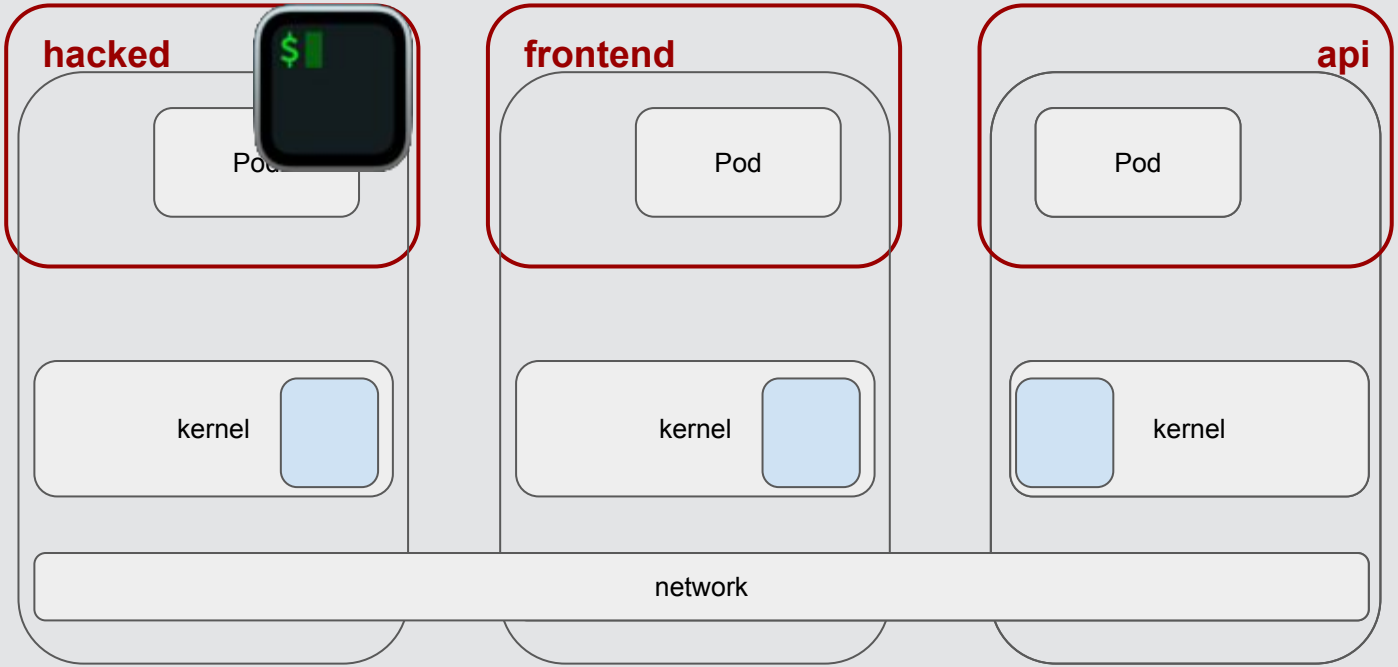
CNI - how is it enforced?



CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

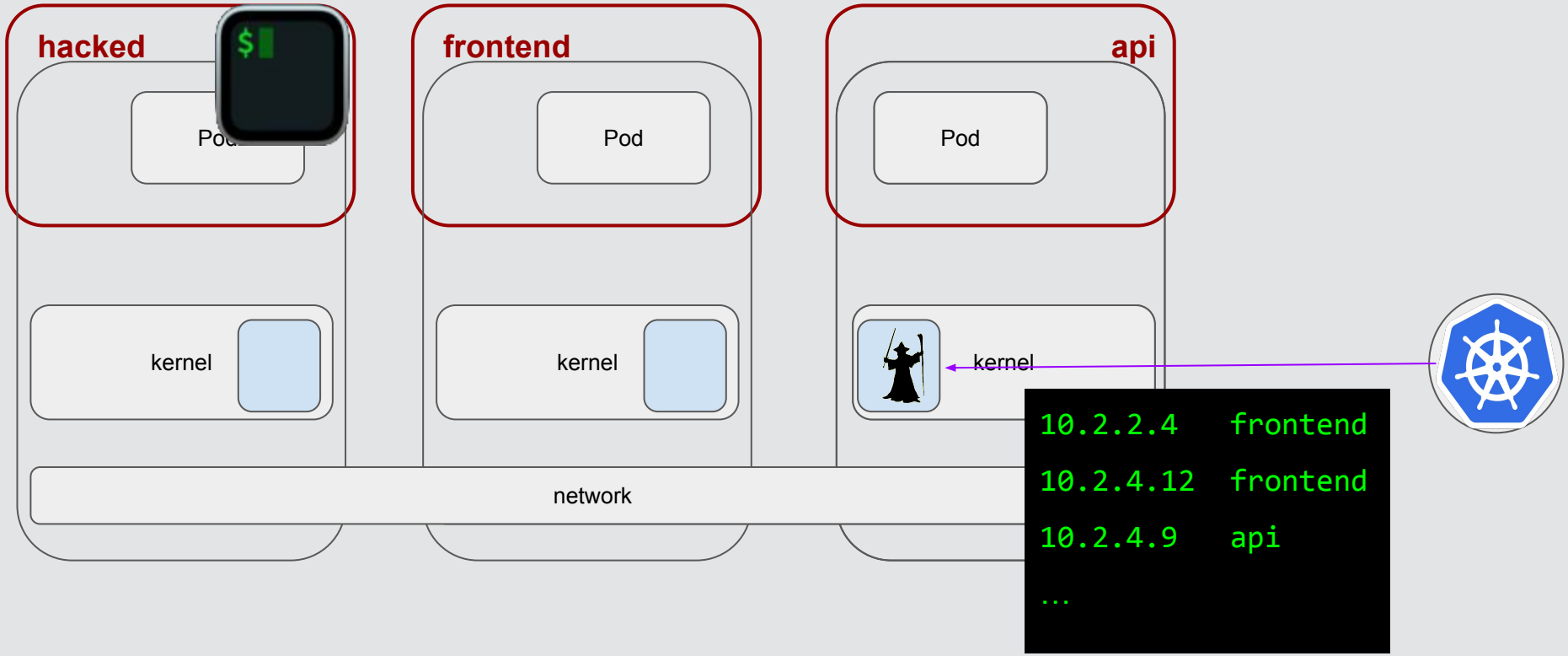
It’s time for a contrived scenario!

CNI - contrived scenario

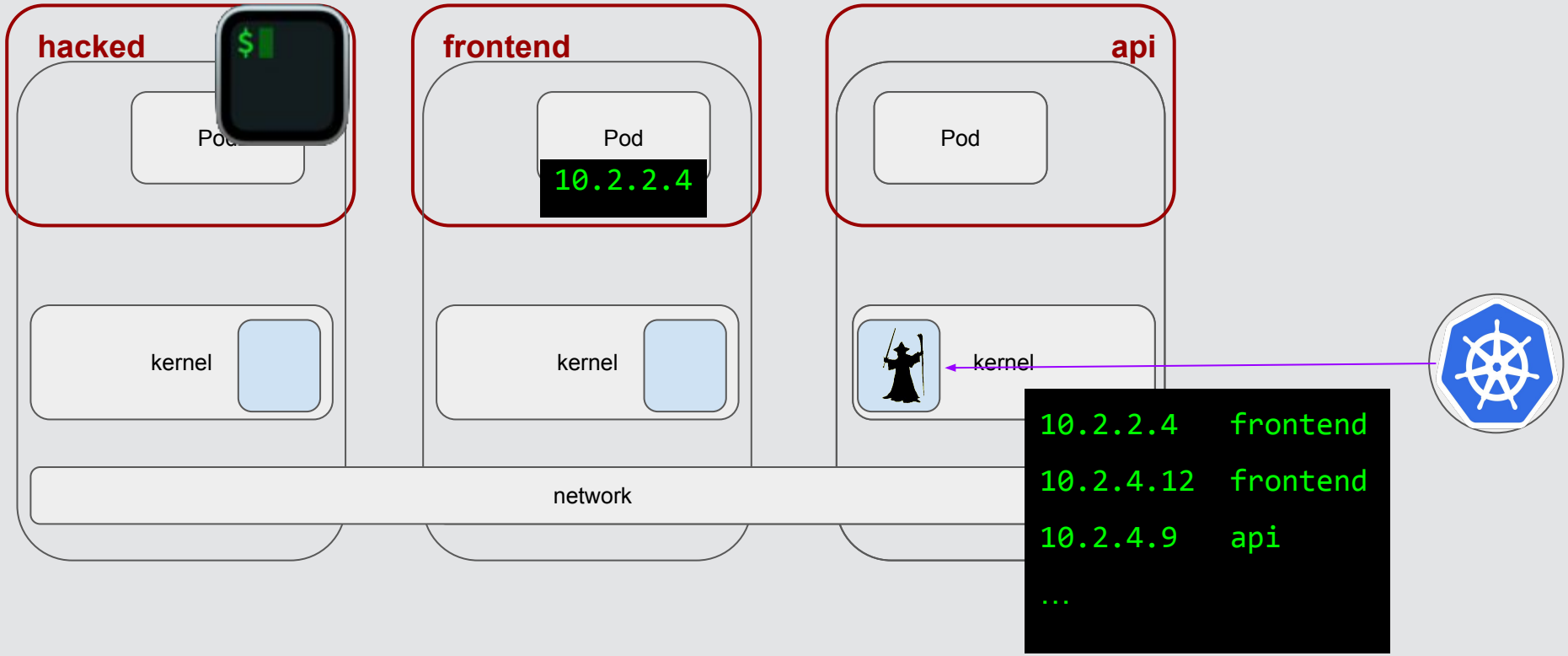



```
$ dear CNI: [pods in frontend] => [pods in api] == OK!
```

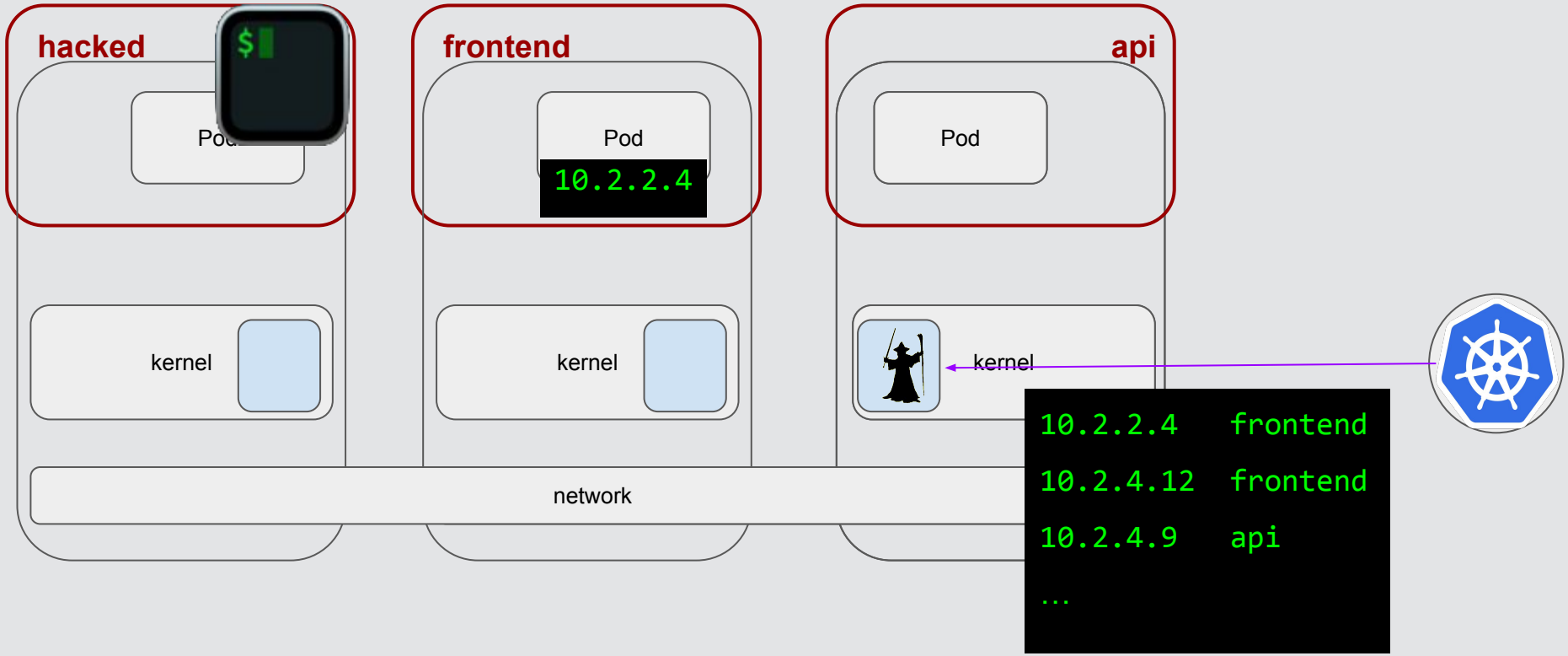
CNI - contrived scenario



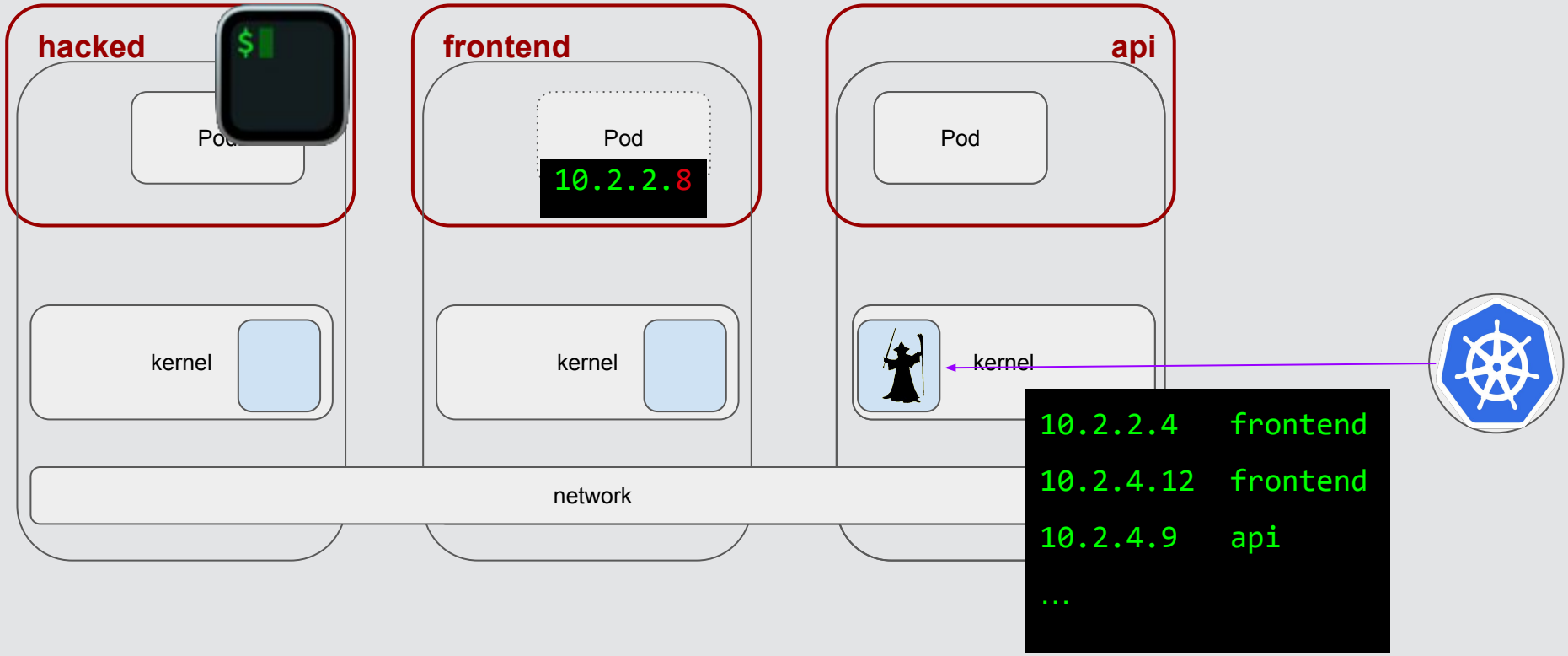
CNI - contrived scenario



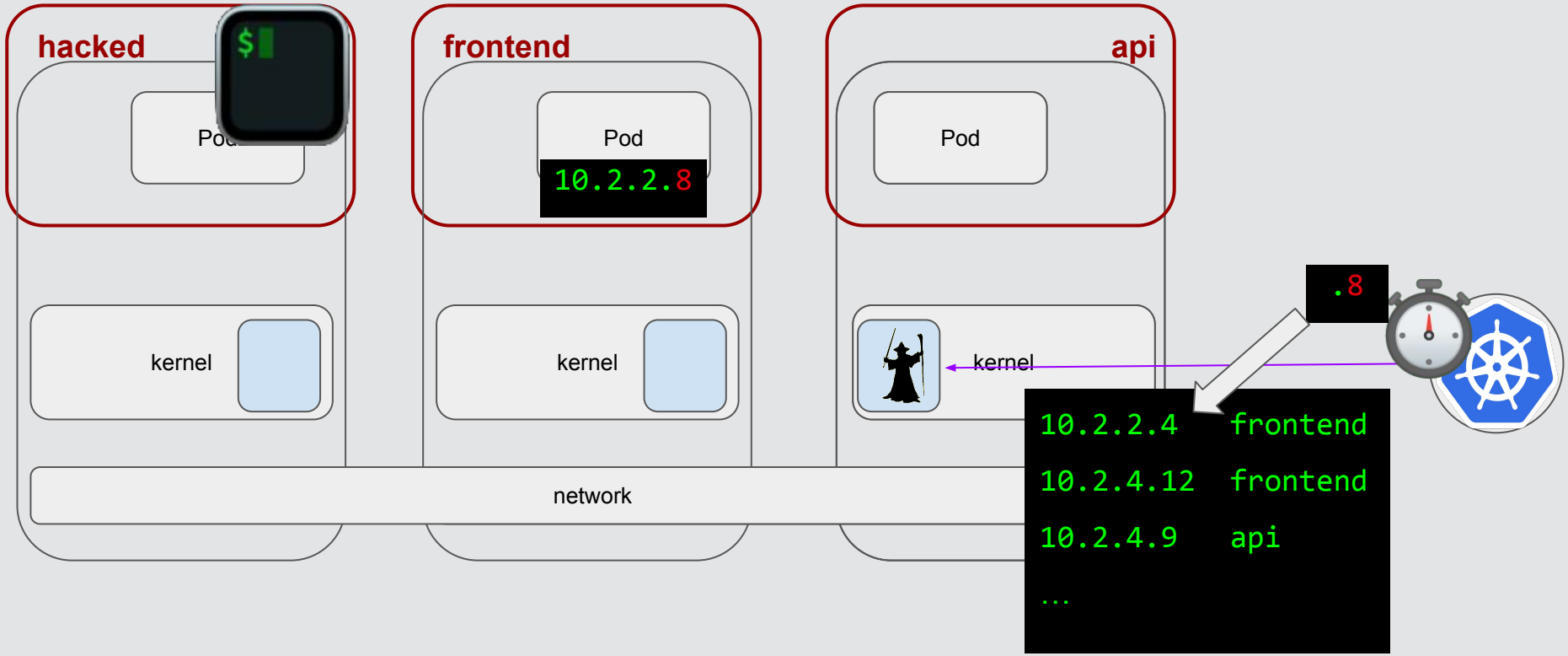
CNI - contrived scenario



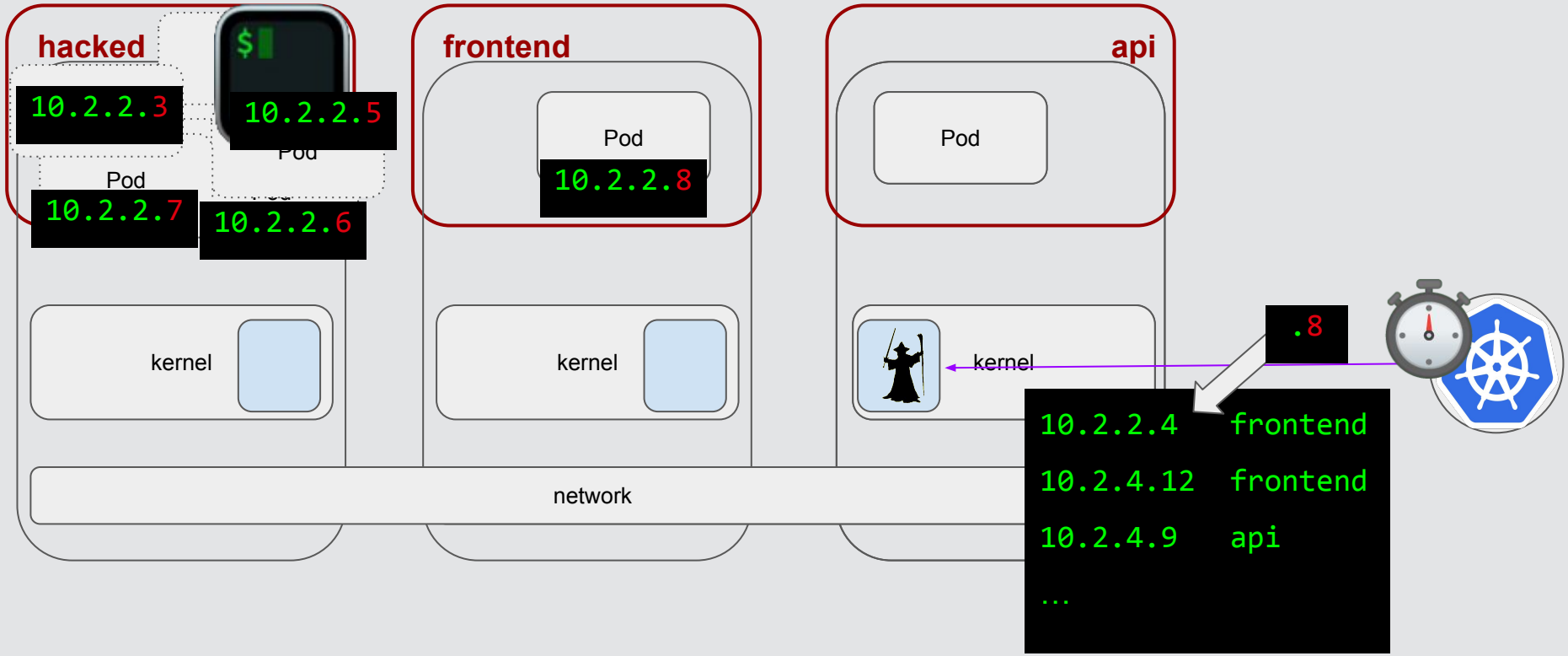
CNI - contrived scenario



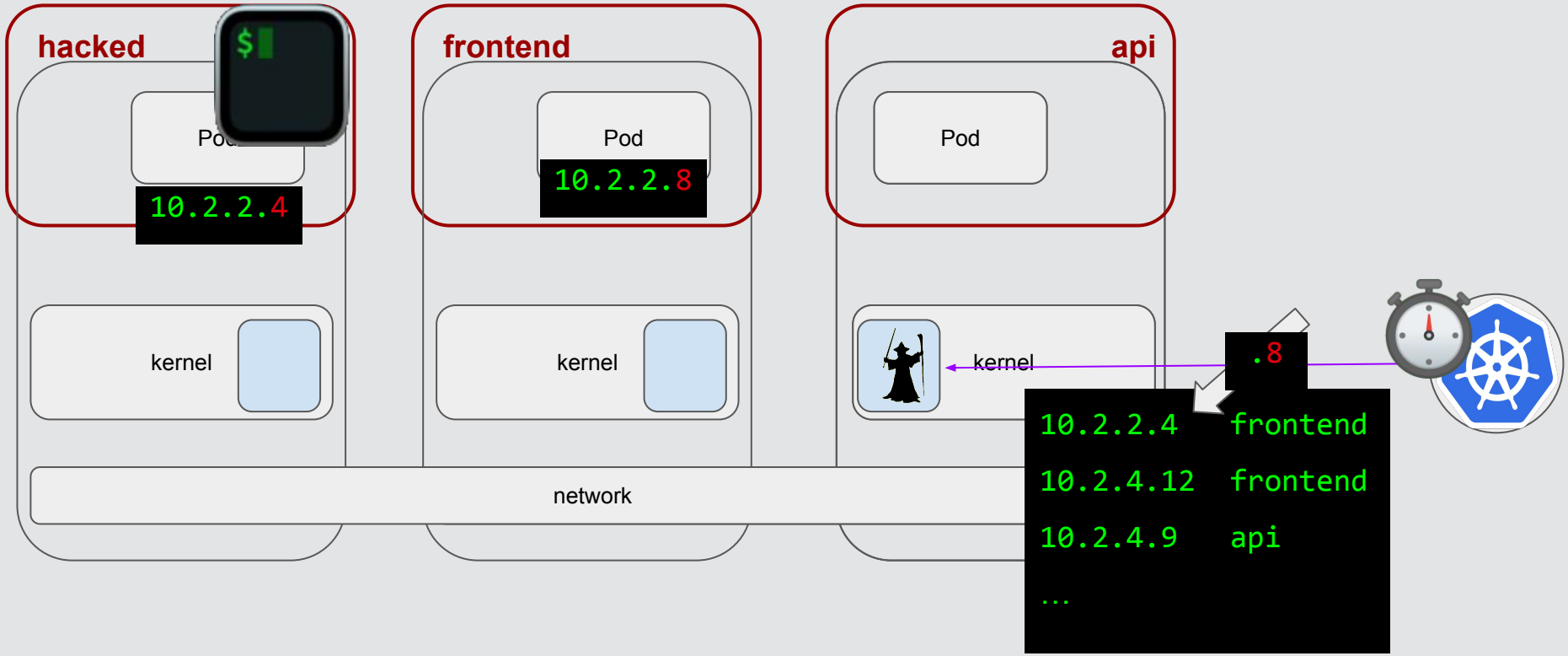
CNI - contrived scenario



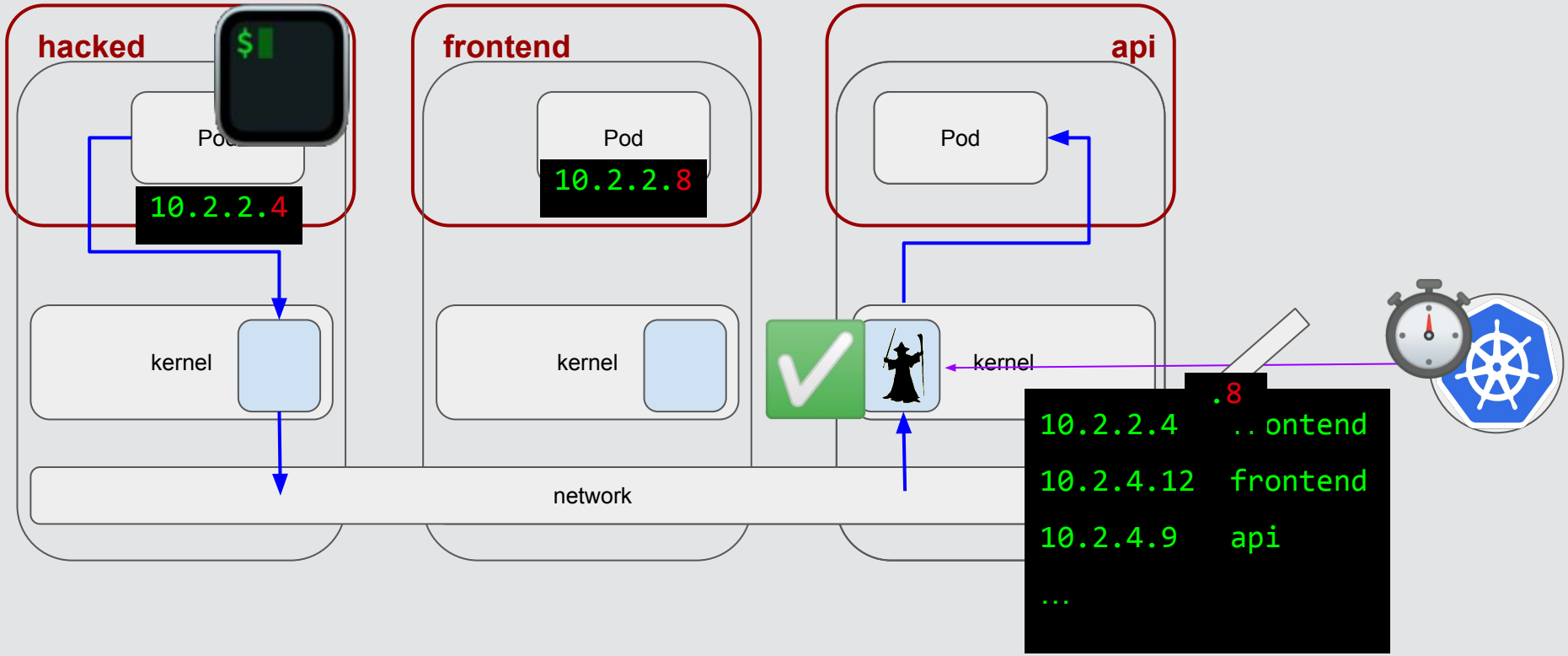
CNI - contrived scenario



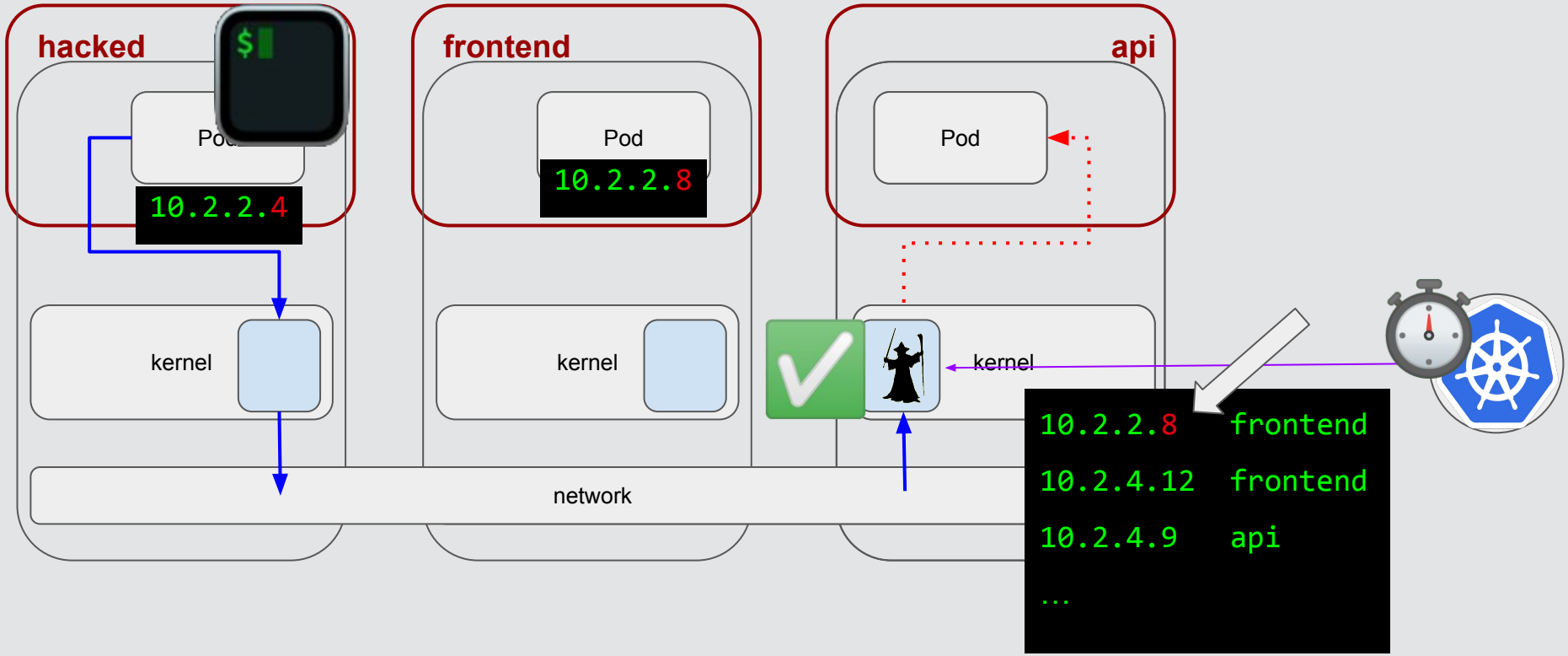
CNI - contrived scenario



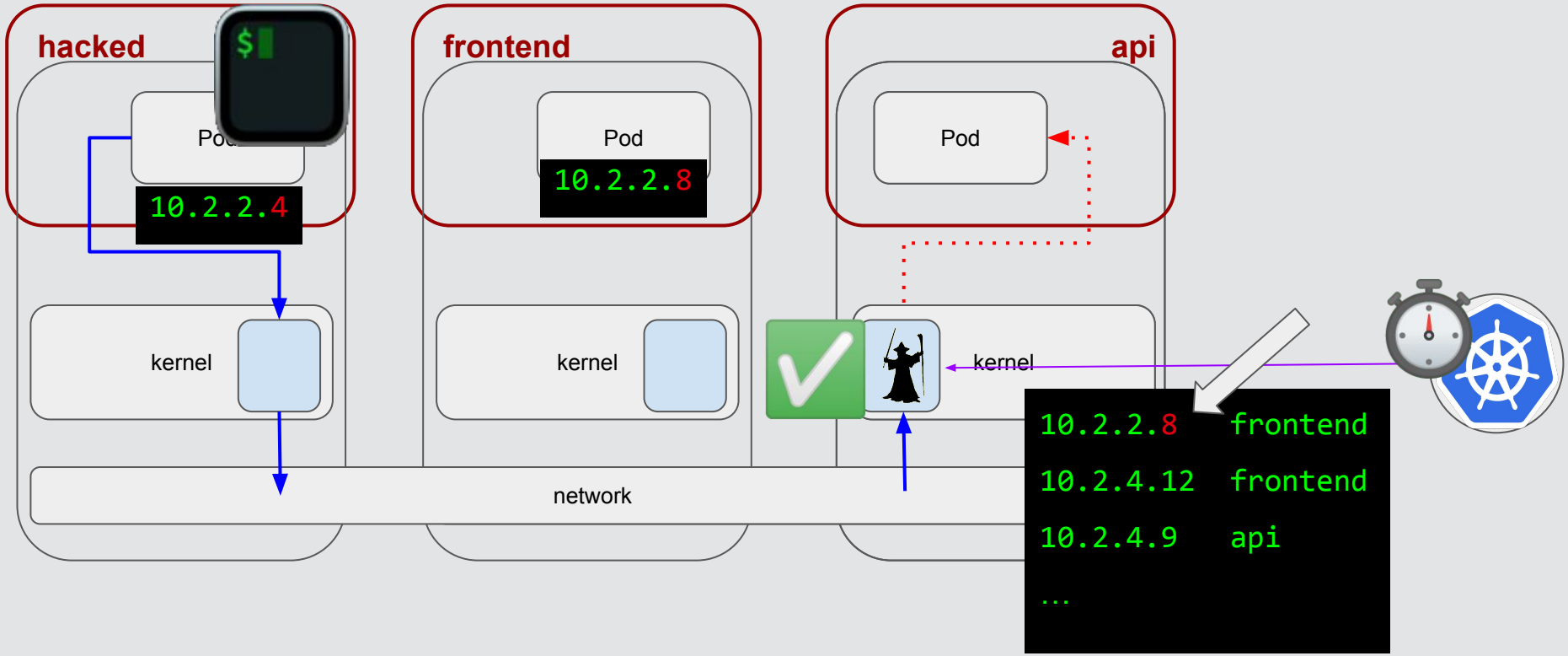
CNI - contrived scenario



CNI - contrived scenario

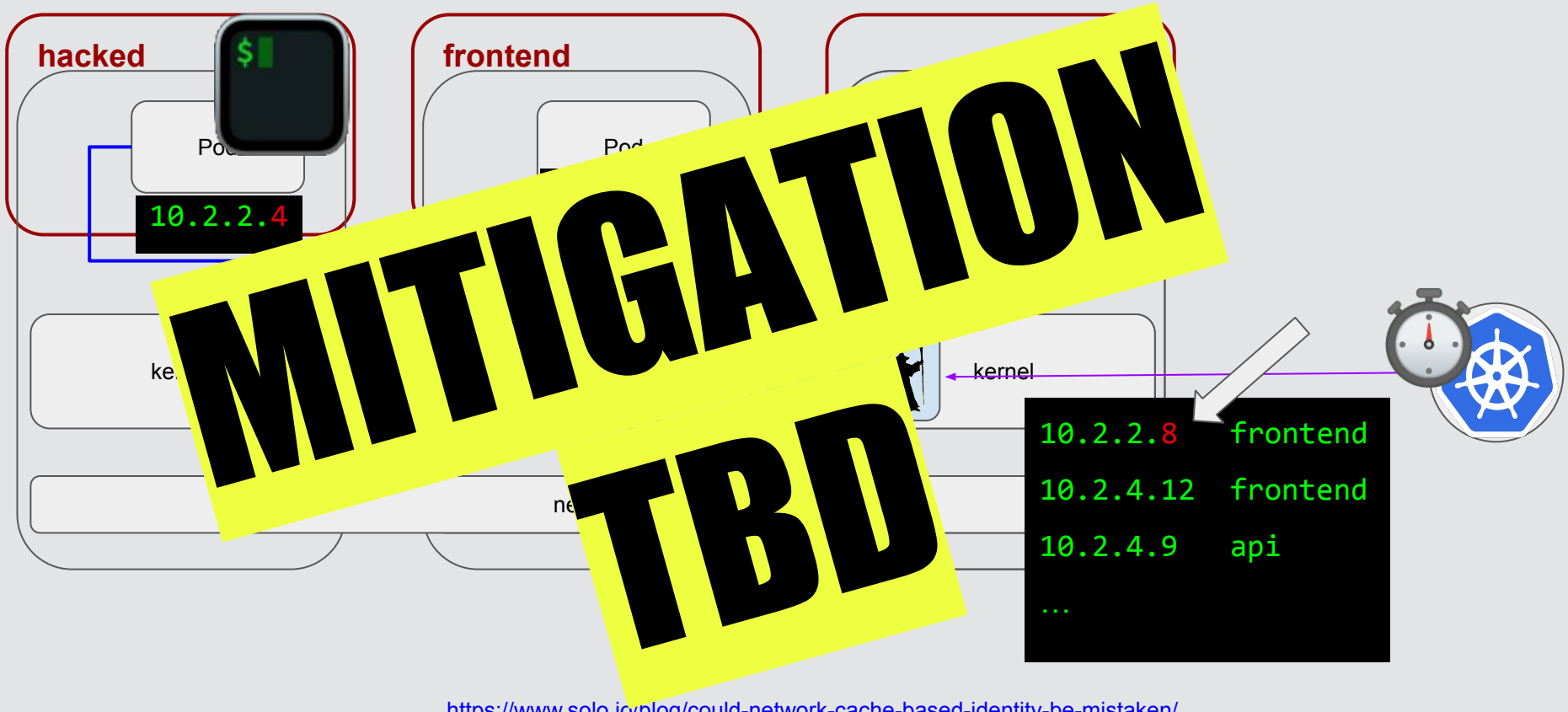


CNI - contrived scenario



https://www.solo.io/blog/could-network-cache-based-identity-be-mistaken/

CNI - contrived scenario



https://www.solo.io/blog/could-network-cache-based-identity-be-mistaken/

Svc Mesh - what is enforceable?

Svc Mesh - what is enforceable?


```
$ kubectl explain ${SERVICE_MESH_AUTH_POLICY}
```

- Allows you to apply policy on traffic which:
  - is going anywhere*
  - is going to a specific K8s Service
  - is going to a specific port(s)

* including loopback or host traffic

Svc Mesh - what is enforceable?


```
$ kubectl explain ${SERVICE_MESH_AUTH_POLICY}
```

- Allows you to apply policy on traffic which:
  - is going anywhere*
  - is going to a specific K8s Service
  - is going to a specific port(s)
  - Allows you to conditionally block/permit requests based on:
    - source IP address or CIDR
    - source kubernetes namespace
    - source kubernetes service account

* including loopback or host traffic

Svc Mesh - what is enforceable?


```
$ kubectl explain ${SERVICE_MESH_AUTH_POLICY}
```

- Allows you to apply policy on traffic which:
  - is going anywhere*
  - is going to a specific K8s Service
  - is going to a specific port(s)
  - Allows you to conditionally block/permit requests based on HTTP properties:
    - specific Host / Authority
    - specific HTTP method
    - specific URI (or prefix)
    - specific header is present or set to a specific value
    - JWT claims (Istio only)

* including loopback or host traffic

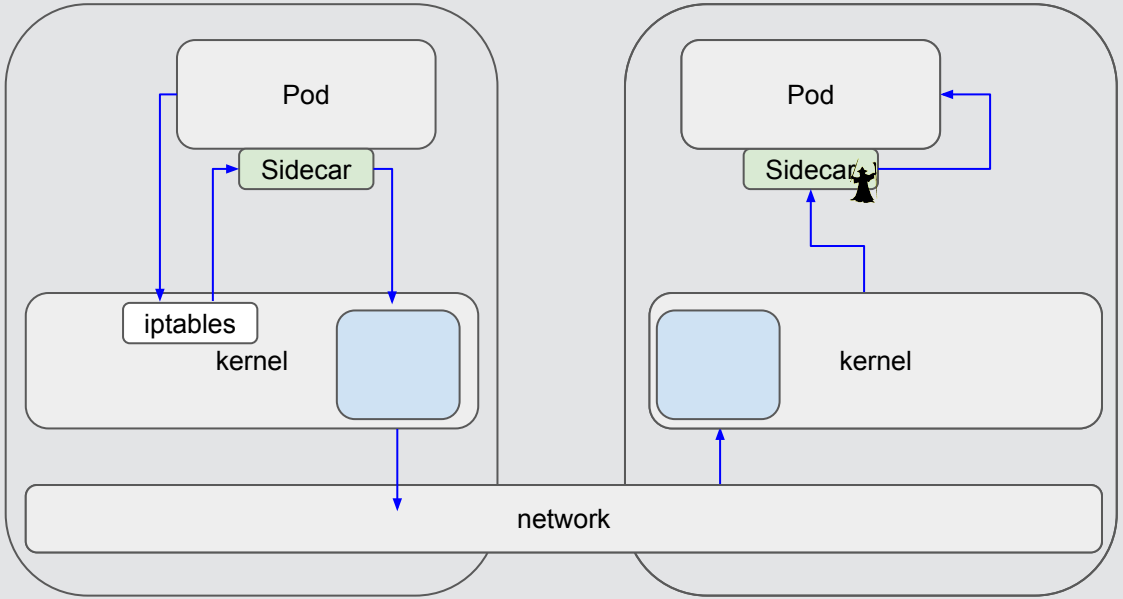
Svc Mesh - what is enforceable?


```
$ kubectl explain ${SERVICE_MESH_AUTH_POLICY}
```

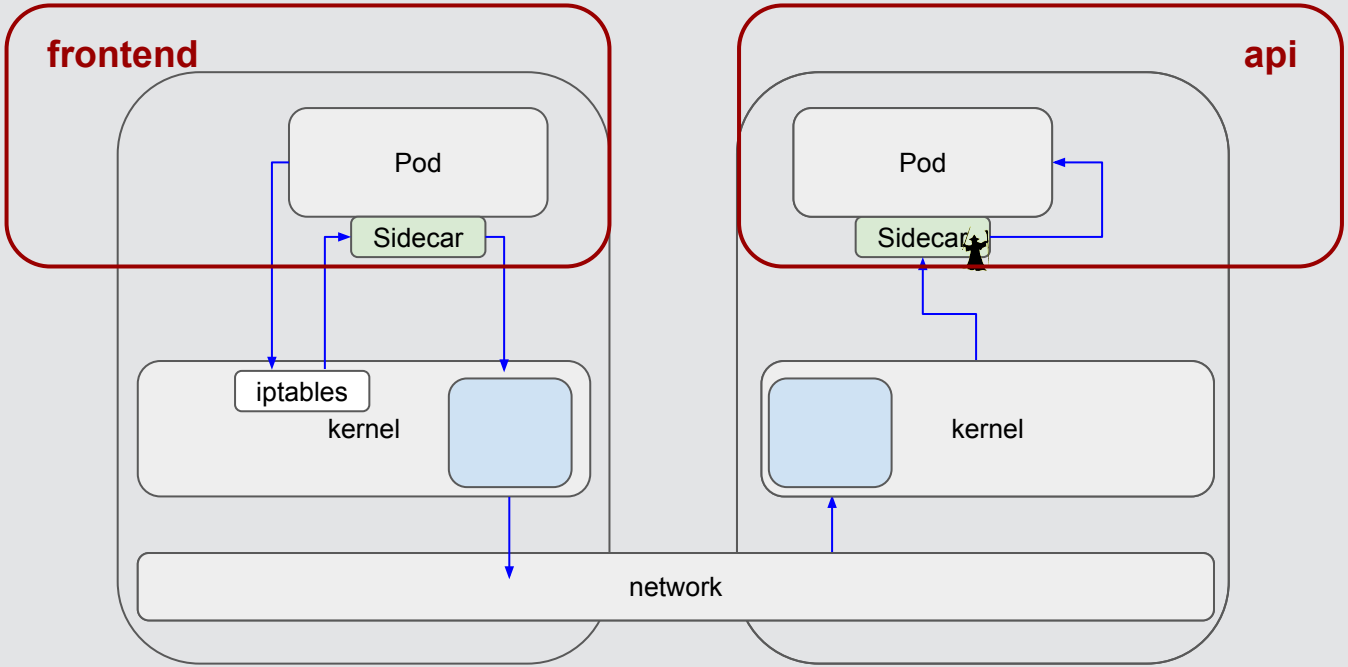
- Allows you to apply policy on traffic which:
  - is going anywhere*
  - is going to a specific K8s Service
  - is going to a specific port(s)
  - Allows you to conditionally block/permit requests based on:
    - source IP address or CIDR
    - source kubernetes namespace
    - source kubernetes service account

* including loopback or host traffic

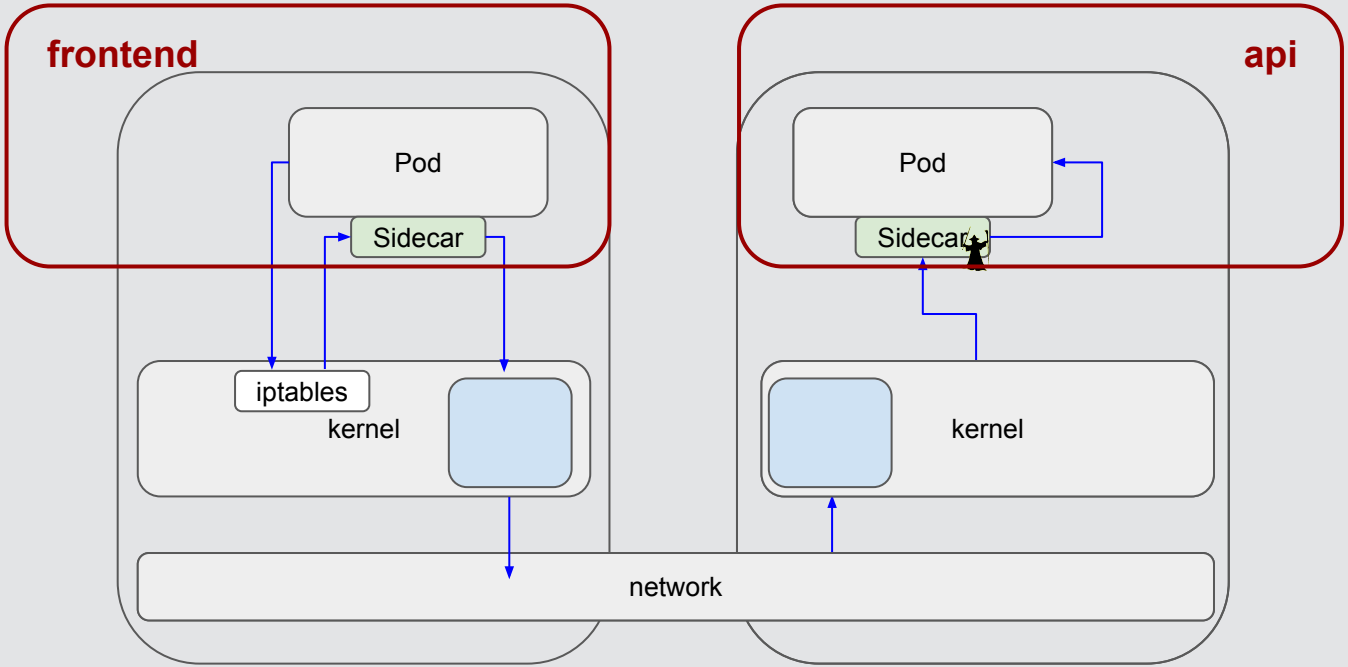
Svc Mesh - how is it enforced?



Svc Mesh - how is it enforced?

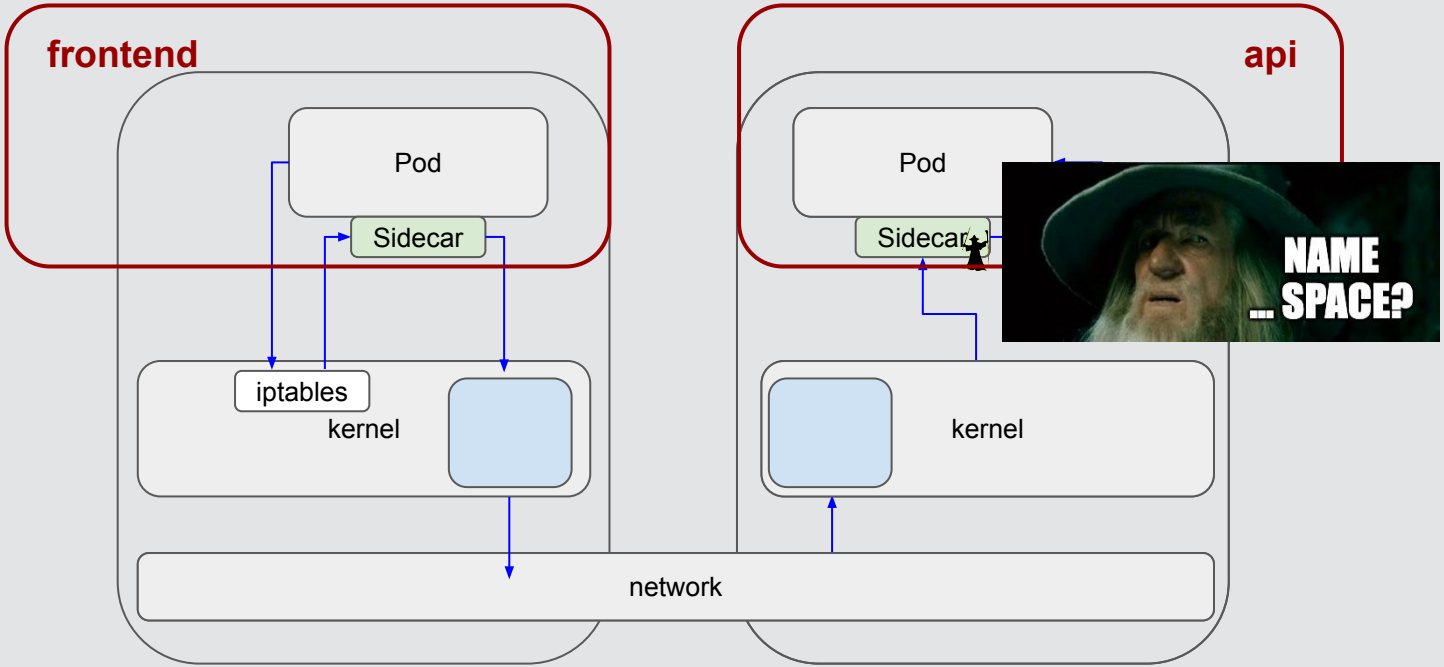


Svc Mesh - how is it enforced?



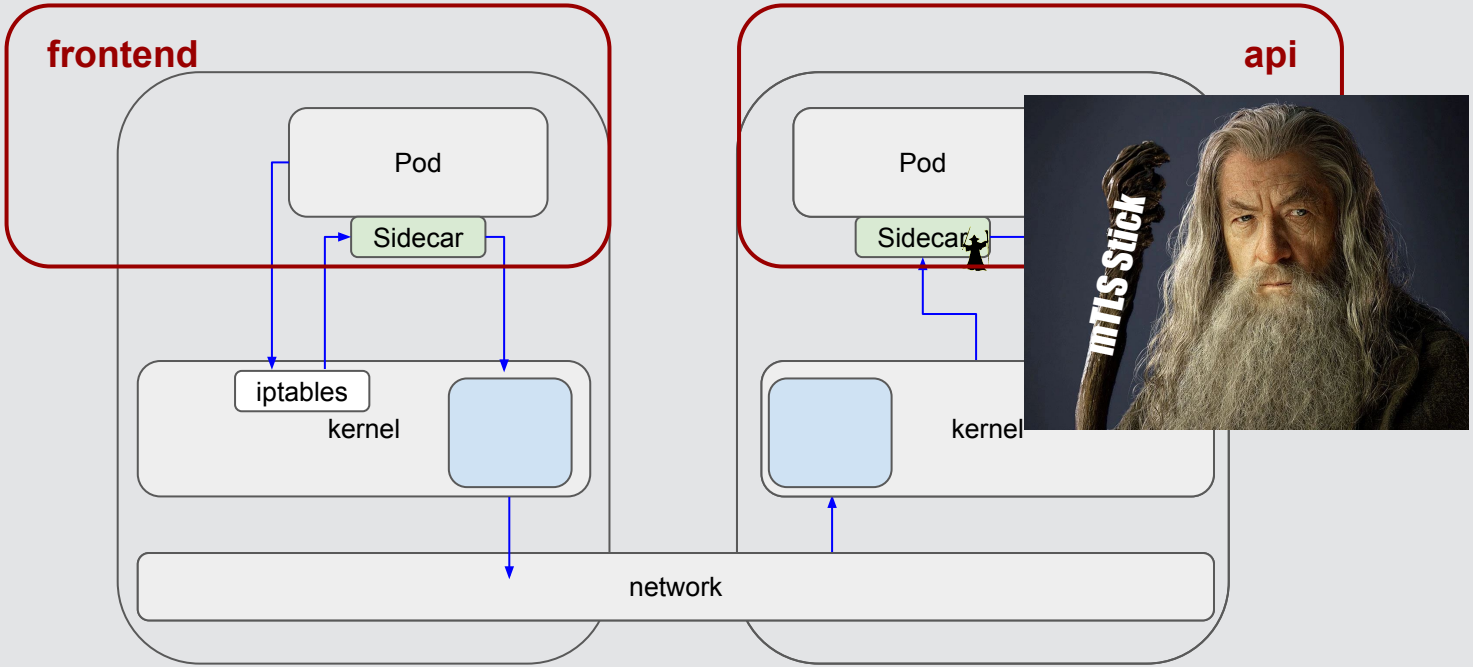

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - how is it enforced?



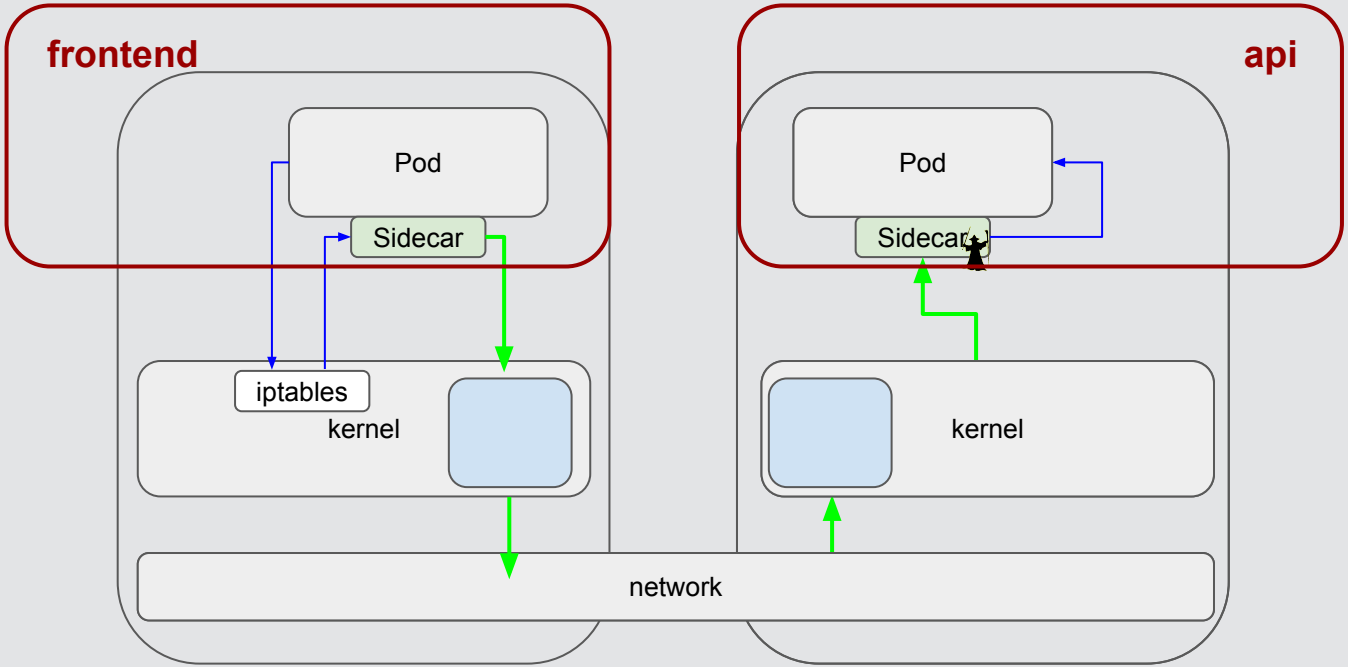

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - how is it enforced?

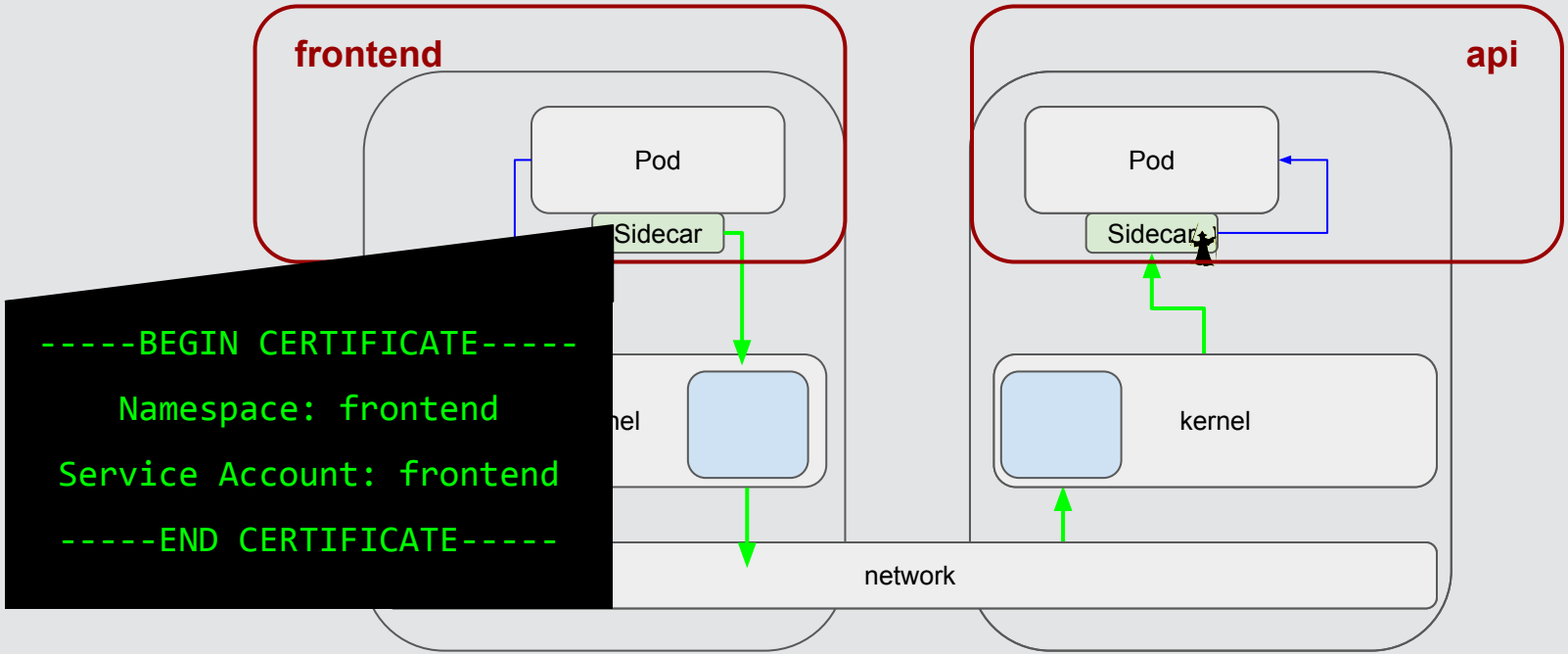



```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

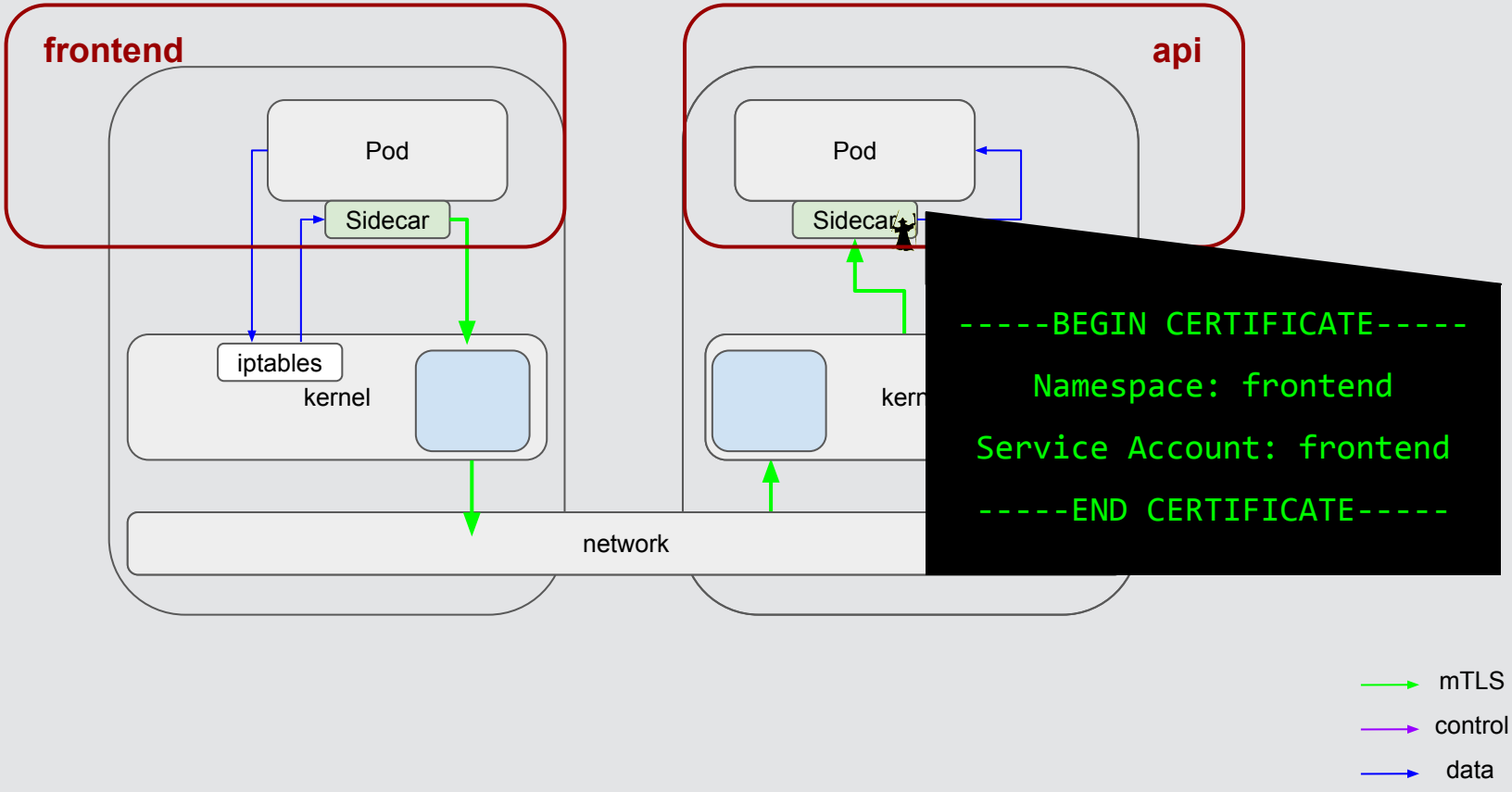
Svc Mesh - how is it enforced?



Svc Mesh - how is it enforced?



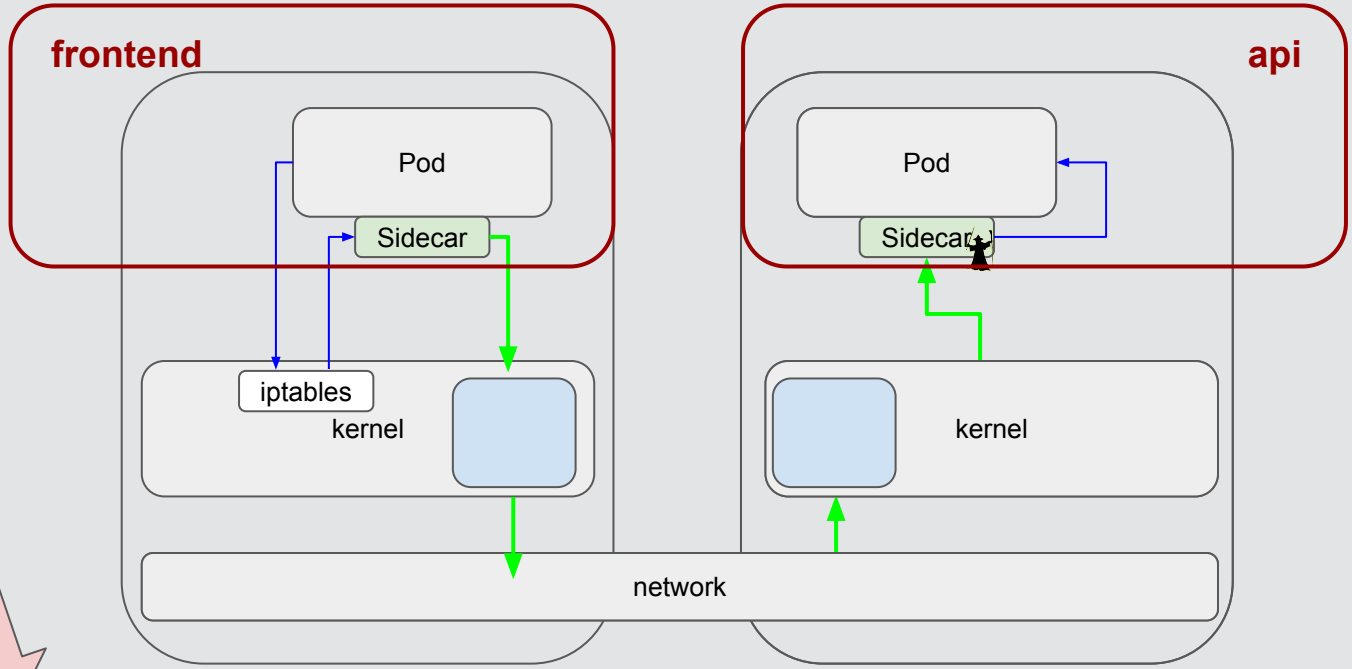
Svc Mesh - how is it enforced?



Svc Mesh - how is it enforced?

Svc Mesh - how is it enforced?

1



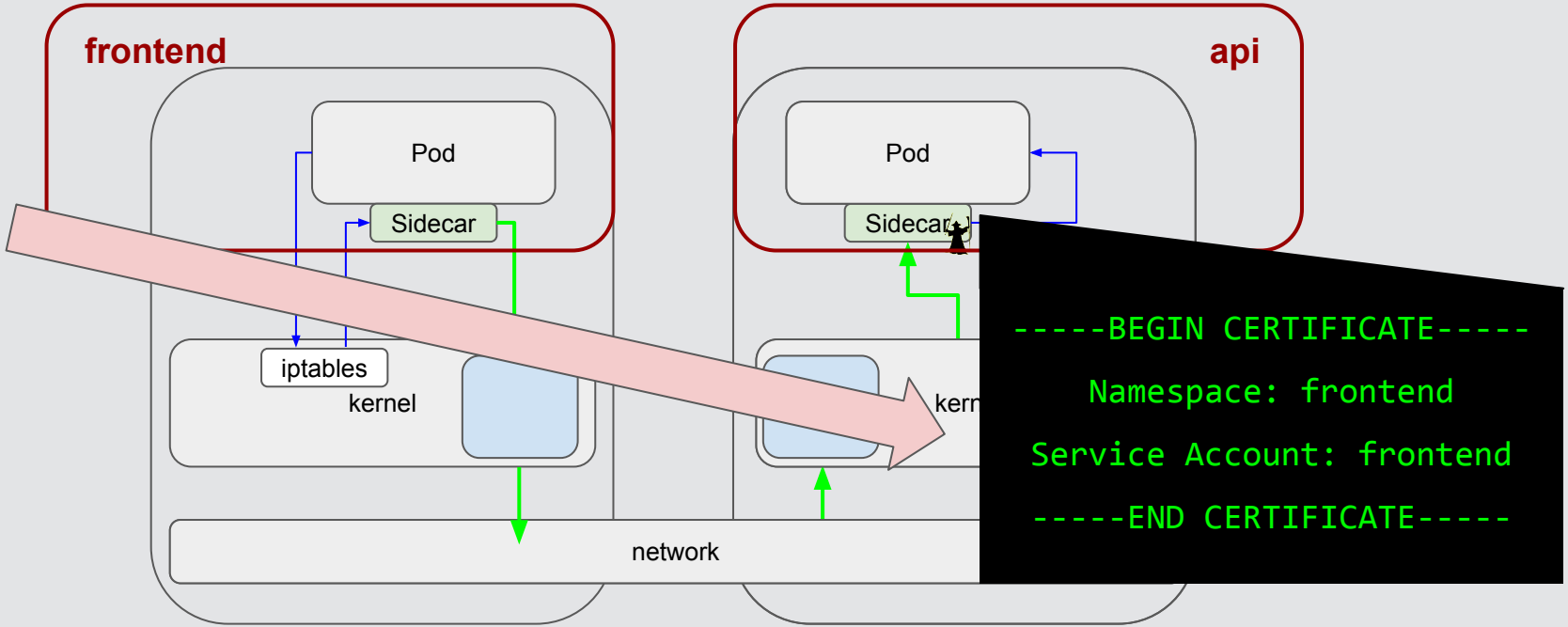

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

data

Svc Mesh - how is it enforced?

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

2

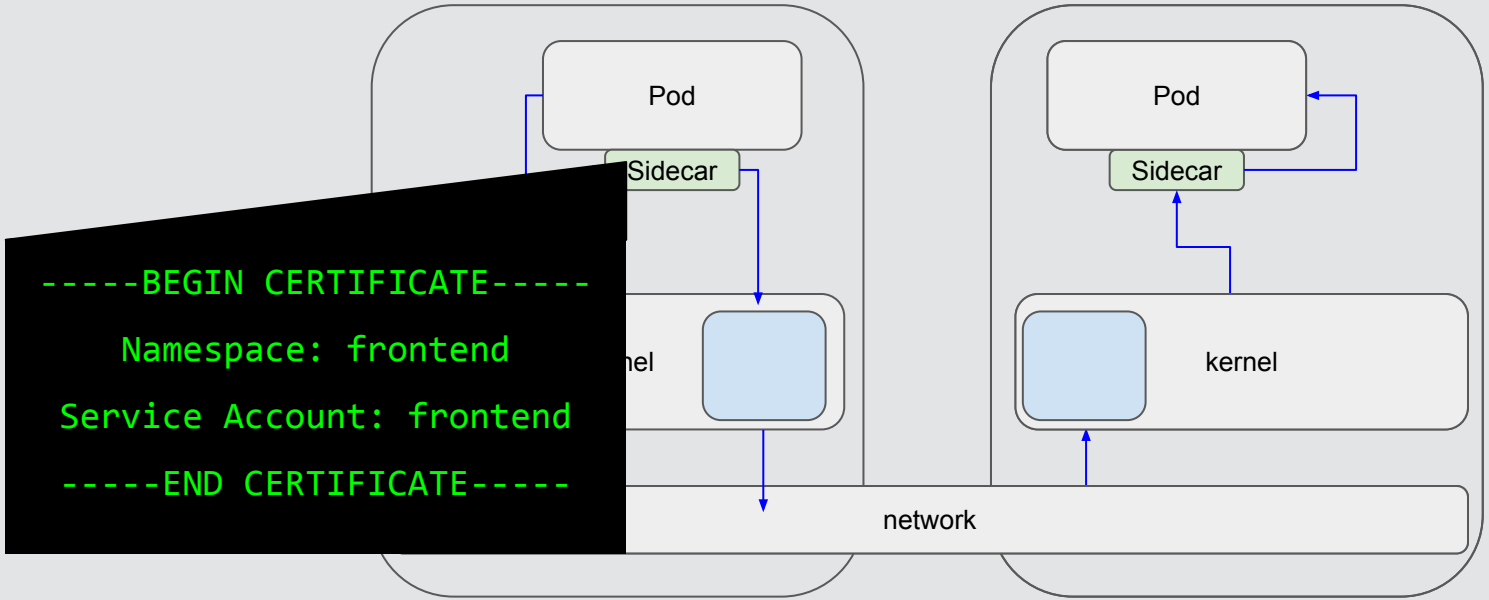


Client Cert - how is it secured?

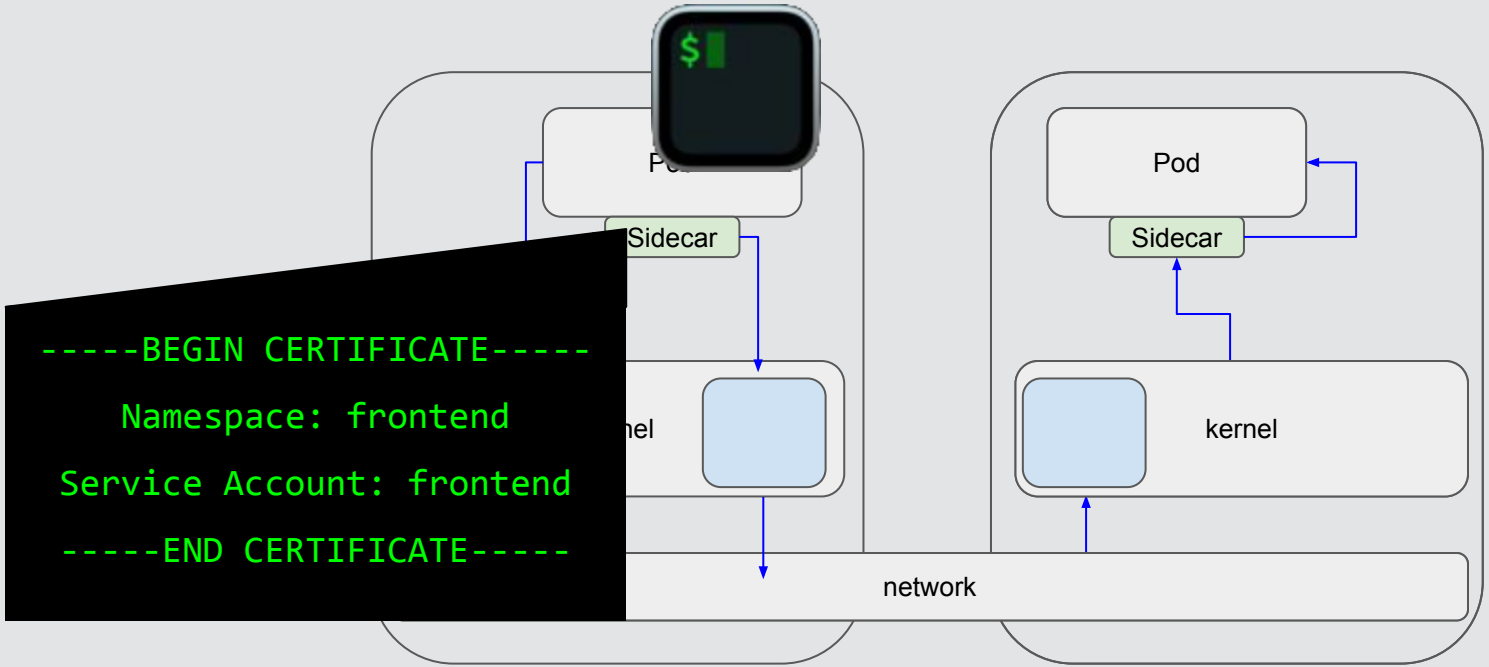

```
-----BEGIN CERTIFICATE-----
    Namespace: frontend
 Service Account: frontend
-----END CERTIFICATE-----
```

mTLS
control
data

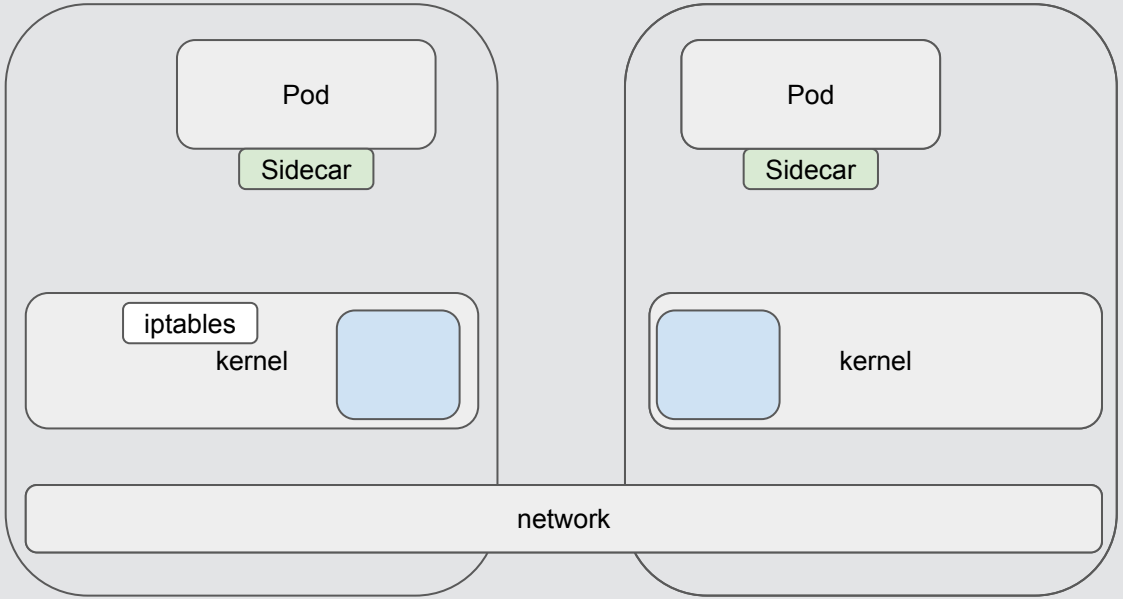
Client Cert - how is it secured?



Client Cert - how is it secured?

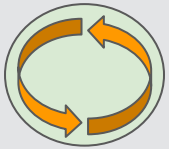


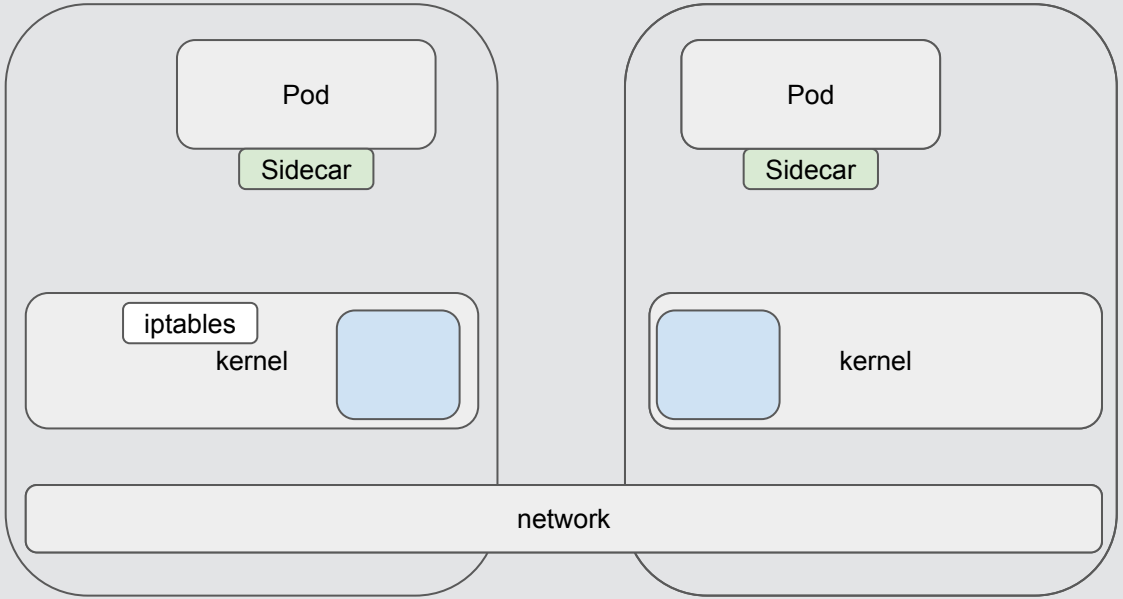
Client Cert - how is it issued?



mTLS
control
data

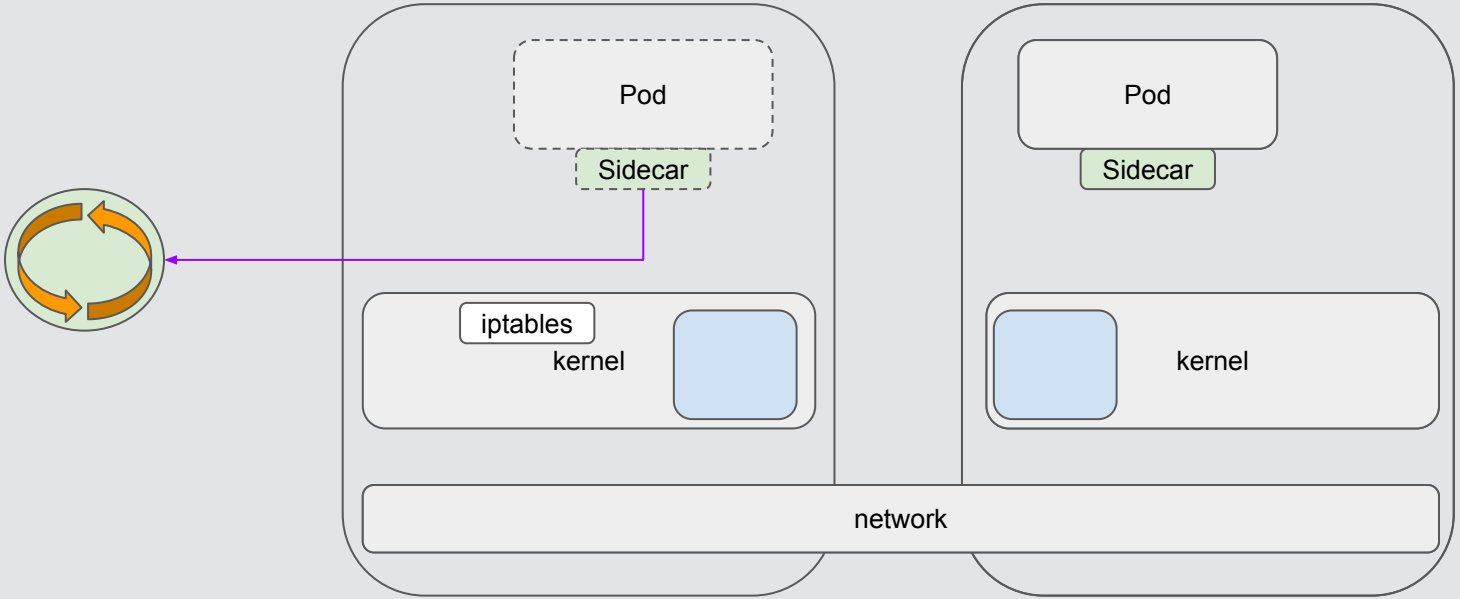
Client Cert - how is it issued?



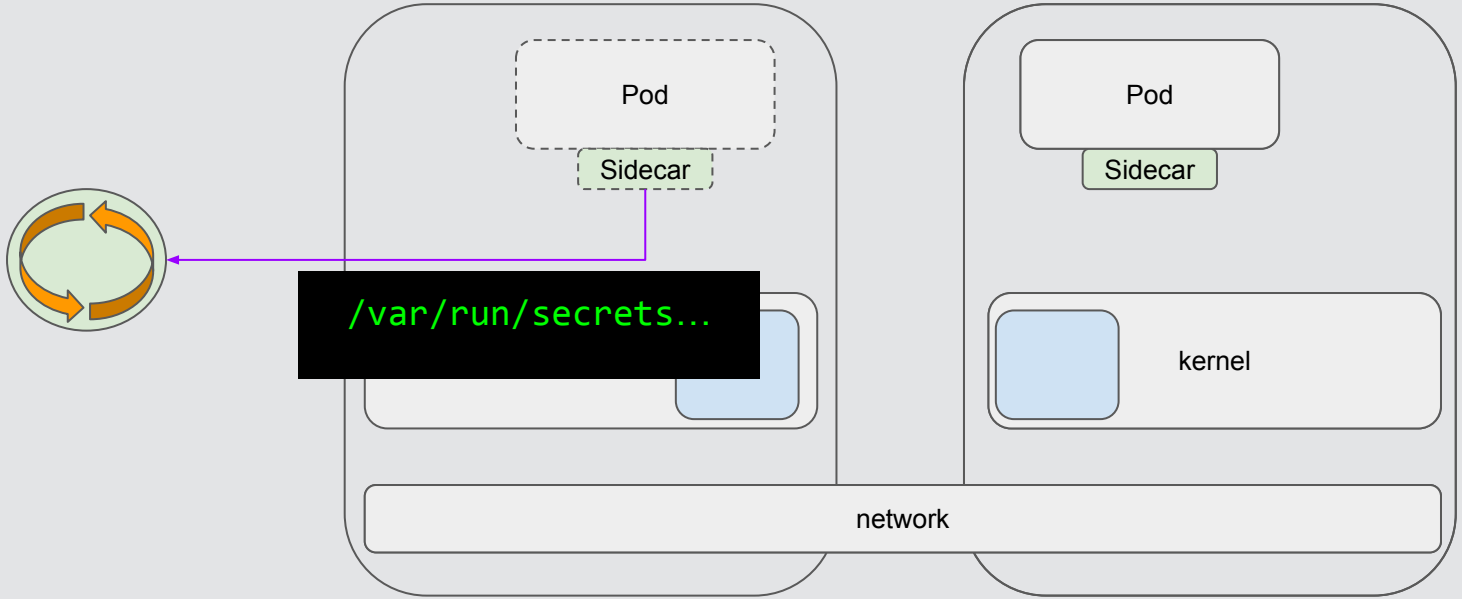


mTLS
control
data

Client Cert - how is it issued?

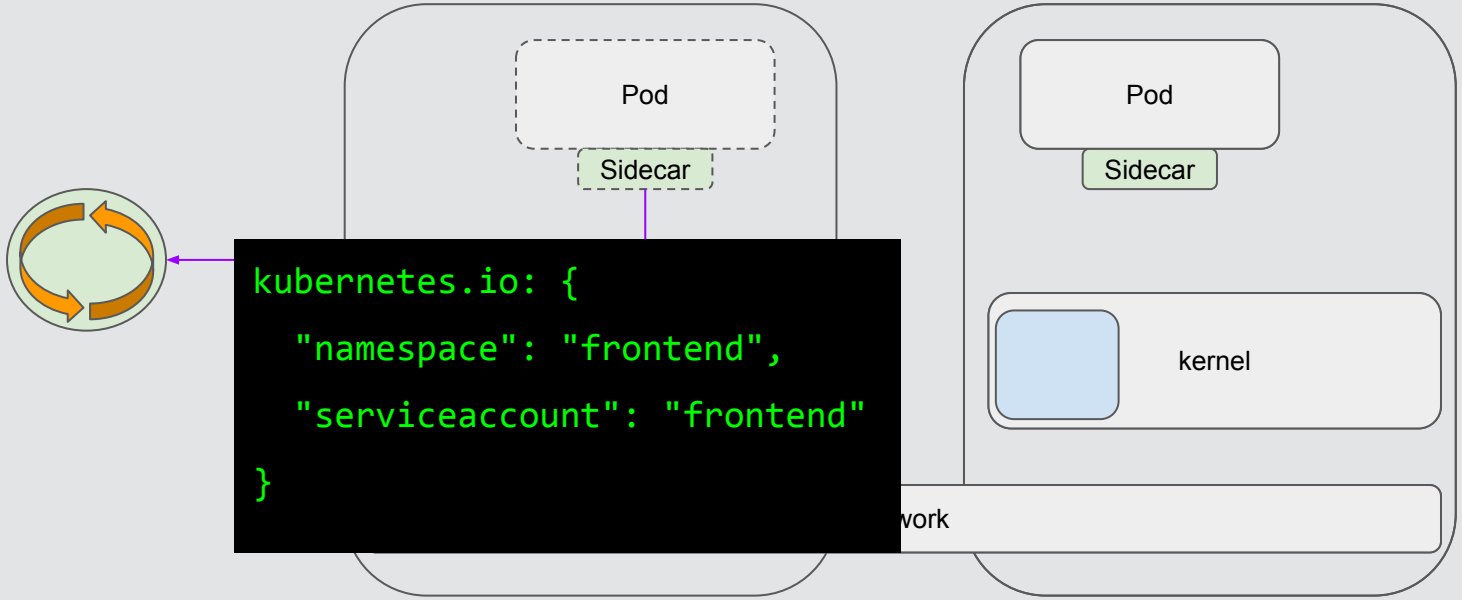


Client Cert - how is it issued?



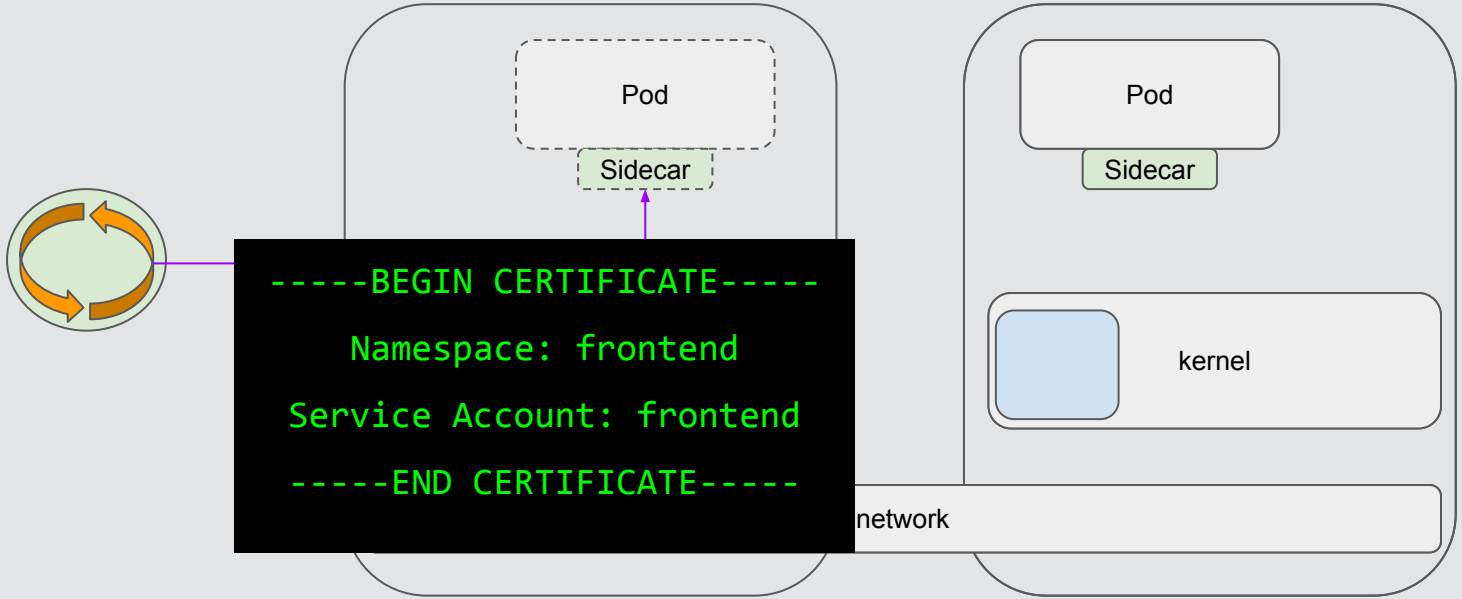
mTLS
control
data

Client Cert - how is it issued?



mTLS
control
data

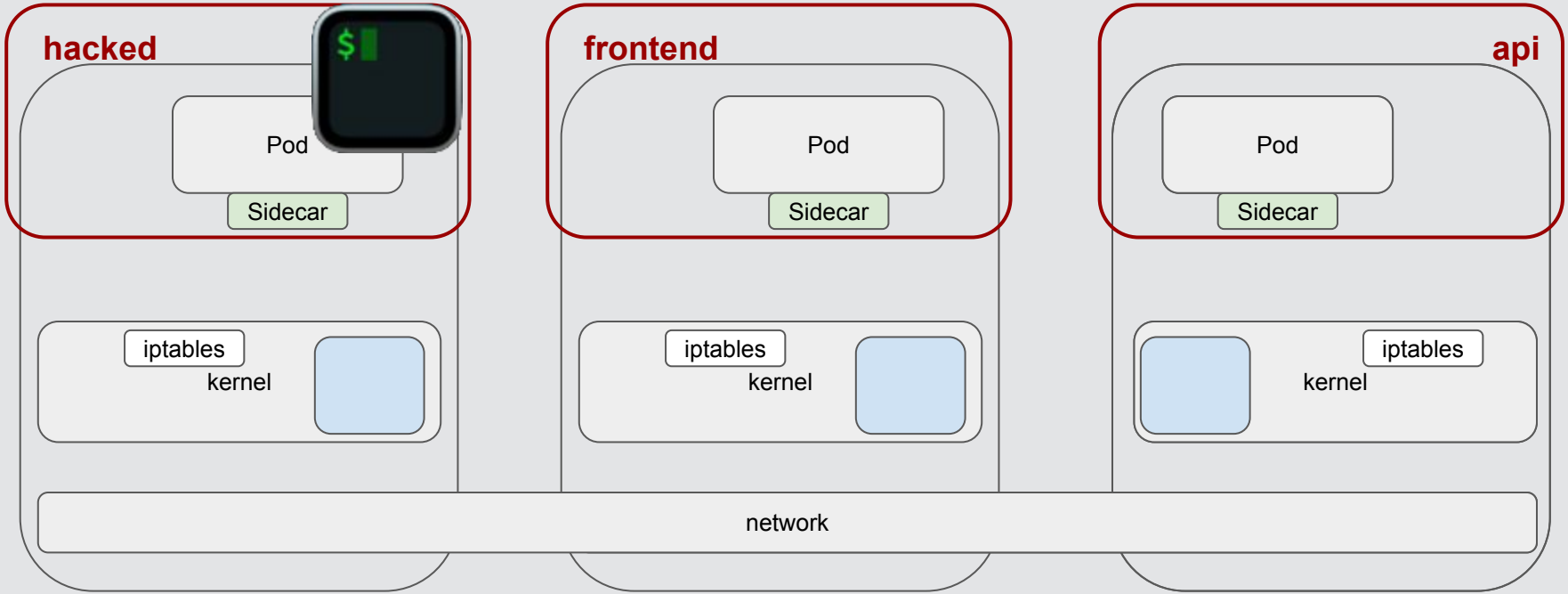
Client Cert - how is it issued?



CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

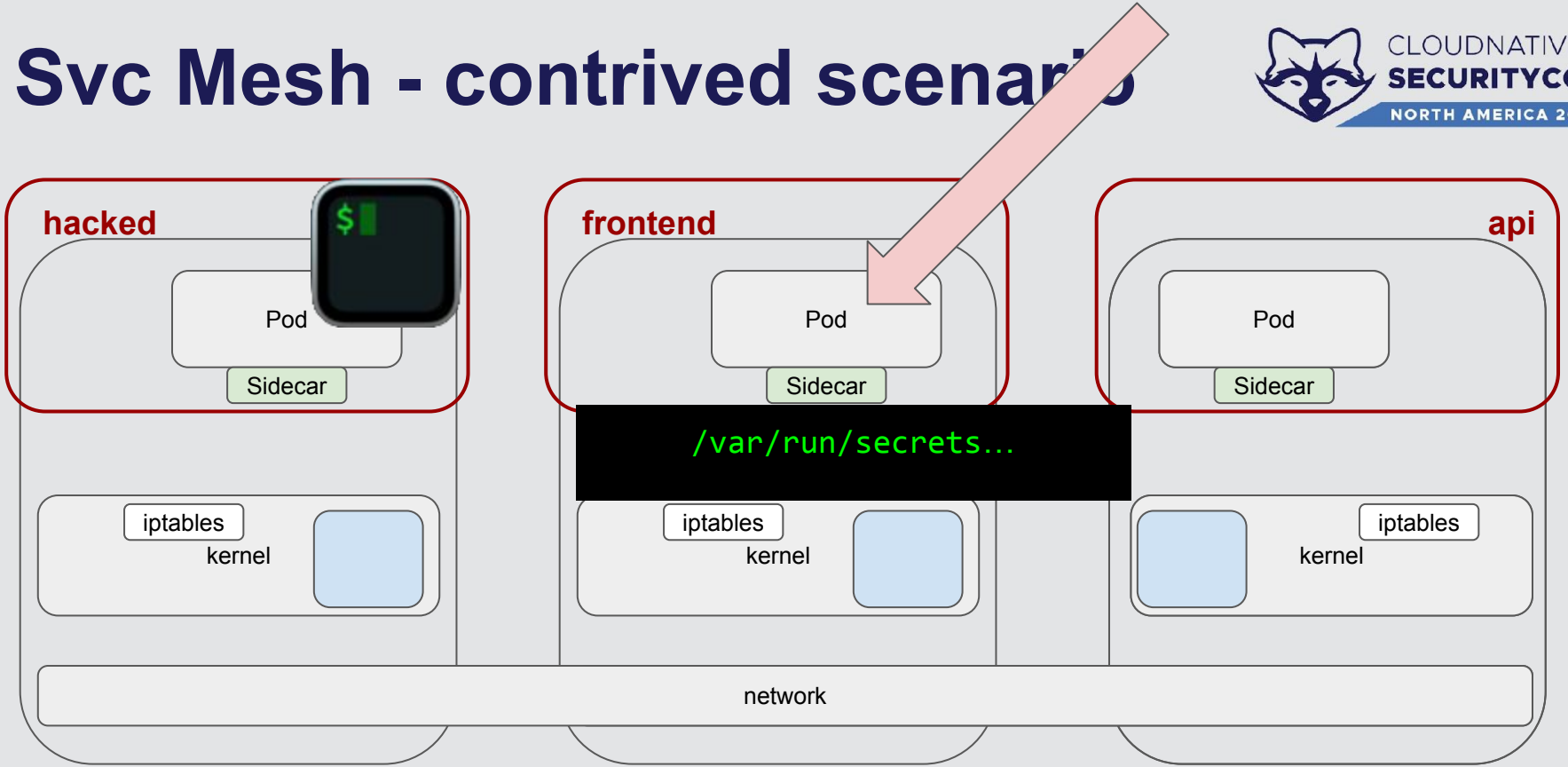
It's time for ~~a~~ another contrived scenario!

Svc Mesh - contrived scenario



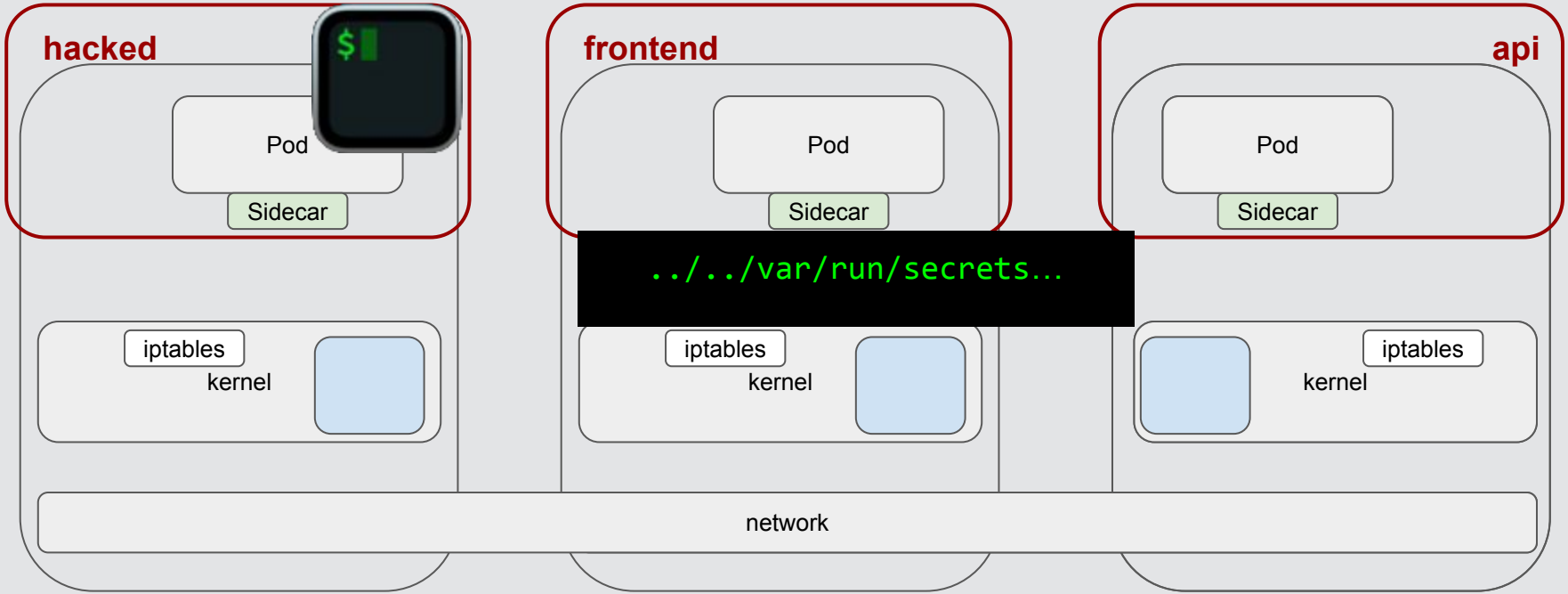

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario



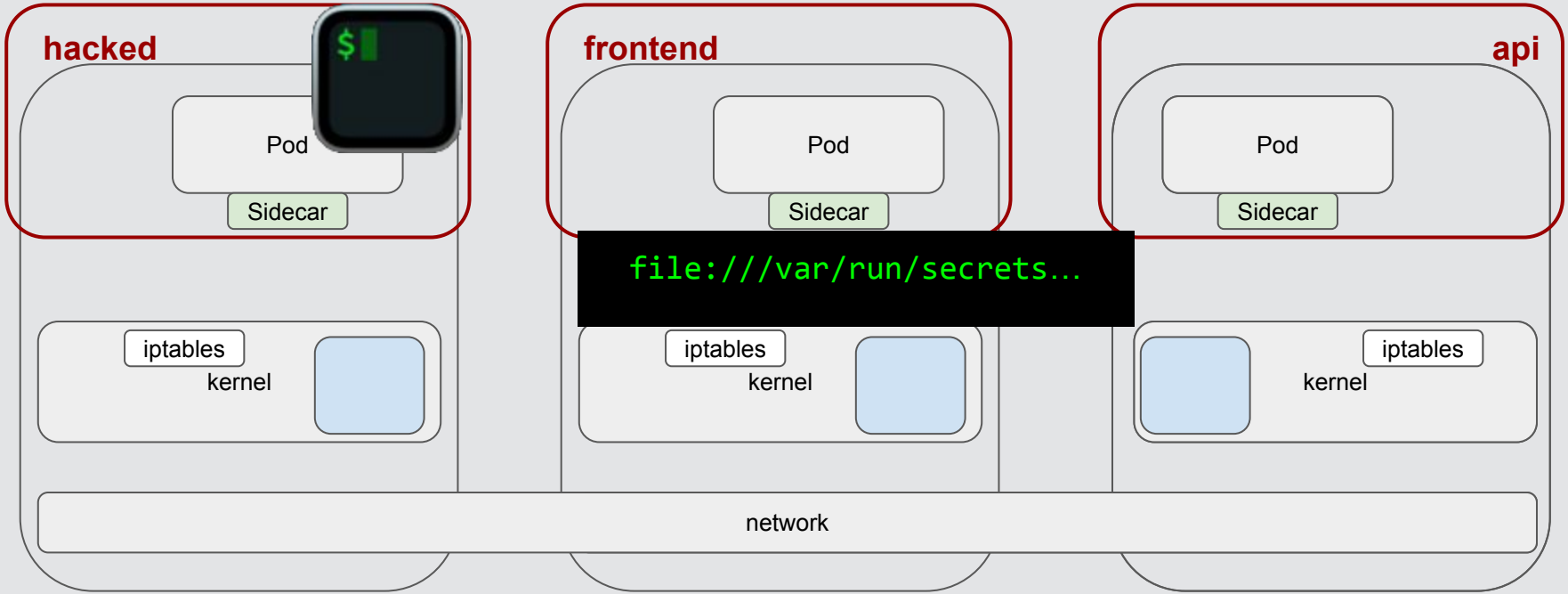

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario




```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario

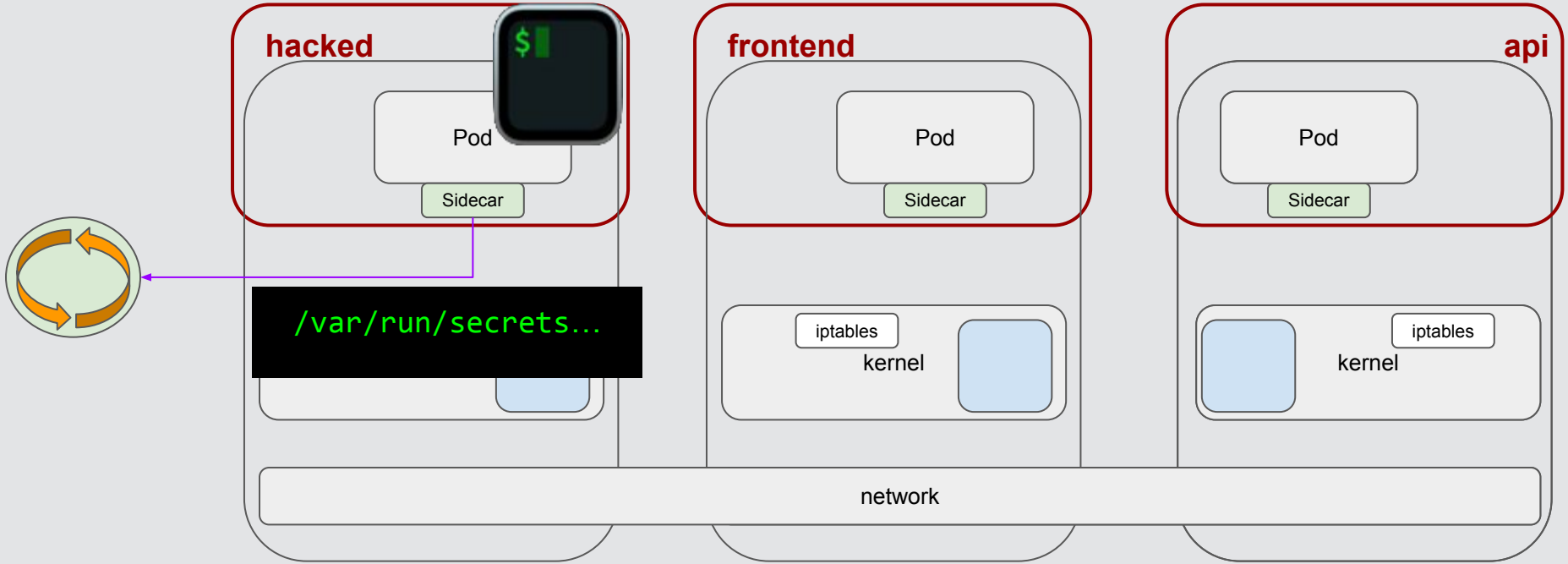



```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario

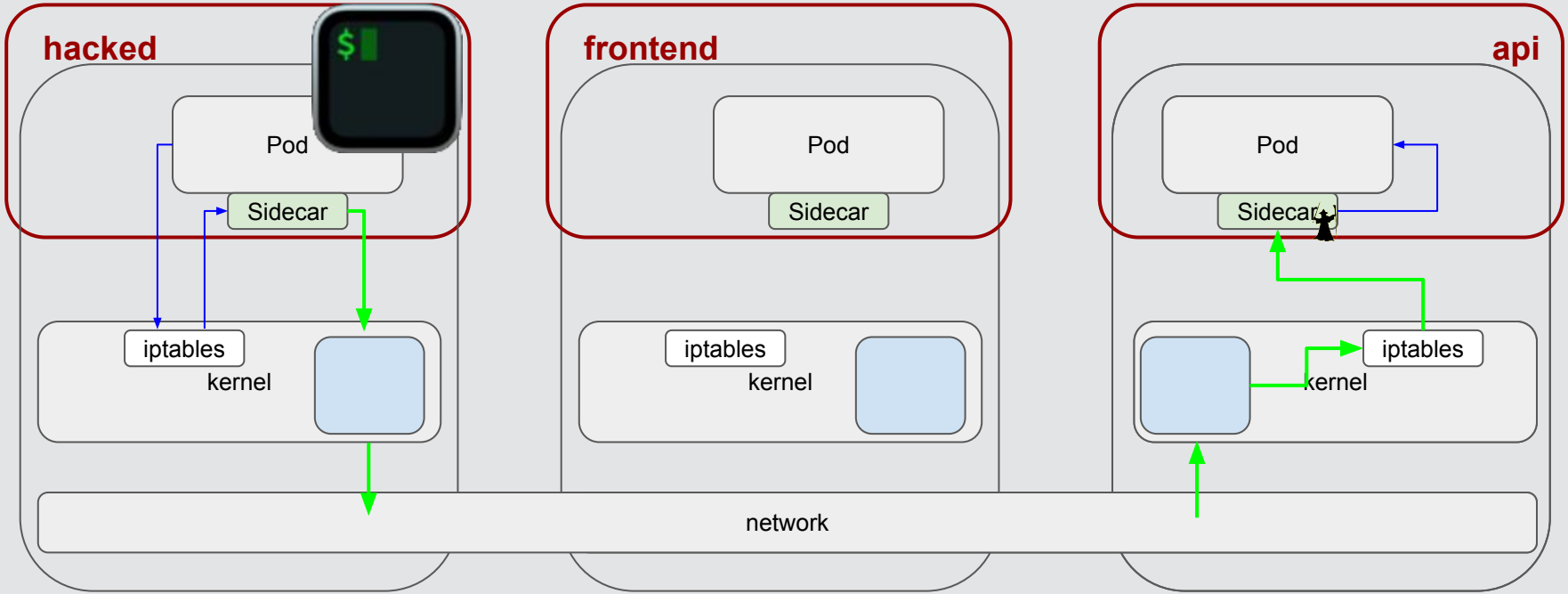

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario



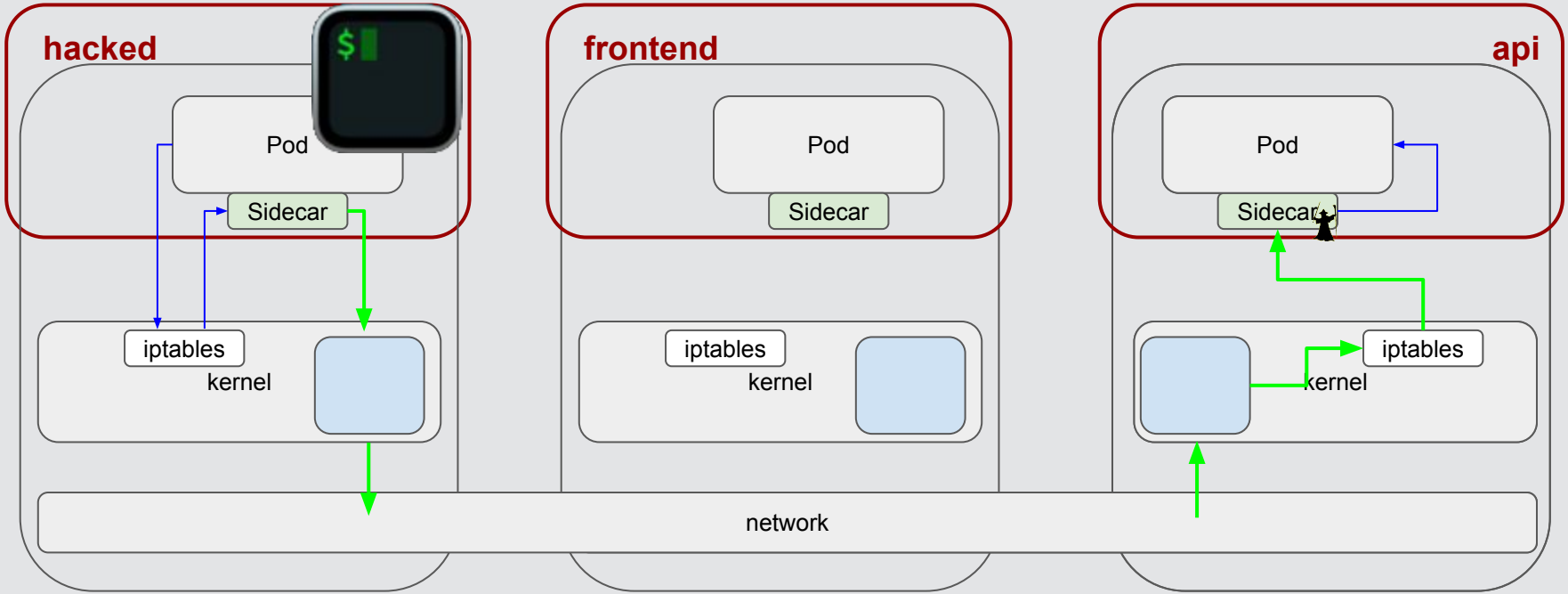

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario




```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

Svc Mesh - contrived scenario

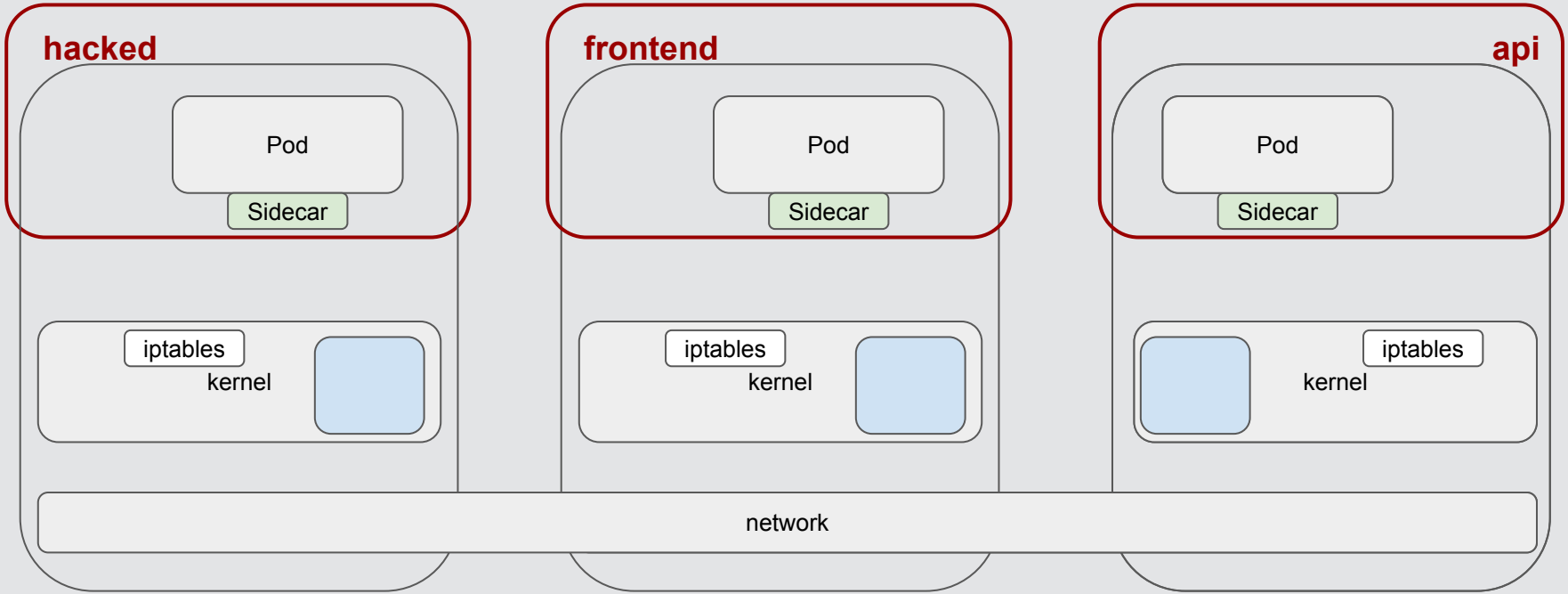



```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

https://github.com/rsalmond/istio-mtls-client-cert-theft

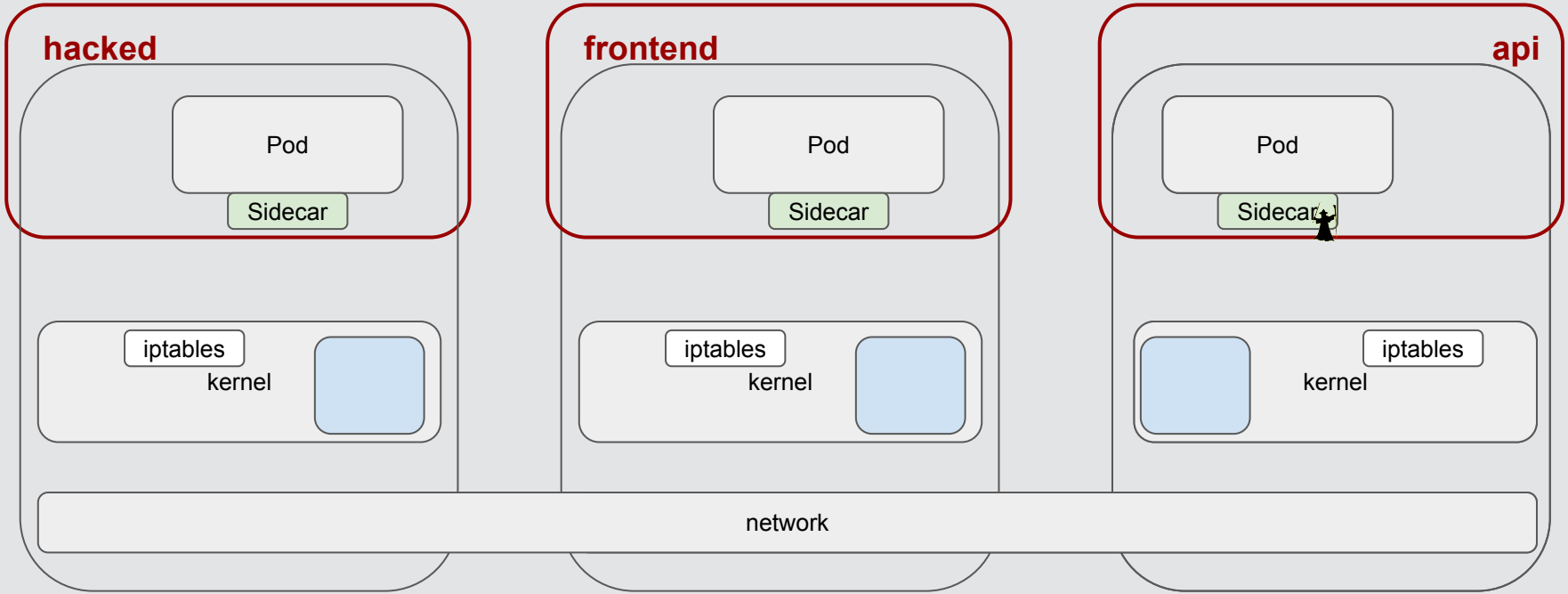
2 mitigations

#1. Right ~~wizard~~ tool, right job.



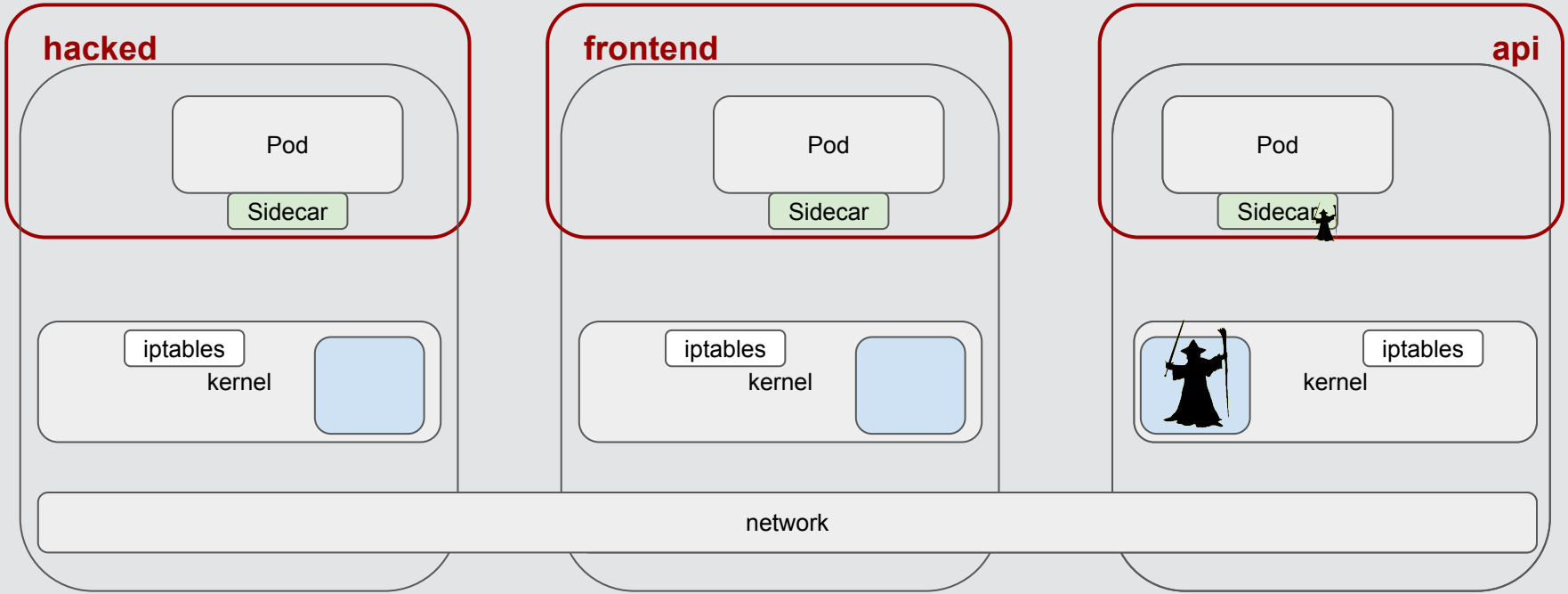
#1. Right ~~wizard~~ tool, right job.

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023



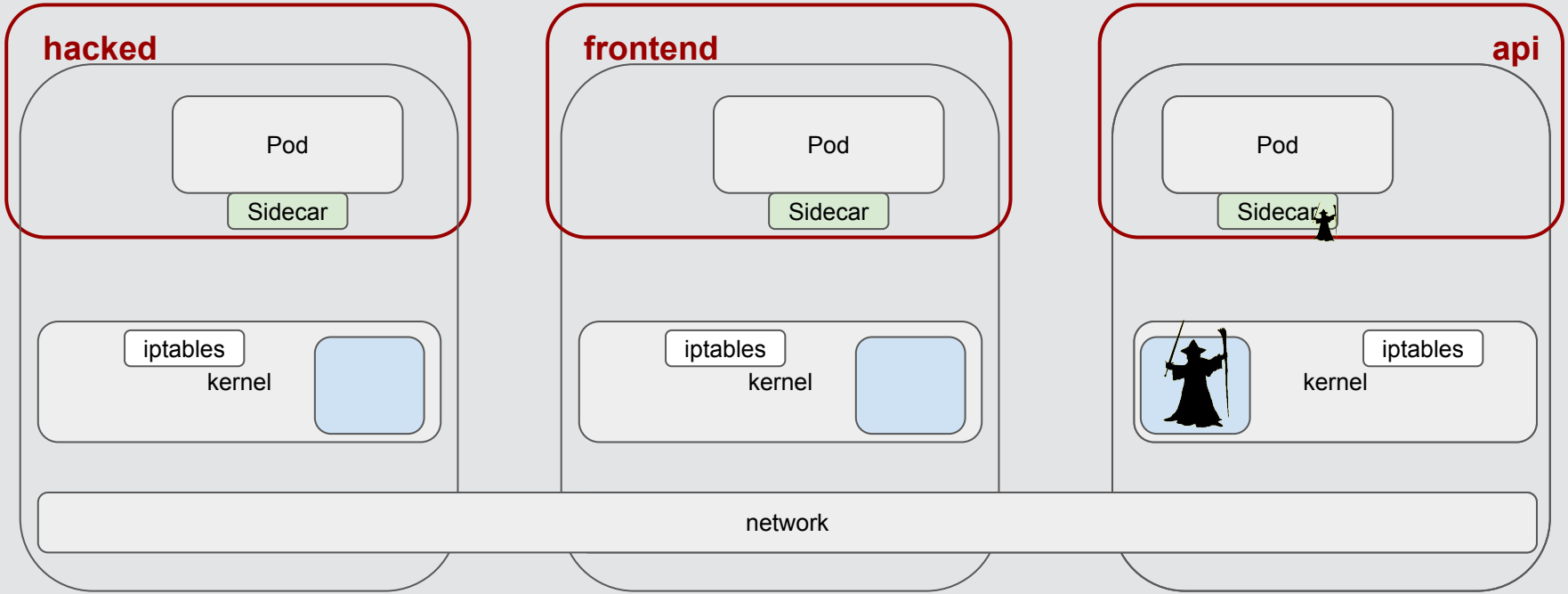

```
$ dear Service Mesh: [pods in frontend] => [pods in api] == OK!
```

#1. Right ~~wizard~~ tool, right job.



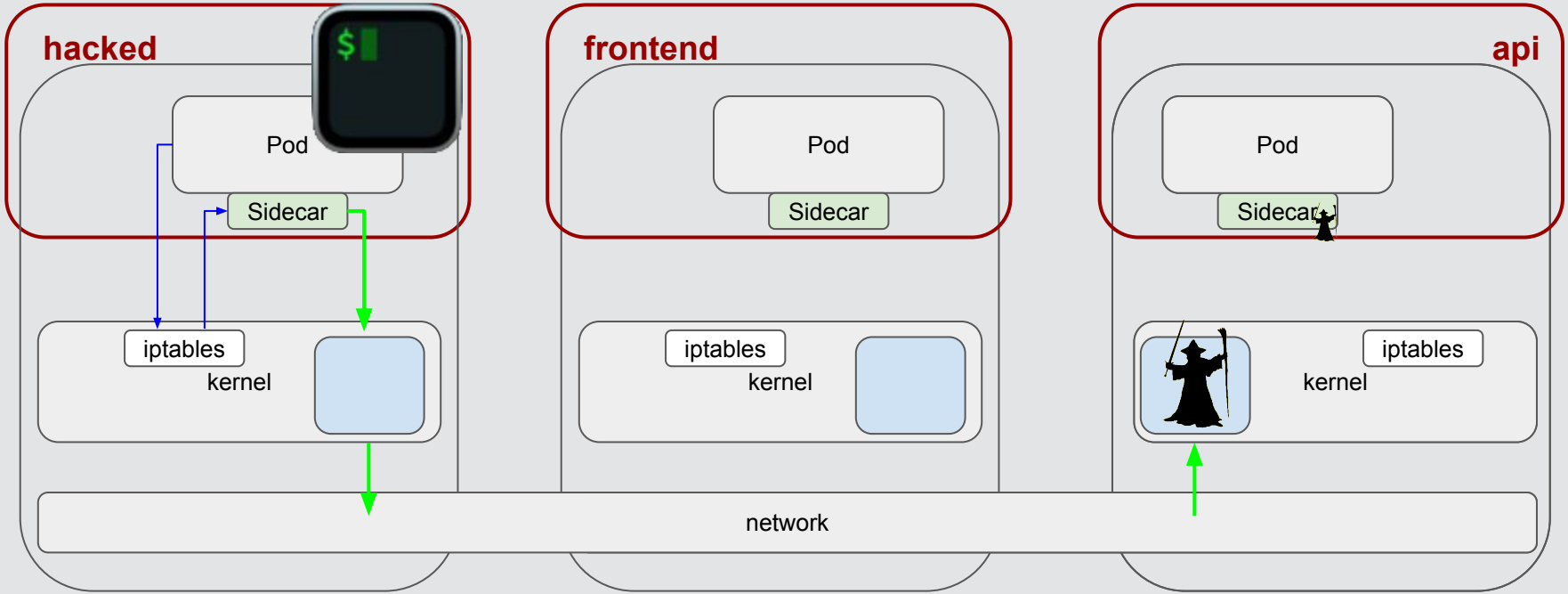

```
$ dear CNI: [pods in frontend] => [pods in api] == OK!
```

#1. Right ~~wizard~~ tool, right job.



#1. Right ~~wizard~~ tool, right job.

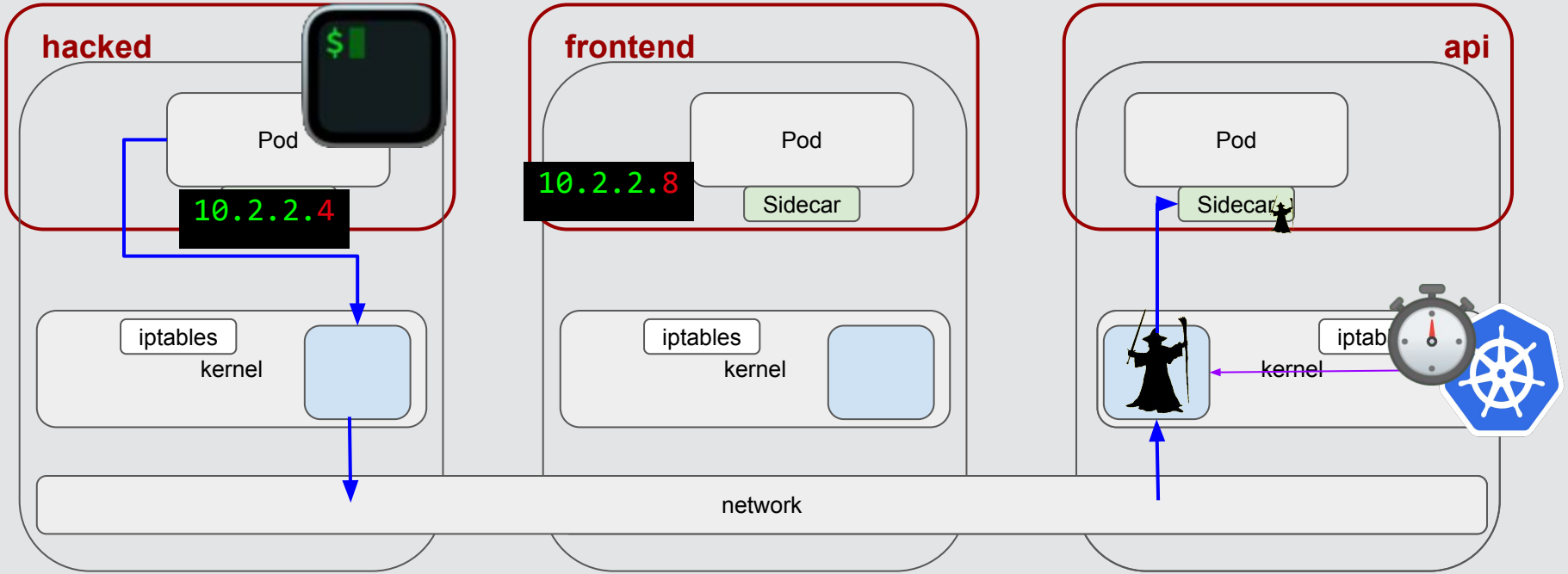
CLOUDNATIVE SECURITYCON NORTH AMERICA 2023



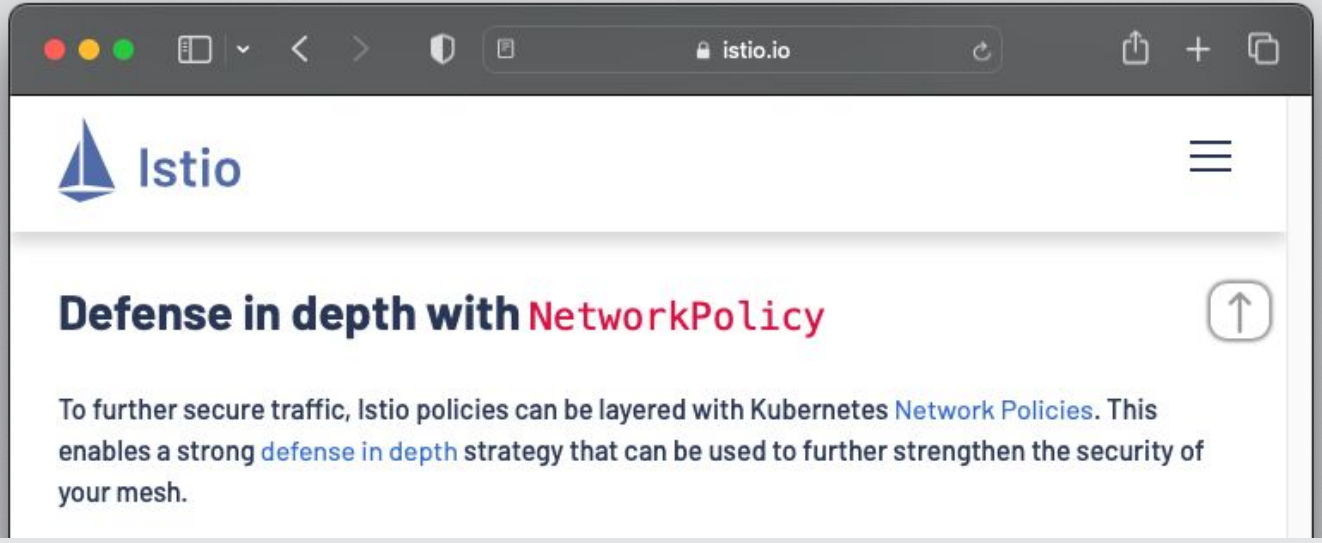

```
$ dear CNI: [pods in frontend] => [pods in api] == OK!
```

#1. Right ~~wizard~~ tool, right job.

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

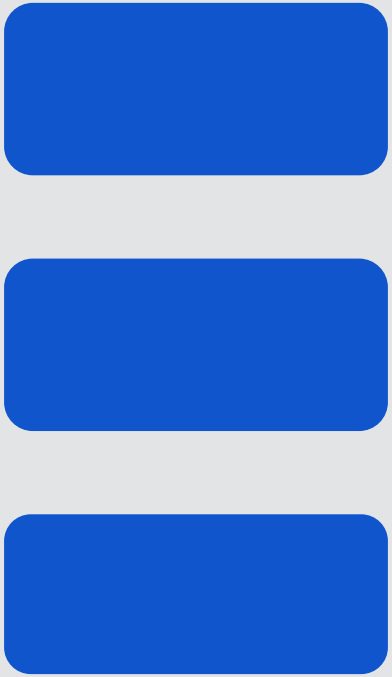


🤫

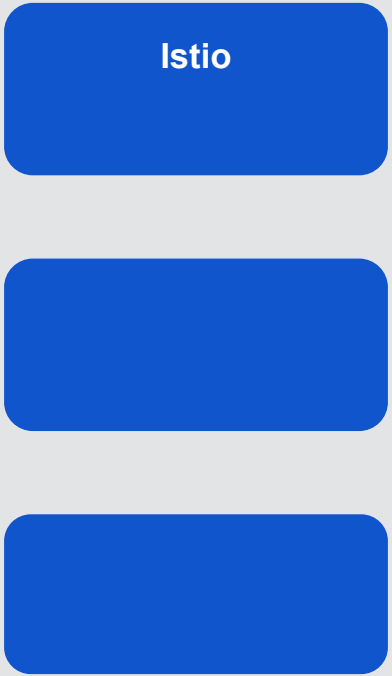

istio.io
Istio
Defense in depth with NetworkPolicy
To further secure traffic, Istio policies can be layered with Kubernetes Network Policies. This enables a strong defense in depth strategy that can be used to further strengthen the security of your mesh.

#2. Evolution.

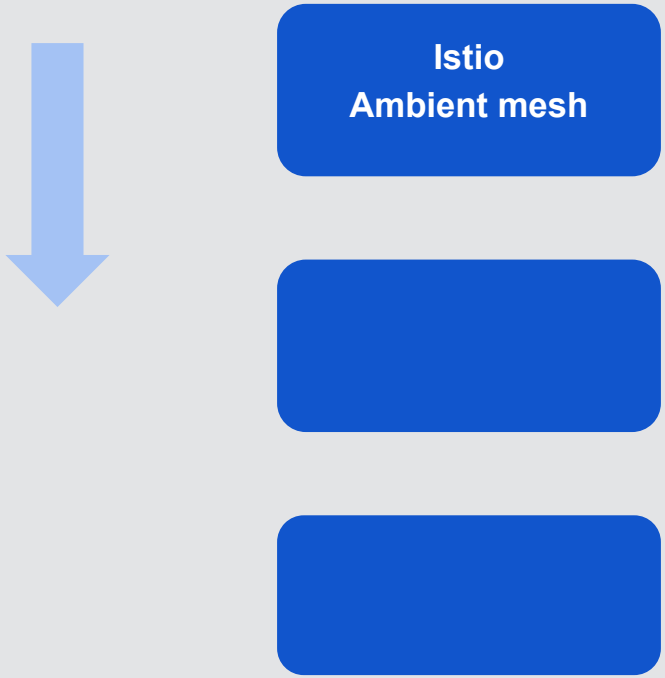
The landscape is changing 🔮



The landscape is changing 🔮



The landscape is changing 🔮



Ambient Mesh

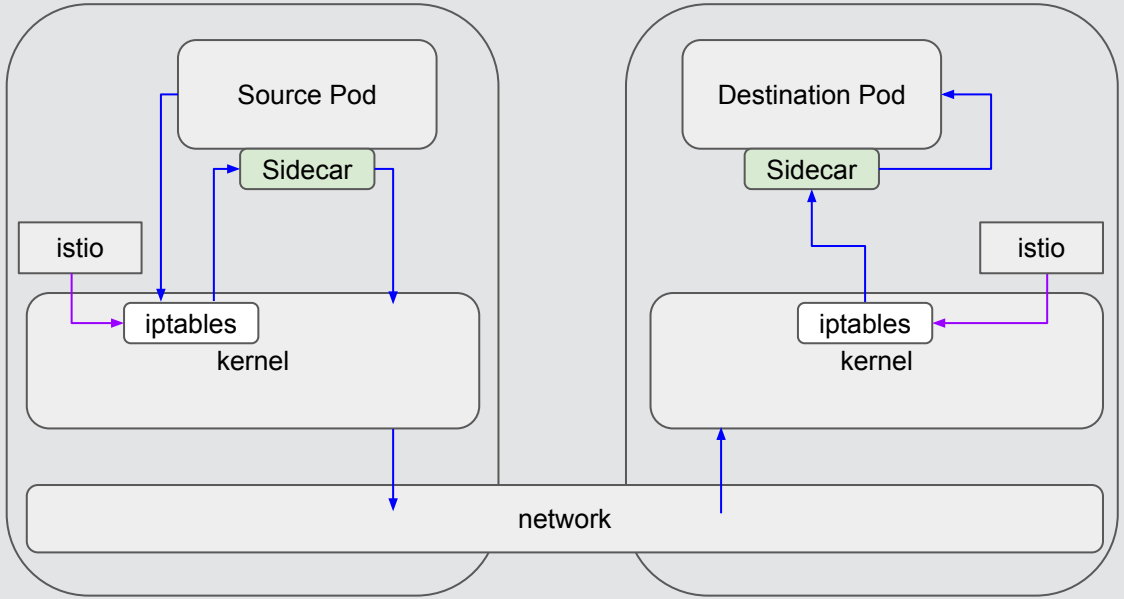
Ambient Mesh

L4 Secure Overlay

ztunnel

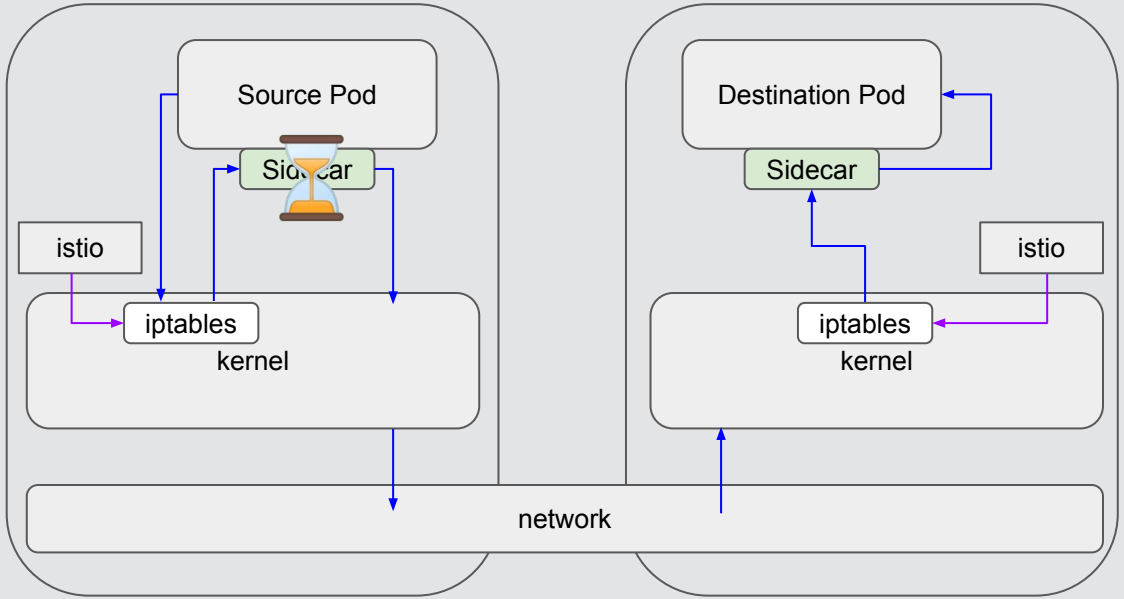
- mTLS,
- Svc-to-svc Authz Policies

Ambient Mesh



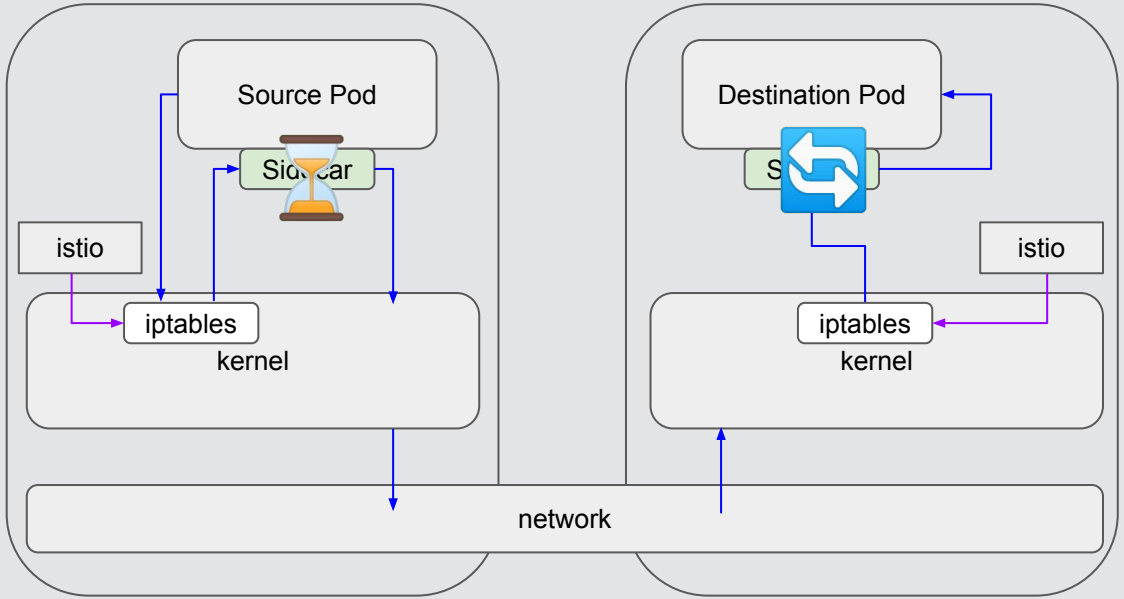
mTLS
control
data

Ambient Mesh



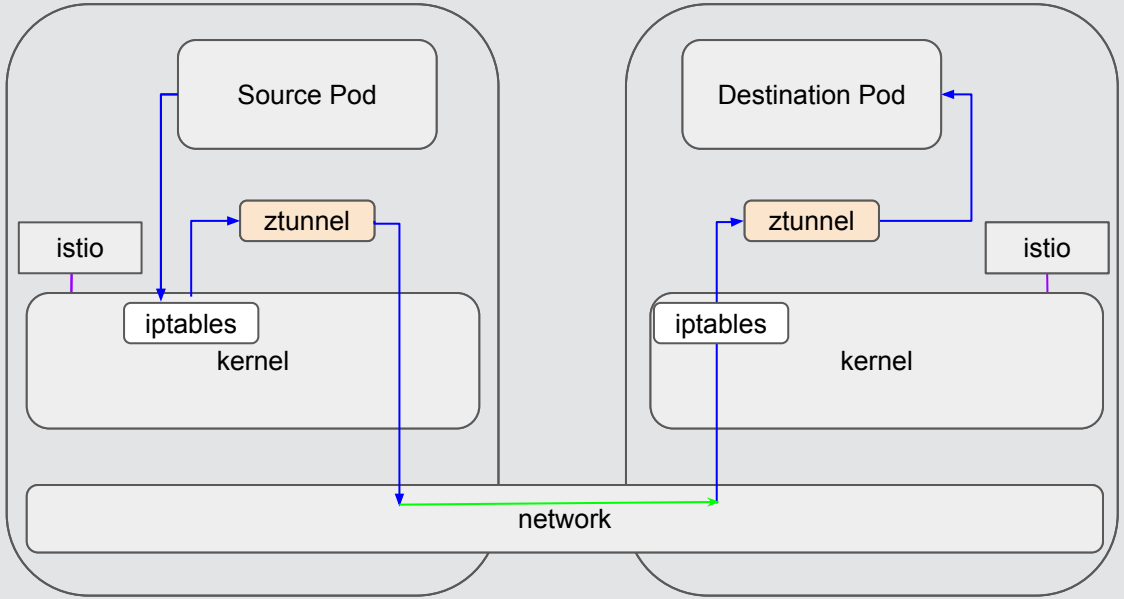
mTLS
control
data

Ambient Mesh



mTLS
control
data

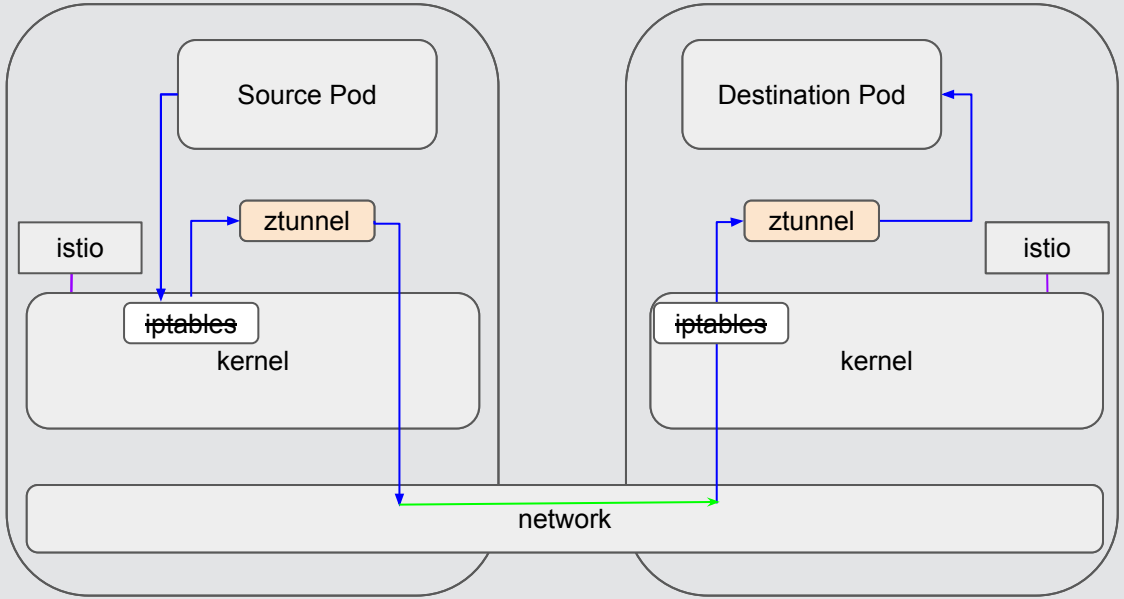
Ambient Mesh



mTLS
control
data

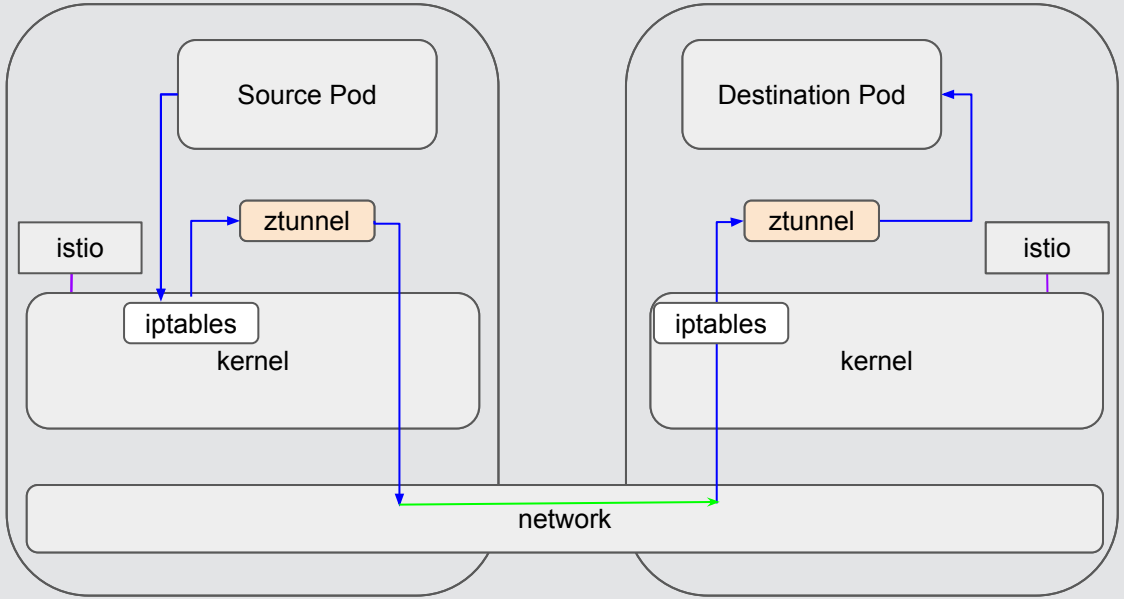
https://github.com/istio/istio/pull/42372

Ambient Mesh



https://github.com/istio/istio/pull/42372

Ambient Mesh



mTLS
control
data

Ambient Mesh

L7 Processing Layer

Waypoint Proxy

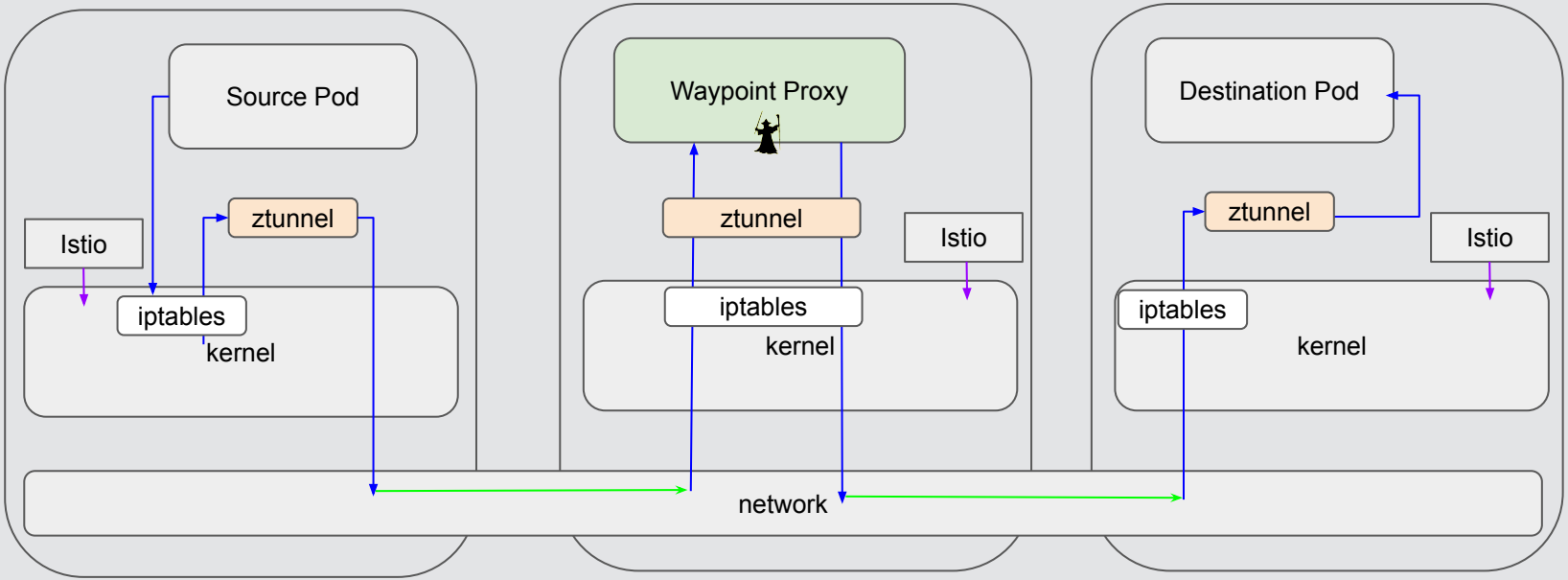
- Rich Authz Policies

L4 Secure Overlay

ztunnel

- mTLS,
- Svc-to-svc Authz Policies

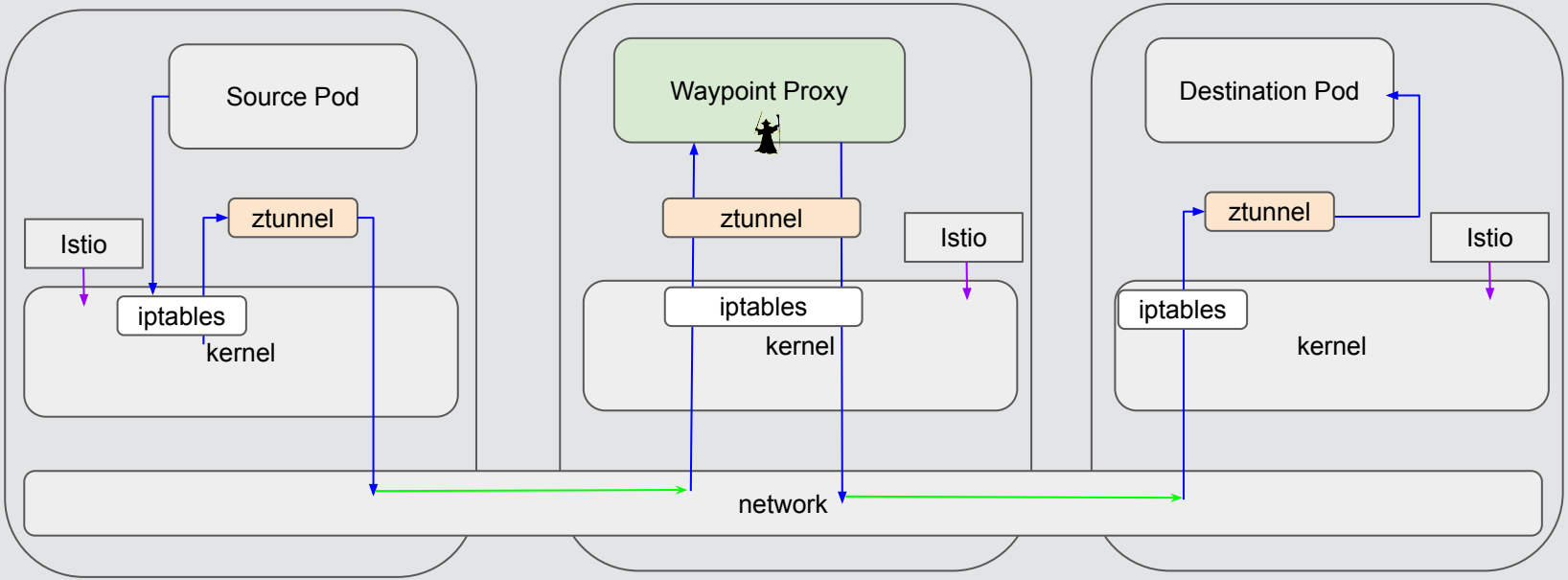
Ambient Mesh



mTLS
control
data

Ambient Mesh

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

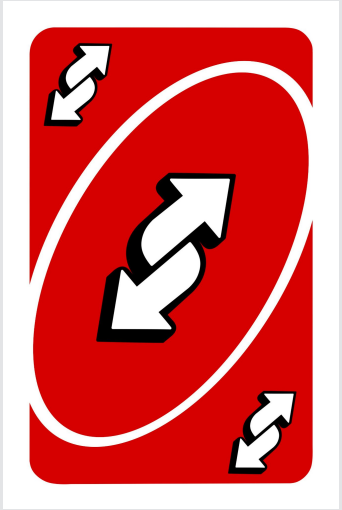


What's a Zero-Trust Tunnel? Exploring Security and Simpler Operations with Istio Ambient Mesh - Jim Barton & Marino Wijay, Solo.io

Room 609

bit.ly/3l00k4Z

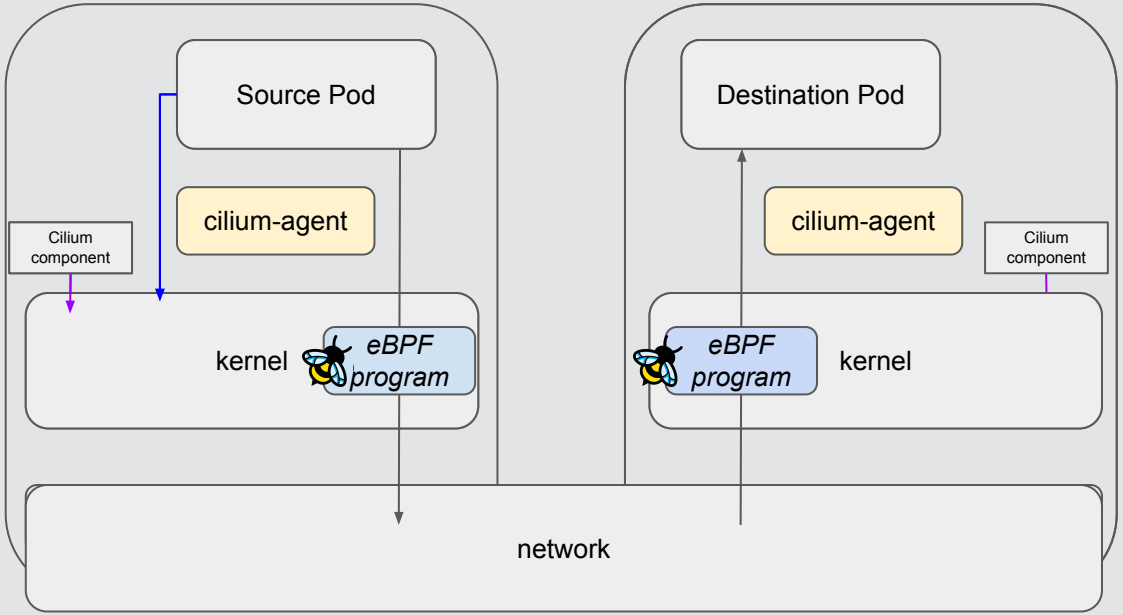
mTLS
control
data



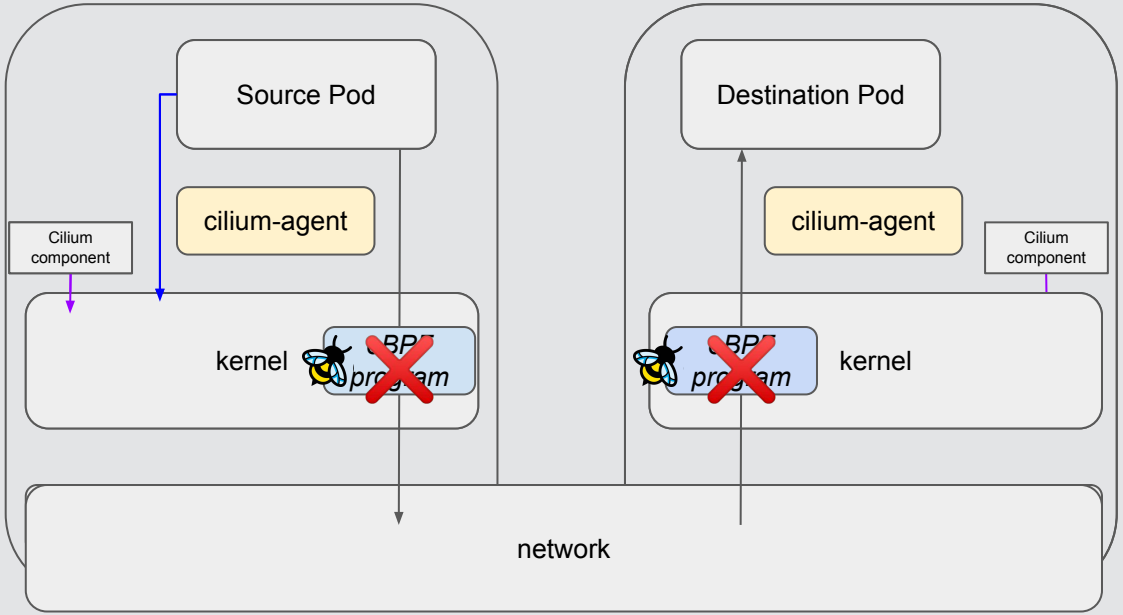
The landscape is changing 🔮

The landscape is changing 🔮

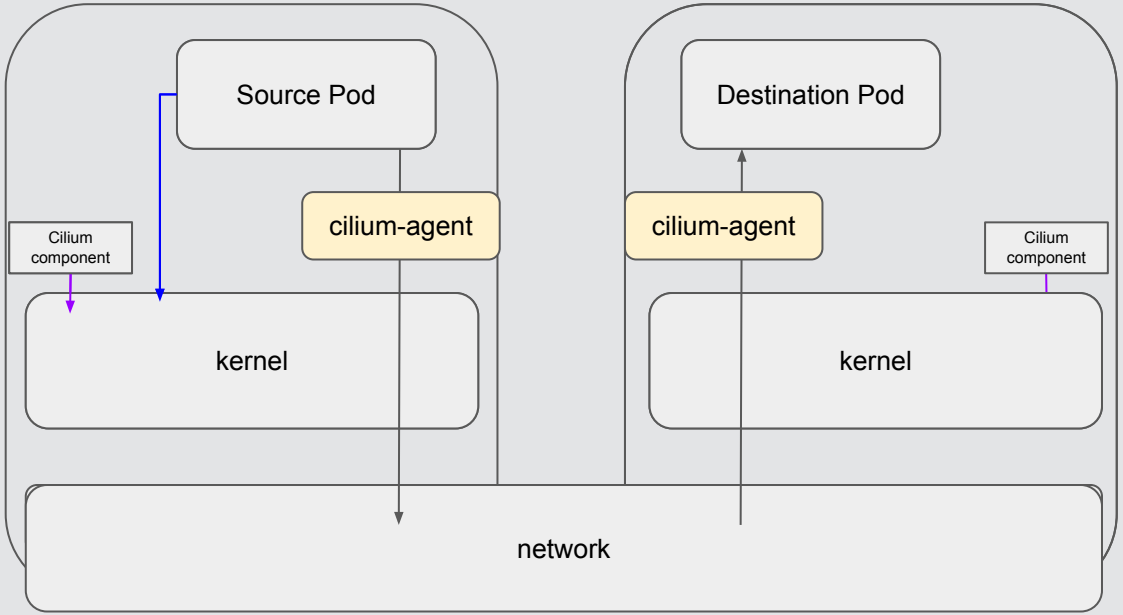
Cilium Service Mesh



Cilium Service Mesh

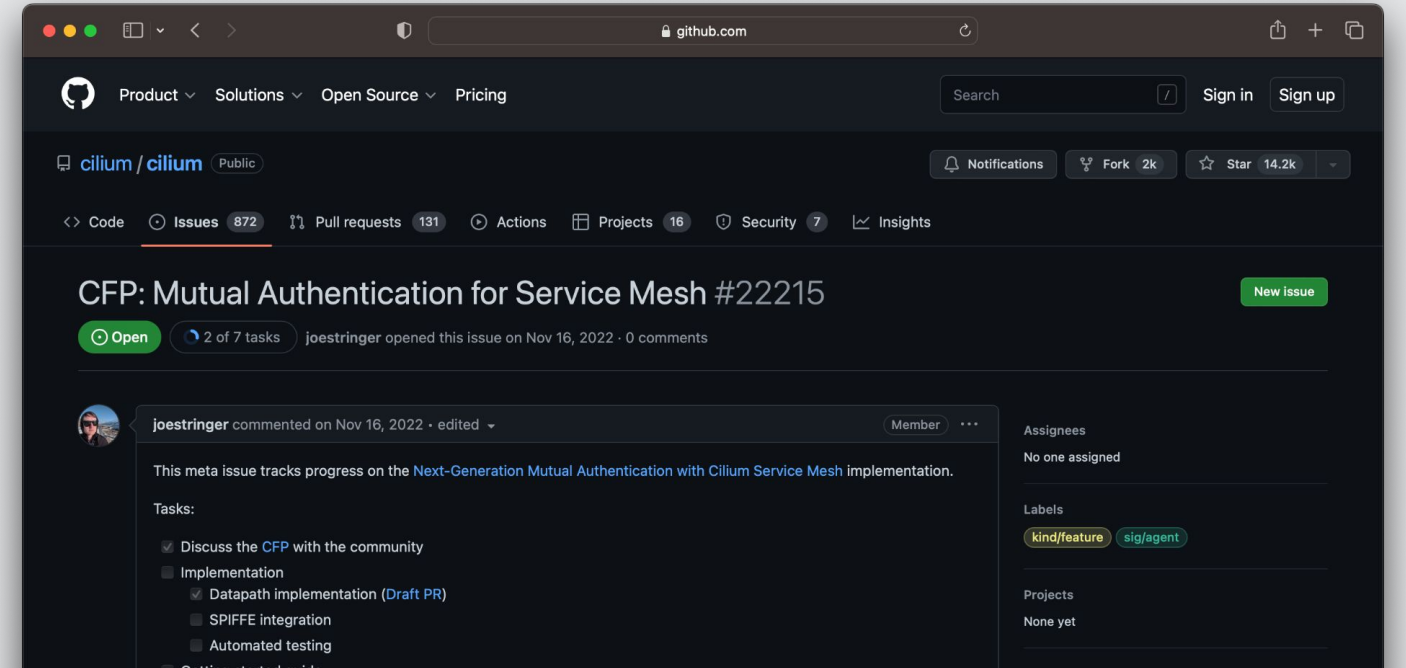


Cilium Service Mesh



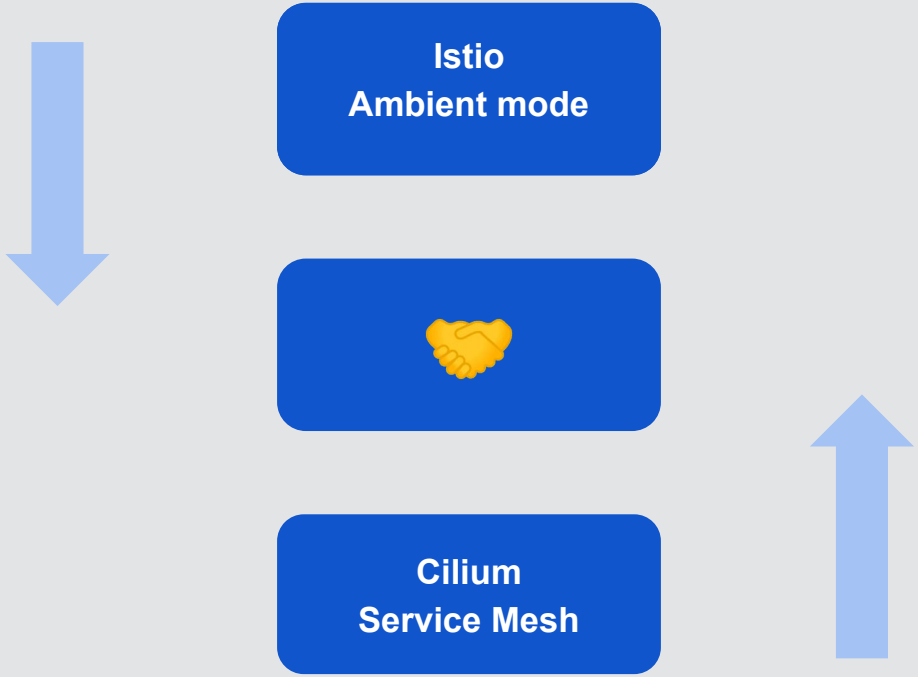
Cilium Service Mesh

- https://github.com/cilium/cilium/issues/22215



The landscape is changing 🔮

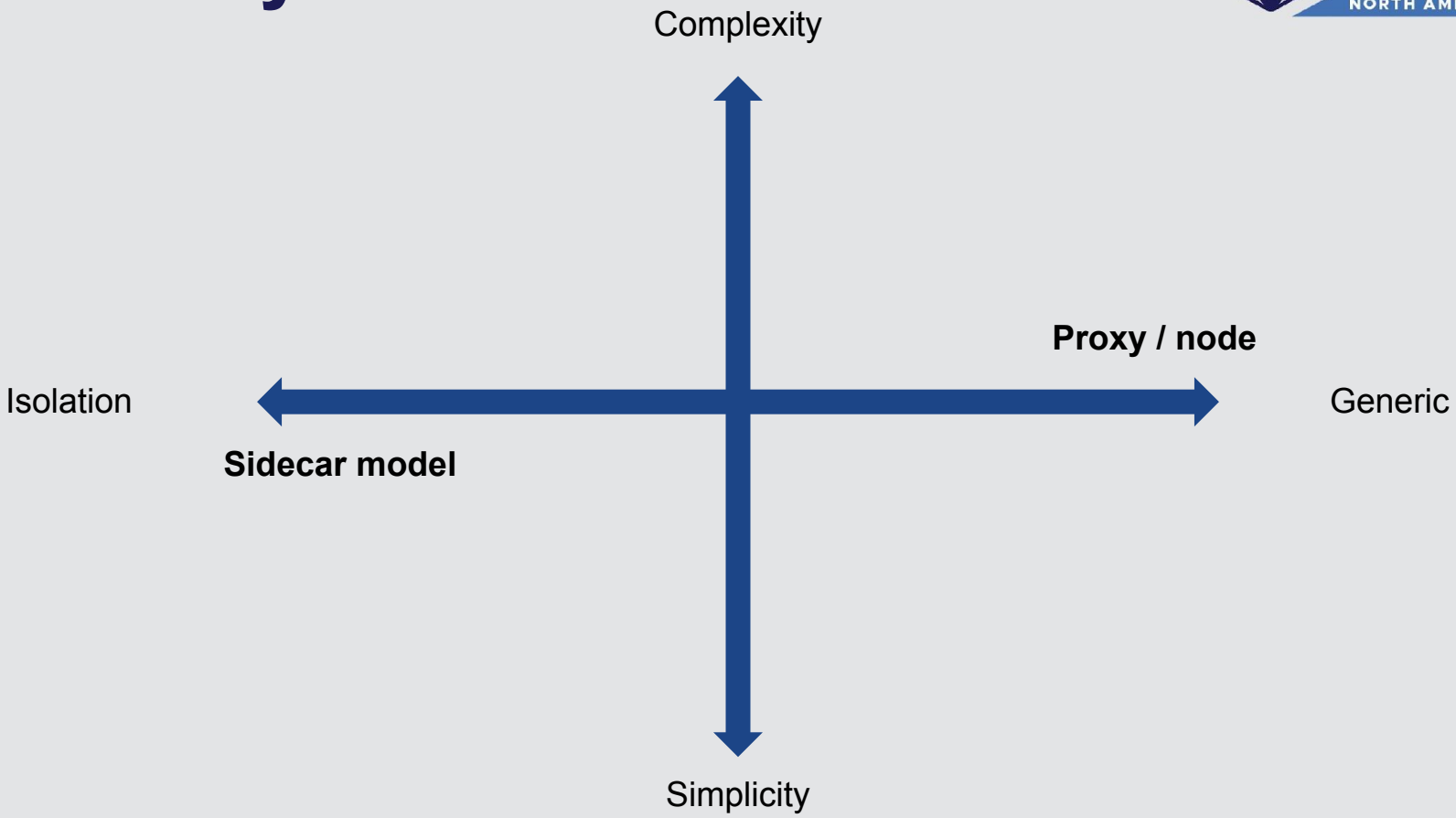
The landscape is ~~changing~~ converging



Takeaways

bit.ly/3YhFrRd

Takeaways




eBPF


CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

eBPF- CNI

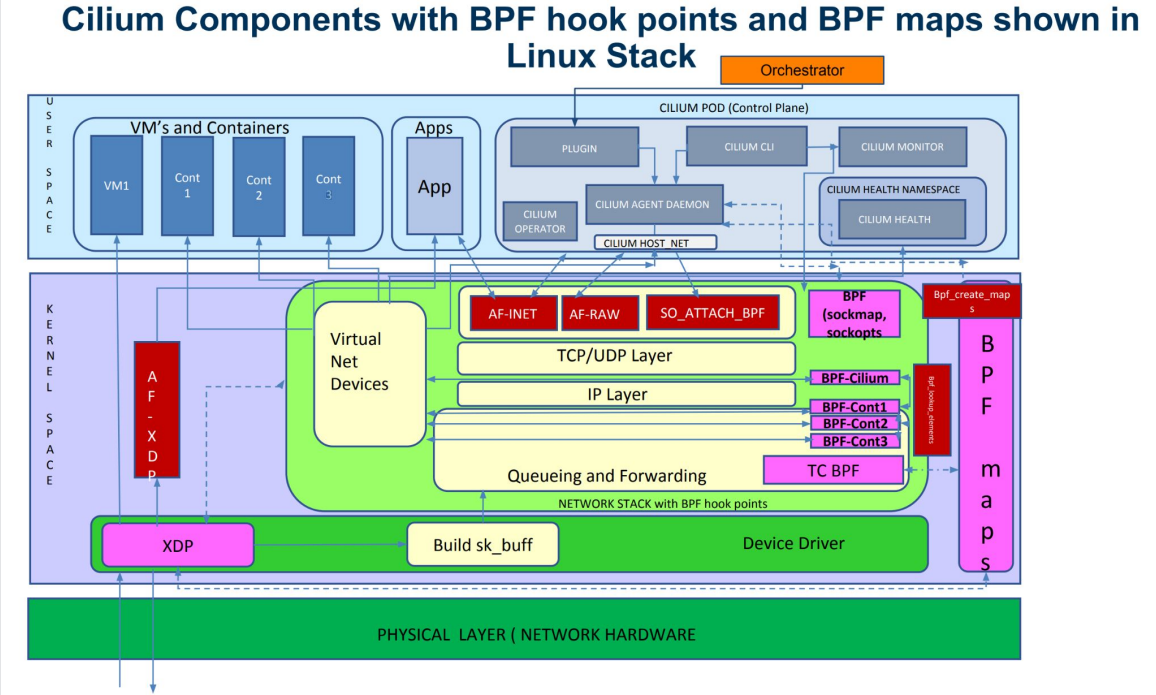
- L3 Observability
- L3 Routing
- L3 Network policy

*Replacing iptables with eBPF in Kubernetes with Cilium - **bit.ly/3DuNNgt***

eBPF

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

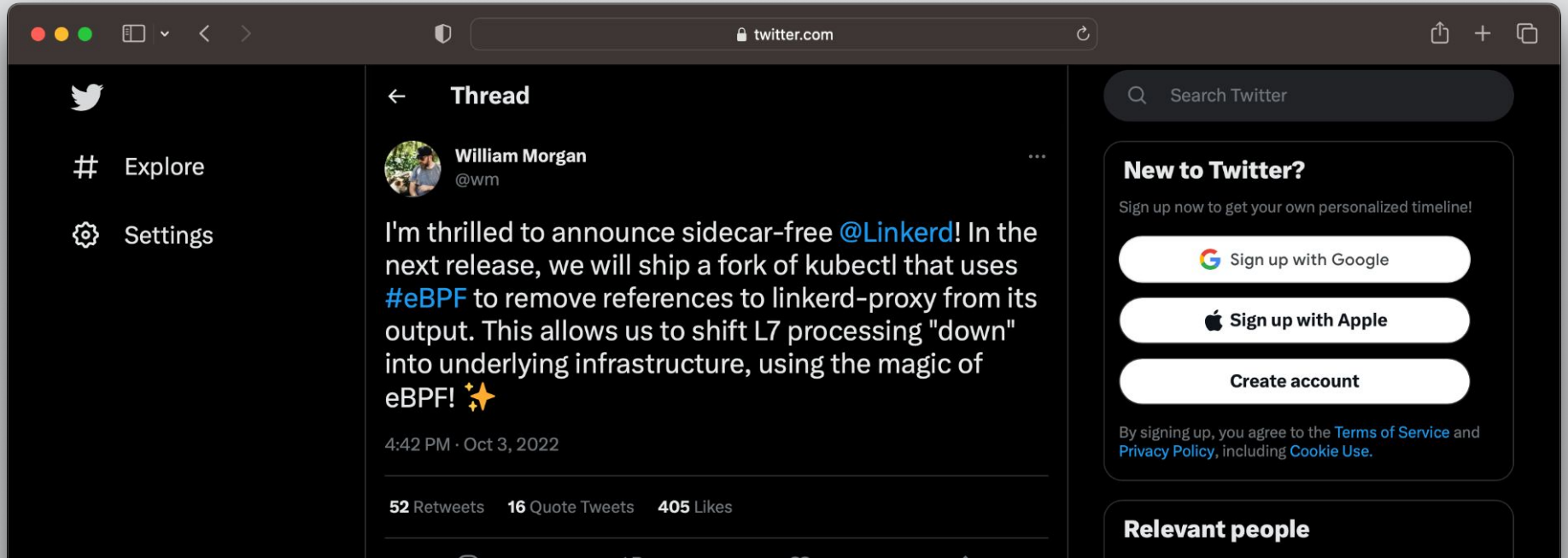
- L3 Observability
- L3 Routing
- L3 Network policy



*Replacing iptables with eBPF in Kubernetes with Cilium - **bit.ly/3DuNNgt***

eBPF

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023



Takeaways

Takeaways

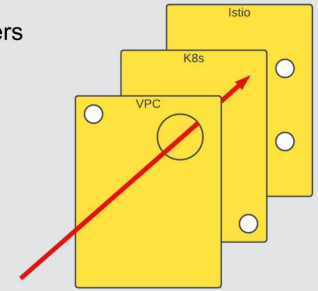
Takeaways

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

Takeaways

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

- **Self-service platforms are hard**
  - Safeguards to avoid users shooting themselves in the foot
  - Provide a Golden Path to avoid configuration errors
- **Defense in depth**: Add redundant security at all layers
- **Observability is key**
  - Help debug
  - Detect misconfiguration



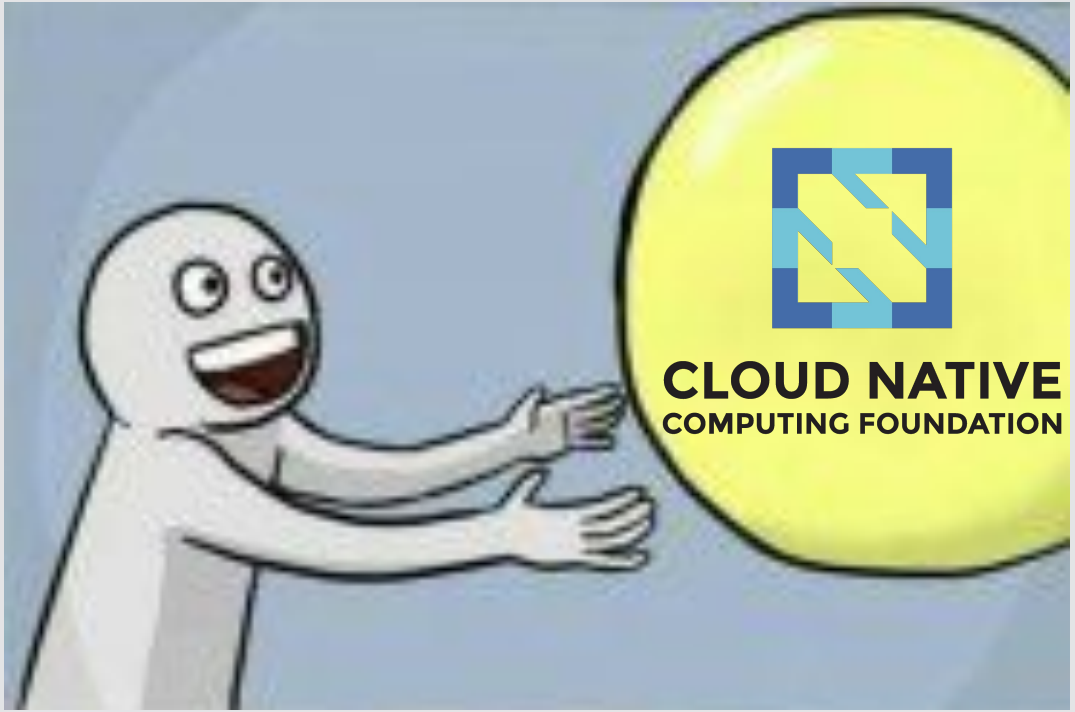
Network Security at Scale: L3 Through L7 at Splunk - Mitch Connors, Aviatrix & Bernard Van De Walle, Splunk

Room 612

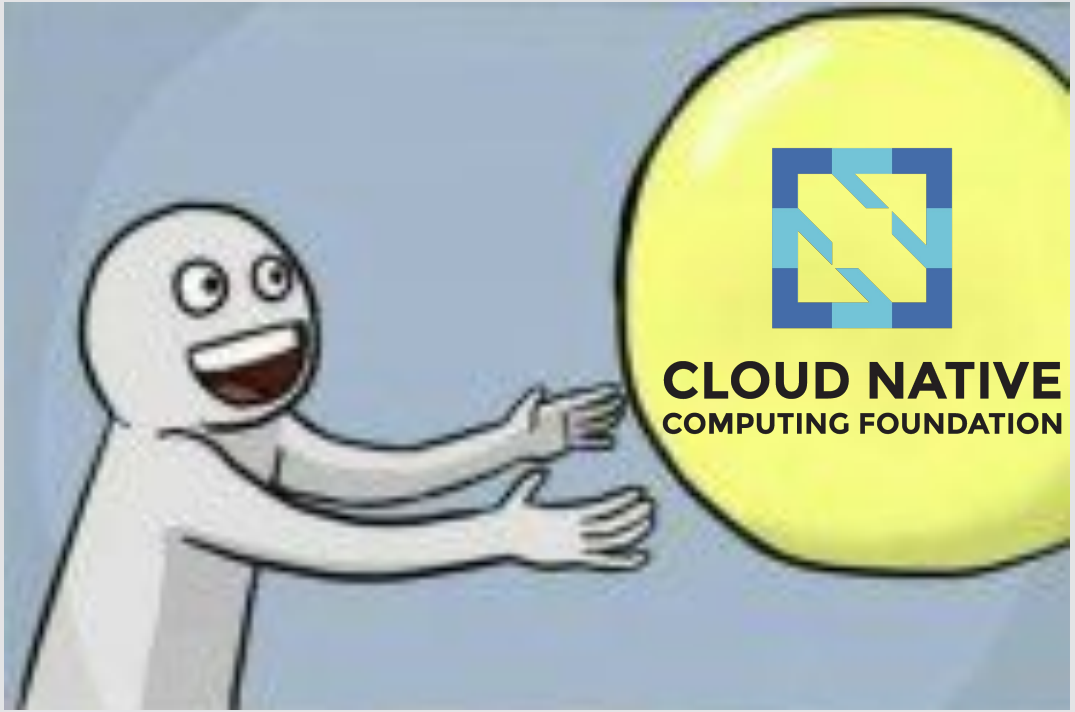
bit.ly/3Hy86uD

Call to action

Call to action

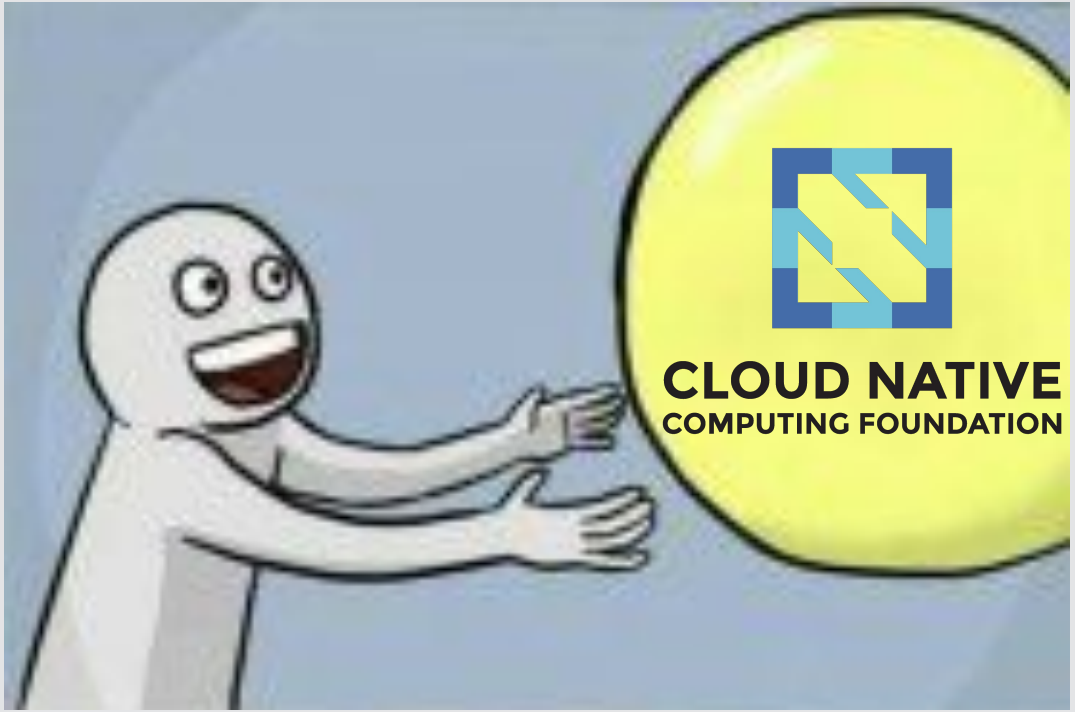


Call to action



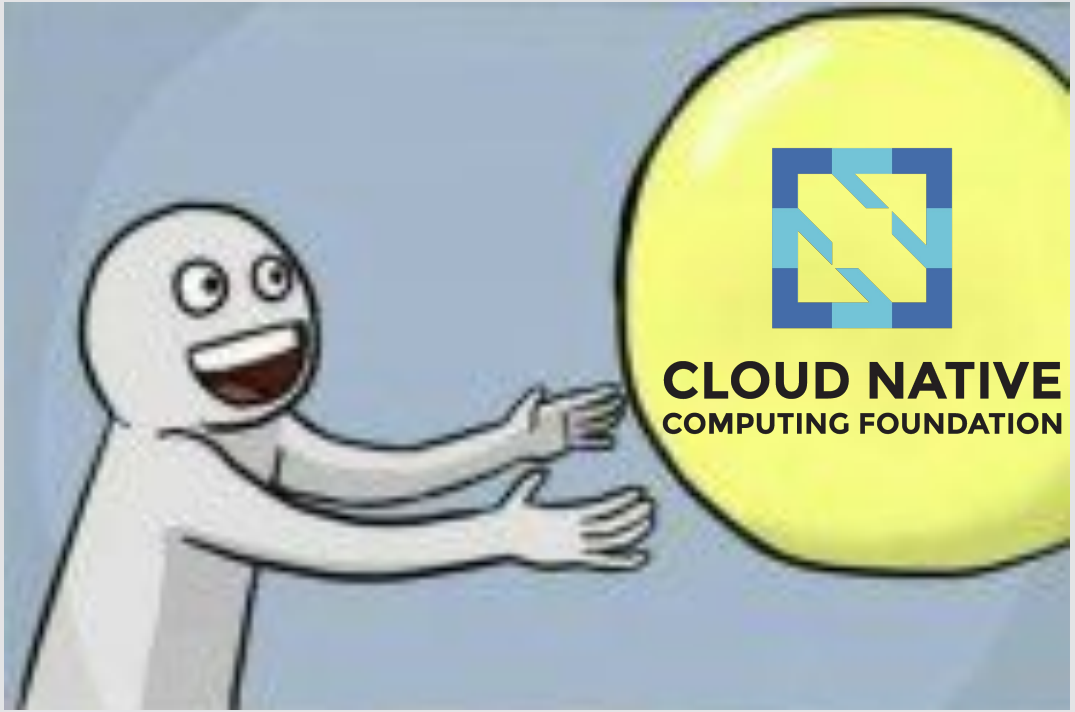
https://istio.io/latest/blog/2022/get-started-ambient/

Call to action



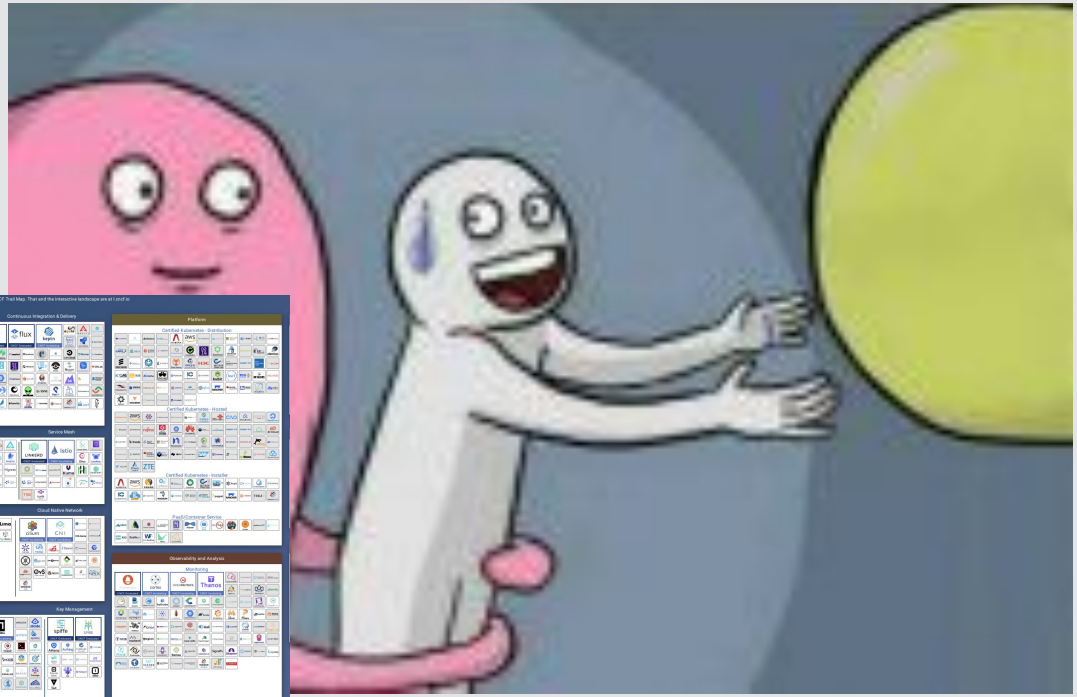
https://github.com/cilium/cilium/issues/22215

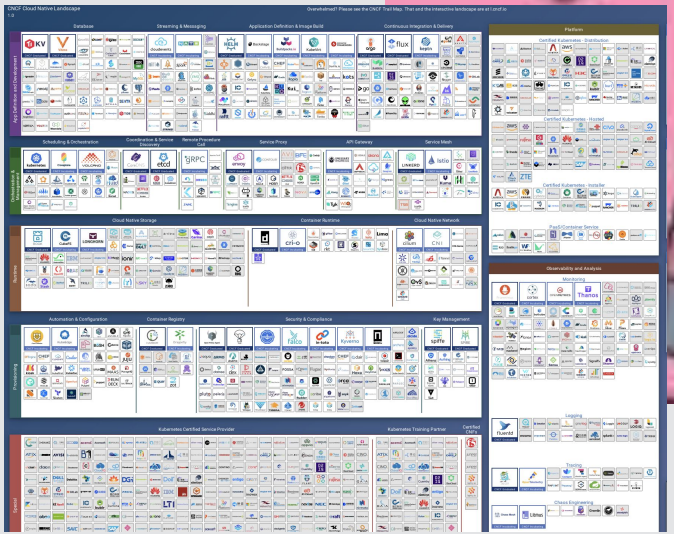
Call to action



Call to action

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

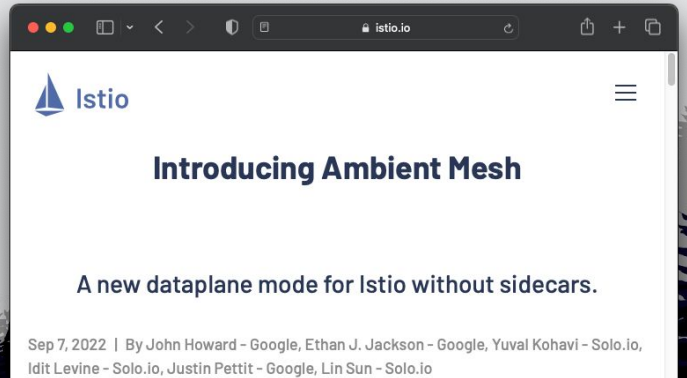




CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

cilium

Istio



CLOUDNATIVE
SECURITYCON
NORTH AMERICA 2023

Christine Kim - Google

Rob Salmond - SuperOrbital

Thanks for Listening!

CLOUDNATIVE SECURITYCON NORTH AMERICA 2023

Scan or visit
sched.co/1FV12
to get slides and
share feedback.

Demo? Questions?