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A Guided Tour of Cilium Service Mesh

Liz Rice | @lizrice

Chief Open Source Officer, Isovalent

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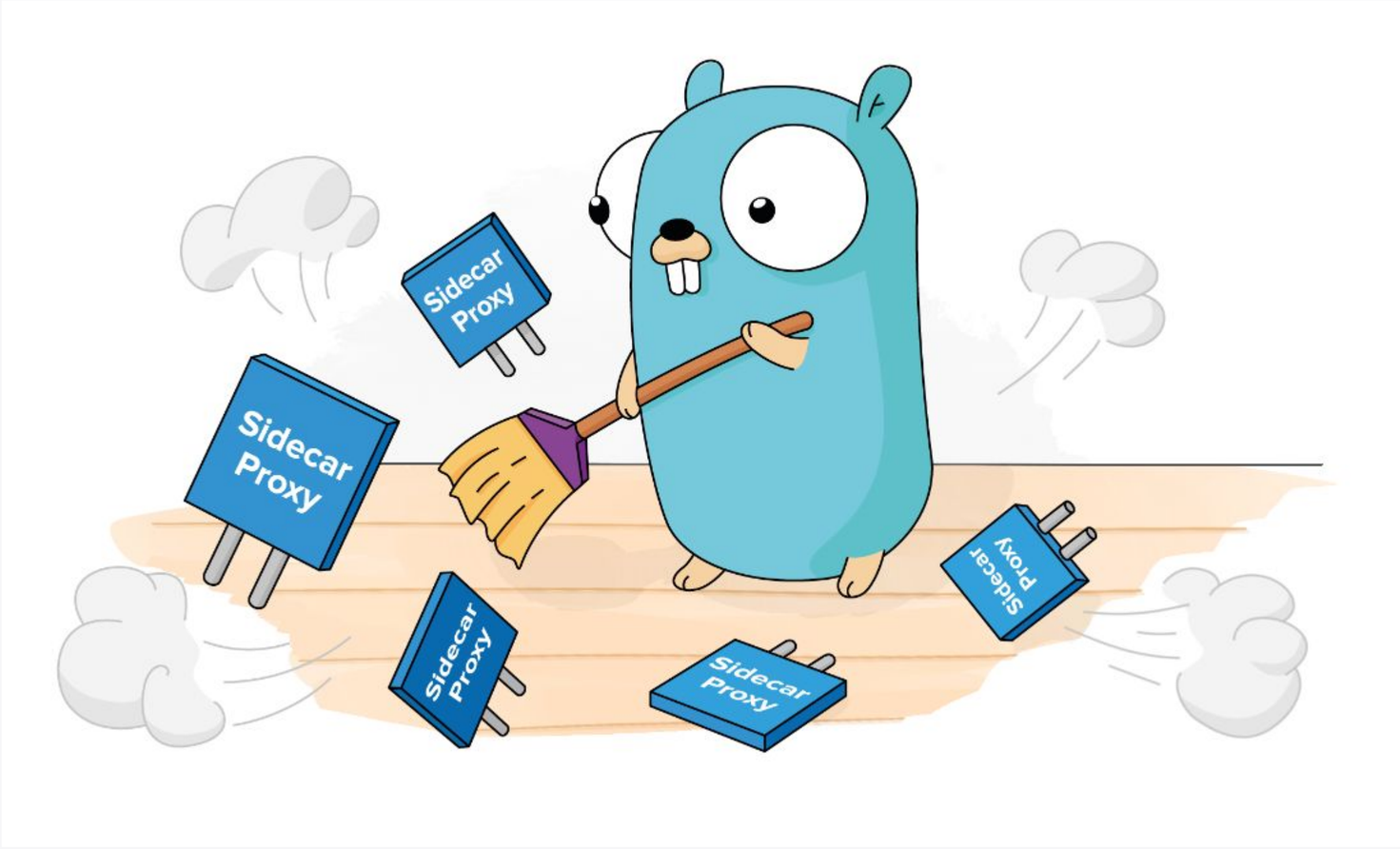
Goodbye Sidecars



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Cilium CNI Overview

Efficient and scalable Kubernetes CNI

- IPv4, IPv6, NAT46, SRv6, ...
- Overlays, BGP, Cloud Provider SDNs

Security

- Kubernetes Network Policy
- Cilium Network Policy (FQDN, L7, ...)
- Transparent Encryption

High performance load-balancing

- Kubernetes proxy replacement
- North-South load-balancer

Multi-Cluster & external workloads

- Global Services, Service Discovery...
- Integration of Metal & VMs
- Egress Gateway

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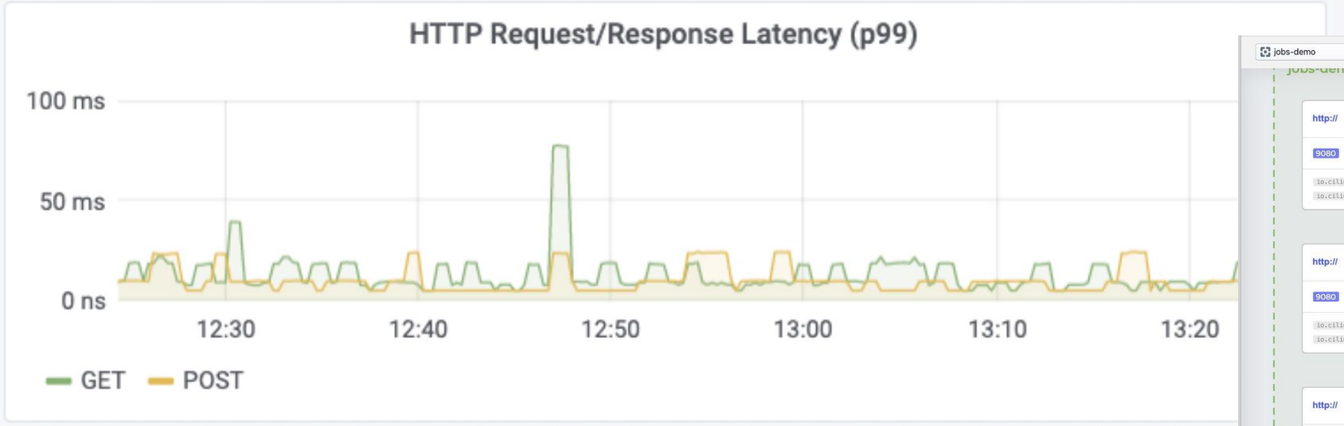
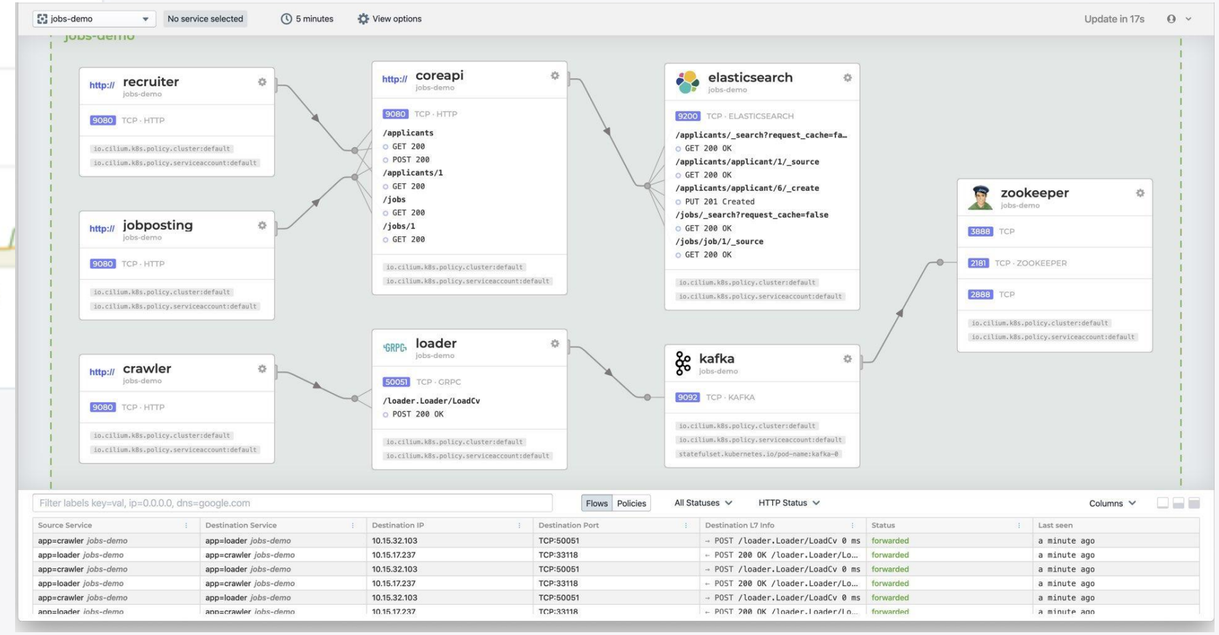
Cilium Hubble observability





Identity-aware visibility

- Network flow logs
- Metrics
- Service map
- L3/4 & L7 (HTTP, DNS, Kafka, ...)



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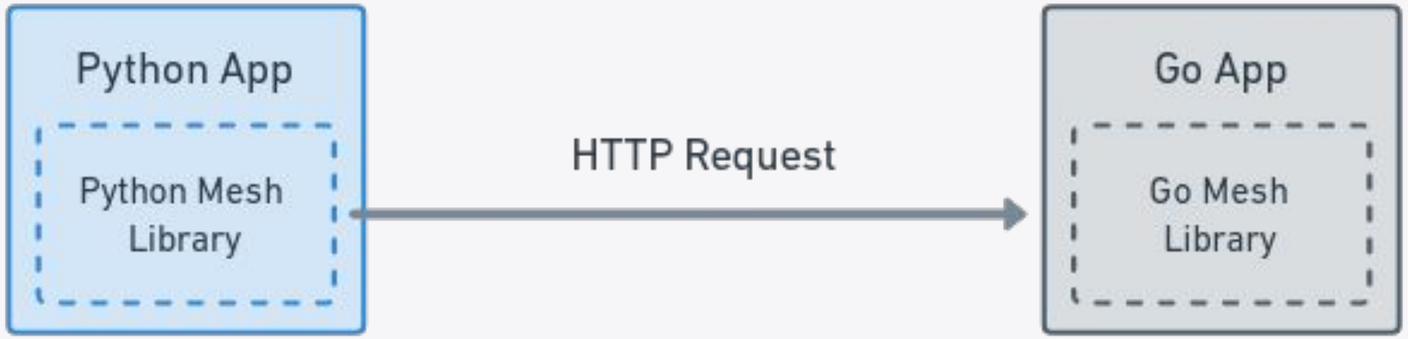
Service Mesh origins



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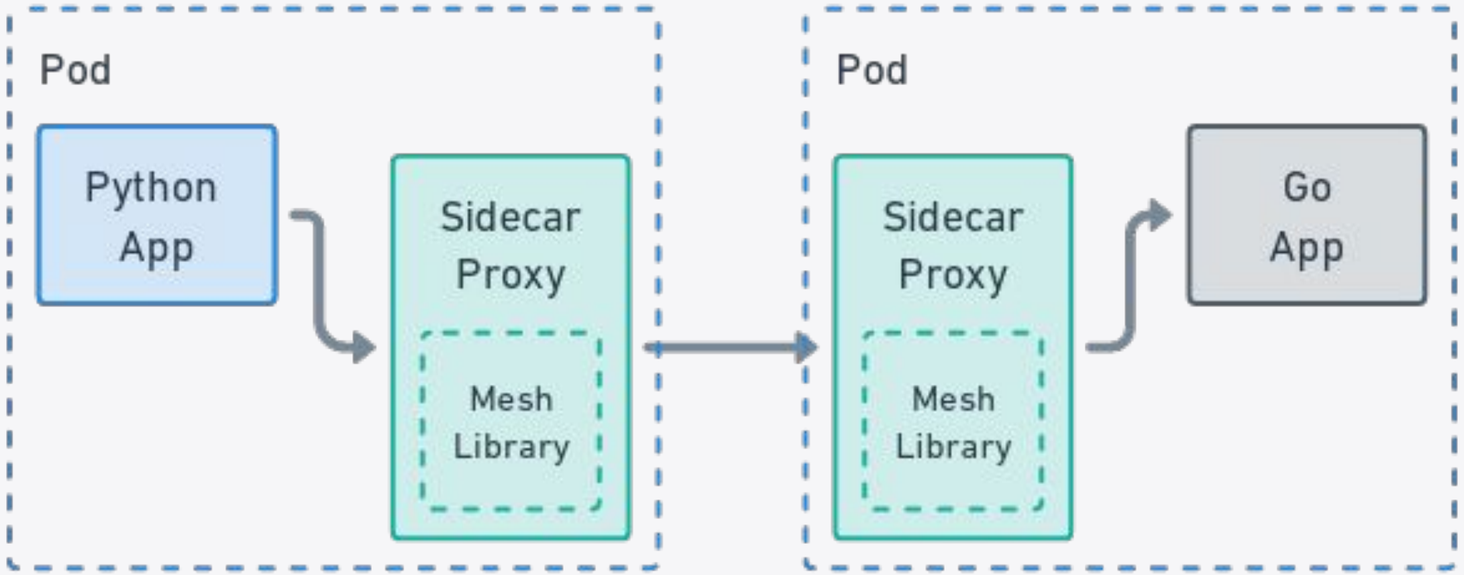
Service Mesh with Sidecars



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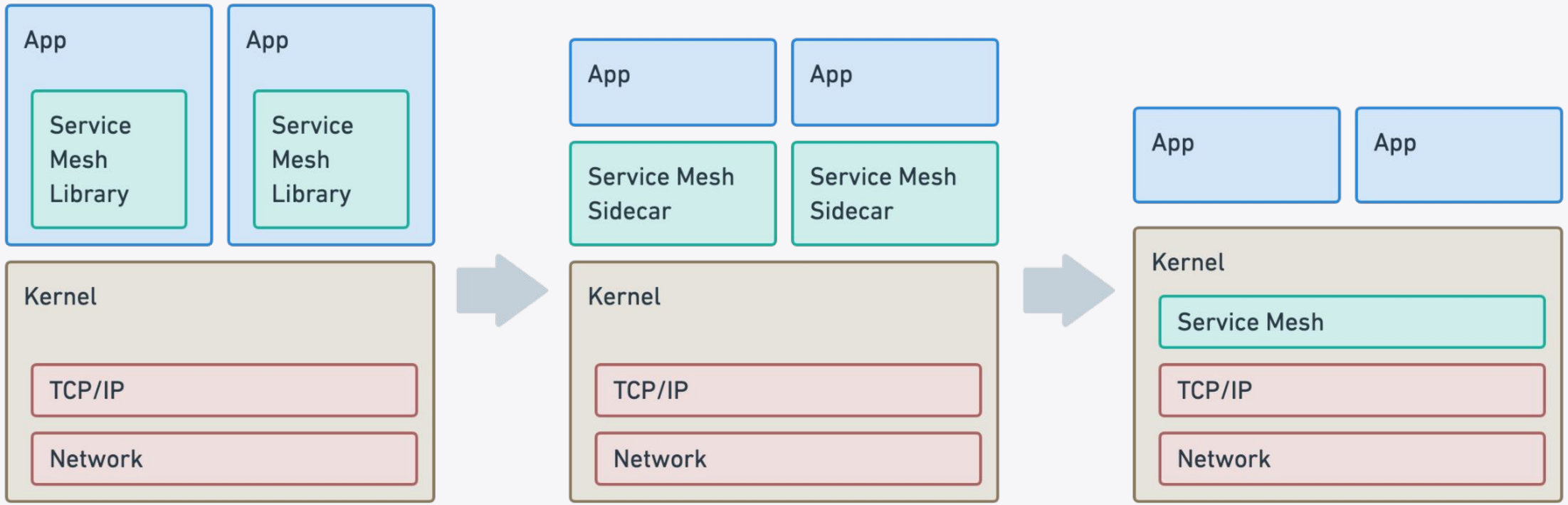
Can we move Service Mesh to the kernel?



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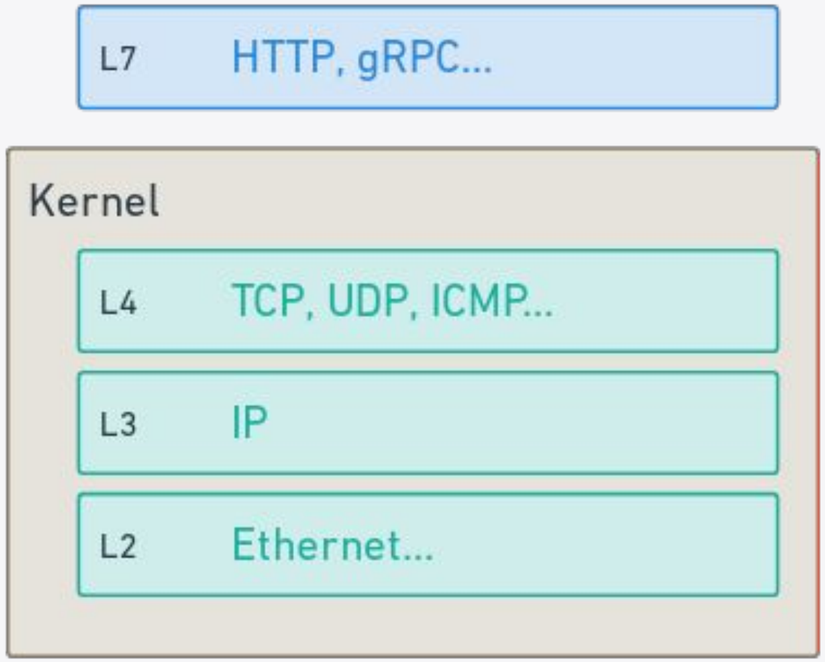
L7 is the only part that is not already there



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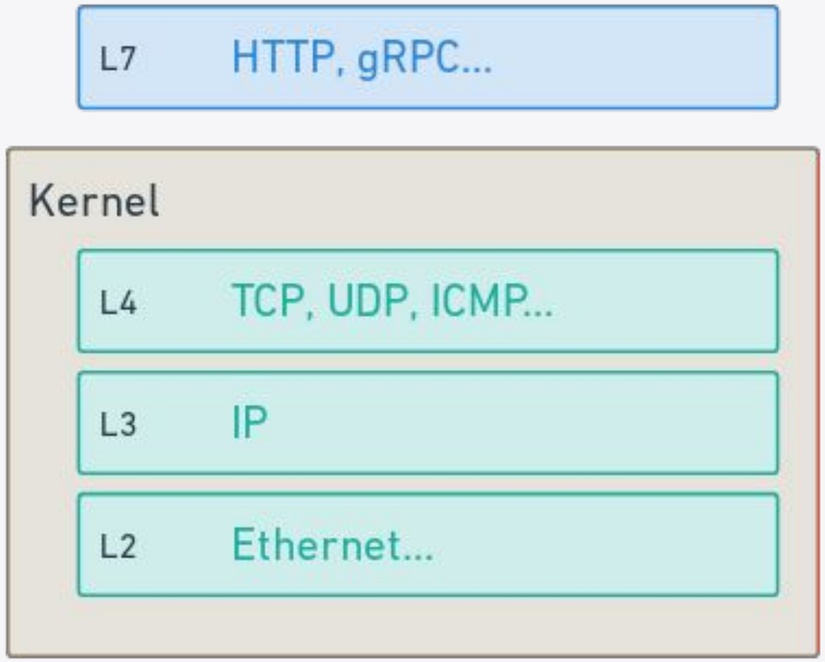
Yet, Cilium already has L7 network policies and visibility



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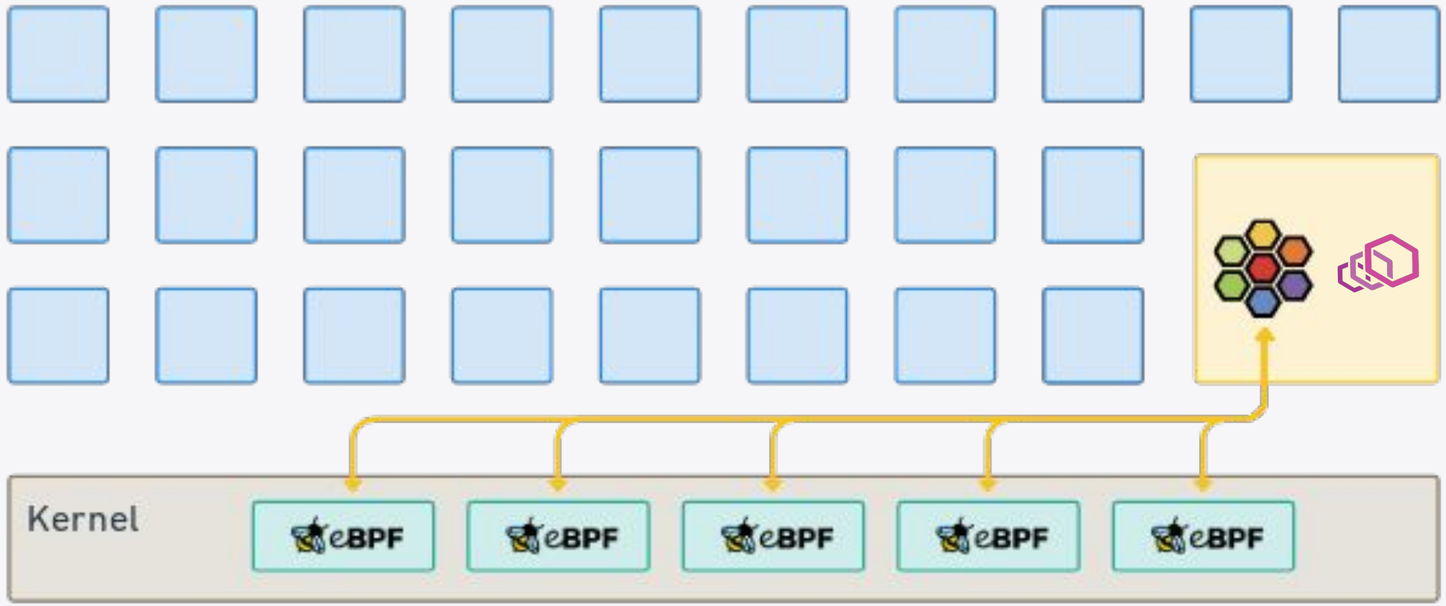
Cilium architecture



- Agent per node
- Dynamic eBPF programs
- Envoy for L7

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Demo - L7 visibility & policy

- Hubble flow shows HTTP
- Policy for allowing / denying traffic based on headers / path
- Prometheus & Grafana metrics

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```
May 20 10:27:21.409: 192.168.170.229:58932 ← farfaraway/deathstar-6f87496b94-pxcp2:80 to-stack FORWARDED (TCP Flags: SYN, ACK)
May 20 10:27:21.409: 192.168.170.229:58932 → farfaraway/deathstar-6f87496b94-pxcp2:80 to-endpoint FORWARDED (TCP Flags: ACK)
May 20 10:27:21.409: 192.168.170.229:58932 → farfaraway/deathstar-6f87496b94-pxcp2:80 to-endpoint FORWARDED (TCP Flags: ACK, FIN)
May 20 10:27:21.410: 10.0.3.133:50714 → farfaraway/deathstar-6f87496b94-pxcp2:80 http-request DROPPED (HTTP/1.1 GET http://deathstar.farfaraway.svc.cluster.local/v1)
May 20 10:27:21.410: 192.168.170.229:58934 → farfaraway/deathstar-6f87496b94-pxcp2:80 L3-L4 FORWARDED (TCP Flags: SYN)
May 20 10:27:21.410: 192.168.170.229:58934 → farfaraway/deathstar-6f87496b94-pxcp2:80 to-endpoint FORWARDED (TCP Flags: SYN)
May 20 10:27:21.410: 192.168.170.229:58934 ← farfaraway/deathstar-6f87496b94-pxcp2:80 to-stack FORWARDED (TCP Flags: SYN, ACK)
May 20 10:27:21.410: 192.168.170.229:58934 → farfaraway/deathstar-6f87496b94-pxcp2:80 to-endpoint FORWARDED (TCP Flags: ACK)
May 20 10:27:21.410: farfaraway/deathstar-6f87496b94-pxcp2:80 ◇ 10.0.3.133:50714 to-overlay FORWARDED (TCP Flags: ACK, PSH)
May 20 10:27:21.410: 10.0.3.133:50714 ◇ farfaraway/deathstar-6f87496b94-pxcp2:80 to-overlay FORWARDED (TCP Flags: ACK)
May 20 10:27:21.411: 192.168.170.229:58932 ← farfaraway/deathstar-6f87496b94-pxcp2:80 to-stack FORWARDED (TCP Flags: ACK, FIN)
```

Default (-zsh)

```
  Description:  L7 policy to restrict access to specific HTTP call
  Endpoint Selector:
    Match Labels:
      Class:  deathstar
      Org:    empire
  Ingress:
    From Endpoints:
      Match Labels:
        Org:  empire
    To Ports:
      Ports:
        Port:      80
        Protocol:  TCP
      Rules:
        Http:
          Method:  POST
          Path:    /v1/request-landing
```

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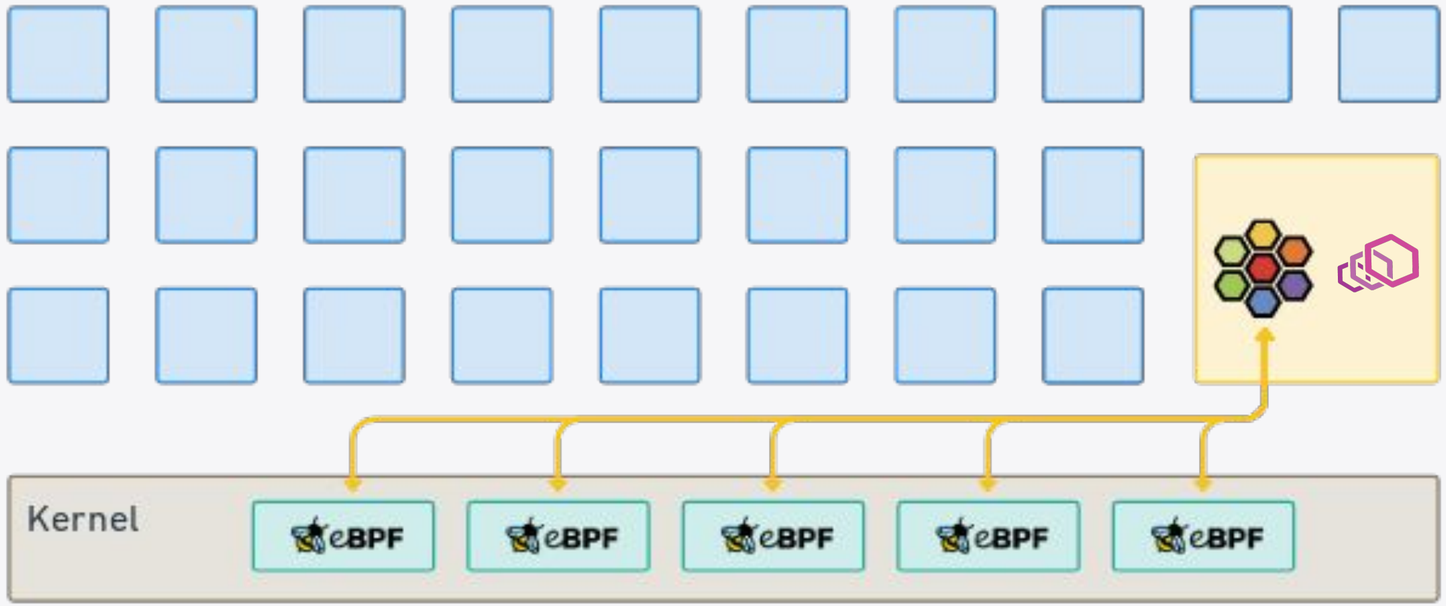
Cilium architecture



- Agent per node
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- Envoy for L7

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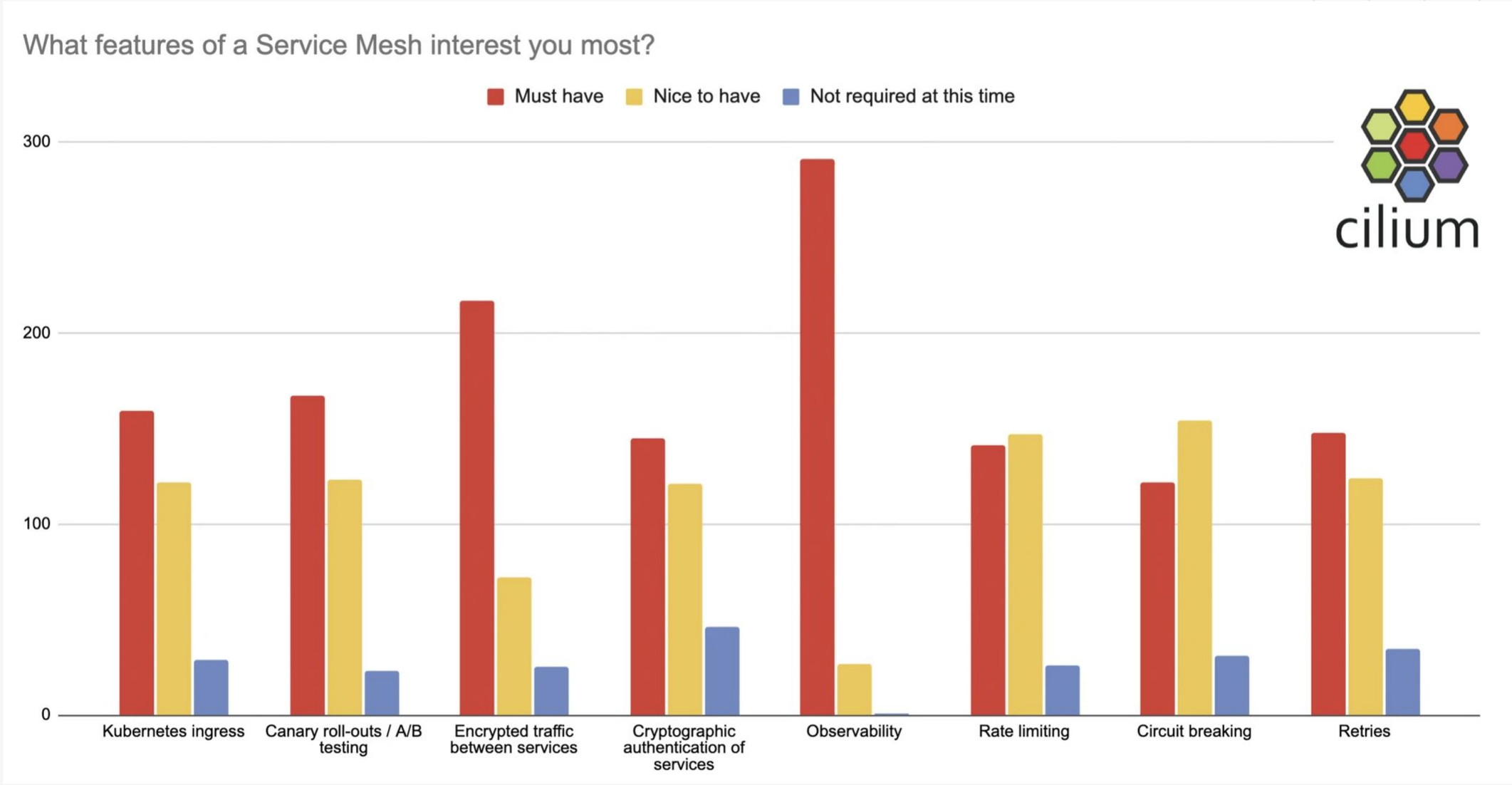

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What is a Service Mesh?

- Observability
- Ingress
  - Load balancing (N-S)
  - Protocol parsing
  - Path-based routing
- L7 traffic management
  - Service load balancing (E-W)
  - Rules (canary rollouts, retries etc)
- Identity-based security

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What is a Service Mesh?

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  - **Protocol parsing**
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- **Identity-based security**

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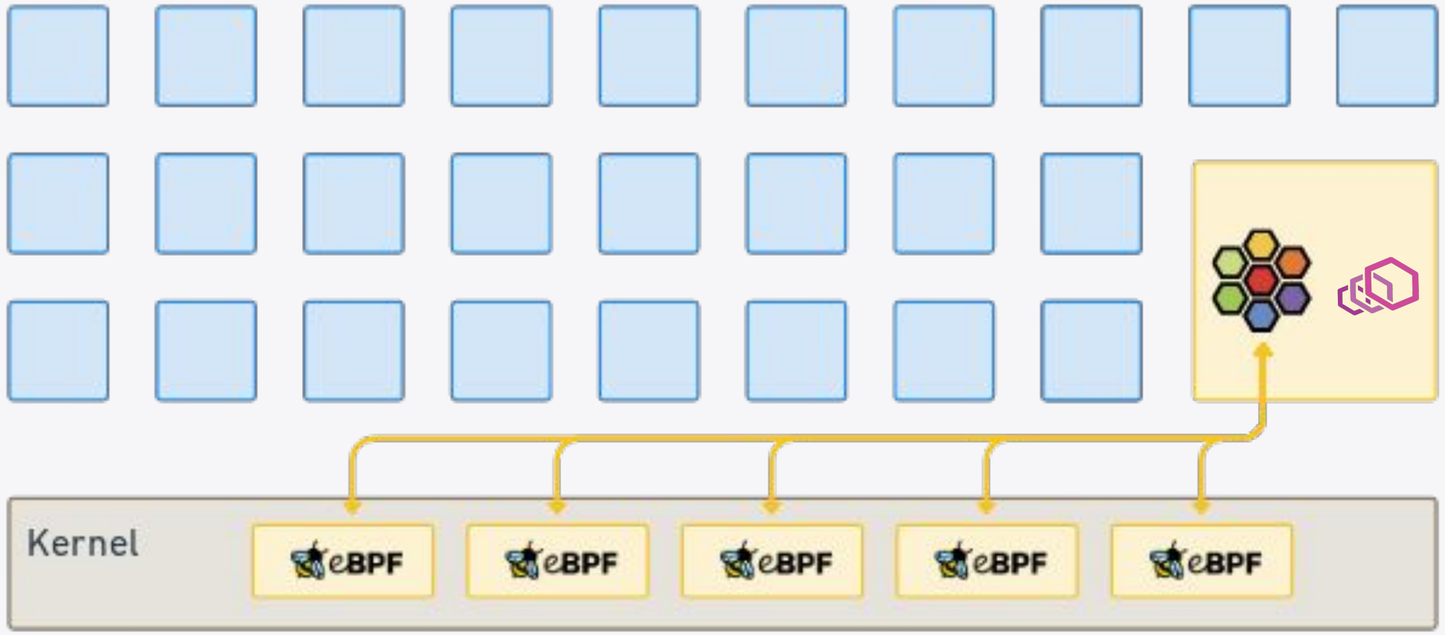
Cilium agent per node



- Dynamic eBPF programs
- Envoy for L7 policies & observability

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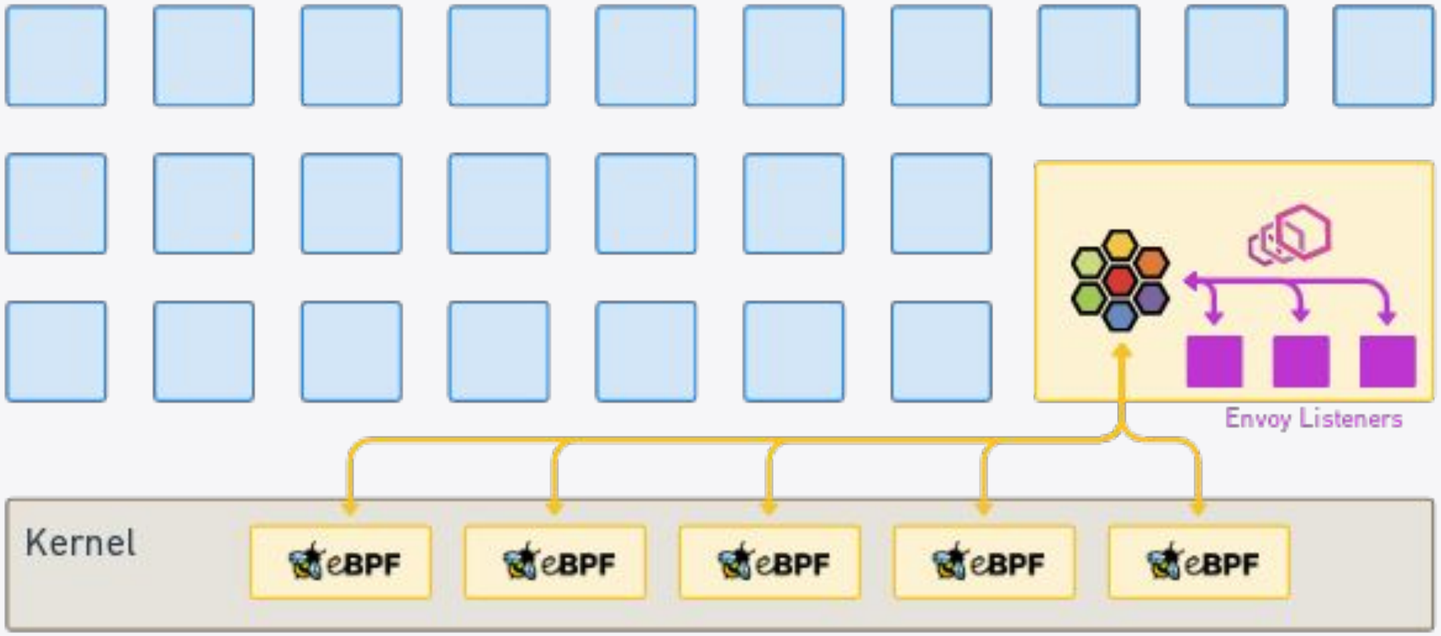
Cilium for sidecarless service mesh



- Dynamic eBPF programs
- Envoy for L7 policies & observability and **traffic management rules** etc

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Ingress Demo

- Kubernetes ingress support
- Creates underlying CiliumEnvoyConfig

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Beta tester comments

“ While we're big fans of Envoy we're not hugely fond of the sidecar model and the extra latency & complexity involved ”

Beta tester comments

“ We've always avoided traditional service mesh as it seemed like too much overhead/complexity compared to the value it provided, however with Cilium it could be the best of both worlds ”

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Beta tester comments

“ Service meshes provide plenty of good features, but most of them also add a lot of complexity and overhead. Having a sidecarless service mesh together with a CNI sounds like a perfect solution ”

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Why are you interested in Cilium Service Mesh?

- Reducing operational complexity
- Reduced resource usage
- Better performance
- Avoid sidecar start-up/shut-down race conditions

Source data from survey

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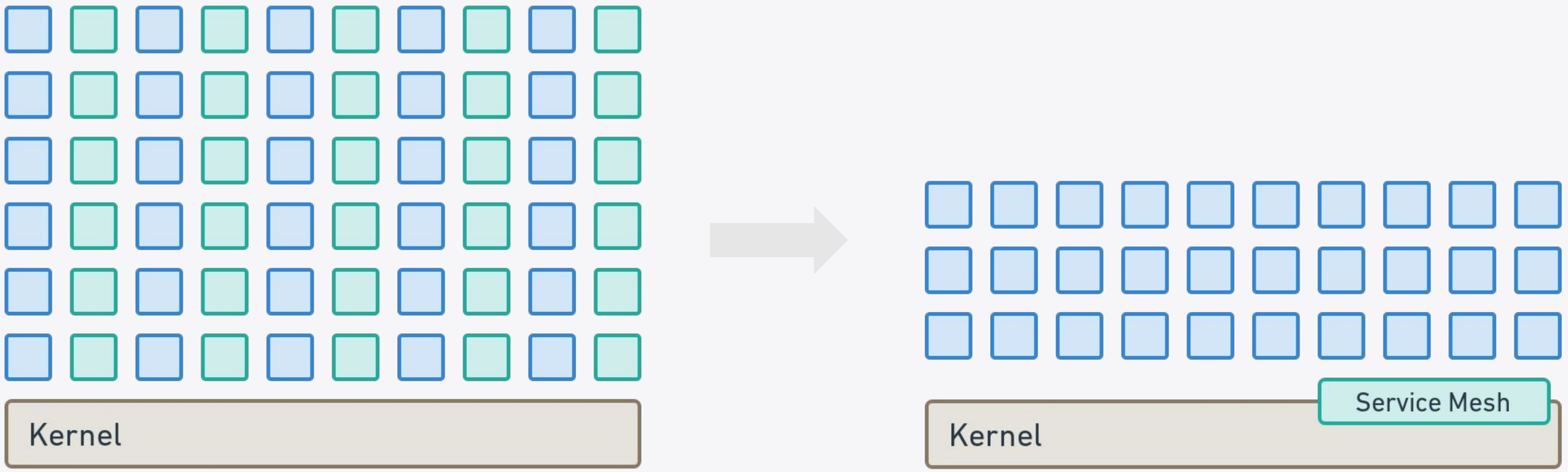
Reduce resource usage



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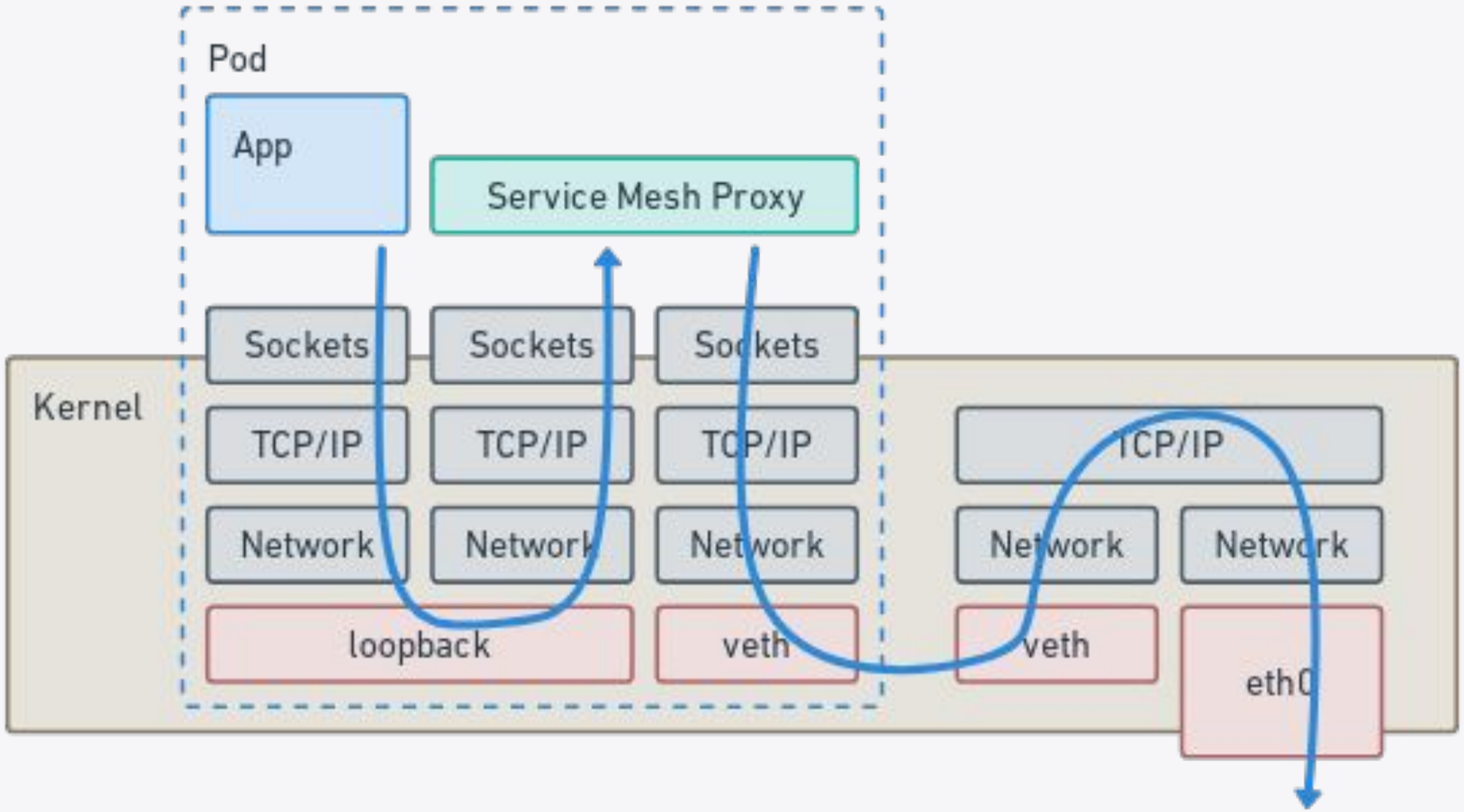
Network path with sidecar



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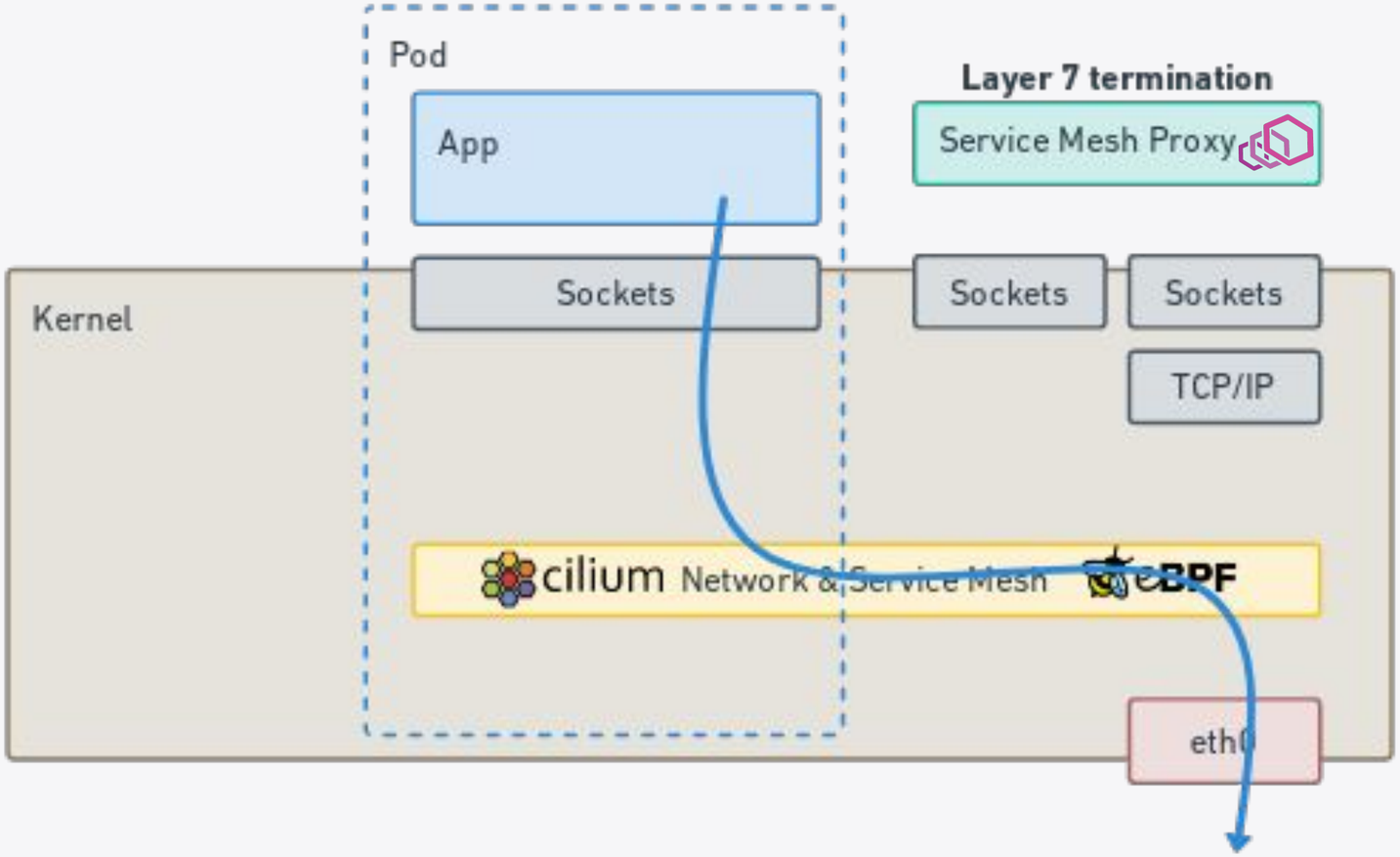
Network path for L3/4 traffic



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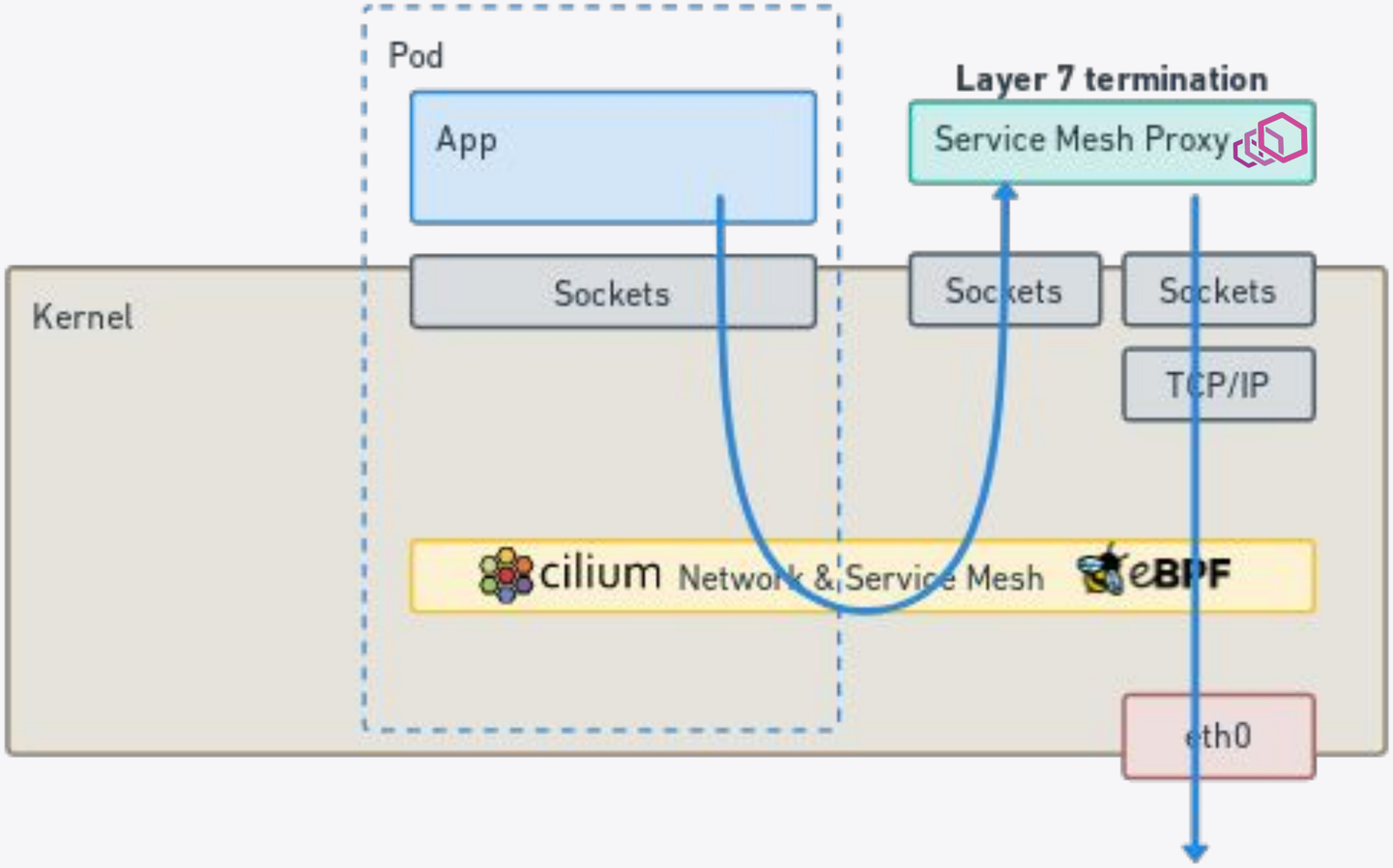
Envoy for Layer 7 terminations when needed



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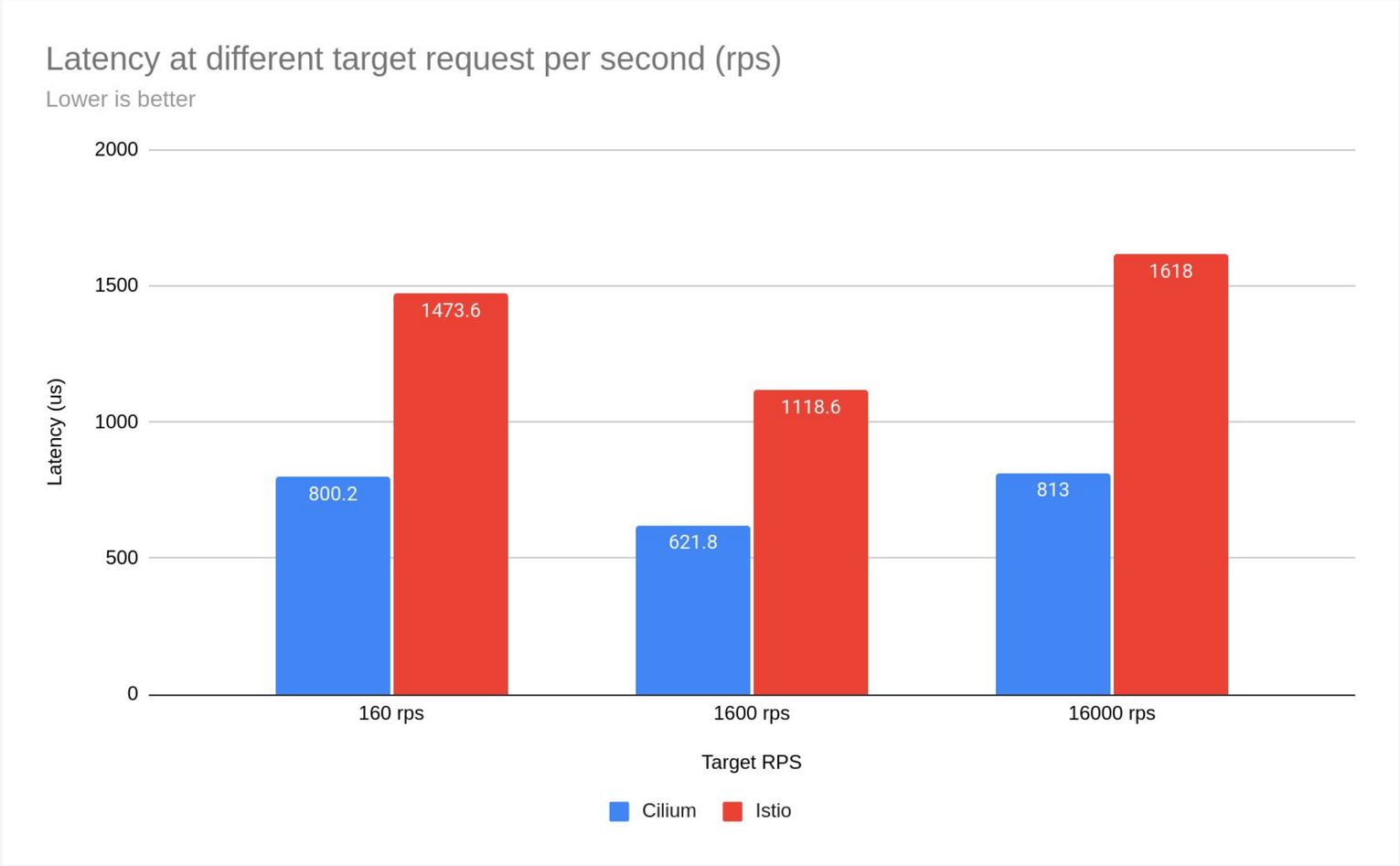
Latency performance



All data & Scripts: https://isovalent.com/blog/post/2022-05-03-servicemesh-security

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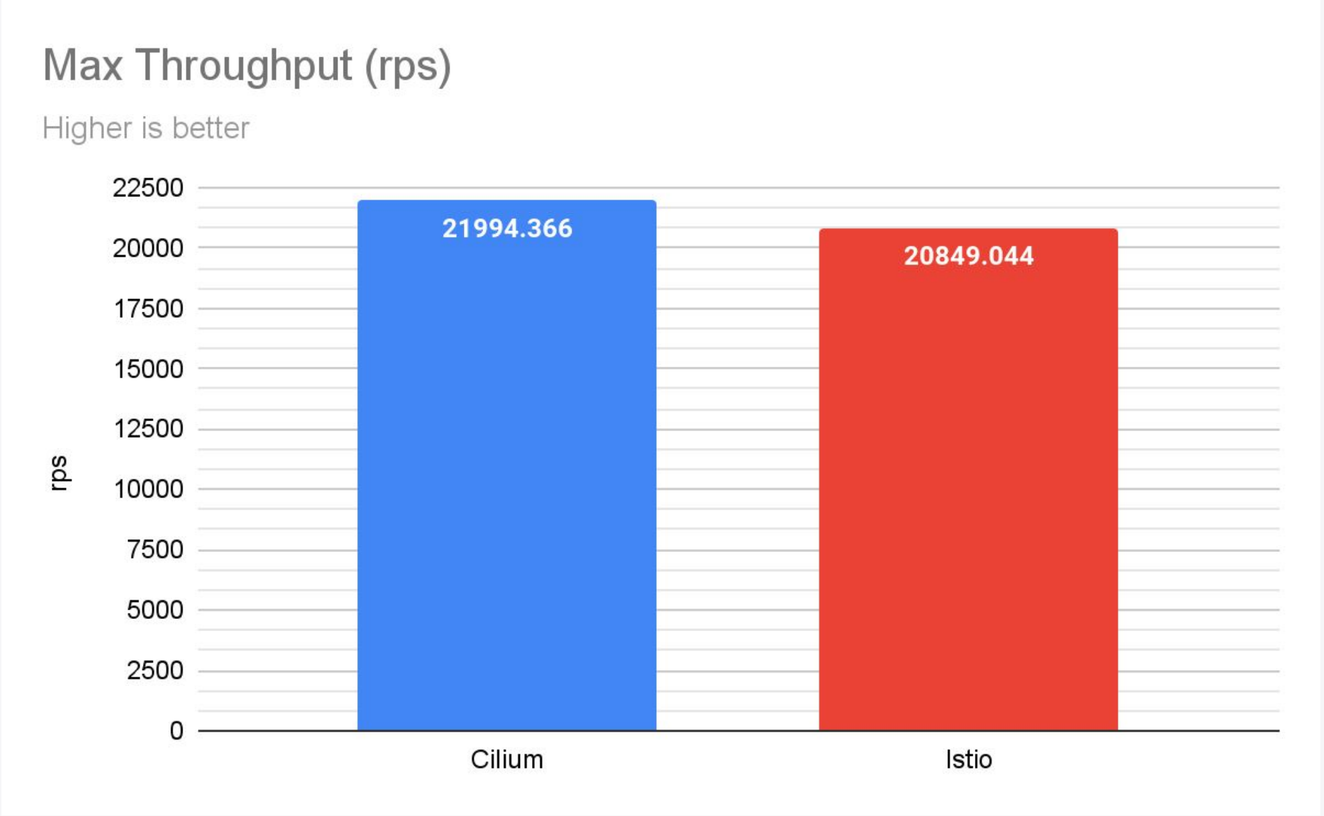
Throughput performance



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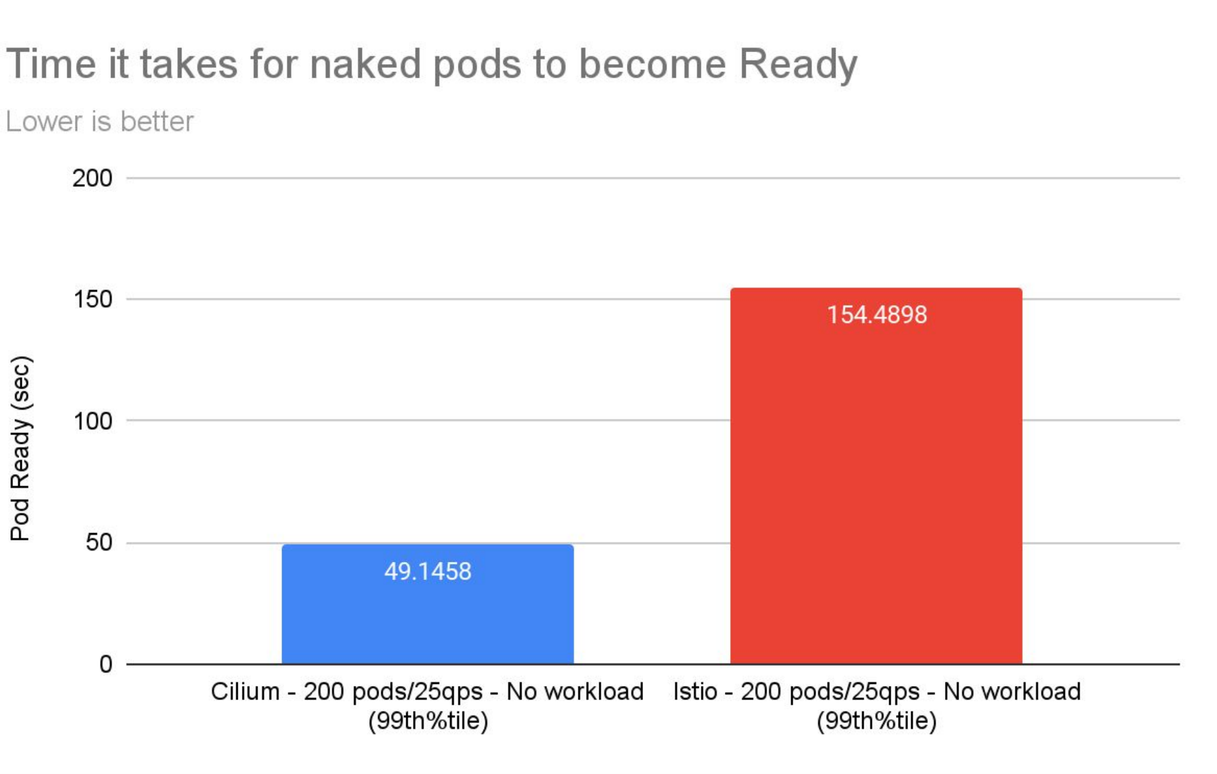
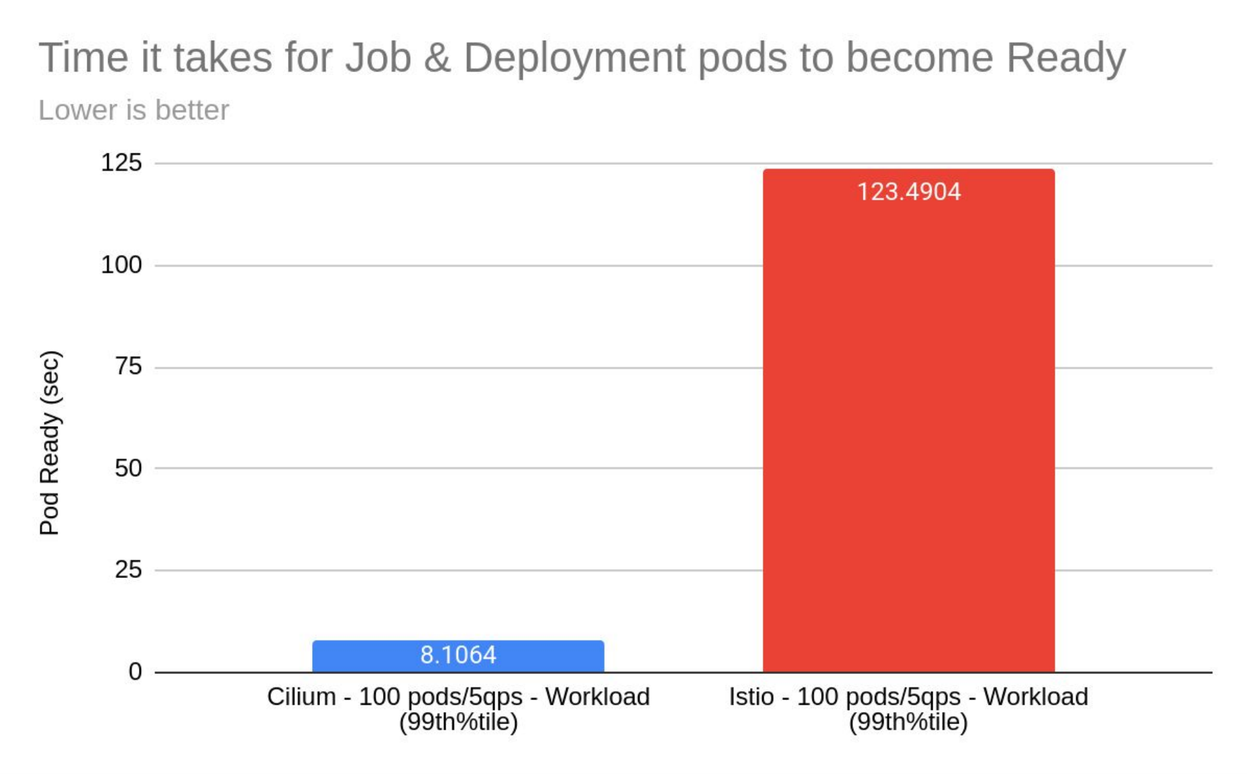
Pod ready performance





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Control plane integrations

CiliumEnvoyConfig (CEC) enables direct configuration of Envoy listeners and rules

Integrations create CEC based on control plane abstractions

SMI

Istio

Ingress / Services

Gateway API

Linkerd

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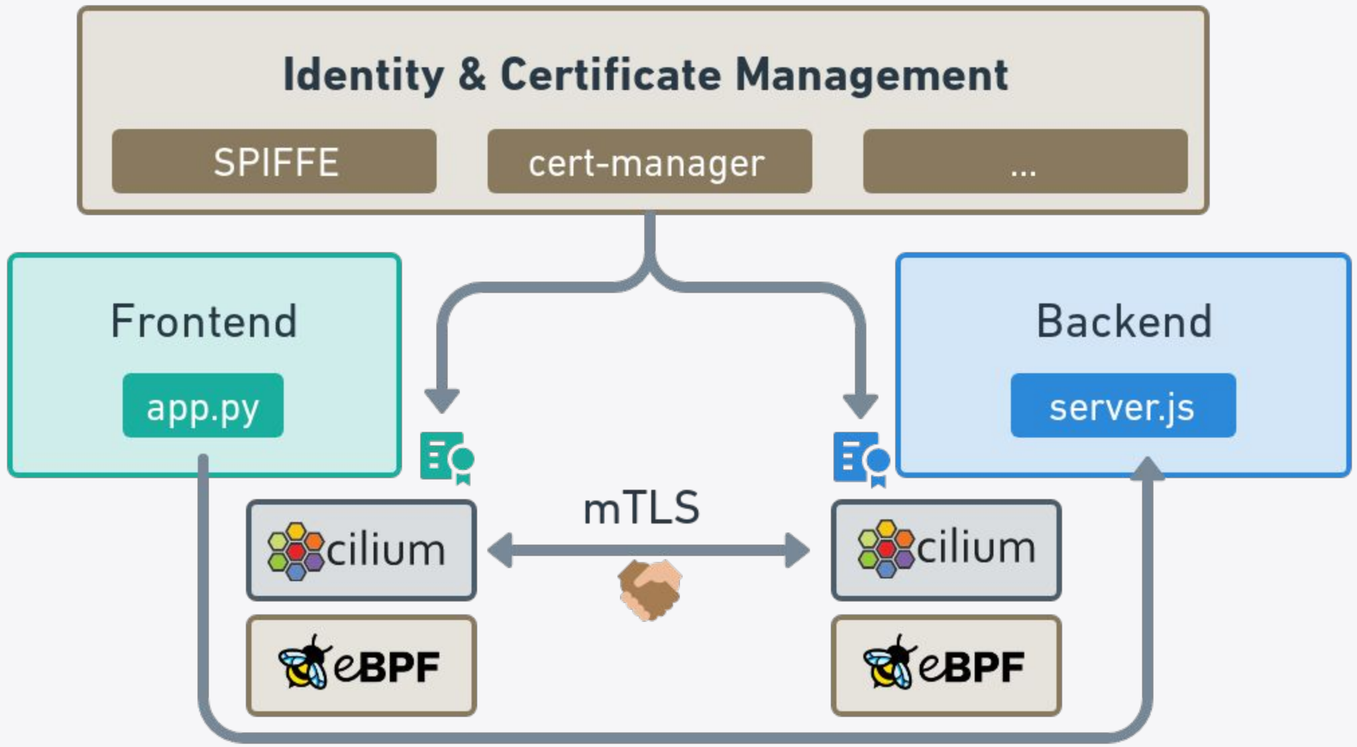
Cilium next-gen mutual authentication & encryption



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Cilium Service Mesh with eBPF

Best possible datapath:

- eBPF where possible, fallback to Envoy as needed
- Native performance & latency
- Support any network traffic (UDP, SCTP, Multicast, ...)

Control plane of your choice:

SMI | Istio | Ingress / Services | Gateway API | SPIFFE | Linkerd

Observability integrations (Hubble + Tetragon):

fluentd | JSON | Grafana | OpenTelemetry

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Cilium CNI

Scalable, Secure, High Performance CNI Plugin

Cilium Service Mesh

Sidecar-free Mesh & Ingress

Hubble

Network Observability

Tetragon

Security Observability & Runtime Enforcement

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Thank you KubeCon!

cilium/cilium

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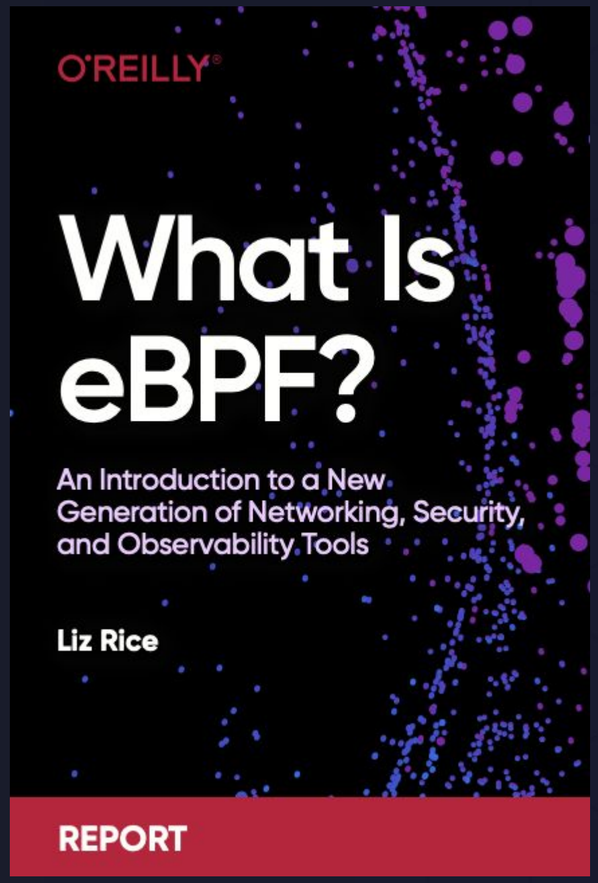

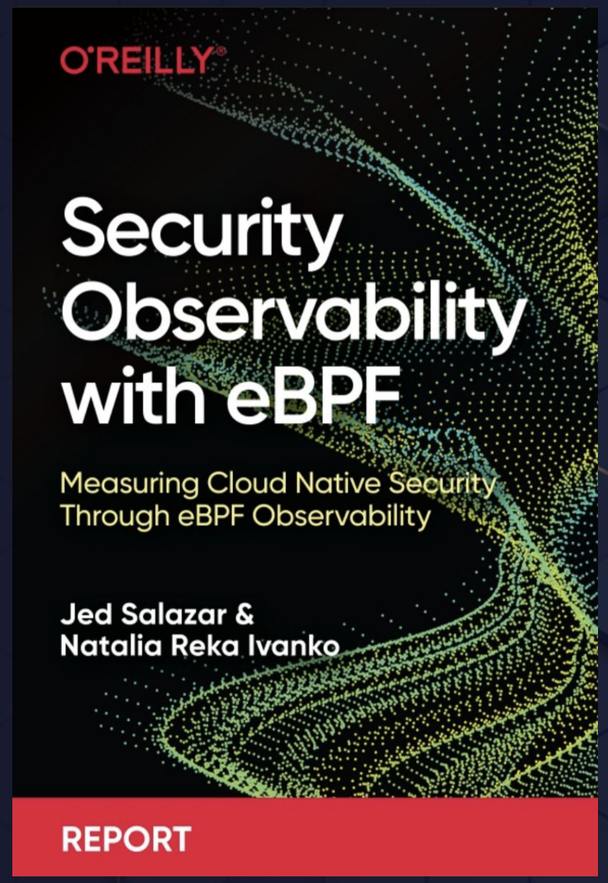

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