KubeCon | CloudNativeCon

Europe 2020

Virtual

Discreetly Studying the Effects of Individual Traffic Control Functions

Lee Calcote

Founder, Layer5

@lcalcote

Prateek Sahu

Contributor, Layer5

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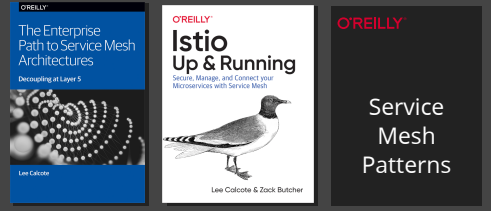
Lee Calcote

cloud native and its management



@lcalcote

layer5.io

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THE SERVICE MESH COMMUNITY

TEXAS

The University of Texas at Austin

slack.layer5.io

Service Mesh Functionality

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Traffic Control

content-based traffic steering

Resiliency

control over chaos

Observability

what gets people hooked on service metrics

Security

identity and policy

Expect more from your infrastructure

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Help with Modernization

address the long-tail of IT services

KubeCon CloudNativeCon Europe 2020 Virtual

- Can modernize your IT inventory without:
  - Rewriting your applications
  - Adopting microservices, regular services are fine
  - Adopting new frameworks
  - Moving to the cloud

Get there for free

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Help with Modernization

address the long-tail of IT services

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- Can modernize your IT inventory without:
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docker

Get there for free

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Why use a Service Mesh?

to avoid...

- Bloated service (application) code
- Duplicating work to make services production-ready
  - Load balancing, auto scaling, rate limiting, traffic routing...
- Inconsistency across services
  - Retry, tls, failover, deadlines, cancellation, etc., for each language, framework
  - Siloed implementations lead to fragmented, non-uniform policy application and difficult debugging
- Diffusing responsibility of service management

Decoupling at Layer 5

where Dev and Ops meet

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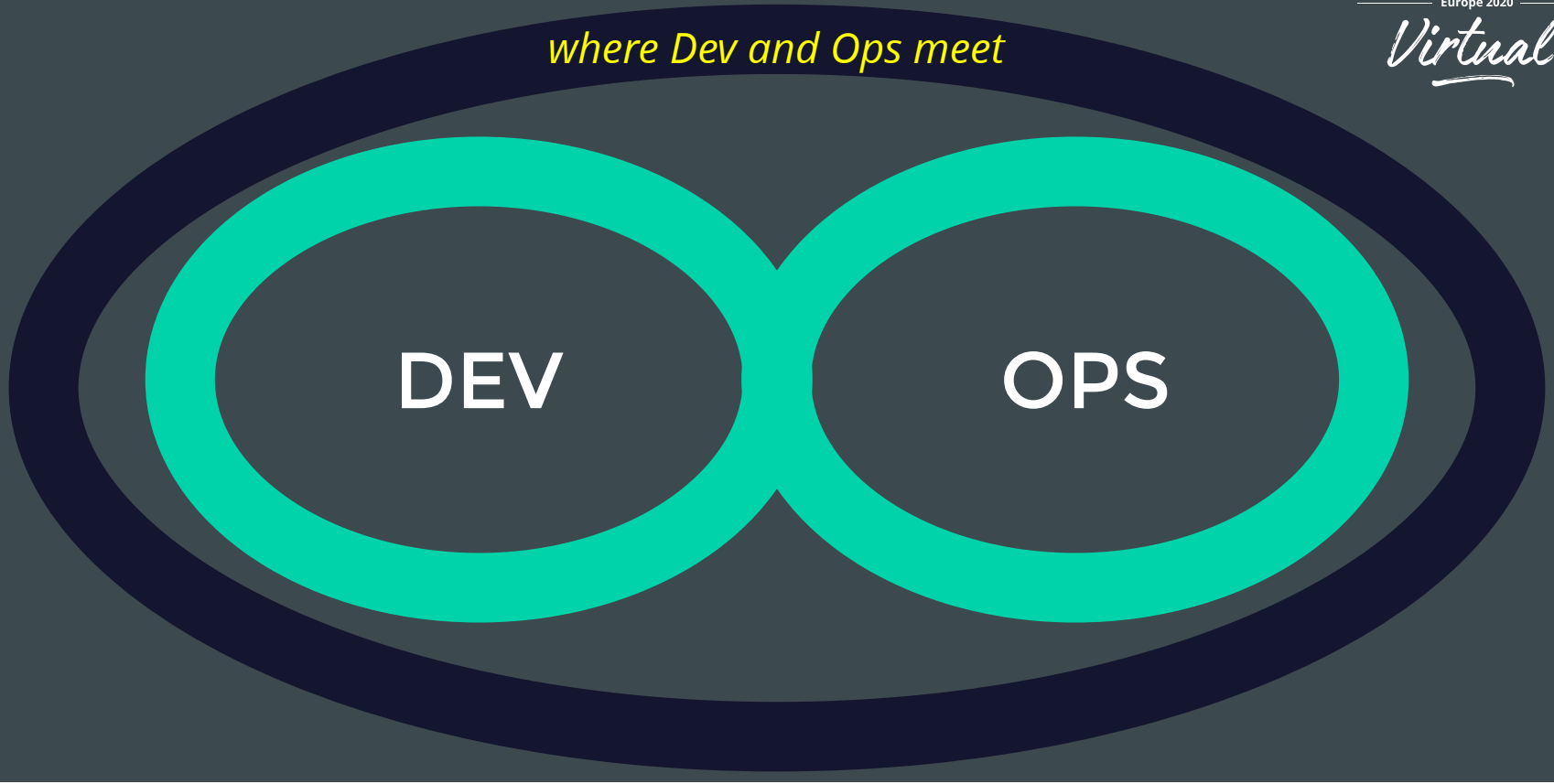

Empowered and independent teams can iterate faster

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Decoupling at Layer 5

where Dev and Ops meet

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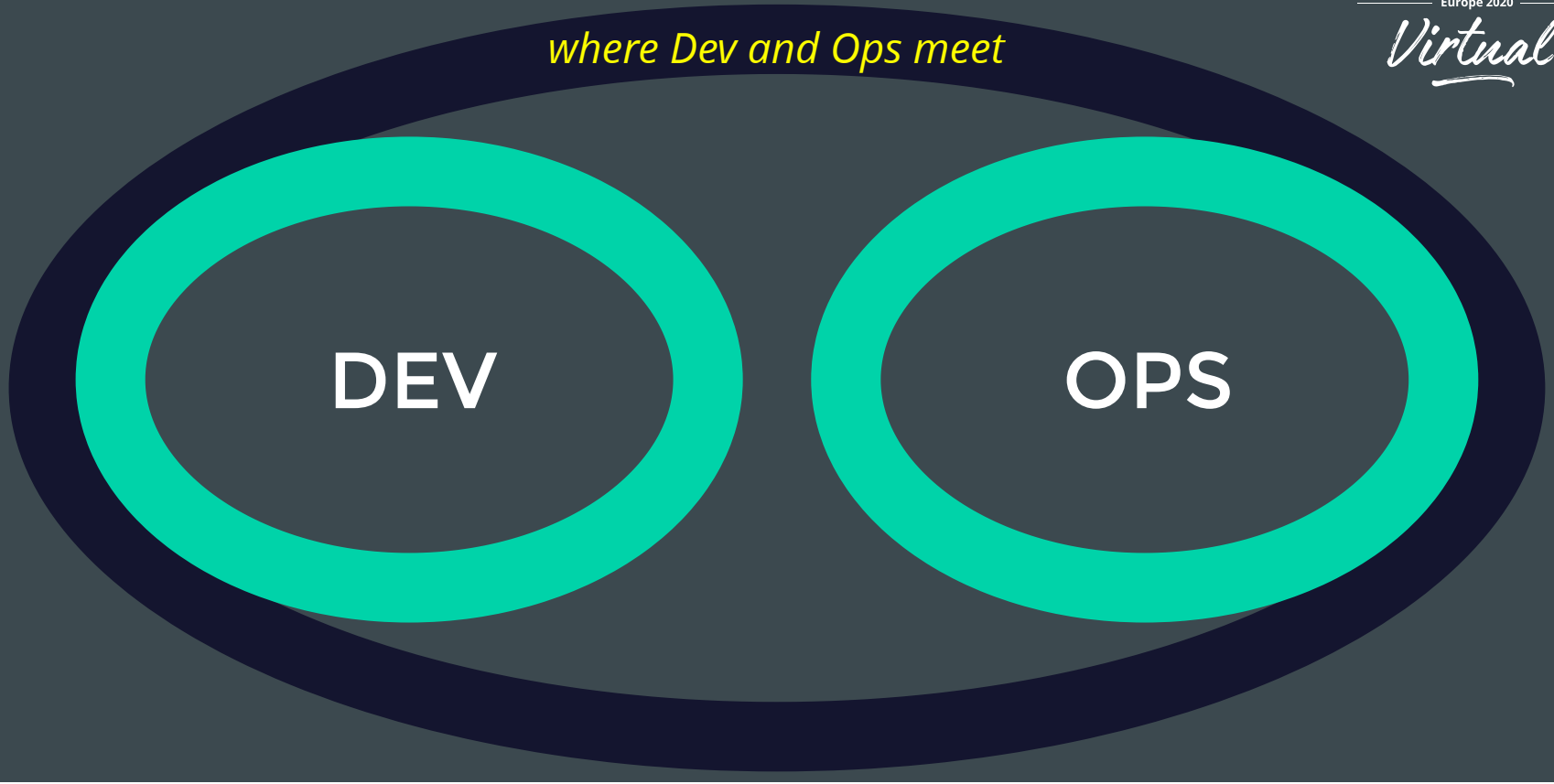

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where Dev and Ops meet

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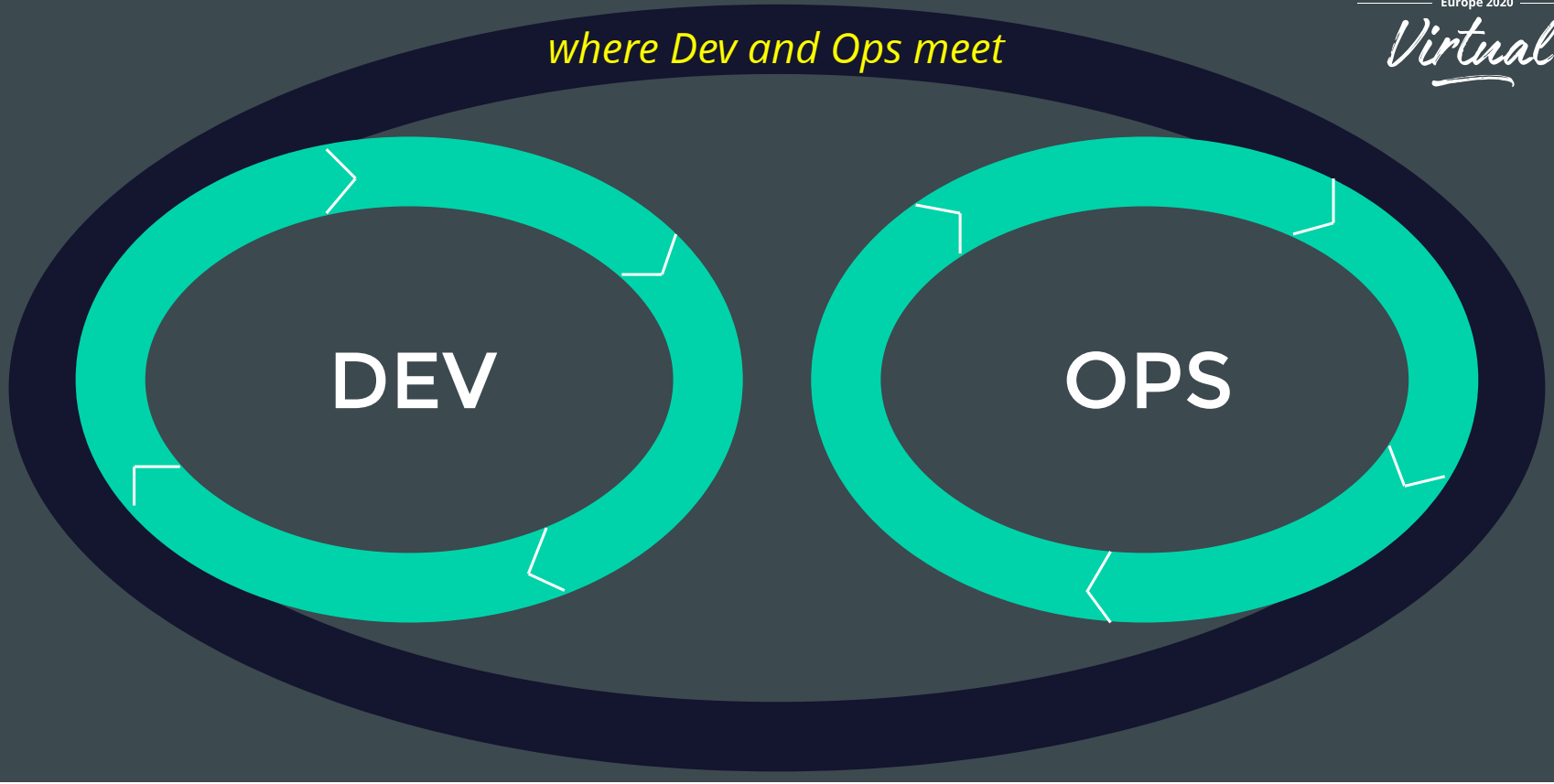

Empowered and independent teams can iterate faster

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Service Mesh Architectures

Service Mesh Architecture

Management Plane

- Provides multi-mesh federation, backend system integration, expanded policy and governance, continuous delivery integration, workflow, chaos engineering, configuration and performance management.

Control Plane

- Provides policy, configuration, and platform integration.
- Takes a set of isolated stateless sidecar proxies and turns them into a service mesh.
- Does not touch any packets/requests in the data path.

Data Plane

- Touches every packet/request in the system.
- Responsible for service discovery, health checking, routing, load balancing, authentication, authorization, and observability.

Ingress Gateway

Egress Gateway

You need a management plane.

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layer5.io/landscape

It's meshy out there.

Service mesh abstractions

to the rescue

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Service Mesh Interface (SMI)

A standard interface for service meshes on Kubernetes.

Multi-Vendor Service Mesh Interoperation (Hamlet)

A set of API standards for enabling service mesh federation.

Meshery is interoperable with these abstractions.

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Service mesh abstractions

to the rescue

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Service Mesh Interface (SMI)

A standard interface for service meshes on Kubernetes.

Service Mesh Performance Specification (SMPS)

A format for describing and capturing service mesh performance.

Multi-Vendor Service Mesh Interoperation (Hamlet)

A set of API standards for enabling service mesh federation.

Meshery is interoperable with these abstractions.

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Service Mesh Performance Specification

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vendor neutral service mesh performance measurement standard

CLOUD NATIVE COMPUTING FOUNDATION

SIG Network: Service Mesh WG

Directly provides:

- A vendor neutral specification for capturing details of infrastructure capacity, service mesh configuration, and workload metadata.

Facilitates:

- a universal performance index to gauge a service mesh's efficiency against deployments in other organizations' environments.
- apples-to-apples performance comparisons of service mesh deployments.

github.com/layer5io/service-mesh-performance-specification

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MESHERY

THE MULTI-MESH MANAGER

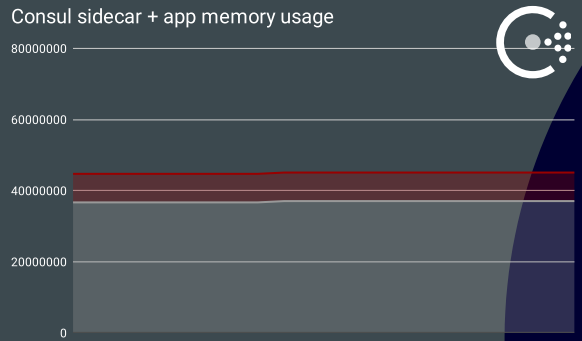
MESHERY

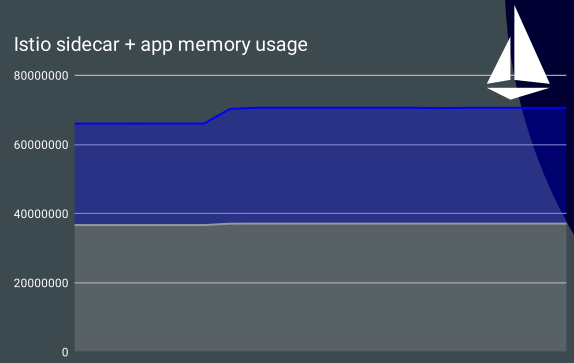
THE MULTI-MESH MANAGER

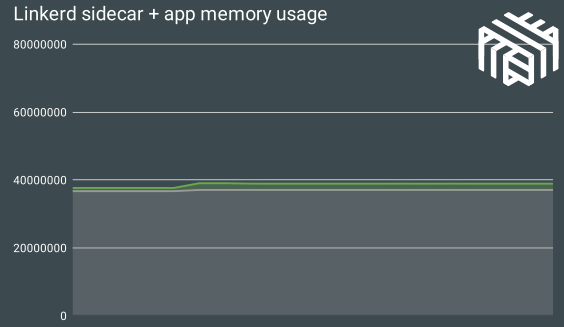
Service Mesh Interface (SMI)

Service Mesh Performance Spec (SMPS)

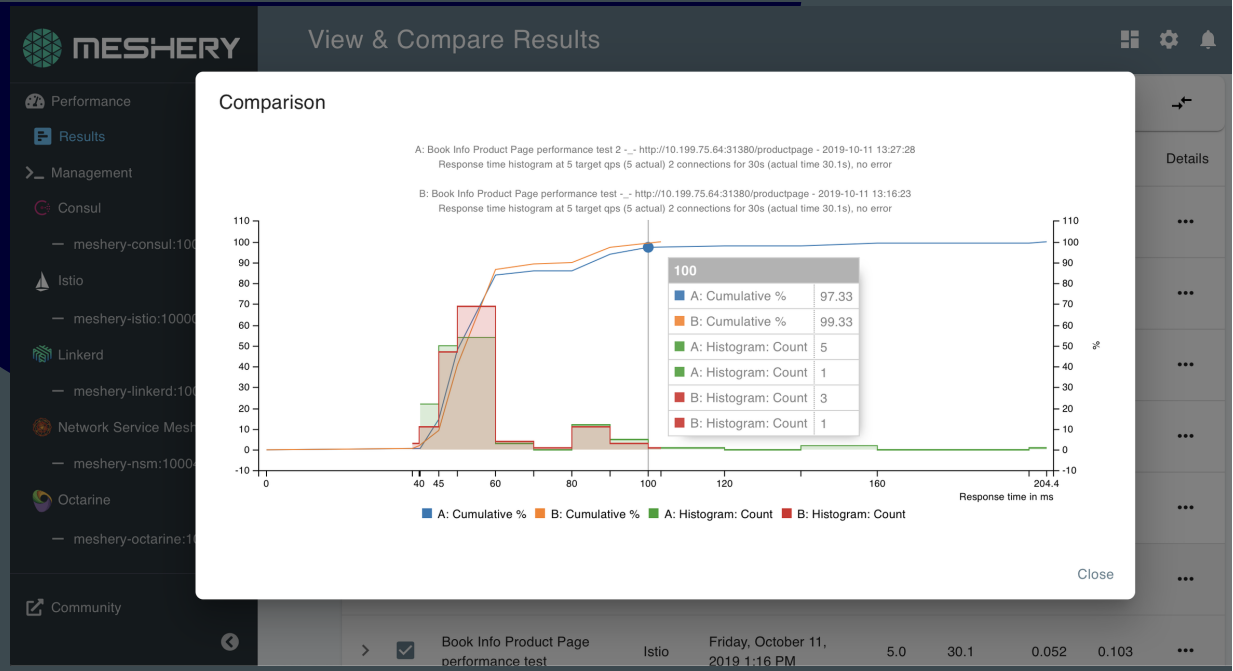
Google Summer of Code







Understand value vs overhead



Practices

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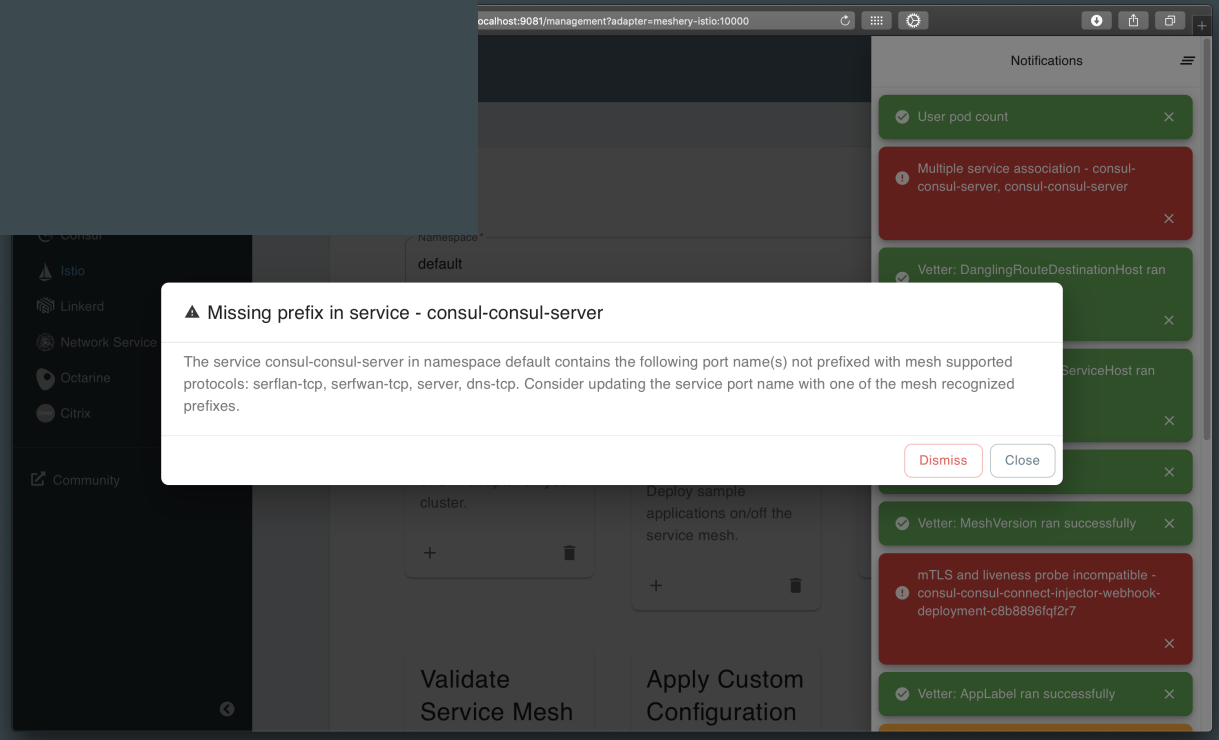
Assess your service mesh configuration against deployment and operational best practices with Meshery's configuration validator.



Meshery analyzes your service mesh and workload configuration

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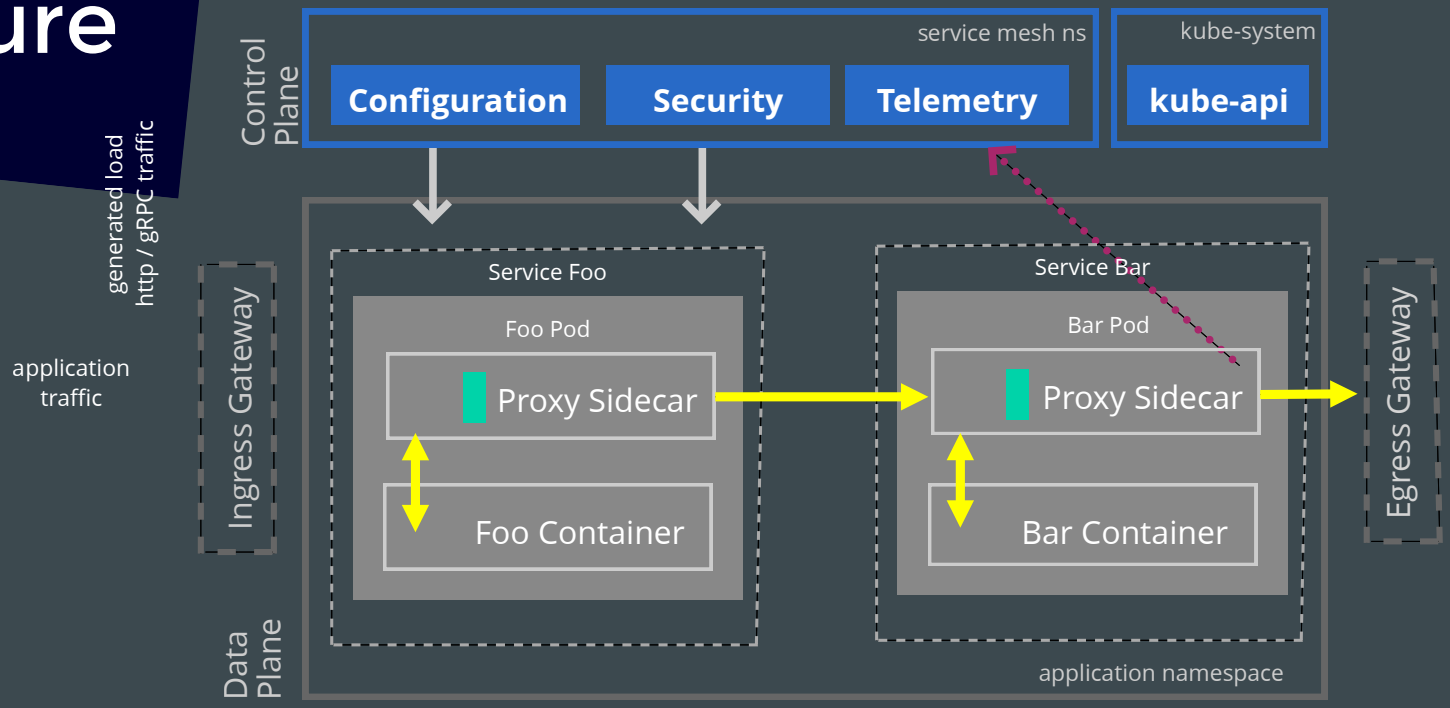
Meshery Architecture



Out-of-band telemetry propagation

Control flow

Application traffic

Meshery WASM Filter

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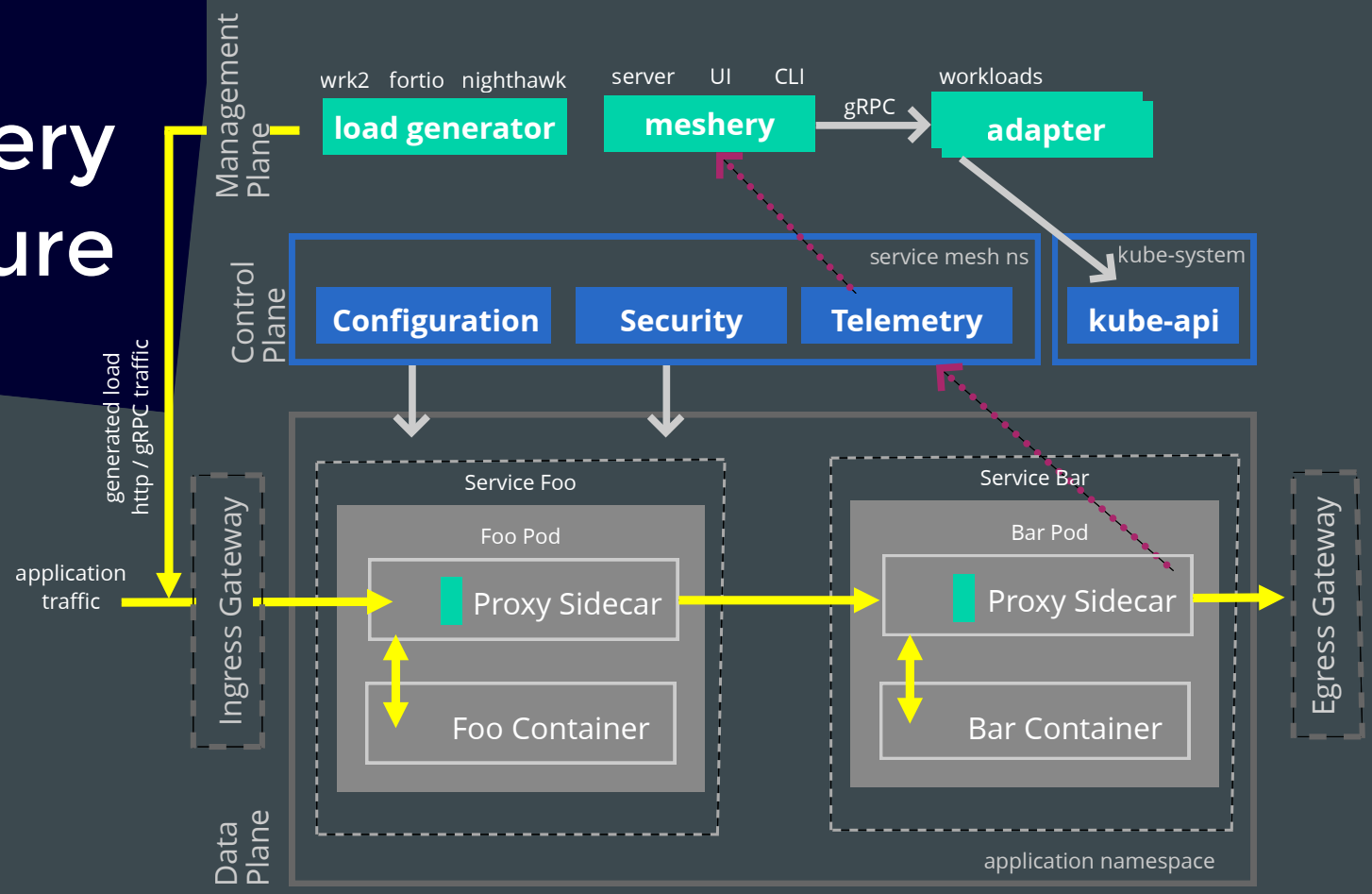
Meshery Architecture



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Control flow

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Meshery WASM Filter

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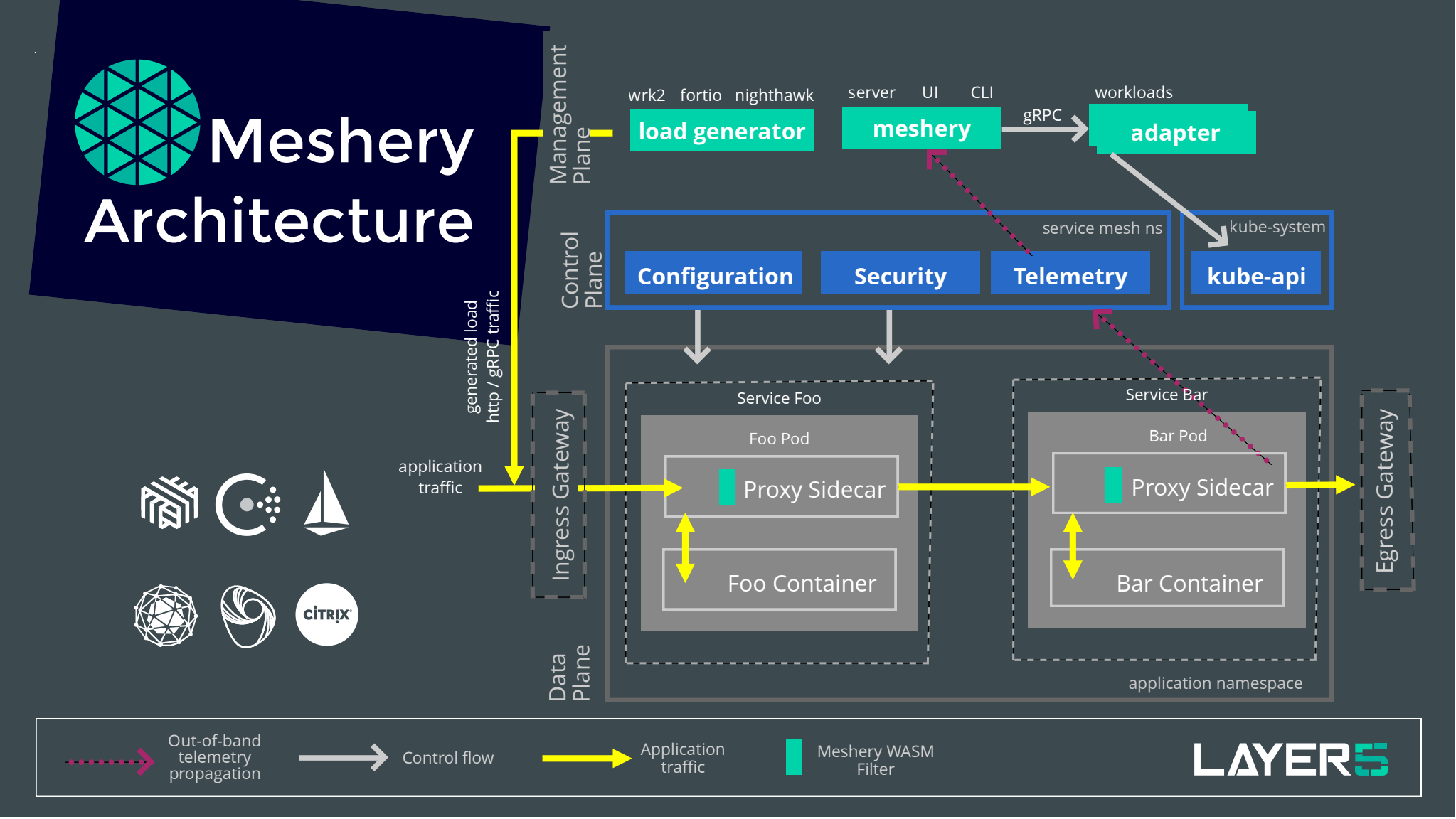
Meshery Architecture



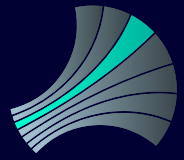


Image Hub

a sample app

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Functionality	In the app	In the filter
User / Token	✓	✗
Subscription Plans	✓	✗
Plan Enforcement	✗	✓

Two application containers

github.com/layer5io/image-hub

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Image Hub on Docker Desktop

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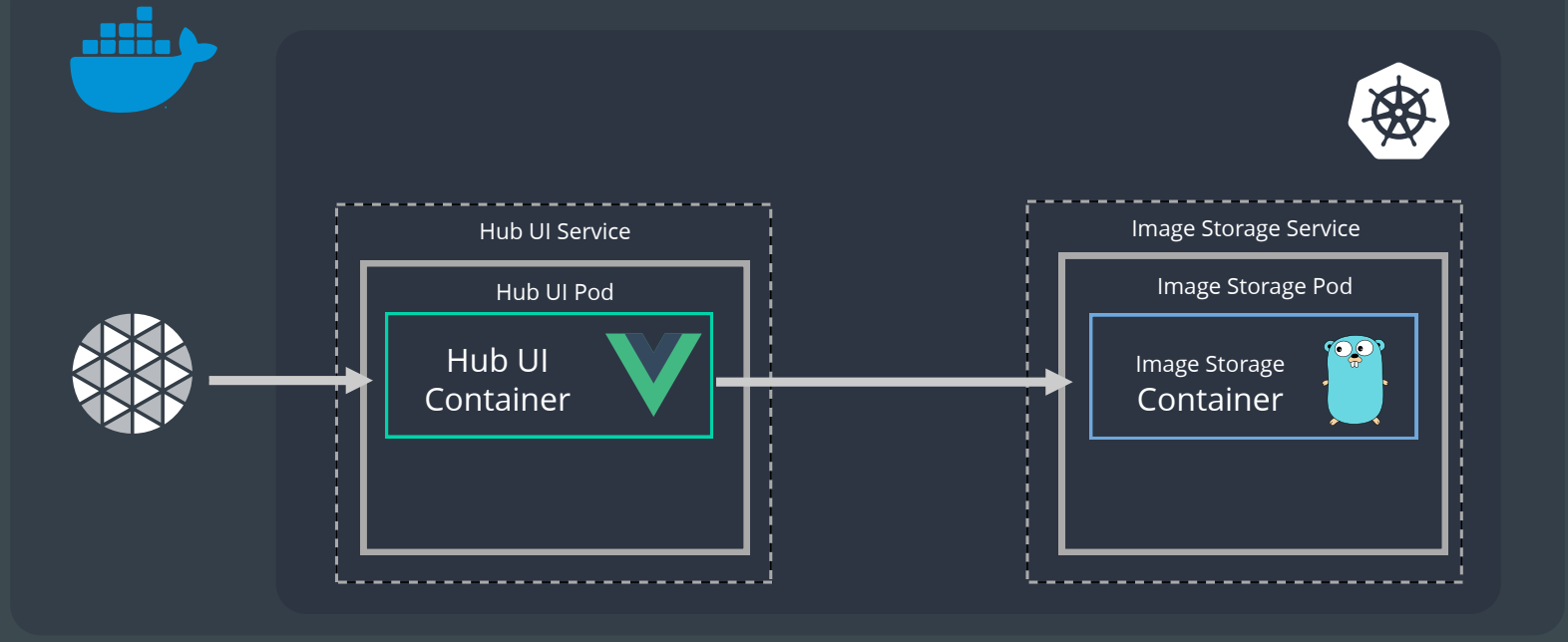

github.com/layer5io/image-hub

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Image Hub on a Service Mesh

with Consul

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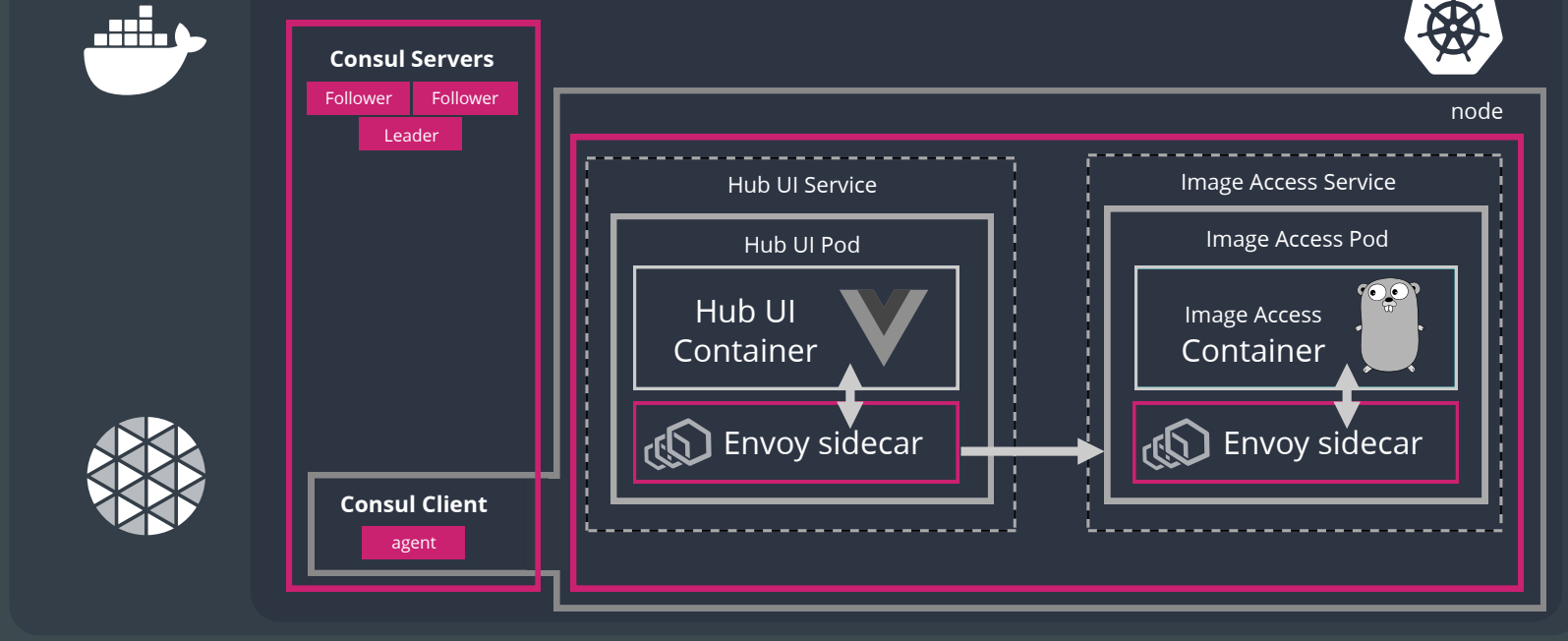

github.com/layer5io/image-hub

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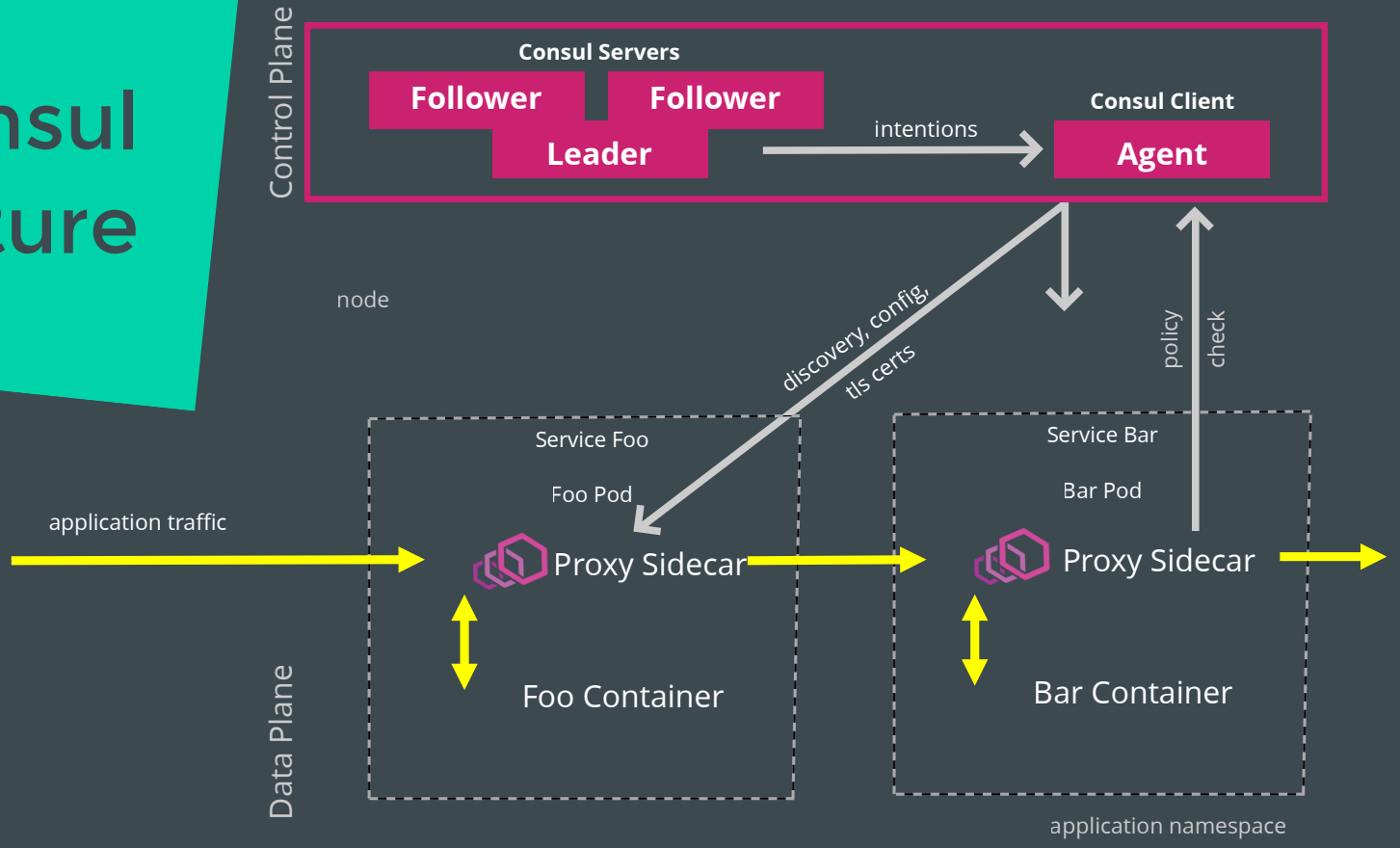
Consul Architecture

Consul Architecture



Consul Architecture

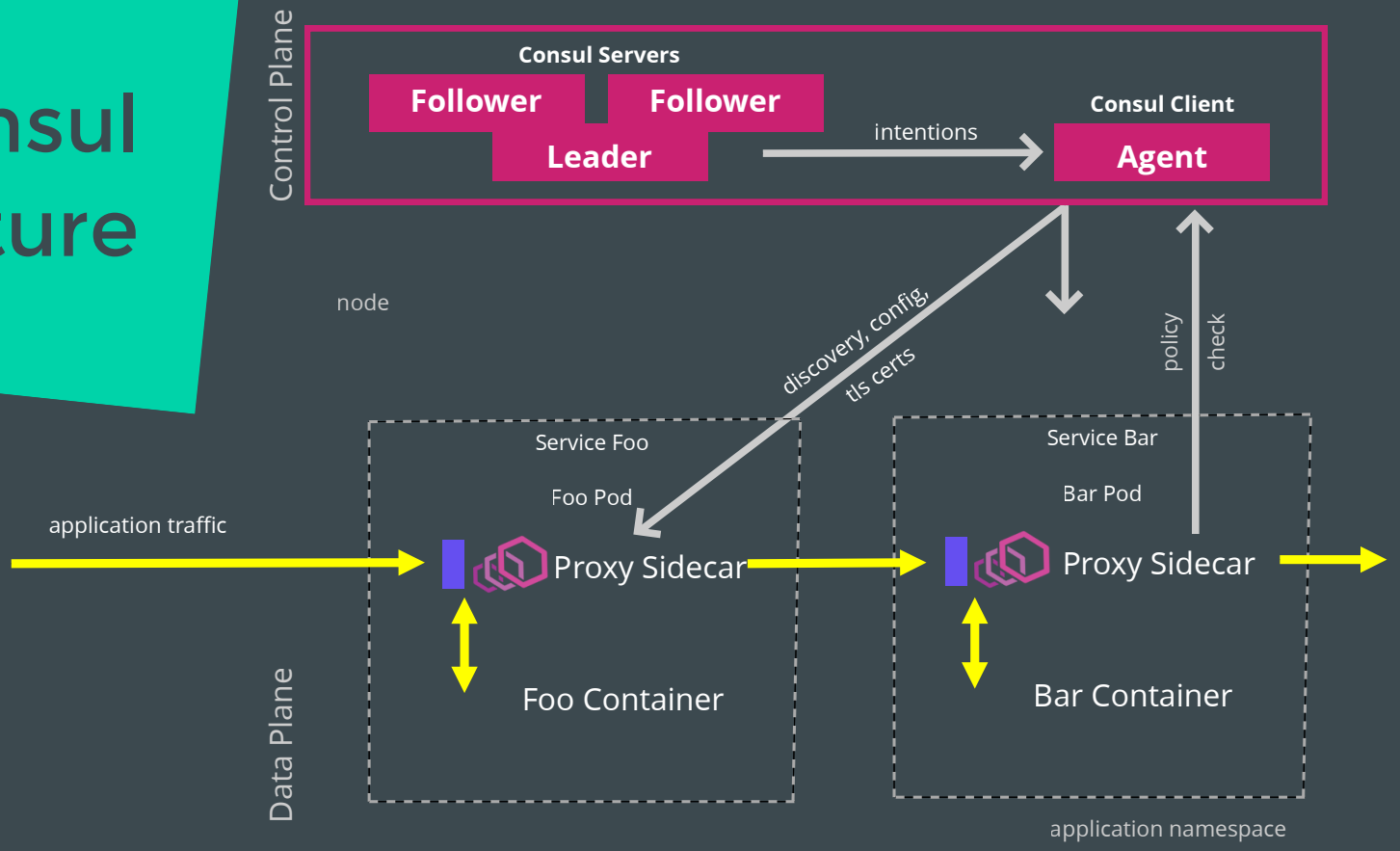


Image Hub on Consul

with a Rust-based WASM filter

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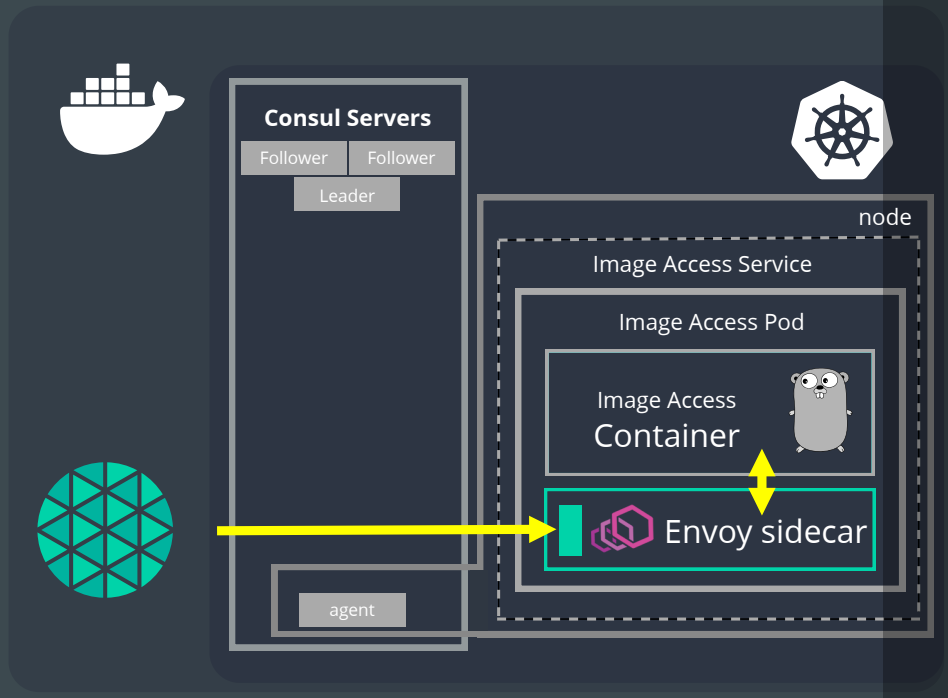


```yaml
apiVersion: apps/v1
kind: Deployment
spec:
  template:
    metadata:
      labels:
        app: api-v1
      annotations:
        "consul.hashicorp.com/connect-inject": "true"
        "consul.hashicorp.com/service-meta-version": "1"
        "consul.hashicorp.com/service-tags": "v1"
        "consul.hashicorp.com/connect-service-protocol": "http"
        "consul.hashicorp.com/connect-wasm-filter-add_header":
"/filters/optimized.wasm"
    spec:
      containers:
      - name: api
        image: layer5/image-hub-api:latest
```

github.com/layer5io/image-hub

WASM Filter

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Image Hub on Consul

with a Rust-based WASM filter

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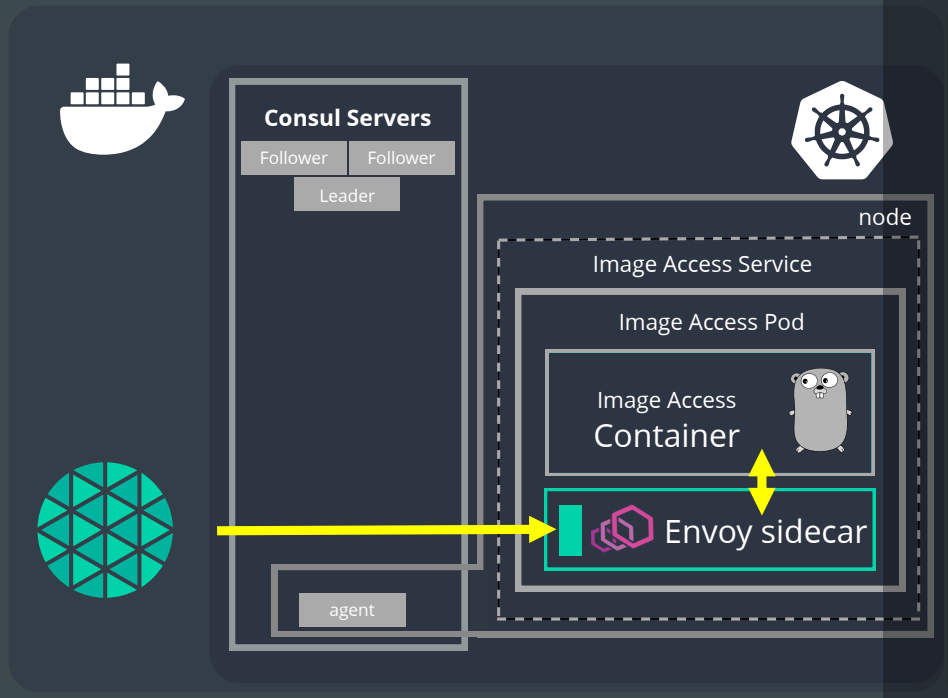


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spec:
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    metadata:
      labels:
        app: api-v1
      annotations:
        "consul.hashicorp.com/connect-inject": "true"
        "consul.hashicorp.com/service-meta-version": "1"
        "consul.hashicorp.com/service-tags": "v1"
        "consul.hashicorp.com/connect-service-protocol": "http"
        "consul.hashicorp.com/connect-wasm-filter-add_header":
"/filters/optimized.wasm"
    spec:
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```

github.com/layer5io/image-hub

WASM Filter

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PERFORMANCE

An optimization game

with many variables

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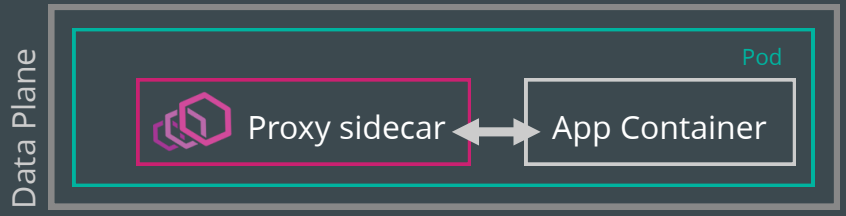

Data plane performance depends on many factors, for example:

- Number of client connections
- Target request rate
- Request size and Response size
- Number of proxy worker threads
- Protocol
- CPU cores
- Number and types of proxy filters

Latency, throughput, and the proxies' CPU and memory consumption affected by these factors

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What is WebAssembly?

for the web, malware and beyond

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- A small, fast binary format that promises near-native performance for web applications.
- Most modern browsers support it.
- Safe and sandboxed execution environment.
- Over 40 languages that support WASM as a compilation target.
- Originally used to speed up large web-applications.

Comparing types of Data Plane filtering

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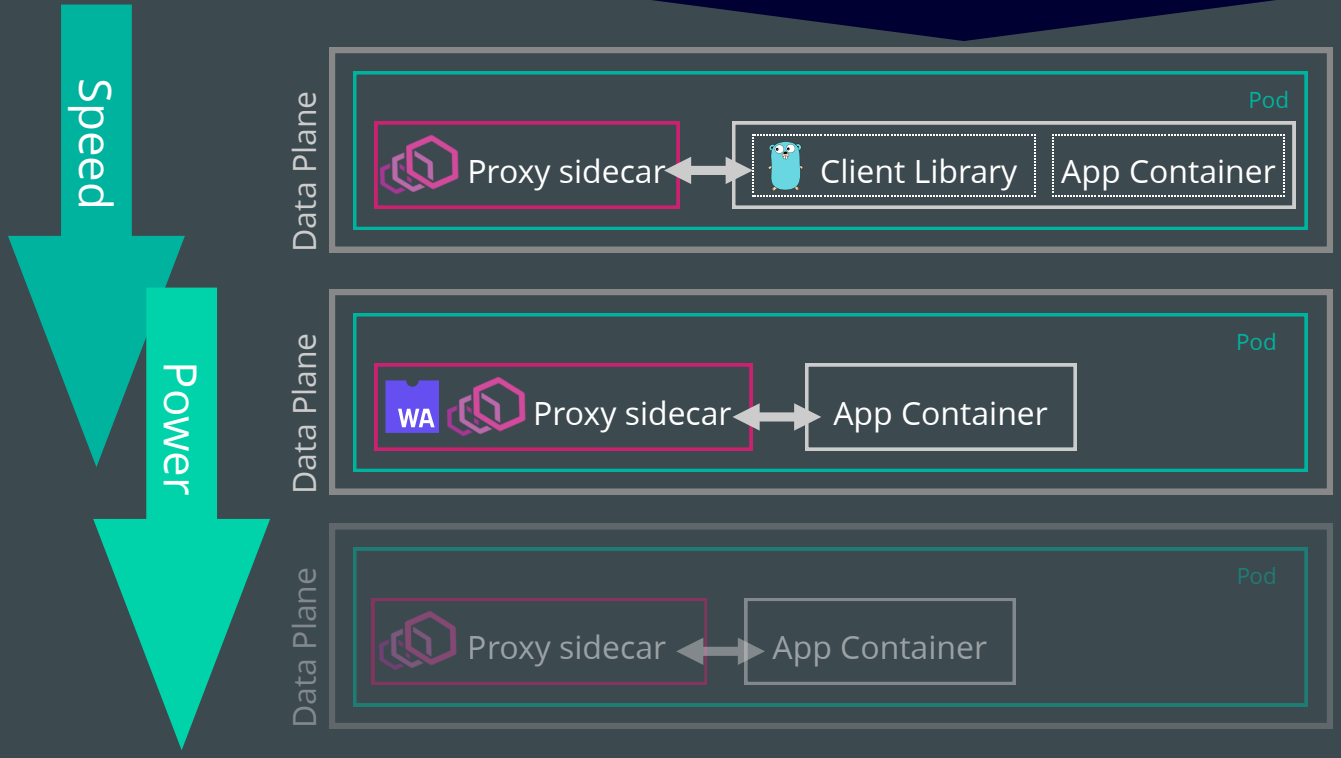

Comparing approaches to data plane filtering

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Comparing types of Data Plane filtering

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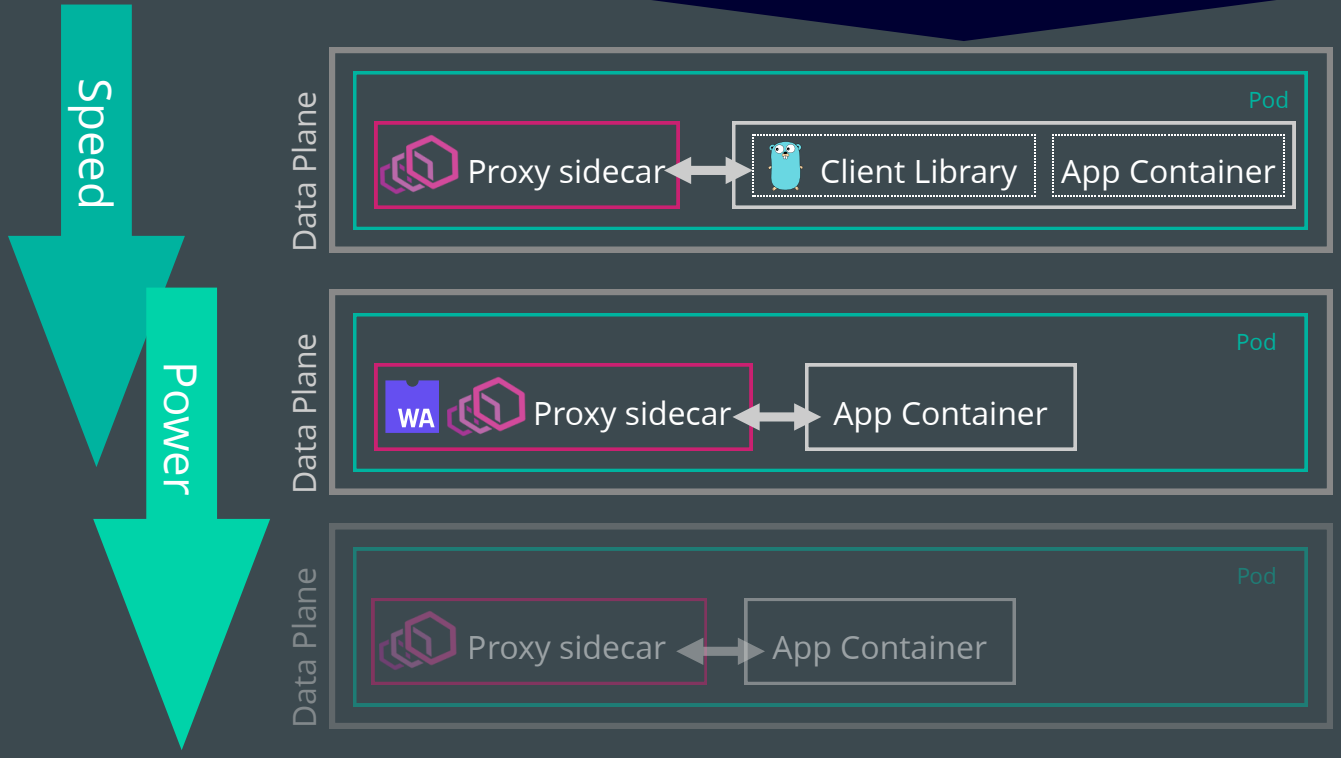

Rate limiting with Go client library

- 100 RPS
  - p50: 3.19ms
- 500 RPS
  - p50: 2.44ms
- Unlimited RPS - 4417
  - p50: 0.66ms

Comparing types of Data Plane filtering

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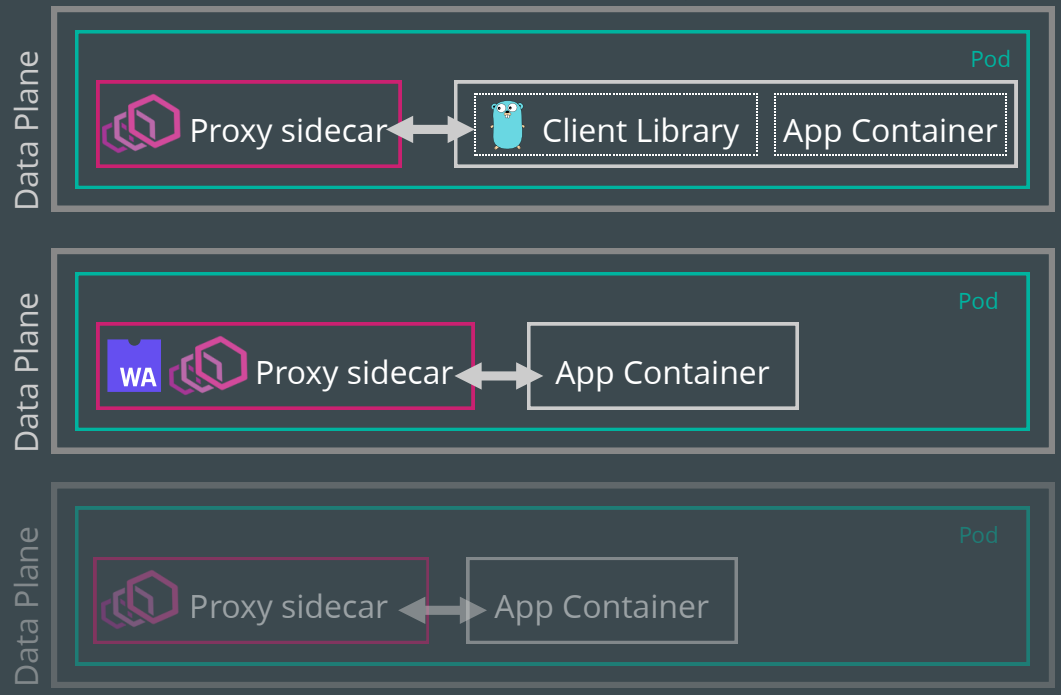
Speed

Power



Rate limiting with Go client library

- 100 RPS
  - p50: 3.19ms
- 500 RPS
  - p50: 2.44ms
- Unlimited RPS - 4417
  - p50: 0.66ms

Rate limiting with WASM module (Rust filter)

- 100 RPS
  - p50: 2.1ms
- 500 RPS
  - p50: 2.22ms
- Unlimited RPS - 5781
  - p50: 0.62ms

Comparing approaches to data plane filtering

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Comparing types of functions

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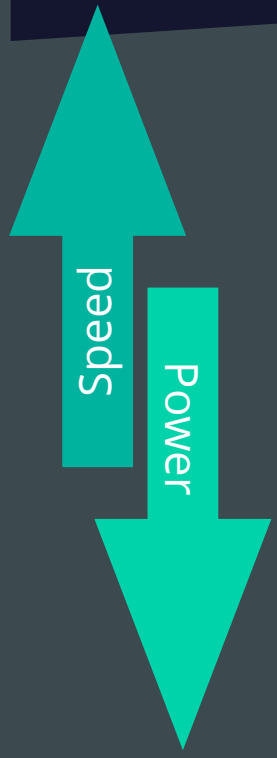

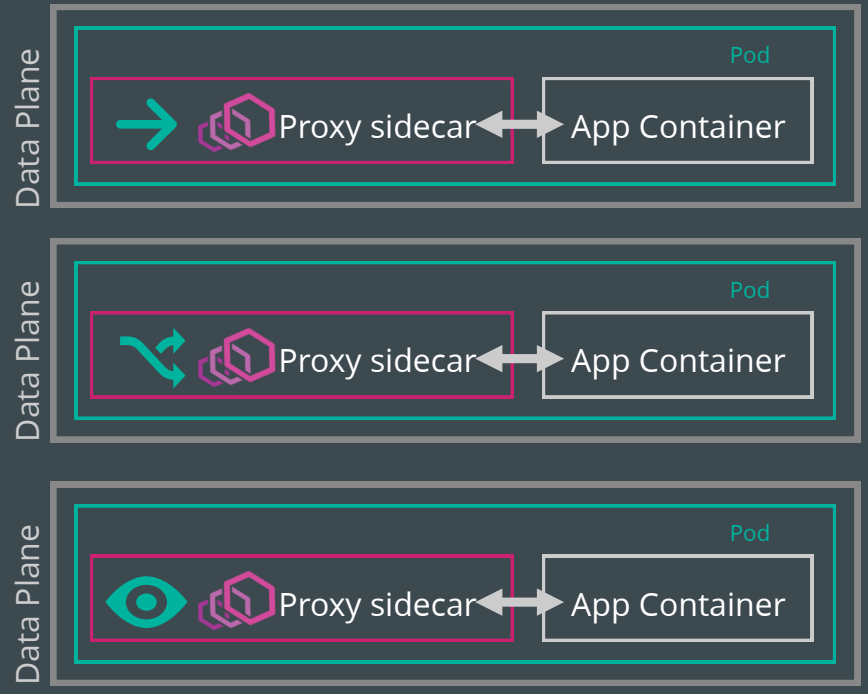

Path-based routing

Round robin
load balancing

Context-based routing

Understanding the trade-off between power and speed

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Optimizing your average response time

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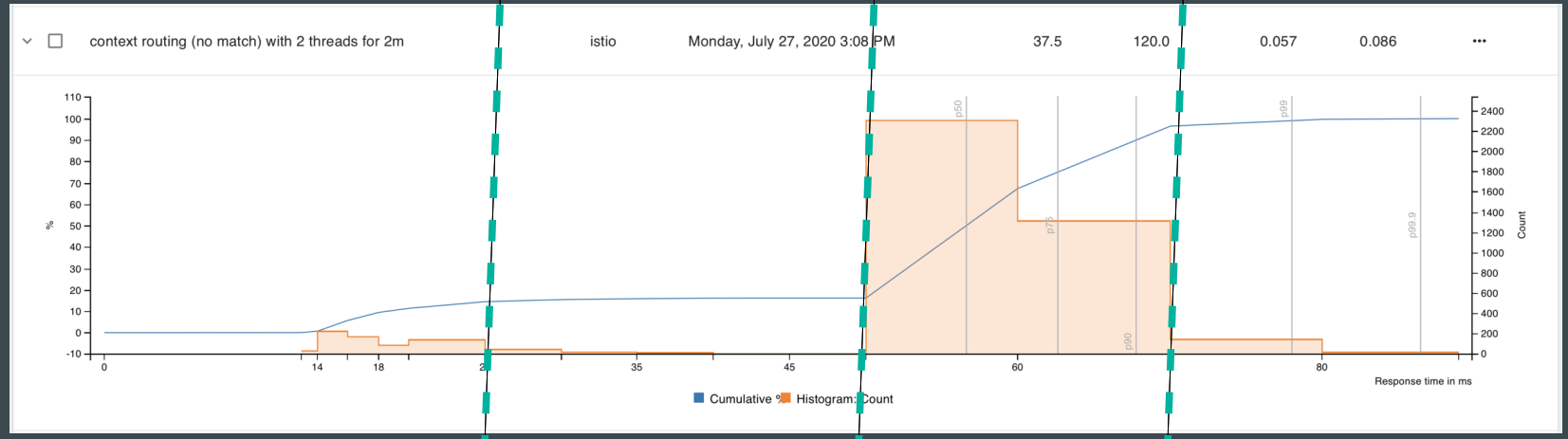
Bucket 1 | Bucket 2 | Bucket 3 | Bucket 4



In the presence of Bucket 1...

...take your largest segment by count and divide by your number of cores

identifying your optimal configuration for most requests

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Performance Testing Best Practices

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Use Meshery's powerful performance management features

- easily reproduce tests
- persist test results
- use different load generators
- baseline and compare over time
- test your workloads on and off the mesh
- tweak configurations and try again
- compare 6 different service meshes and counting...

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THE SERVICE MESH COMMUNITY

Join the discussion

slack.layer5.io

Lee Calcote

@lcalcote

Prateek Sahu

@PrateekSahu22

Service Mesh Architecture

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Ingress Gateway

Data Plane

- Touches every packet/request in the system.
- Responsible for service discovery, health checking, routing, load balancing, authentication, authorization, and observability.

Egress Gateway

Service Mesh Architecture

Control Plane

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Ingress Gateway

Data Plane

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- Responsible for service discovery, health checking, routing, load balancing, authentication, authorization, and observability.

Egress Gateway

No control plane? Not a service mesh.

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Comparing types of Data Plane filtering

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Speed

Power

Data Plane

Pod

Proxy sidecar

Client Library

App Container

Data Plane

Pod

Proxy sidecar

App Container

envoy

Data Plane

Pod

Proxy sidecar

App Container

WA + envoy

Comparing approaches to data plane filtering

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What is a Service Mesh?

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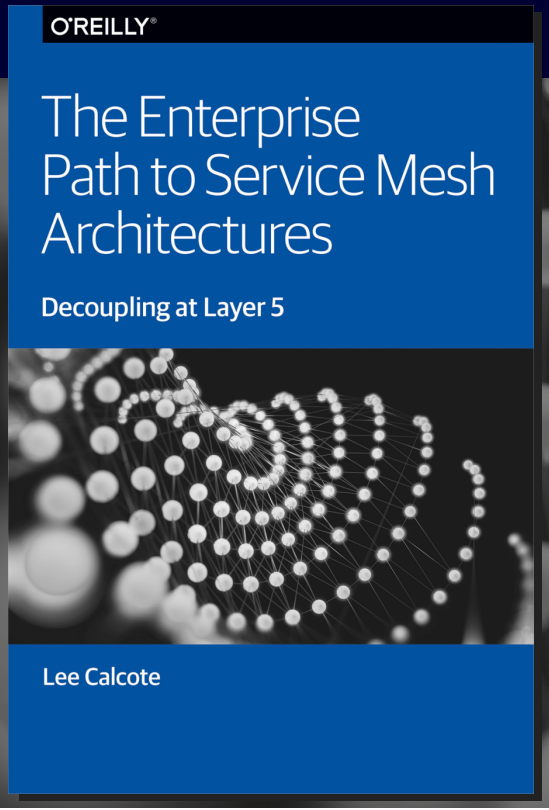

a services-first network

layer5.io/books/the-enterprise-path-to-service-mesh-architectures

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Third step in Cloud Native journey

dockercon LIVE 2020

Announced

7 years ago
(Mar 2013)

Container

v1.0

5.5 years
(Jun 2014)

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Third step in Cloud Native journey

dockercon LIVE 2020

Announced	7 years ago (Mar 2013)	5.5 years ago (Jun 2014)
	Container	**Orchestrator**
v1.0	5.5 years (Jun 2014)	4.5 years (Jul 2015)

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Third step in Cloud Native journey

dockercon LIVE 2020

Announced	7 years ago (Mar 2013)	5.5 years ago (Jun 2014)	4 years ago (Feb 2016)
	Container	**Orchestrator**	**Mesh**
v1.0	5.5 years (Jun 2014)	4.5 years (Jul 2015)	3 years (Apr 2017)

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