Adfinis

Plan. Innovatively | **Build.** Sustainably | **Run.** Resiliently

Potential. Unlocked

Using Service Mesh for Resilience and Observability

Photo by Uriel SC on Unsplash

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Thanks for having us!

Welcome to Adfinis!

Topics for today

- Resilience and Observability for Networking?
- What is eBPF?
- What is Cilium?
- What is OpenTelemetry?
- Installing Cilium on OpenShift
- Integrating Hubble with OpenTelemetry
- Live demo 🤞
- Wrap up

Resilience and Observability for Networking?

Observability

- collect relevant data (e.g. metrics, traces, and logs)
- send this data to systems that store and analyze it
- visualize the data to provide insights

Service Mesh 101

- dedicated infrastructure layer for facilitating service-to-service communications
- provides:
  - observability into communications
  - security through mutual authentication (mTLS)
  - Resilience by providing features like retries and backoffs
- most common service meshes are a control plane for Envoy
- save on costs because you can solve things centrally

Envoy?

- open source edge and service proxy, designed for cloud-native applications
- API driven and highly cloud-native
- usually bundled into other solutions (like Istio, Cilium, …)
- can take care of OSI layers 3–7 for the mesh

Service Mesh Benefits

As a Developer:

- no need to care about infra since it’s provided by the platform
- secured comms without work

As a Platform Operator:

- one tool to rule all the networks
- set downstream policies for users (devs)

As a Manager:

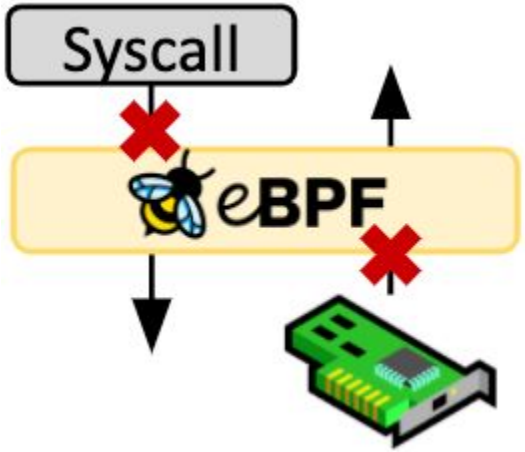
- assurance that the platform fulfills all governance requirements

What is eBPF?

What is eBPF?

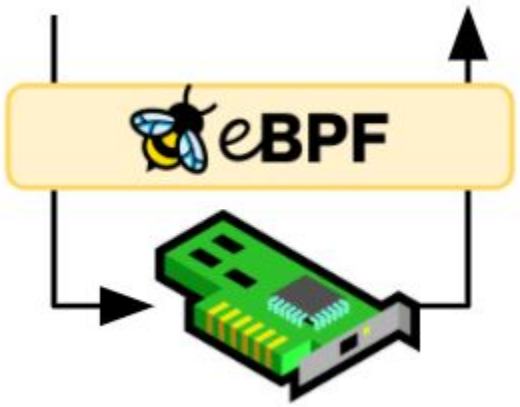
- revolutionary
- what JavaScript was to the browser, eBPF is to the kernel
- next wave of tools covering a wide variety of use cases

Security



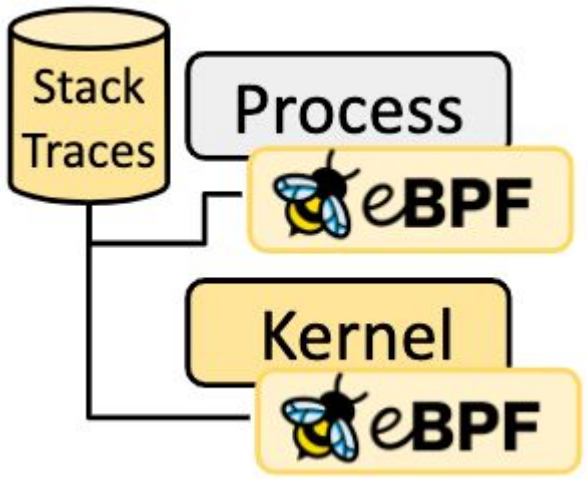
- log, filter, and process all syscalls
- allows security systems to operate with more context and a better level of control

Networking



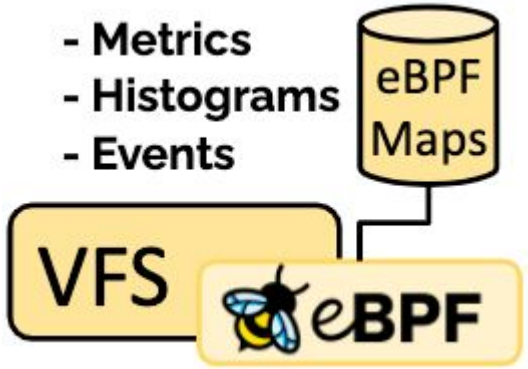
- started as extended Berkeley Packet Filter (eBPF)
- process network packages without them leaving the kernel

Tracing & Profiling



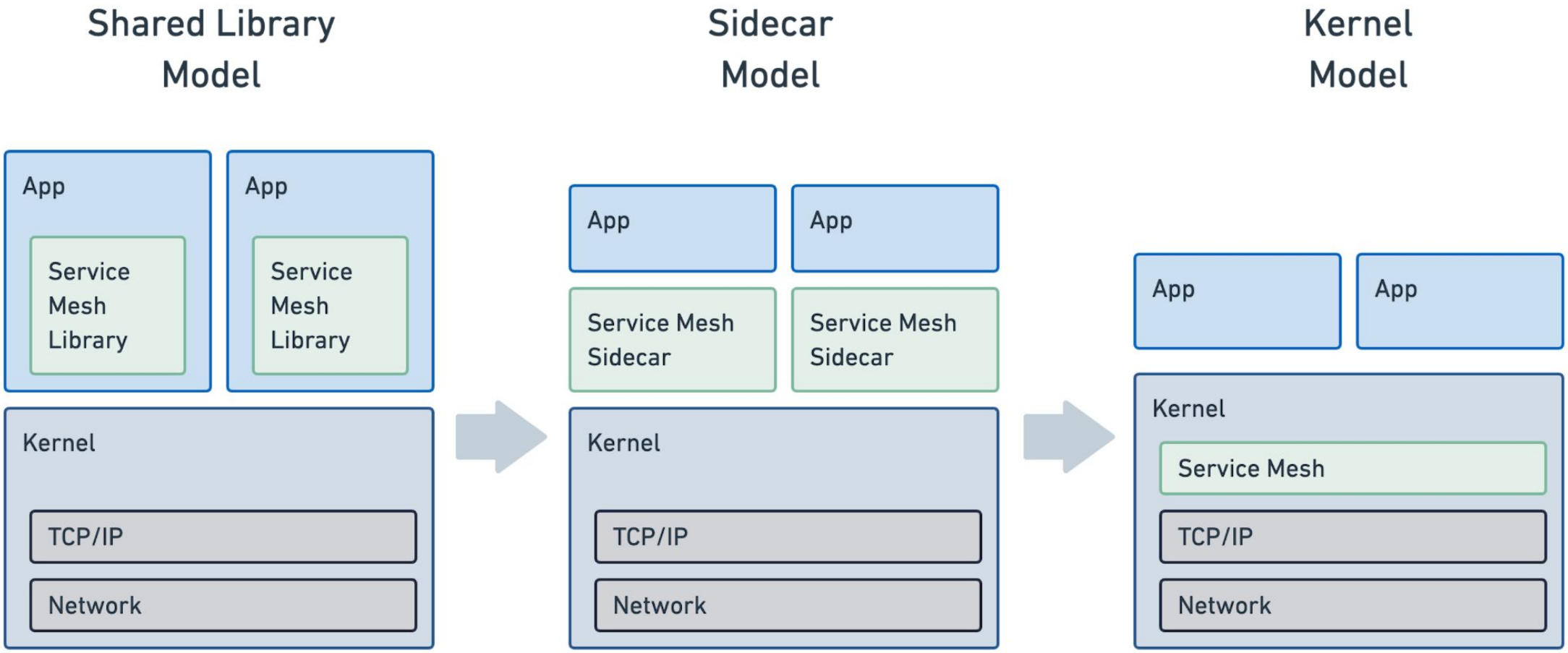
- unprecedented visibility
- runtime behavior of applications and the system
- unique insights to troubleshoot system performance problems

Observability & Monitoring



- collection & in-kernel aggregation of custom metrics
- generation of visibility events based on a wide range of sources
- extends the depth of visibility and reduces the overall system overhead

Benefits of eBPFing all the things



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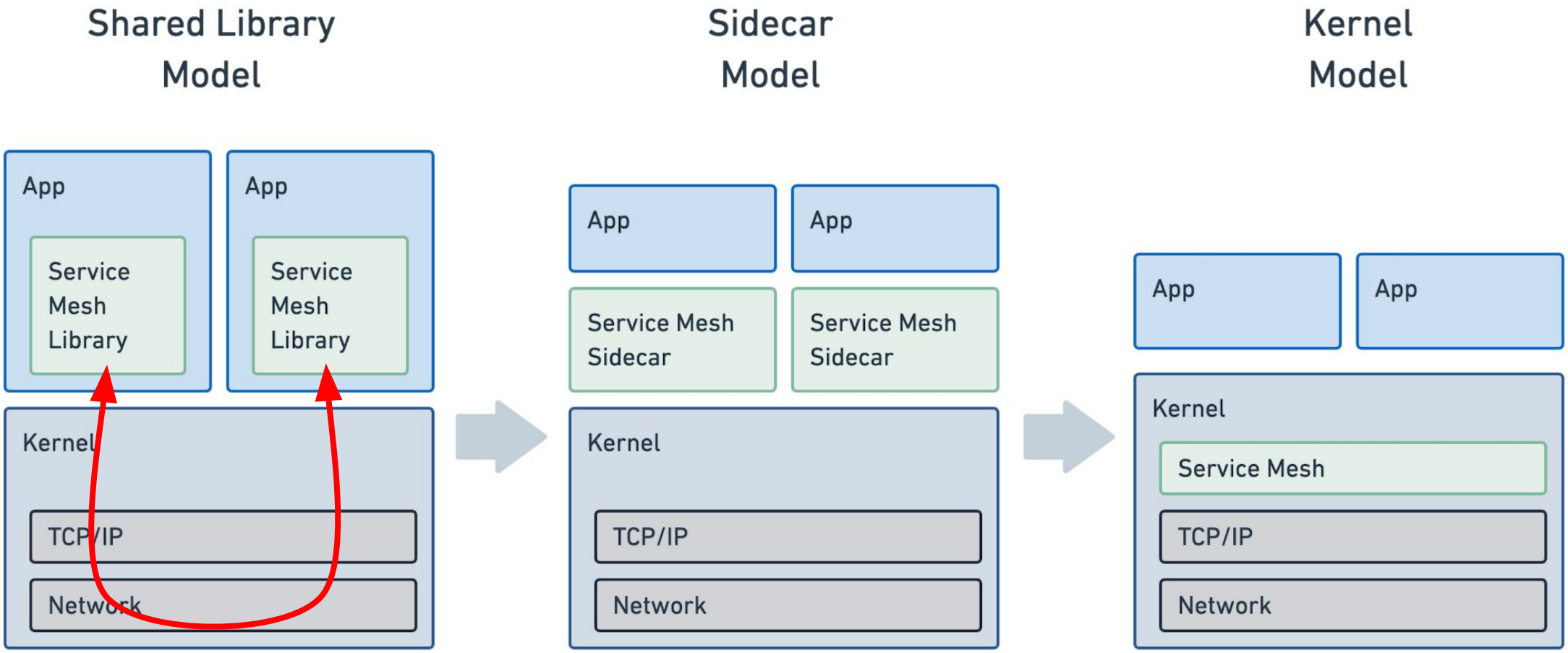

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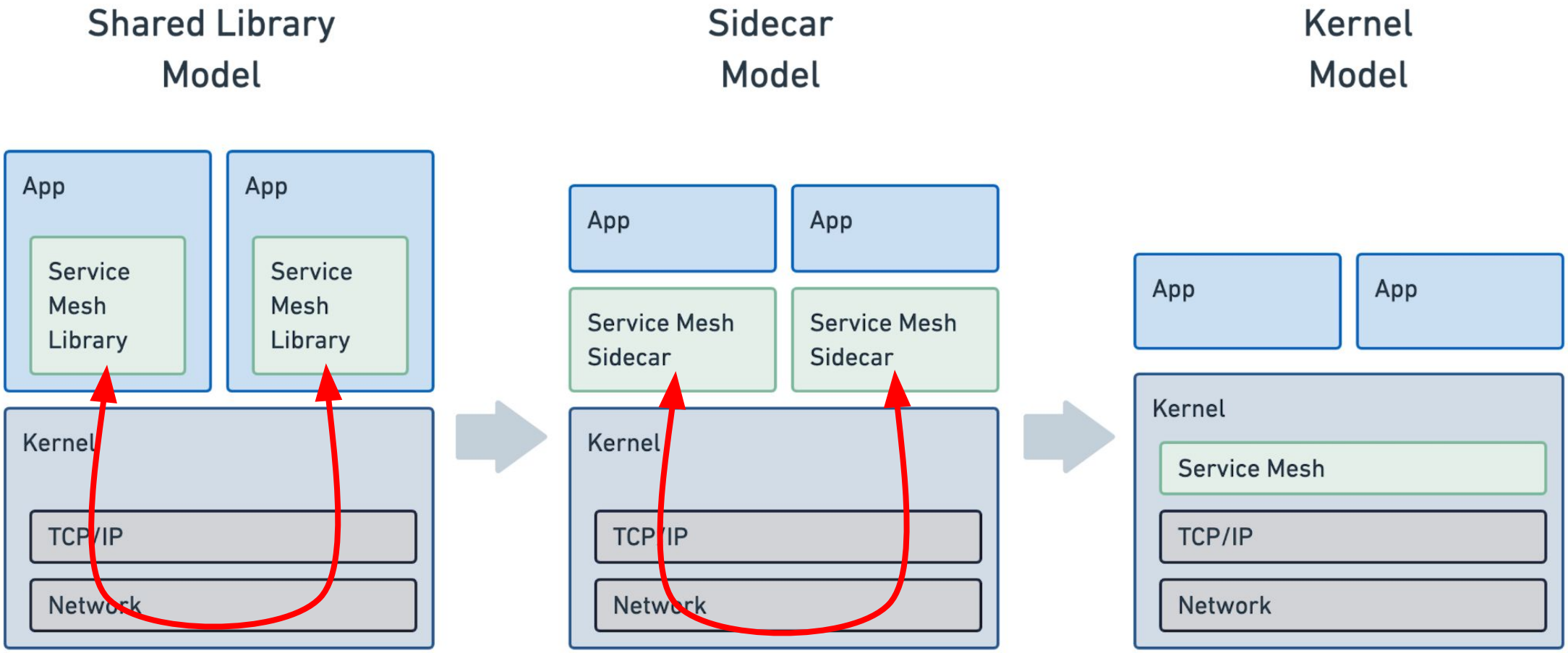

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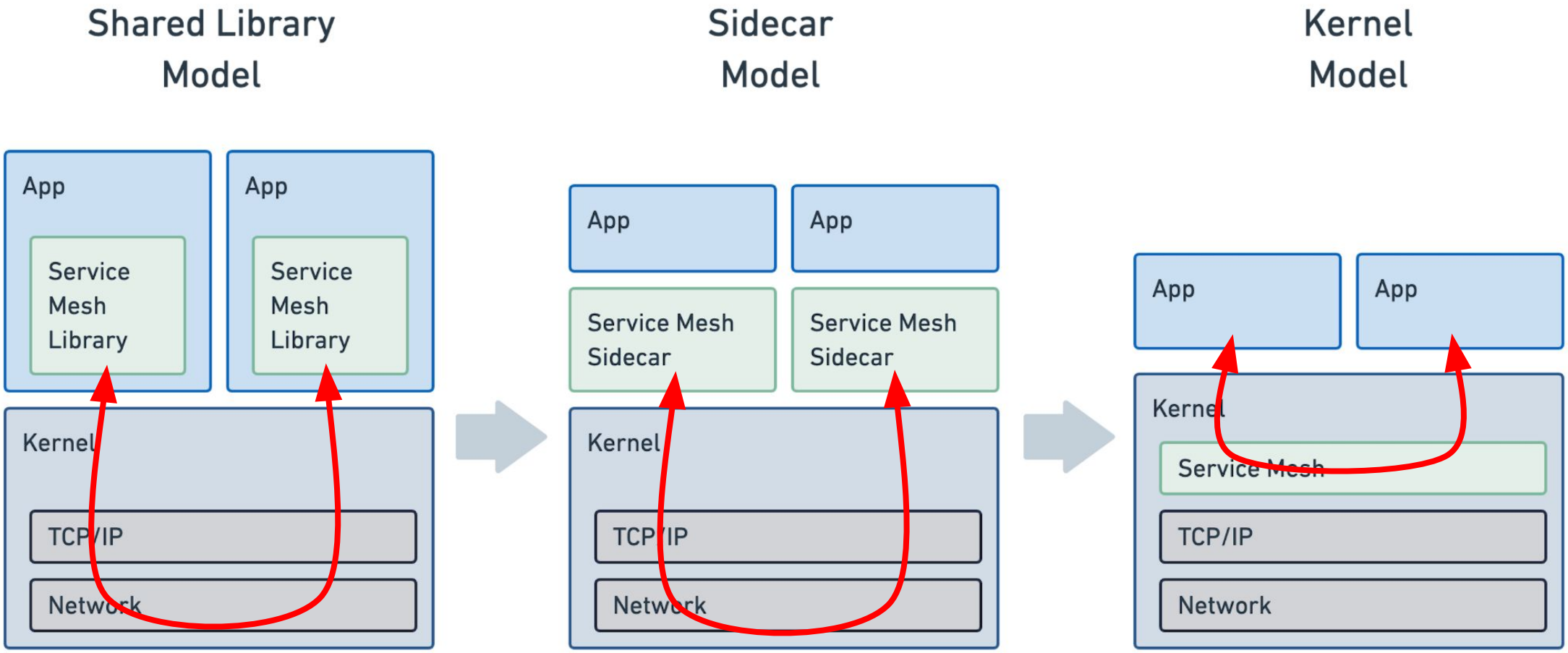


Learn more about eBPF

- Read the fine manual on ebpf.io

- Take eBPF for a spin locally with `bcc` and `bpftrace`
  - `dnf install bcc-tools`
    - `sudo /usr/share/bcc/tools/biosnoop`
  - `dnf install bpftrace`
    - `sudo bpftrace /usr/share/bpftrace/tools/biosnoop.bt`

What is OpenTelemetry?

What is OpenTelemetry?

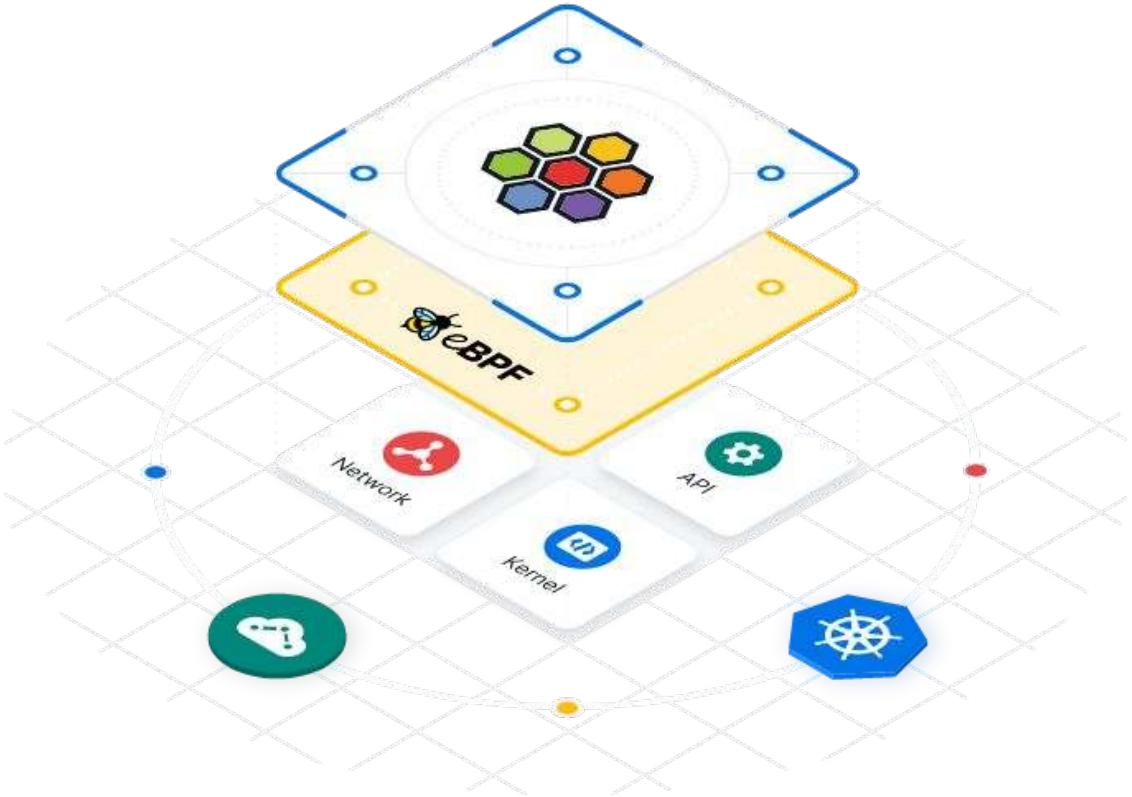
- High-quality, ubiquitous, and portable telemetry
- OpenTelemetry is the result of a merge of two projects
  - OpenTracing – open Telemetry API
  - OpenCensus – open source libraries to instrument code
- Instrument your code once, run it anywhere
- Support for traces, metrics and logs
- Supported by Red Hat OpenShift

Where to get more OpenTelemetry

- Check out opentelemetry.io
- SDKs for all the languages:
  - C++
  - .NET
  - Go
  - Java
  - JavaScript
  - Python
  - And more

What is Cilium?

What is Cilium?



- eBPF is complex and needs higher order tooling to leverage it properly
- Cilium provides, secures, and observes network connectivity between container workloads using eBPF

What does Cilium do?

- high-performance networking
- multi-cluster and -cloud capabilities
- advanced load balancing
- transparent encryption
- network security capabilities
- transparent observability
- much more

Features and Roadmap

- ✅ eBPF Networking (CNI, LB, Policy, …)
- ✅ ClusterMesh (Multi-Cluster CNI)
- ✅ Observability (Hubble)
- ✅ Service Mesh (Ingress)
- ⏳ SPIFFE, Gateway API, Transparent encryption, BGP, …
- ⏳ CNCF Graduation
- ⏳ Your awesome contribution

Cilium on OpenShift

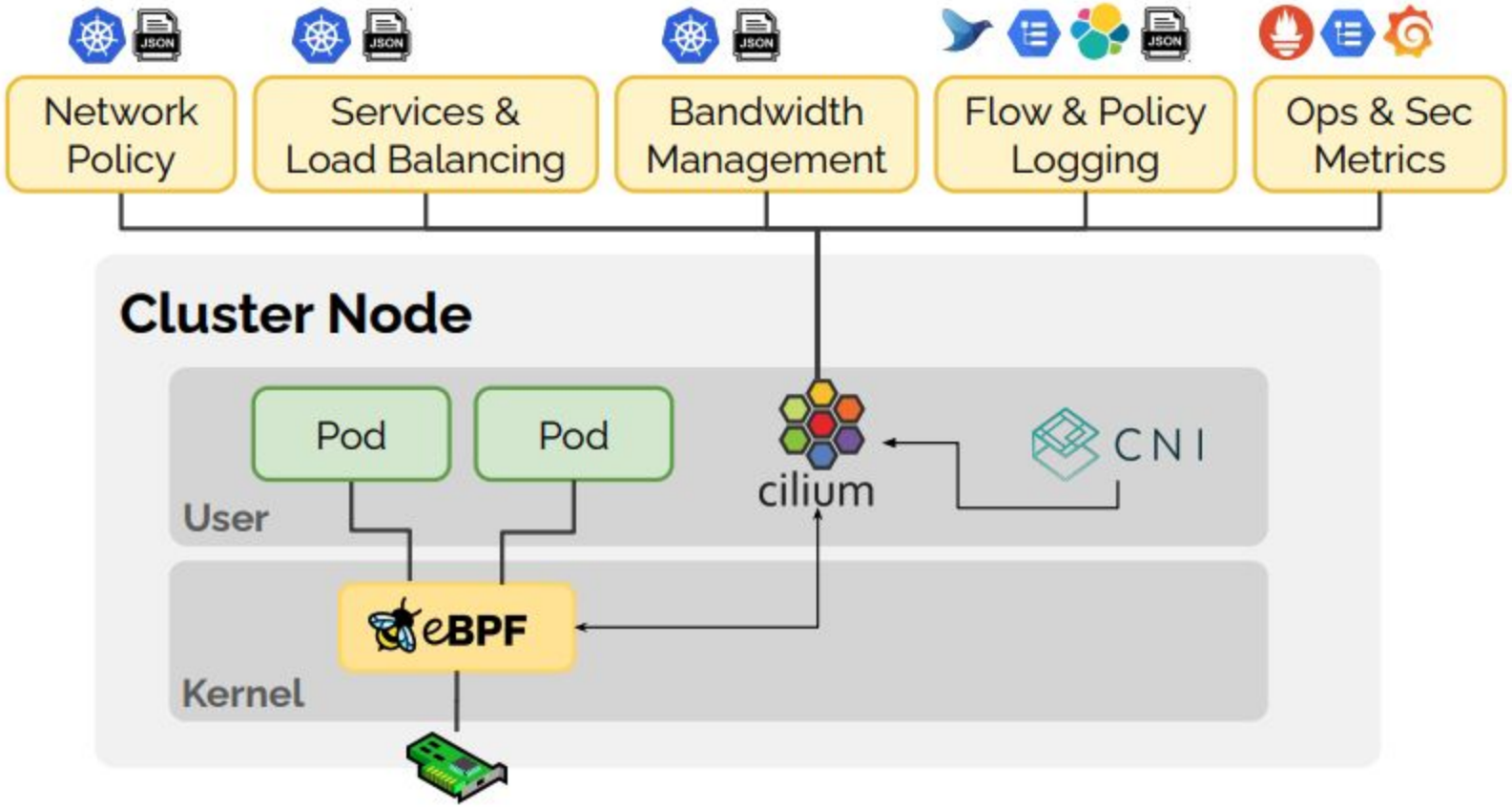
Installing Cilium on OpenShift

- Installation has to be done on a new cluster
- Installation uses the Cilium Operator certified by Red Hat
- If bootstrapping fails
  - Ensure that network configuration matches
    - `clusterPoolIPv4PodCIDR` must match OpenShift `clusterNetwork` CIDR
  - Make sure you configured `Cilium` as `networkType`
- Grab a coffee and wait for your cluster to become ready

What's running in the cluster already

- Cilium Operator managing the deployment and configuration
- Cilium is now configured as your CNI solution
- Cilium agent deployed on each node
- Cilium eBPF programs are running in the kernel
- All endpoints have been assigned an identity
  - Identities are managed by Cilium
  - Used to perform mTLS authentication between services

Cilium components



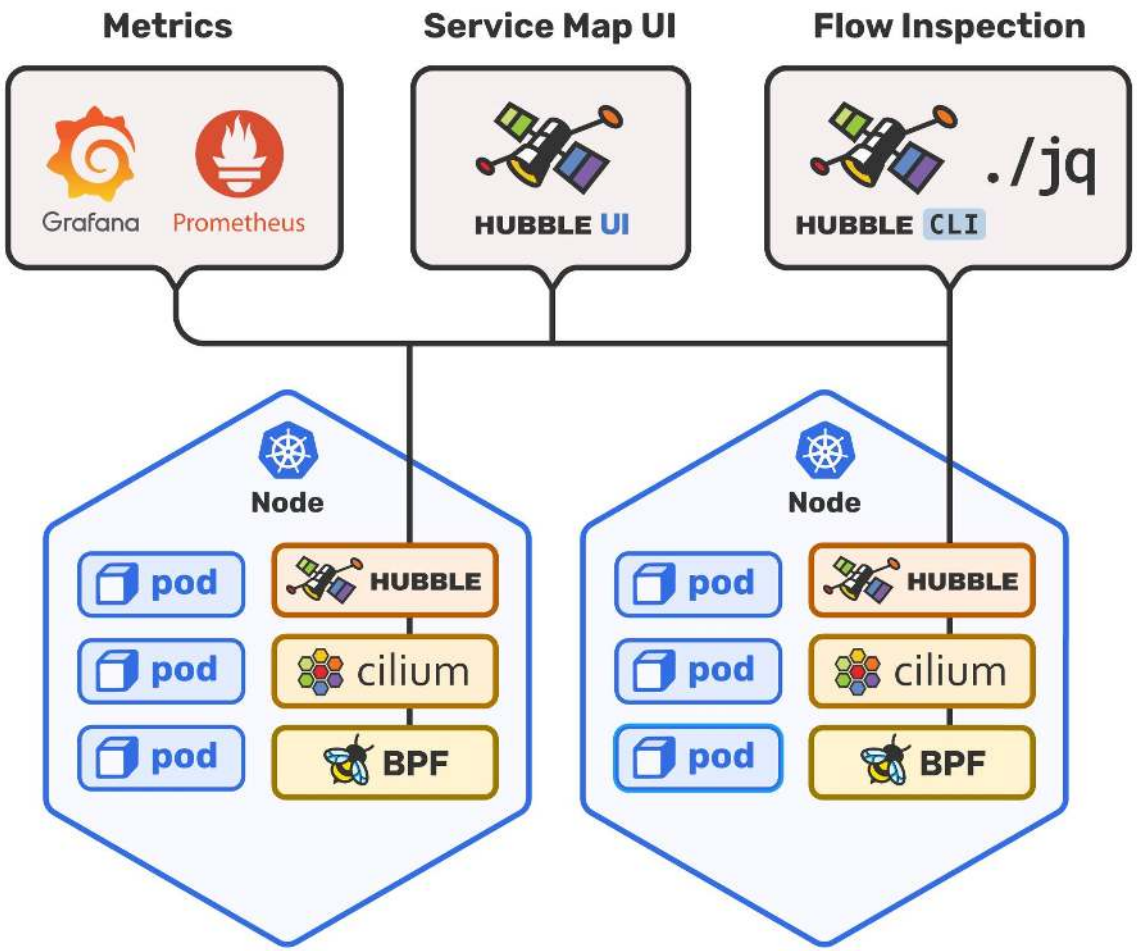
Source: cilium_overview.png on GitHub

Hubble

What is Hubble?

- Optional observability component integrated in Cilium
- Enables insights into any network connection in the cluster
- Enables live debugging of network traffic up to layer 7
- Provides insight into communication patterns
  - What endpoints does my application talk to
- Provides insight into your policies
  - Which connections are being blocked

What is Hubble?



Source: hubble_arch.png on GitHub

How to work with Hubble

- Hubble relay accesses observability data in Cilium agent
- Hubble UI to access the data accessible in the browser
- Hubble CLI to follow traces in the terminal
- Layer 3 & 4 are available out of the box
- Layer 7 requires Pod annotations to enable visibility
  - `io.cilium.proxy-visibility="<Ingress/8080/TCP/HTTP>"`
    - This will now route traffic via Envoy in the Cilium Agent

But what's next?

Attach Hubble to OpenTelemetry and push it to Jaeger

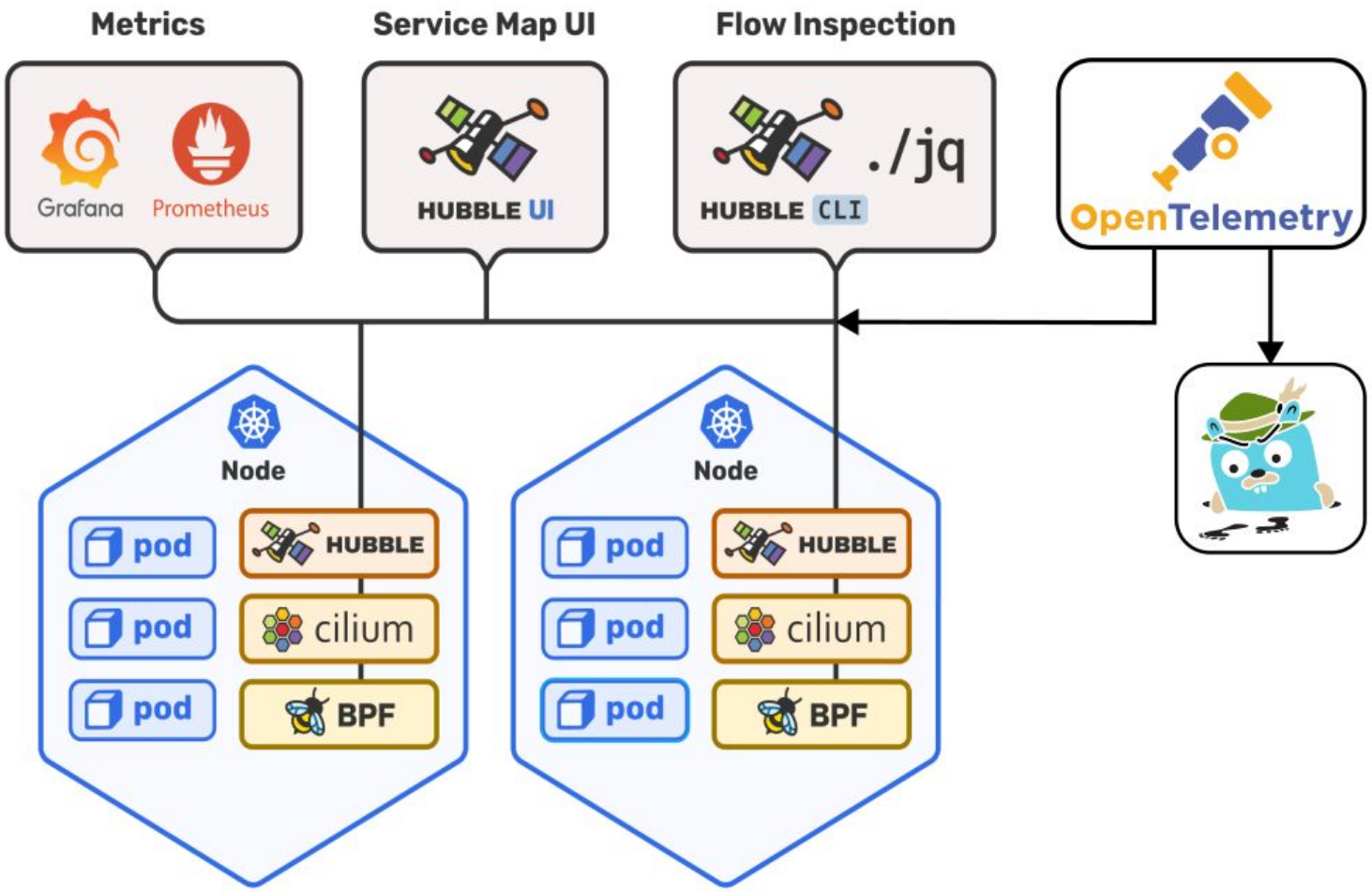
Source: David Bell on Twitter

Integrate Hubble and OpenTelemetry

OpenTelemetry on OpenShift

- Install two operators
  - Red Hat OpenShift distributed tracing platform – Jaeger
  - Red Hat OpenShift distributed data collection – OpenTelemetry Collector
- Deploy Jaeger
- Deploy OpenTelemetry Collector
  - Pull data from Hubble
  - Receive data from applications via OTLP
  - Forward everything to Jaeger

OpenTelemetry on OpenShift



Live demo 🤞

Live Demo 🤞

- Hubble UI: https://hubble-ui.apps.cilium-demo.os4.sycloud.ch/
- Hubble CLI
  - `cilium hubble port-forward --namespace cilium &`
  - `hubble observe --namespace cilium-demo --follow --type l7`
- Jaeger UI:
  - Hubble traces: https://jaeger/search?service=cilium-demo
  - OTLP traces: https://jaeger/search?service=cart-service

Wrap up

What is possible today

- Deep network insights without sidecar injection
- Layer 7 observability without any instrumentation
- Network policies up to layer 7 for supported protocols
- Mutual authentication between endpoints
- Transparent encryption between endpoints
- Dependency graph between endpoints

What are the current limitations

- Context propagation in traces is not yet supported
  - Only a request and its response is visible in Jaeger
- Cilium should not (yet) stop you from instrumenting your code
- Hubble metrics and OpenTelemetry integration are not yet stable

What's next

- ServiceMesh will improve Ingress support
- ServiceMesh will gain Gateway API support
- ClusterMesh will become topology aware

Check the roadmap for more details:

https://docs.cilium.io/en/stable/community/roadmap/

Questions

Links

- Deployment instructions for Cilium on OpenShift

  https://github.com/tongpu/cilium-on-openshift

Stay in Touch

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