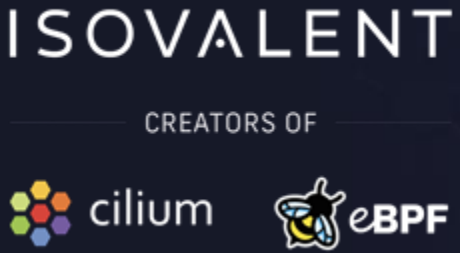
From Alps to Cloud, Cilium's Path to Global Network

Thomas Graf
Co-Founder, Isovalent
VP & CTO Cloud Networking, Cisco



Isovalent
About the Company

- Isovalent is the creator of the popular CNCF open-source project **Cilium** and **eBPF**.
- We are passionate about making customers successful with **Networking, Security & Observability**

Top expertise in Cloud Native, Kubernetes, & Multi- & Hybrid-Cloud:

› Linux Networking, Security & eBPF
› Kubernetes & Distributed Systems
› Open-Source Ecosystem & Standards

Trusted by Enterprises Around the Globe

VISA, Northwestern Mutual, London Stock Exchange, Adobe, Capital One, AstraZeneca, overstock, GitHub, S&P Global, Bloomberg, Palantir, Cognite, Bell, Roche, Schuberg Philis, telenor, Azure, aws, Sony, Google Cloud, databricks, sky

Gartner COOL VENDOR 2021 2021 - 2022

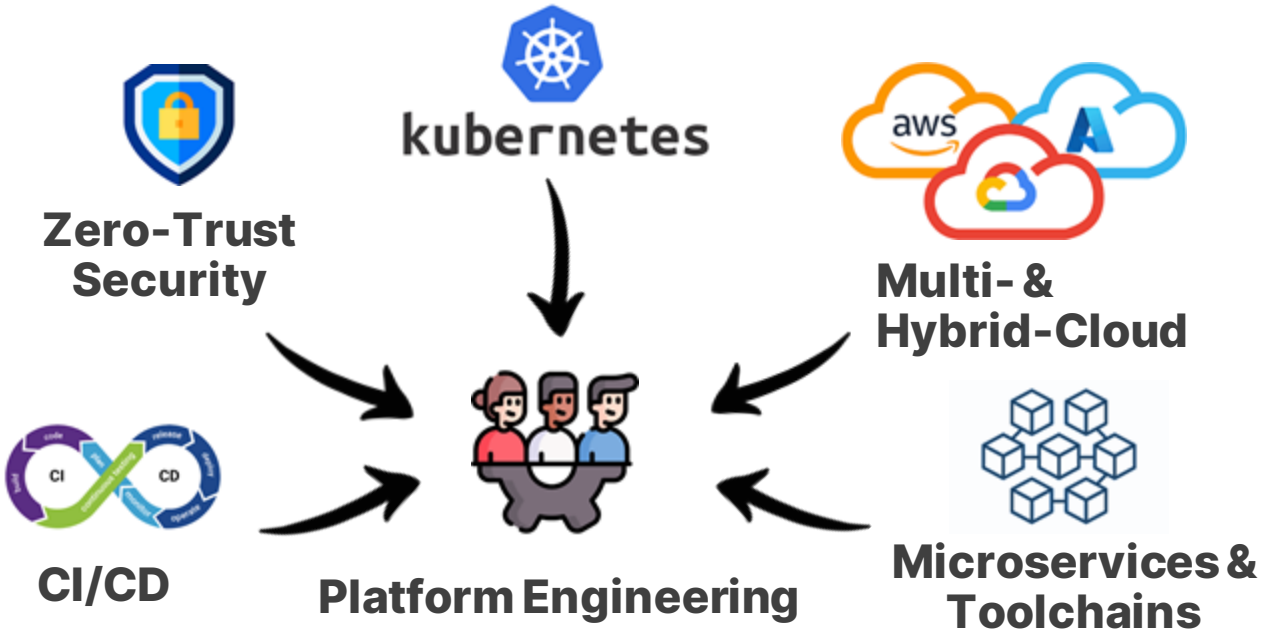
GIGAOM RADAR REPORT CLOUD NETWORKING LEADER 2023

Investors

Andreessen Horowitz, Mirae Asset, Thomvest, Grafana Labs, Mango, Google, M12, cisco, SVAngel

Platform Engineering

Key Infrastructure Trend



Platform engineering is the newest sociotechnical discipline to arise in response to the cloud native world. As the process of designing, building, and maintaining workflows and tools for software engineering organizations, platform engineering helps drive consistency and speed up common tasks.

cilium

Created by ISOVALENT

eBPF-based:

- Networking
- Security
- Observability
- Service Mesh & Ingress

Foundation

CLOUD NATIVE COMPUTING FOUNDATION

Technology

eBPF envoy

Cilium CNI

Scalable, Secure, High Perfomance Networking

Cilium Service Mesh

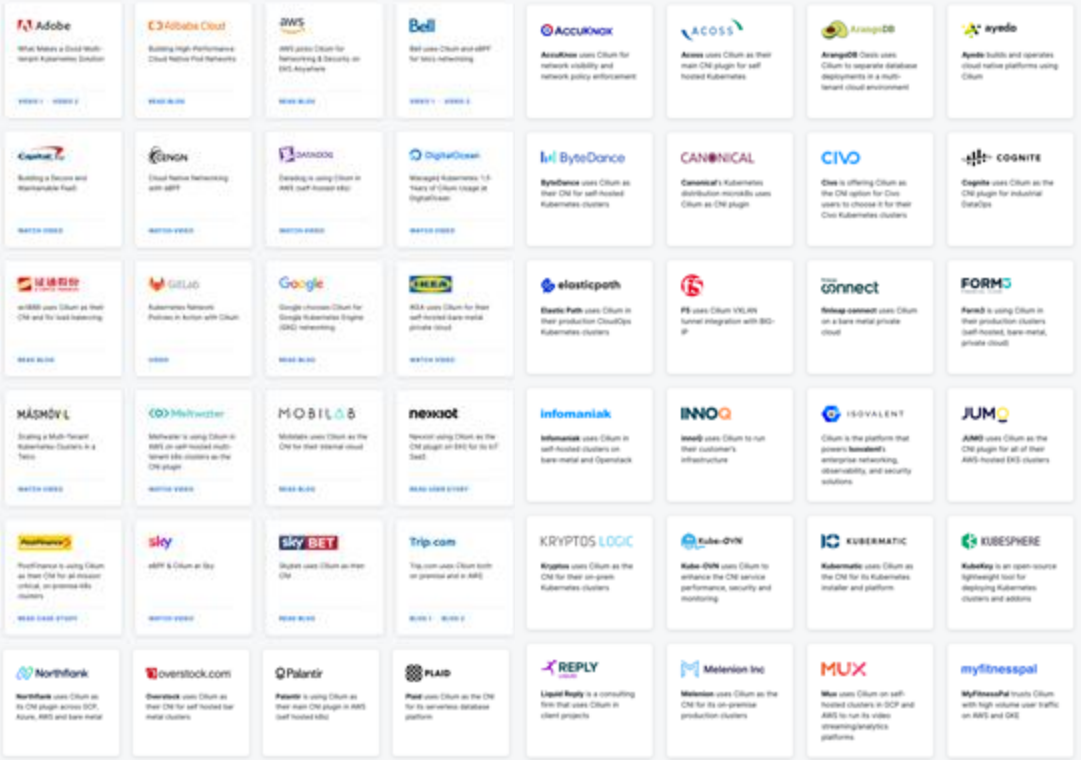
Sidecar-free Service Mesh, Ingress, & Gateway API

Hubble

Network Observability & Monitoring

Tetragon

Security Observability & Runtime Enforcement



Cloud-Native & Platform Engineers Standardize on Cilium

Financials

VISA
Northwestern Mutual
CapitalOne
London Stock Exchange
S&P Global
Robinhood
Bloomberg

E-Commerce

IKEA
ebay
overstock
Trip.com

SaaS

Adobe
ByteDance
DATADOG
GitHub
GitLab

Data & Analytics

Palantir
databricks
ClickHouse
Cognite

Telco

T Systems
telenor
Bell

Cloud Providers

aws
Azure
Google Cloud
EQUINIX
Tencent Cloud

Pharma

Roche
AstraZeneca

...

SAP
sky
SCHUBERG PHILIS
SONY
The New York Times

The Origins....

Then

Cilium Design Summit,
Diavolezza, 2016

Now

Isovalent Team, 2023


eBPF

Highly efficient sandboxed virtual machine in the Linux kernel making the Linux kernel programmable at native execution speed.


```
$ clang -target bpf -emit-llvm -S \
   32-bit-example.c
$ llc -march=bpf 32-bit-example.ll
$ cat 32-bit-example.s
    cal:
      r1 = *(u32 *)(r1 + 0)
      r2 = *(u32 *)(r2 + 0)
      r2 += r1
      *(u32 *)(r3 + 0) = r2
      exit
```

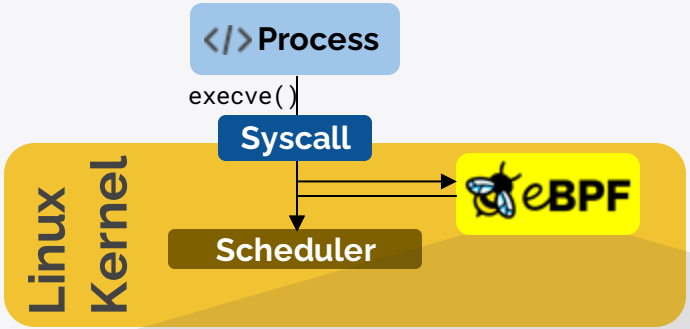
Jointly maintained by Cilium and Facebook with collaborations from Google, Red Hat, Netflix, and many others.

More info: ebpf.io

eBPF

Makes the Linux kernel programmable in a secure and efficient way.

Biggest shift in infrastructure software innovation in decades.

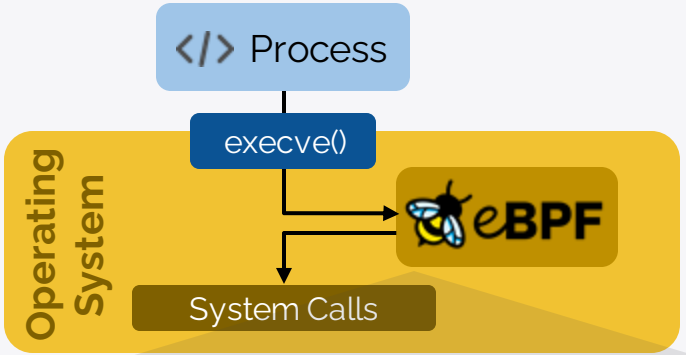



```
int syscall__ret_execve(struct pt_regs *ctx)
{
        struct comm_event event = {
                .pid = bpf_get_current_pid_tgid() >> 32,
                .type = TYPE_RETURN,
        };

        bpf_get_current_comm(&event.comm, sizeof(event.comm));
        comm_events.perf_submit(ctx, &event, sizeof(event));

        return 0;
}
```

Website

Submit

```
function hello() {
  alert('hello')
}
</script>
<form onsubmit="return false;">
  <input type="submit"
         name="hello"
         onclick="hello()">
</form>
```




```
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                .type = TYPE_RETURN,
        };

        bpf_get_current_comm(&event.comm, sizeof(event.comm));
        comm_events.perf_submit(ctx, &event, sizeof(event));

        return 0;
}
```

Isovalent Cilium Enterprise:

One Solution For Your Cloud Native Journey

Service Mesh

RESILIENCE · AUTHENTICATION · TRAFFIC MANAGEMENT

cilium Service Mesh

Ingress · Gateway API · spiffe

Observability

METRICS · TRACING · SERVICE MAP · LOGS

cilium Hubble

SIEM · JSON · fluentd · Grafana · OpenTelemetry

Networking

ENCRYPTION · LOAD-BALANCING · NETWORK POLICY · NETWORKING

cilium CNI

IPsec
Wireguard

Kubernetes
DSR • Maglev

DNS • L7
L3/L4

IPv4 • IPv6 • Overlay • BGP
Egress Gateway • Multi-Cluster

Runtime Security

OBSERVABILITY
ENFORCEMENT

Tetragon

SIEM · JSON · fluentd

Kubernetes · Container · VM · Metal

aws · Google Cloud · Azure · Alibaba Cloud · Red Hat OpenShift · vmware

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cilium

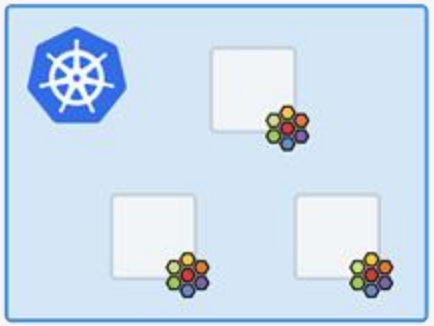
Phase II: Network Security

Zero-Trust & Compliance

"We choose Cilium as it supports Network Policies at Layer 3/4/7, Cloud agnostic & easy to deploy anywhere."

– Adelina Simion, Technology Evangelist

FORM3



aws Azure

Networking

- Container Networking
- L3-L4 Load Balancing

Network Security

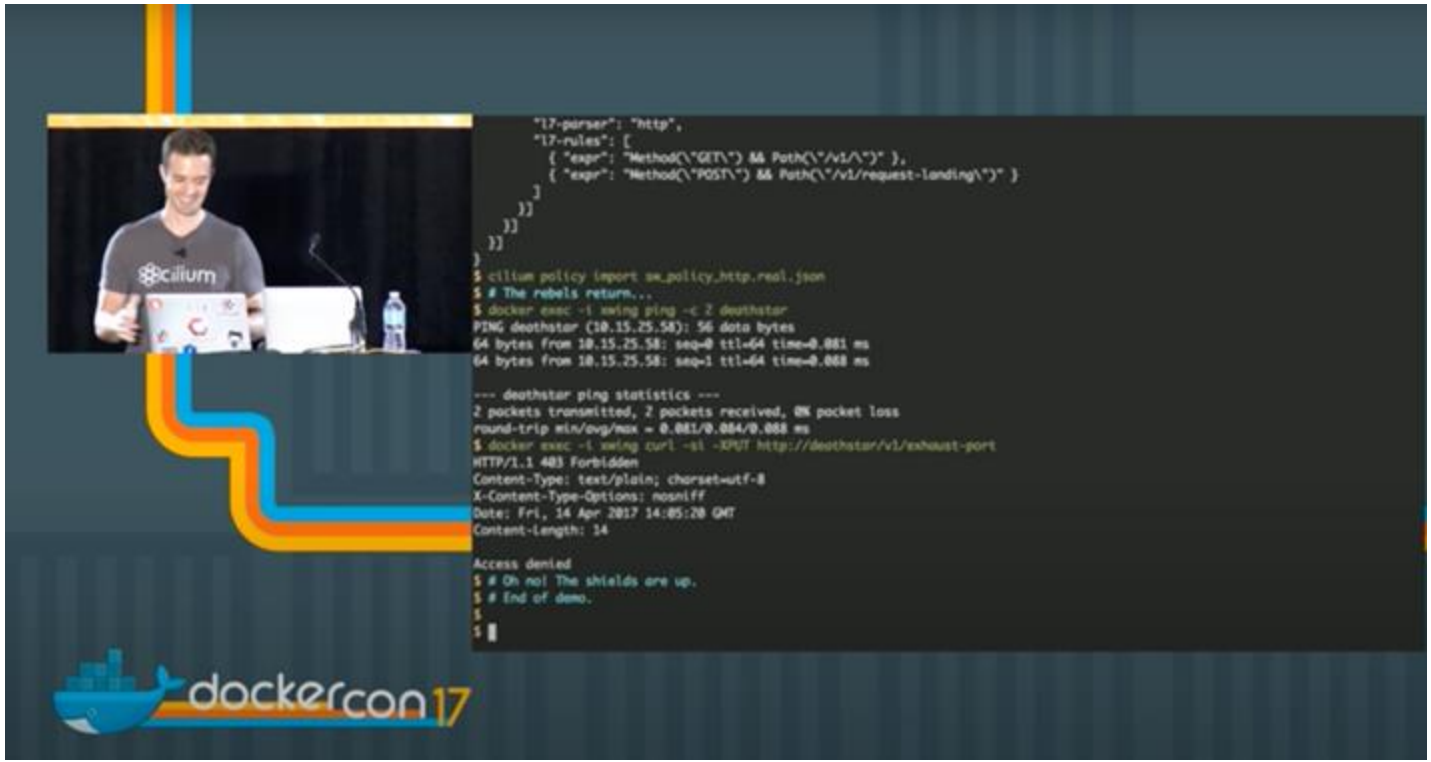
- Network Policy L3-L7
- Encryption

"We are a bank. Everything is security first. We had to have a way to audit the network traffic down to the specific application that initiated the connection."

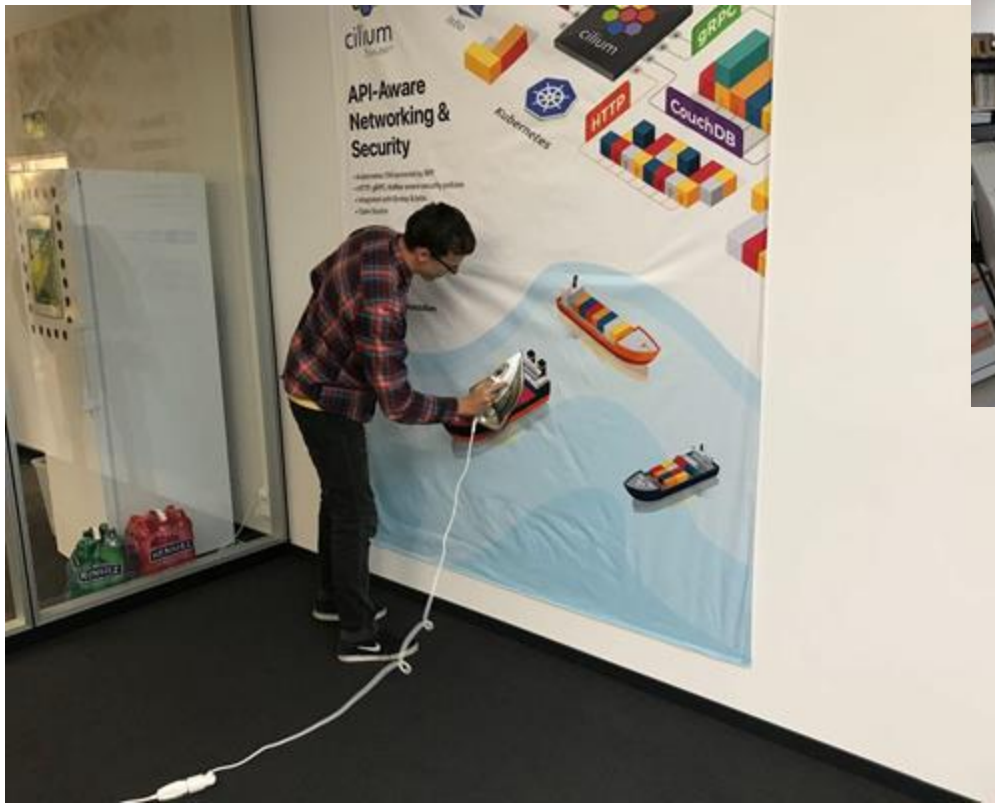
– Bradley Whitfield, Senior Lead Platform Engineer

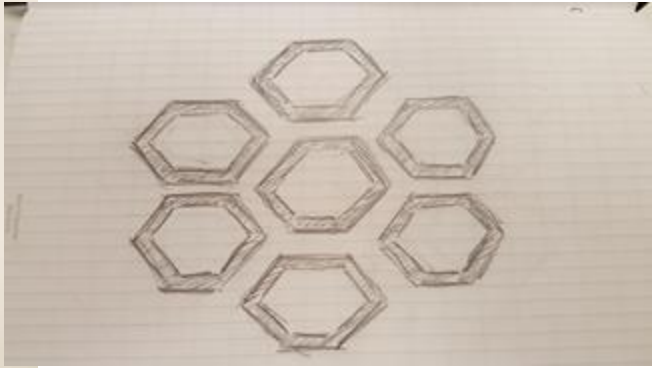
Capital One

DockerCon 2017
When everything changed

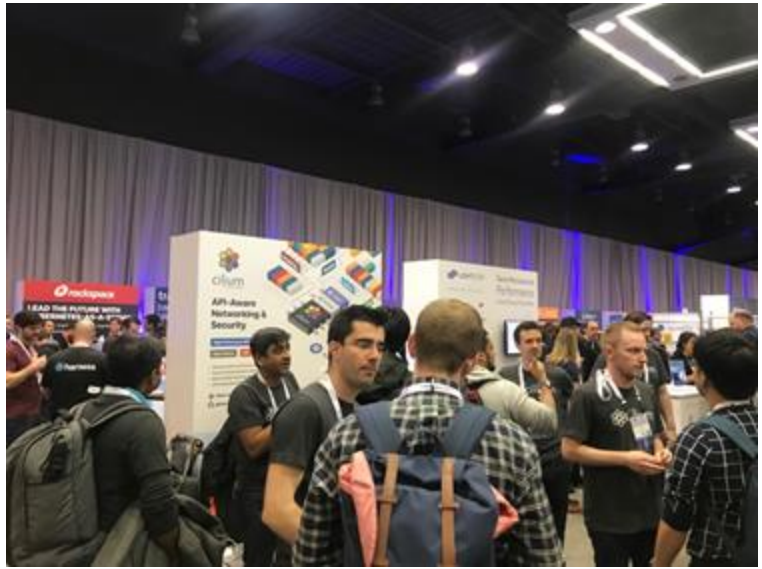


2017 - First Office





2018
Starting to Grow

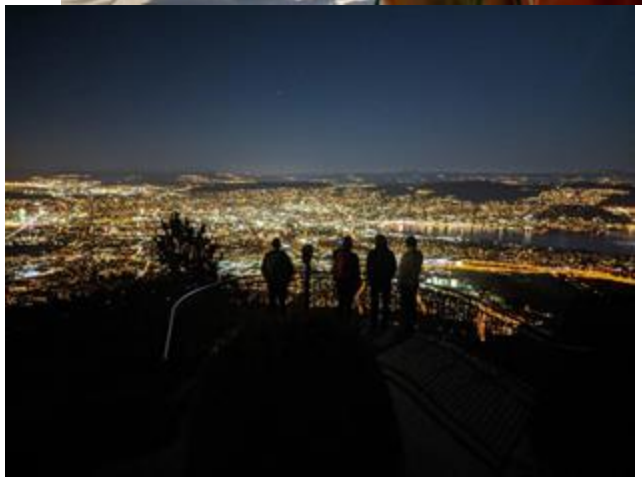


2019
Team Building

The Snow Chains Incident, Julier Pass

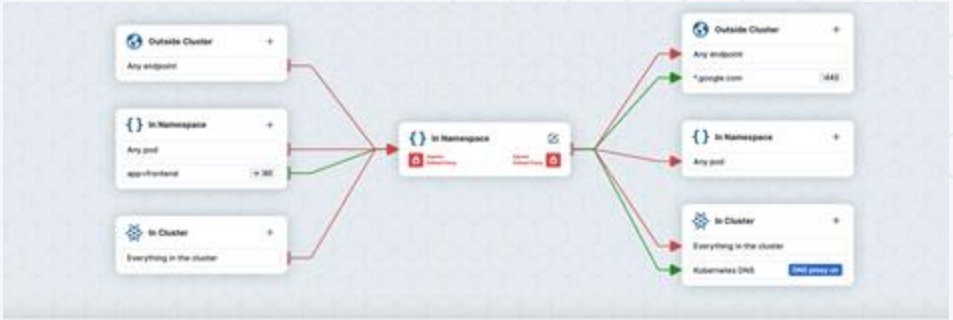
2019
Swiss Culture

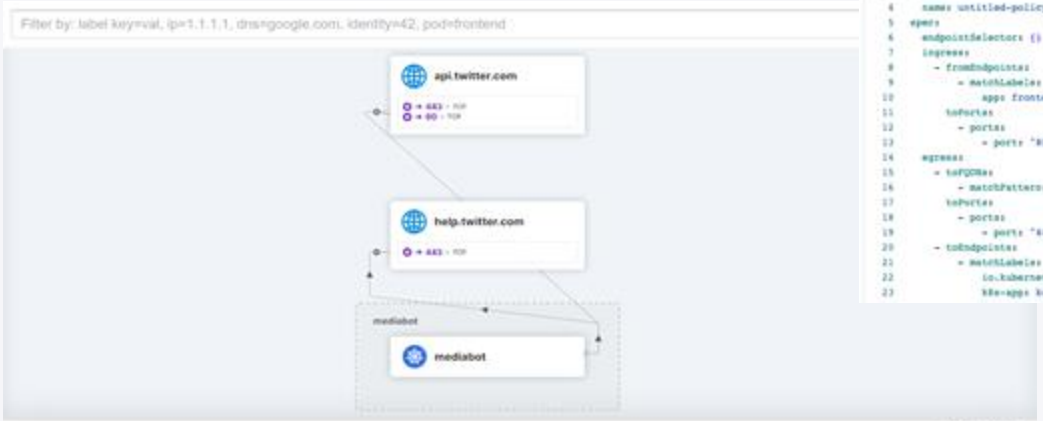
Fondue,
AirBnB,
Palo Alto



Phase II: Policy Management

Zero-Trust & Compliance





Columns

Source Service	Destination Service	Destination Port	Verdict	TCP Flags	Timestamp
mediabot /mediabot	api.twitter.com	80	dropped	SYN	2021/12/13 10:25:35 (-05)
mediabot /mediabot	api.twitter.com	80	dropped	SYN	2021/12/13 10:25:34 (-05)
mediabot /mediabot	api.twitter.com	80	dropped	SYN	2021/12/13 10:25:33 (-05)
mediabot /mediabot	help.twitter.com	443	dropped	SYN	2021/12/13 10:25:03 (-05)
mediabot /mediabot	api.twitter.com	443	forwarded	SYN	2021/12/13 10:24:48 (-05)
mediabot /mediabot	help.twitter.com	443	dropped	SYN	2021/12/13 10:23:49 (-05)
mediabot /mediabot	api.twitter.com	443	forwarded	SYN	2021/12/13 10:23:28 (-05)

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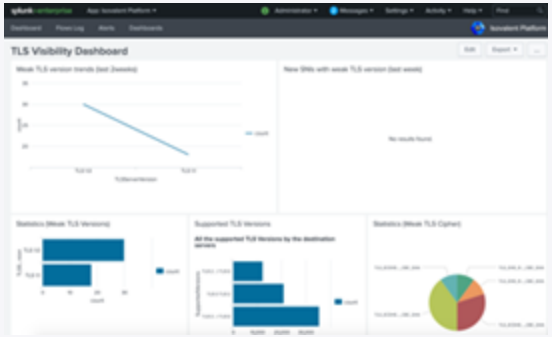
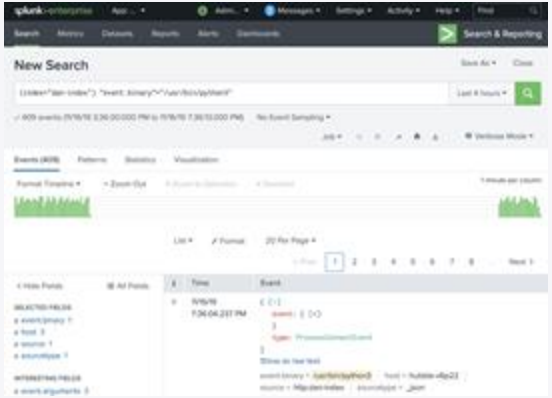
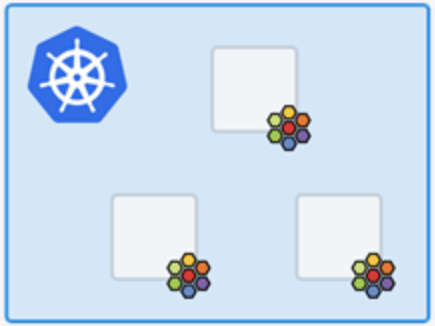
Phase II: SIEM Integration

Zero-Trust & Compliance







aws Azure

Networking

- Container Networking
- L3-L4 Load Balancing

splunk> elastic

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration

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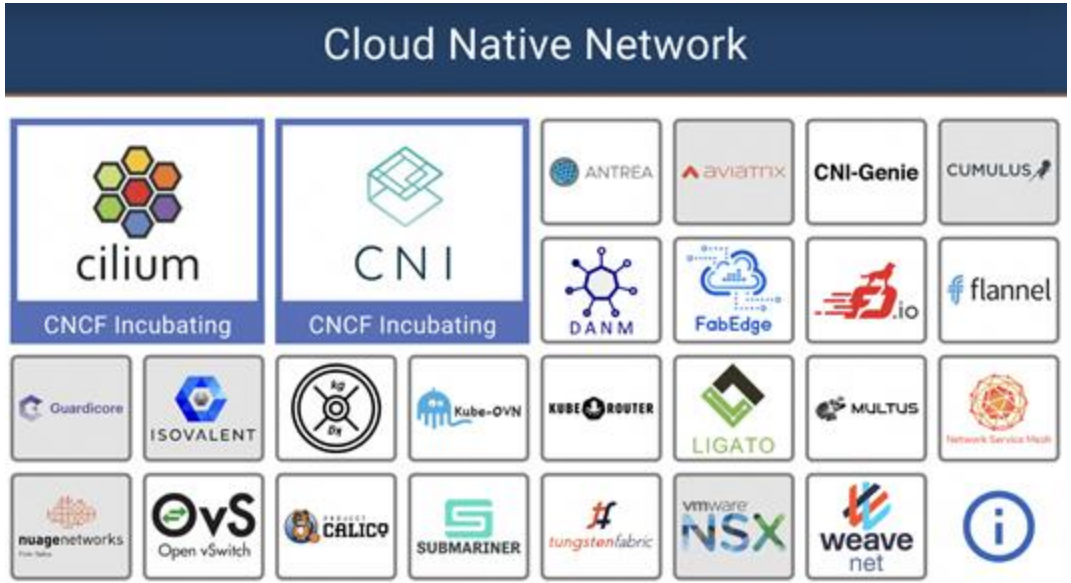
2021- Things start to get crazy…

Cilium joins the CNCF



AWS picks Cilium

aws

cilium
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Google picks Cilium

Google

Google Kubernetes Engine

eBPF

cilium

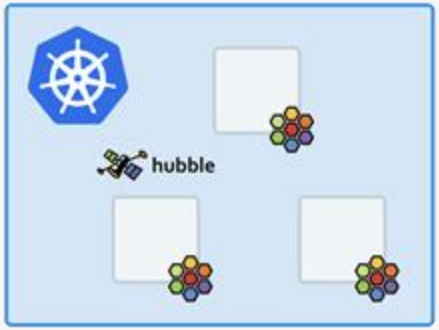
Phase II: Network Observability

Zero-Trust & Compliance

With Hubble, we are able to get easy traceability of network calls associated to a Kubernetes pod.

– Vlad Ungureanu, Backend Software Engineer

Palantir



aws Azure

Networking

- Container Networking
- L3-L4 Load Balancing

splunk> elastic

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration

Grafana

Network Observability

- Flow Logs
- Metrics
- Troubleshooting

Live View

Namespace

Show clusterwide data

anna-otel-demo

Flows verdict

Any verdict

Forwarded

Dropped

Aggregate flows

Visual filters

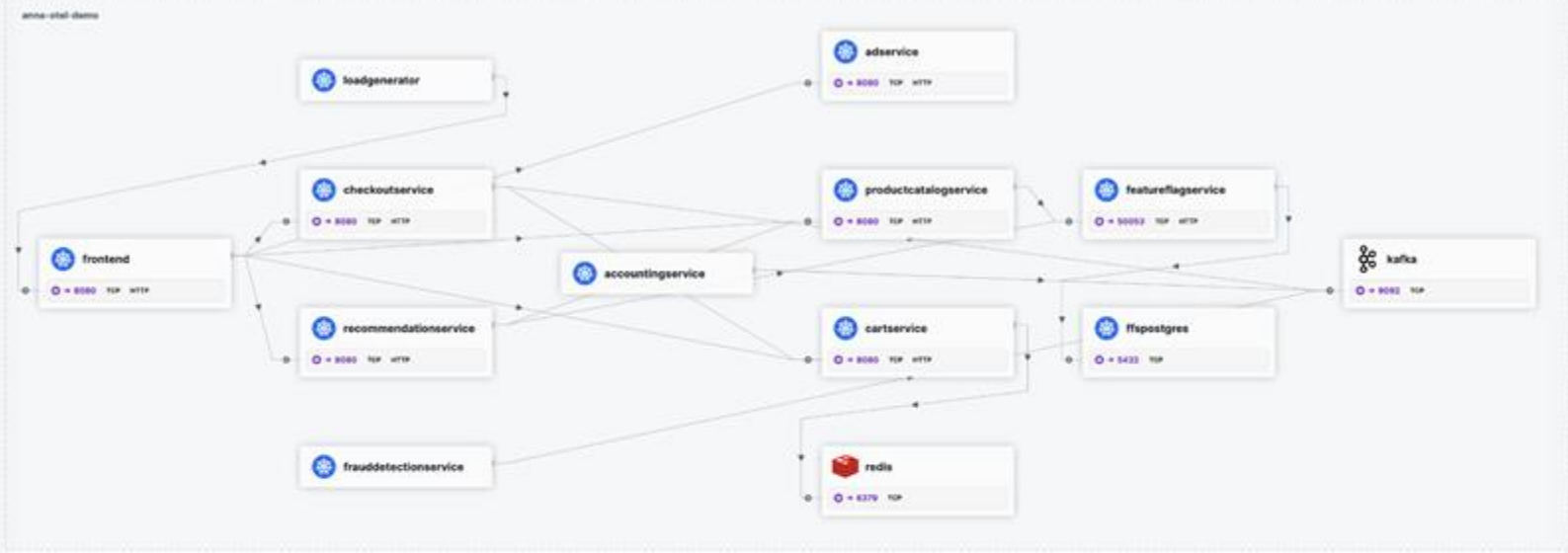
Host service

Kube-DNS:53 pod

Remote node

Prometheus app

Filter by: label key=val, ip=1.1.1.1, dns=google.com, identity=42, pod=frontend



2023-04-15T08:52:22.000Z

Flows | Metrics | Services

Columns

Source Identity	Destination Identity	Destination Port	L7 info	Traffic Direction	Verdict	TCP Flags	Timestamp
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET /api/products/66VCHSJNUP 0ms	ingress	forwarded		2023/04/15 10:52:32 (+02)
checkoutservice anna-otel-demo	kafka anna-otel-demo	9092	—	egress	forwarded	ACK	2023/04/15 10:52:31 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET / 0ms	ingress	forwarded		2023/04/15 10:52:28 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET /api/products/L9ECAV7KIM 0ms	ingress	forwarded		2023/04/15 10:52:26 (+02)
cartservice anna-otel-demo	redis anna-otel-demo	6379	—	egress	forwarded	ACK PSH	2023/04/15 10:52:26 (+02)
productcatalogservice anna-otel-demo	featureflagservice anna-otel-demo	50053	→ POST /oteldemo.FeatureFlagService/...	ingress	forwarded		2023/04/15 10:52:25 (+02)
productcatalogservice anna-otel-demo	featureflagservice anna-otel-demo	50053	—	egress	forwarded	SYN	2023/04/15 10:52:25 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET /api/products/0LJCESPC7Z 0ms	ingress	forwarded		2023/04/15 10:52:25 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET /api/products/2ZYFJ3GM2N 0ms	ingress	forwarded		2023/04/15 10:52:24 (+02)
frontend anna-otel-demo	cartservice anna-otel-demo	8080	→ POST /oteldemo.CartService/GetCart...	ingress	forwarded		2023/04/15 10:52:22 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ GET /api/cart 0ms	ingress	forwarded		2023/04/15 10:52:22 (+02)
frontend anna-otel-demo	checkoutservice anna-otel-demo	8080	→ POST /oteldemo.CheckoutService/Pla...	ingress	forwarded		2023/04/15 10:52:22 (+02)
loadgenerator anna-otel-demo	frontend anna-otel-demo	8080	→ POST /api/checkout 0ms	ingress	forwarded		2023/04/15 10:52:22 (+02)
frontend anna-otel-demo	cartservice anna-otel-demo	8080	→ POST /oteldemo.CartService/AddIte...	ingress	forwarded		2023/04/15 10:52:22 (+02)

2022 - The Business grows...

Isovalent raises $40M Series B led by Thomvest Ventures

by Ashish Nain • September 8, 2022

Isovalent announced it has closed a $40M Series B funding round led by Thomvest Ventures. M12 (Microsoft's Venture Fund) and Grafana Labs joined Google and Cisco as existing strategic investors in the company, highlighting the central position that Isovalent occupies in the eBPF and broader cloud native ecosystem. Additional investors include Andreessen Horowitz, Mango Capital, and Mirae Asset Capital.

THOMVEST

Grafana

Microsoft

a16z ANDREESSEN HOROWITZ

Google

cisco

Strategic Observability Partnership


Hubble UI / Cilium / Components / L3 Policy
Last 30 minutes
30s
Data Source
default
cluster
All
namespace
All
pod
All
top k
10
Cilium Overviews
Cilium Components
Top Pod Ingress Packet Forward Rates
10000
1000
100
10:30
10:35
10:40
10:45
10:50
10:55
cilium-4ghf5
cilium-jl2sd
cilium-tkf8b
cilium-xj9lk
Top Drop Rates
0.4 ops/s
0.3 ops/s
0.2 ops/s
0.1 ops/s
0 ops/s
cilium-jl2sd:EGRESS
cilium-tkf8b:EGRESS
cilium-xj9lk:EGRESS
cilium-4ghf5:INGRESS
cilium-jl2sd:INGRESS
cilium-tkf8b:INGRESS
cilium-xj9lk:INGRESS
Egress Packet Drop Reasons
10000
1000
100
10
1
0.100
Reason: No mapping for NAT masquerade
Reason: Policy denied by denylist
Reason: Unsupported L3 protocol
Forwarded
Ingress Packets by Reason
10000
1000
100
10
1
0.100
0.0100
0.00100
Reason: First logical datagram fragment not found
Reason: Policy denied
Reason: Service backend not found
Reason: Unsupported L3 protocol
Forwarded
Cilium L3 Ingress Packet Counts
10K ops/s
1K ops/s
100 ops/s
10 ops/s
1 ops/s
0.100 ops/s
0.0100 ops/s
0.00100 ops/s
Reason: First logical datagram fragment not found
Reason: Policy denied
Reason: Service backend not found
Reason: Unsupported L3 protocol
Forwarded
Total Forwarded Traffic
64 MiB/s
32 MiB/s
16 MiB/s
8 MiB/s
EGRESS
INGRESS
Total

Hubble / Hubble HTTP Golden Signals by W...

Last 6 hours | 30s

Prometheus: Prometheus | Cluster: None | Destination Namespace: otel-demo | Destination Workload: otel-demo-featureflagservice | Reporter: server | Source Namespace: All | Source Workload: All

General

Incoming Request Volume

0.800 req/s

Incoming Request Success Rate (non-5xx responses)

114%

Request Duration

500 ms
0 s
03:00 04:00 05:00 06:00 07:00 08:00

P50 Last *: 15.7 ms P95 Last *: 41.5 ms P99 Last *: 118 ms

Requests by Source

Incoming Requests by Source and Response Code

1 req/s
0.8 req/s
0.6 req/s
0.4 req/s
0.2 req/s
0 req/s
03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

	Max	Mean	Total	Last *
otel-demo/otel-demo-adservice: 200	0.0730 req/s	0.0218 req/s	15.7 req/s	0.0360 req/s
otel-demo/otel-demo-frontendproxy: 200	0 req/s	0 req/s	0 req/s	0 req/s
otel-demo/otel-demo-frontendproxy: 302	0 req/s	0 req/s	0 req/s	0 req/s
otel-demo/otel-demo-frontendproxy: 404	0 req/s	0 req/s	0 req/s	0 req/s

Incoming Request Success Rate (non-5xx responses) By Source

800%
600%
400%
200%
0%
03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

	Mean	Min	Max	Last *
otel-demo/otel-demo-adservice	NaN	9.09%	∞%	36.4%
otel-demo/otel-demo-frontendproxy	NaN			NaN
otel-demo/otel-demo-productcatalogservice	∞%	14.7%	∞%	182%
otel-demo/otel-demo-recommendationservice	∞%	24.7%	∞%	103%

HTTP Request Duration by Source

1 s
800 ms
600 ms
400 ms
200 ms
0 s
03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

CPU Usage by Source

0.03
0.02
0.01
0
03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

ISOVALENT

#pets

We've shared our loved ones









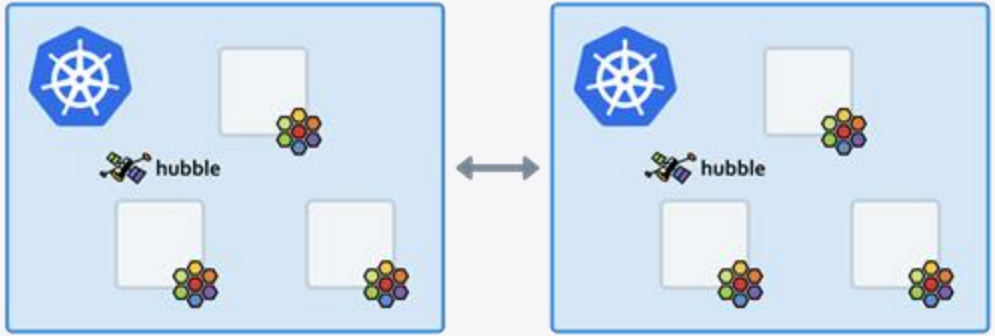






Phase III: Multi-Cluster

Multi-Cloud & Legacy Integrations



"What makes Cilium Cluster Mesh unique in our opinion is:

- *Cross cluster Service Discovery*
- *Cross cluster Service Load Balancing*
- *Cross Cluster Network Policies"*

– Karsten Nielsen, Senior Systems Engineer

IKEA

aws Azure

Networking

- Container Networking
- L3-L4 Load Balancing
- Multi-Cluster

splunk> elastic

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration

Grafana Prometheus

Network Observability

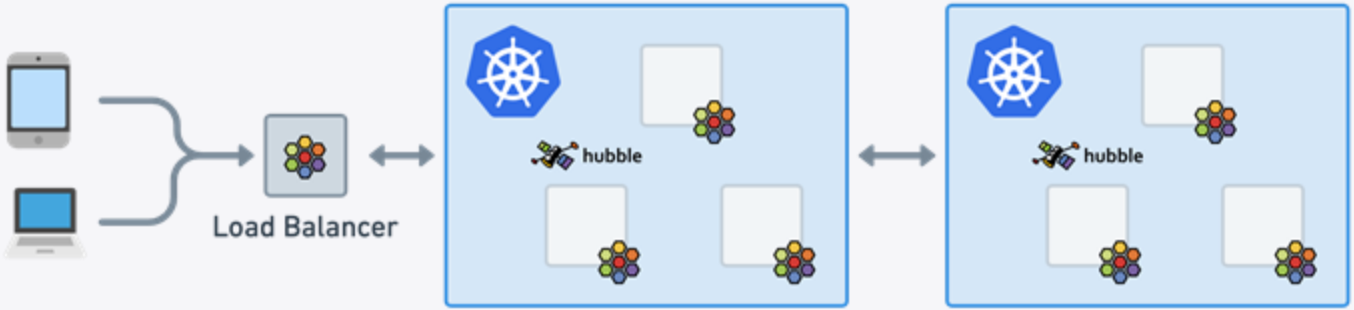
- Flow Logs
- Metrics
- Troubleshooting

More Team Building was needed

ISOVALENT

Phase III: Load-Balancer

Multi-Cloud & Legacy Integrations



"At one point, we were not sure if we had a bug somewhere because the CPU load was so low when the Cilium Load Balancer was handling the traffic."

– Ondrej Blazek, Infrastructure Engineer

SEZNAM.CZ

Networking

- Container Networking
- L3-L4 Load Balancing
- Standalone LB
- Multi-Cluster

Network Security

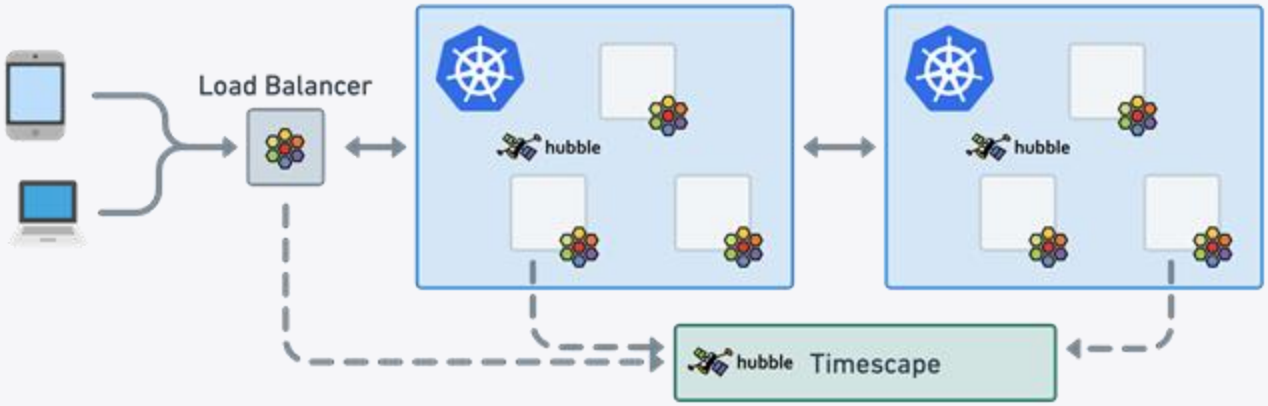
- Network Policy L3-L7
- Encryption
- SIEM Integration

Network Observability

- Flow Logs
- Metrics
- Troubleshooting

Phase III: Timescape - Historic Visibility

Multi-Cloud & Legacy Integrations



aws Azure

Networking

- Container Networking
- L3-L4 Load Balancing
- Standalone LB
- Multi-Cluster

splunk> elastic

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration

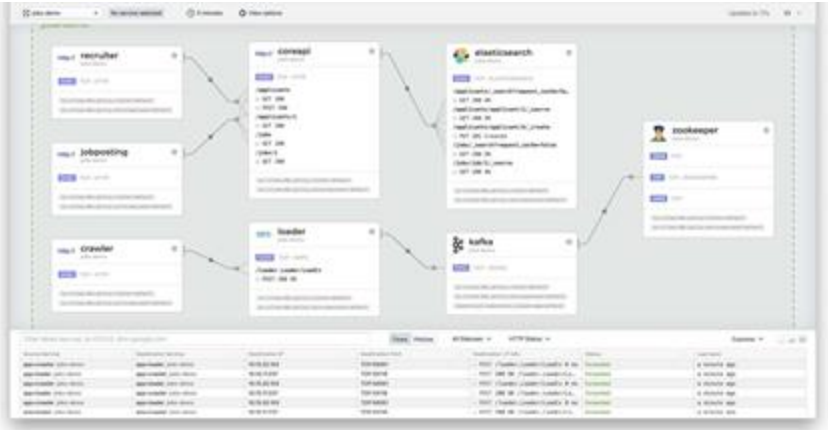
Grafana ClickHouse

Network Observability

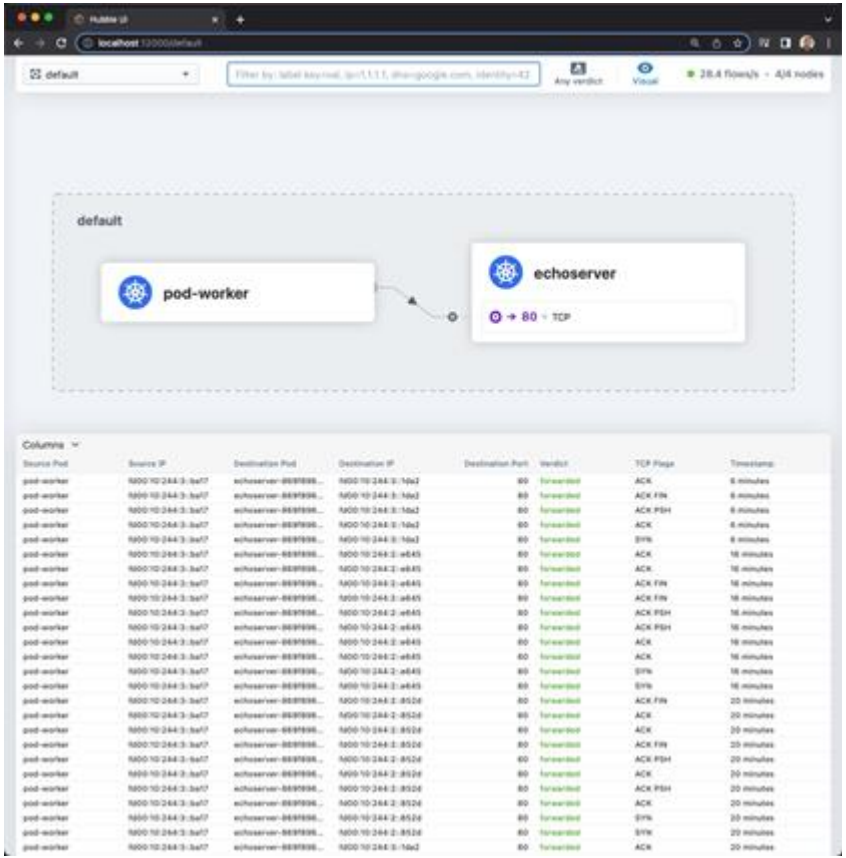
- Flow Logs
- Metrics
- Troubleshooting
- Network Time Machine

Phase III: Timescape - Historic Visibility

Multi-Cloud & Legacy Integrations



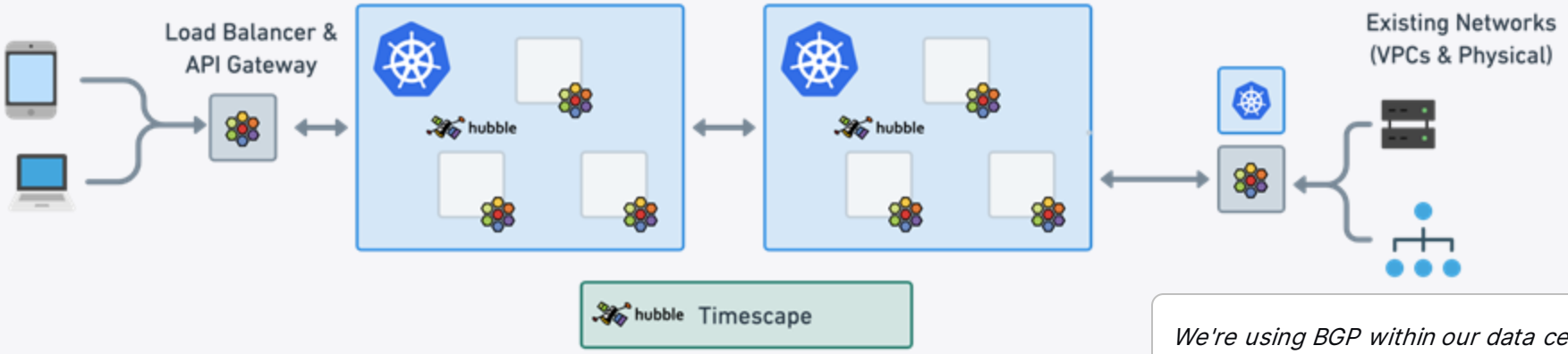

```
$ kubectl get pods
NAME                          READY   STATUS    RESTARTS   AGE
tiefighter                    1/1     Running   0          2m34s
xwing                         1/1     Running   0          2m34s
deathstar-5b7489bc84-crlxh    1/1     Running   0          2m34s
deathstar-5b7489bc84-j7qwq    1/1     Running   0          2m34s

$ hubble observe --follow -l class=xwing
# DNS lookup to coredns
default/xwing:41391 (ID:16092) -> kube-system/coredns-66bff467f8-28dgp:53 (ID:45) to-proxy FORWARDED (UDP)
kube-system/coredns-66bff467f8-28dgp:53 (ID:45) -> default/xwing:41391 (ID:16092) to-endpoint FORWARDED (UDP)
# ...
# Successful HTTPS request to www.disney.com
default/xwing:37836 (ID:16092) -> www.disney.com:443 (world) to-stack FORWARDED (TCP Flags: SYN)
www.disney.com:443 (world) -> default/xwing:37836 (ID:16092) to-endpoint FORWARDED (TCP Flags: SYN, ACK)
www.disney.com:443 (world) -> default/xwing:37836 (ID:16092) to-endpoint FORWARDED (TCP Flags: ACK, FIN)
default/xwing:37836 (ID:16092) -> www.disney.com:443 (world) to-stack FORWARDED (TCP Flags: RST)
# ...
# Blocked HTTP request to deathstar backend
default/xwing:49610 (ID:16092) -> default/deathstar:80 (ID:16081) Policy denied DROPPED (TCP Flags: SYN)
```



Food and Laser Tag keep Engineering teams motivated

Phase III: Multi- & Hybrid-Cloud Networking

Multi-Cloud & Legacy Integrations



Networking

- Container Networking
- L3-L4 Load Balancing
- Standalone LB
- Multi-Cluster
- Multi-Cloud
- Gateway Support

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration
- mTLS

Network Observability

- Flow Logs
- Metrics
- Troubleshooting
- Network Time Machine

We're using BGP within our data center. It gives us is a lot of flexibility, scalability and redundancy!
With Cilium, it's quite simple to connect your Kubernetes network to your BGP environment.

– Karsten Nielsen, Senior Systems Engineer

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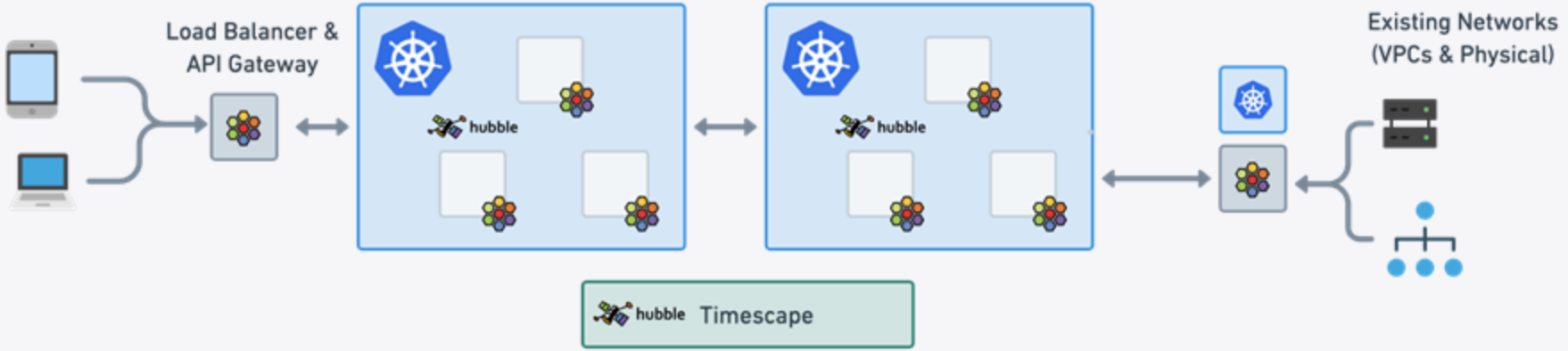
Phase IV: Service Mesh

Enterprise-Wide Microservices Platform



Networking

- Container Networking
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- Standalone LB
- Multi-Cluster
- Multi-Cloud
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Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration
- mTLS

Network Observability

- Flow Logs
- Metrics
- Troubleshooting
- Network Time Machine

Service Mesh

- L7 Load Balancing
- Tracing
- mTLS
- API Gateway

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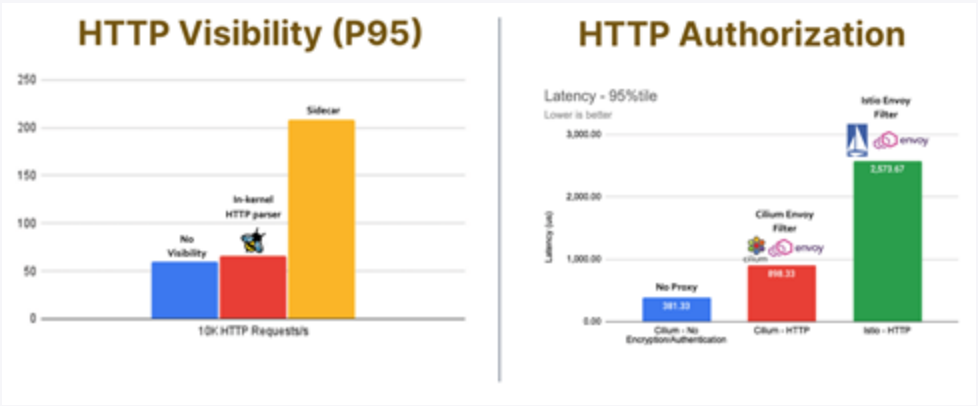
Phase IV: Service Mesh

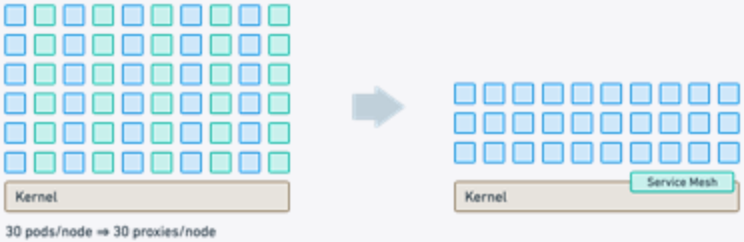
Enterprise-Wide Microservices Platform

"The advantages of a service mesh without the management overhead of running Istio or Linkerd is mind-blowing"

– Aditya Purandarem, Staff Software Engineer

myfitnesspal





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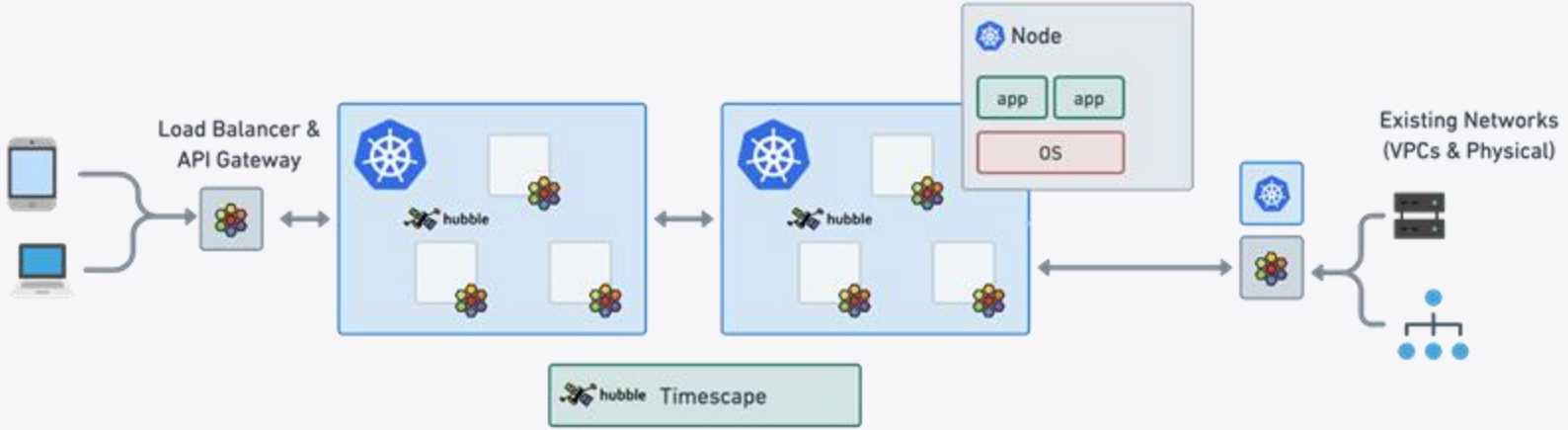
2023 - Instant Regret Hikes were invented

Phase IV: Runtime Security

Enterprise-Wide Microservices Platform



Networking

- Container Networking
- L3-L4 Load Balancing
- Standalone LB
- Multi-Cluster
- Multi-Cloud
- Gateway Support

Network Security

- Network Policy L3-L7
- Encryption
- SIEM Integration
- mTLS

Network Observability

- Flow Logs
- Metrics
- Troubleshooting
- Network Time Machine

Service Mesh

- L7 Load Balancing
- Tracing
- mTLS
- API Gateway

Runtime Security

- Runtime Enforcement
- Cloud Native Application Protection Platform

Runtime Observability

- Syscall, File, Privilege, and Network Observability
- SIEM Integration

Tetragon

Security Observability & Runtime Enforcement

CLOUD NATIVE COMPUTING FOUNDATION

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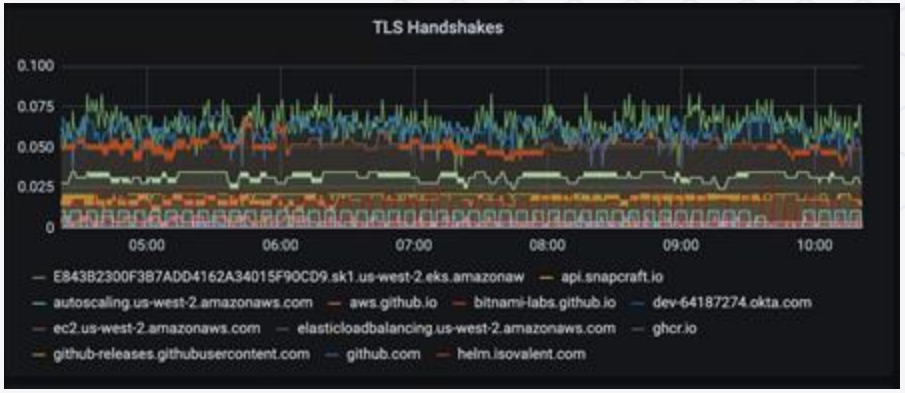
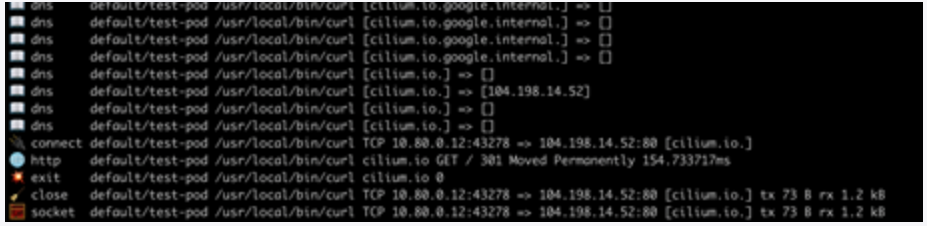
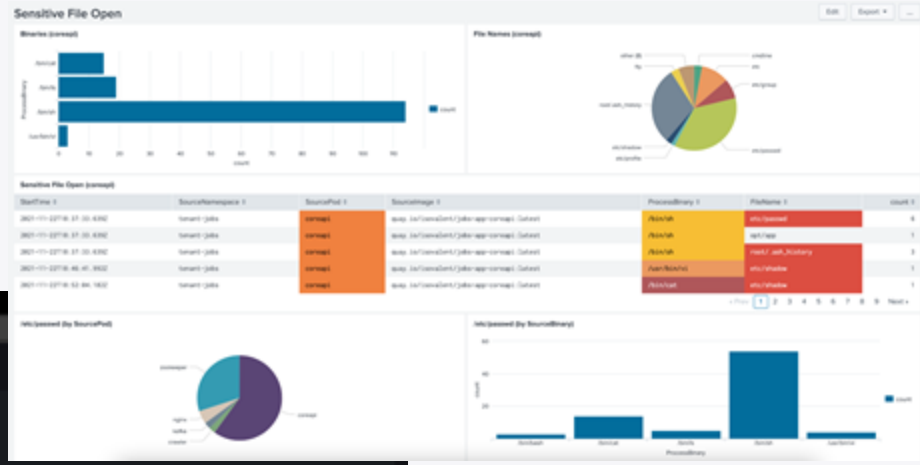
Network Interface Metrics
Network Interface TX Bytes
Network Interface RX Bytes
Network Interface TX Segments
Network Interface RX Segments
Network Interface TX Drops
Network Interface RX Drops


TLS Handshakes
0.100
0.075
0.050
0.025
0
05:00
06:00
07:00
08:00
09:00
10:00
E843B2300F3B7ADD4162A34015F90CD9.sk1.us-west-2.eks.amazonaw
api.snapcraft.io
autoscaling.us-west-2.amazonaws.com
aws.github.io
bitnami-labs.github.io
dev-64187274.okta.com
ec2.us-west-2.amazonaws.com
elasticloadbalancing.us-west-2.amazonaws.com
ghcr.io
github-releases.githubusercontent.com
github.com
helm.isovalent.com


dns default/test-pod /usr/local/bin/curl [cilium.io.google.internal.] => []
dns default/test-pod /usr/local/bin/curl [cilium.io.google.internal.] => []
dns default/test-pod /usr/local/bin/curl [cilium.io.google.internal.] => []
dns default/test-pod /usr/local/bin/curl [cilium.io.] => []
dns default/test-pod /usr/local/bin/curl [cilium.io.] => [104.198.14.52]
dns default/test-pod /usr/local/bin/curl [cilium.io.] => []
dns default/test-pod /usr/local/bin/curl [cilium.io.] => []
connect default/test-pod /usr/local/bin/curl TCP 10.80.0.12:43278 => 104.198.14.52:80 [cilium.io.]
http default/test-pod /usr/local/bin/curl cilium.io GET / 301 Moved Permanently 154.733717ms
exit default/test-pod /usr/local/bin/curl cilium.io 0
close default/test-pod /usr/local/bin/curl TCP 10.80.0.12:43278 => 104.198.14.52:80 [cilium.io.] tx 73 B rx 1.2 kB
socket default/test-pod /usr/local/bin/curl TCP 10.80.0.12:43278 => 104.198.14.52:80 [cilium.io.] tx 73 B rx 1.2 kB


Sensitive File Open


Process Ancestry - Dash
General / Process Ancestry
Panel Title
gke-grafana-dev-beefy-dfd77161-ljmj > tenant-jobs > crawler-5d9888cdf-jqhdn
16671 containerd-shim-runc-v2 -namespace k8s.io -id d858574062dcb64f2…
Oct 14, 2022, 07:12 PM crawler
0 ms 1 (26602) docker-entrypoint.sh /usr/local/bin/docker-entrypoint.sh
0 ms 1 (26602) node crawler.js
4318 50051 53 Expand
loader.tenant-jobs.svc.cluster.local.
50051

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