cilium

HUBBLE

tetragon

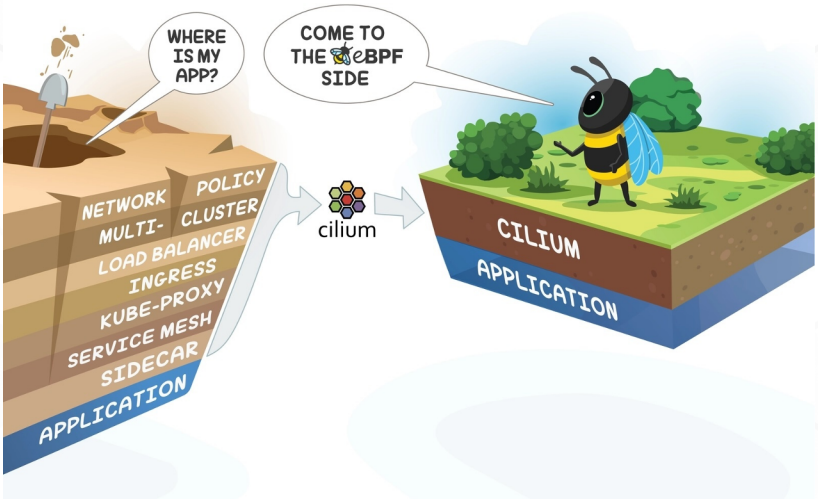
2024 Annual Report

The Year of Kubernetes Networking

About this report

As we celebrate nearly a decade since Cilium's first commit, we see the momentum behind the project continuing to accelerate, redefining the cloud native networking and security landscape. It has also been a transitional year for the whole cloud native ecosystem, with platform engineering emphasizing toolchain simplification and reduced complexity and a broader industry trend toward integration. This has made 2024 a pivotal year for Cilium as companies turn towards the project to manage their whole Kubernetes networking stack.

After Cilium's graduation last year, it became the de-facto standard CNI for Kubernetes. **Now as companies look to consolidate their platform, Cilium has solidified its role not just as the leading CNI, but as *the* comprehensive networking stack for Kubernetes environments.** Cilium's evolution reflects its unmatched ability to address the challenges of modern cloud native environments. What began as a solution for pod-to-pod connectivity has expanded into a project that unifies the critical domains of networking, observability, and security under a single eBPF-powered umbrella.



Nowhere is this more evident than in the adoption of Cilium's advanced features. **From multi-cluster networking to Tetragon's deep security observability capabilities, and support for service mesh use cases, Cilium is driving the industry towards a future where Kubernetes networking is seamless, secure, and simplified.** With a single, unified stack that replaces the need for multiple tools, Cilium is leading the charge to make Kubernetes networking not only easier but also more powerful and resilient.

Finally, the Cilium community has never been stronger. The number of contributors and contributing companies continues to grow as does the user base across many industries like financial services, logistics, media, and telecommunications. As we look ahead, I'm more optimistic than ever about what the future holds for Cilium. The purpose of this report is to celebrate the achievements of 2024 and share key milestones, events, and feedback from our incredible community. The data included in this report is taken from the Cilium User Survey, the project's public dashboard, GitHub organization, Slack, blog, and social media. If you have any comments or feedback about this report, please reach out to the project at contribute@cilium.io.

Let's build the future of Kubernetes networking and security together!

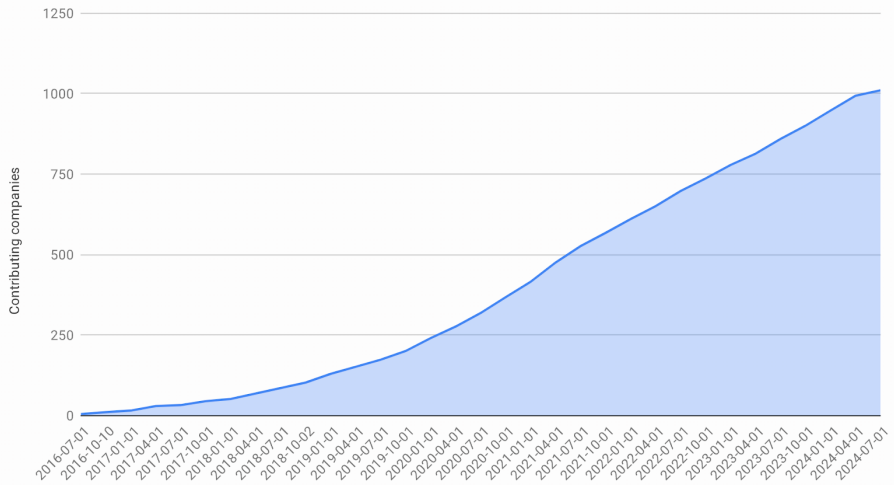
Project Snapshot

Contributors

As highlighted by the Cilium project journey report from CNCF, Cilium continues to see accelerating growth in the number of contributors and contributing companies. The number of contributing companies has increased by 90% since Cilium joined CNCF, from 533 to 1,011. This growth corresponds to a rise in individual contributors from 1,269 when it joined to 4,464 today, representing a 252% increase. Cilium is also the third fastest moving project in the whole CNCF ecosystem. Thank you to everyone that has helped make the project what it is today!

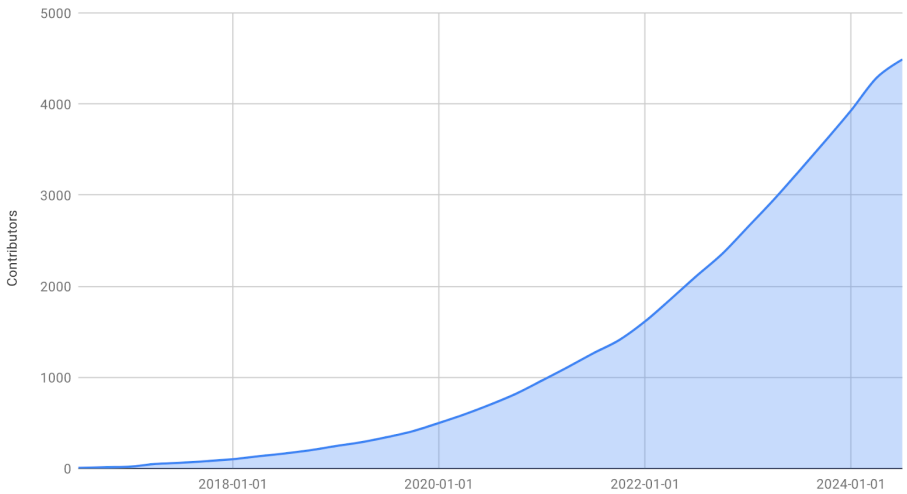
Cumulative growth of contributing companies

2016-07-01 — 2024-07-01



Cumulative growth of contributing companies

2016-07-01 — 2024-07-01



Top 10 contributors to Cilium in 2024

1. Marco Iorio
2. Tam Mach
3. Julian Wiedmann
4. Marco Hofstetter
5. Jarno Rajahalme
6. André Martins
7. Jussi Mäki
8. Michi Mutsuzaki
9. Joe Stringer
10. Tobias Klauser

Top 10 contributors to Tetragon:

1. Jiri Olsa
2. Kornilios Kourtis
3. Mahé Tardy
4. Anna Kapuścińska
5. Djalal Harouni
6. Anastasios Papagiannis
7. Andrei Fedotov
8. William Findlay
9. Kevin Sheldrake
10. Philip Schmid

A special thanks to all of these individuals for all of the hard work they have put into the project.

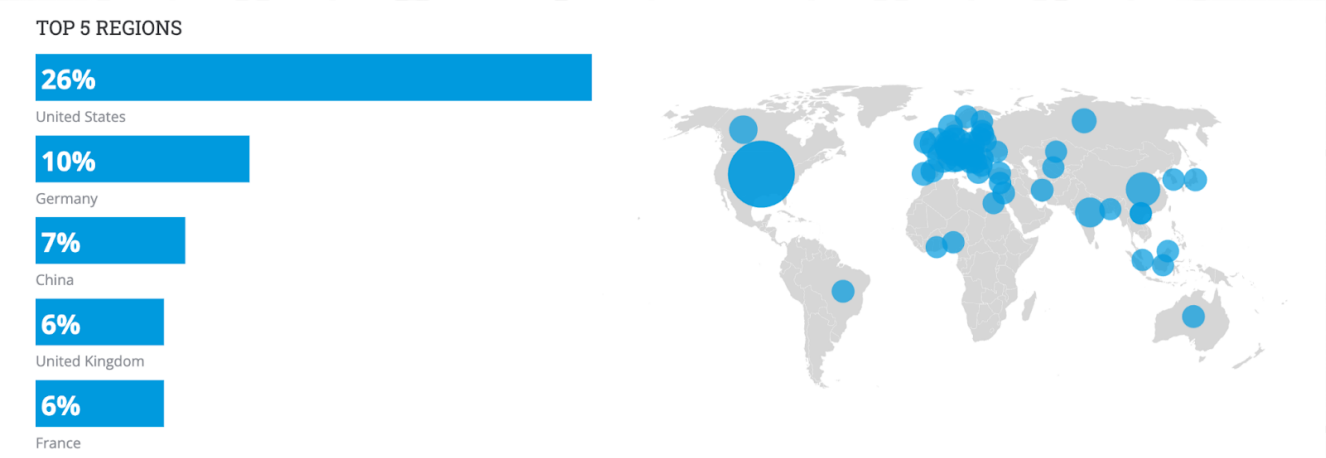
Committers

We would also like to thank all of the hard-working committers for the time and effort they consistently put into the project. Cilium committers come from the following companies:

- Isovalent
- Datadog
- Deepfence
- AMD
- Palantir
- Google
- Hedgehog
- independent

Geographic location of contributors

Geographical Distribution



Users

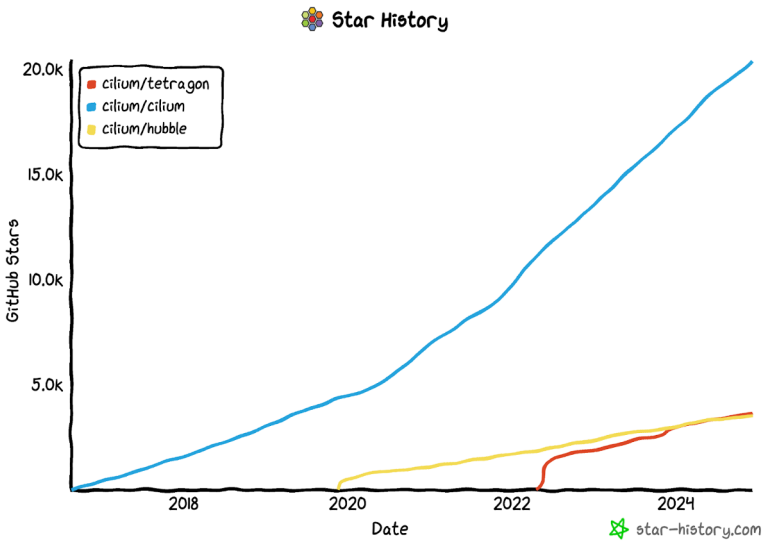
The number of public users has increased from 121 to 153! Additionally, Cilium public case studies have seen some growth, rising from 53 to 82 this year.

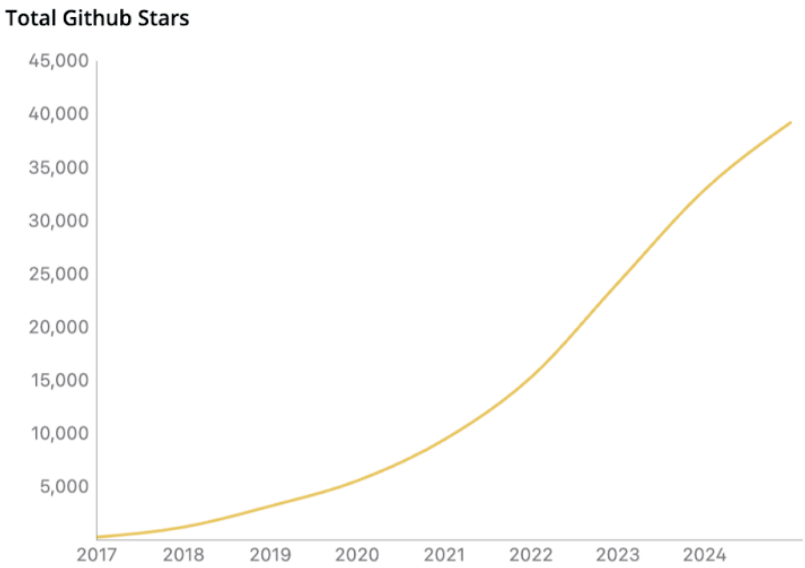
Github Stars ...50k stars here we come

Cilium
From 16.9k to 20.5k

Hubble
From 2.9k to 3.6k

Tetragon
From 2.8k to 3.7k

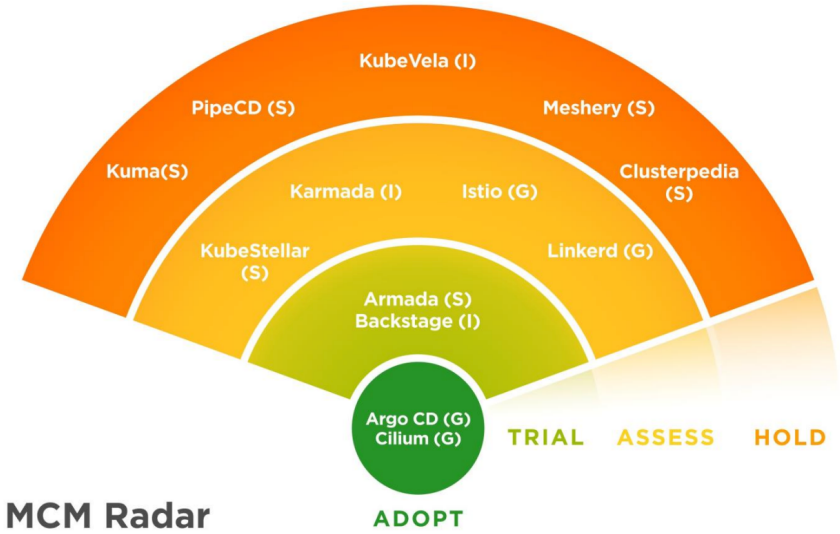




Awards

CNCF Multi cluster Management Technology Radar

In November, CNCF released a Technology Radar, which surveyed over 300 end users on which projects they use and trust in production, on multi-cluster management. Cilium was rated as the top technology to adopt, receiving the highest both usefulness and maturity scores, "cementing its position as a technology that the community considers both the most useful and mature".



OpenUK Awards

The Cilium project was the winner of OpenUK's 2024 award in the Open Source Software category. Criteria for this prize include "novel contributions to the state of the art, projects with wide adoption, or impact as well as community and collaboratively developed projects".

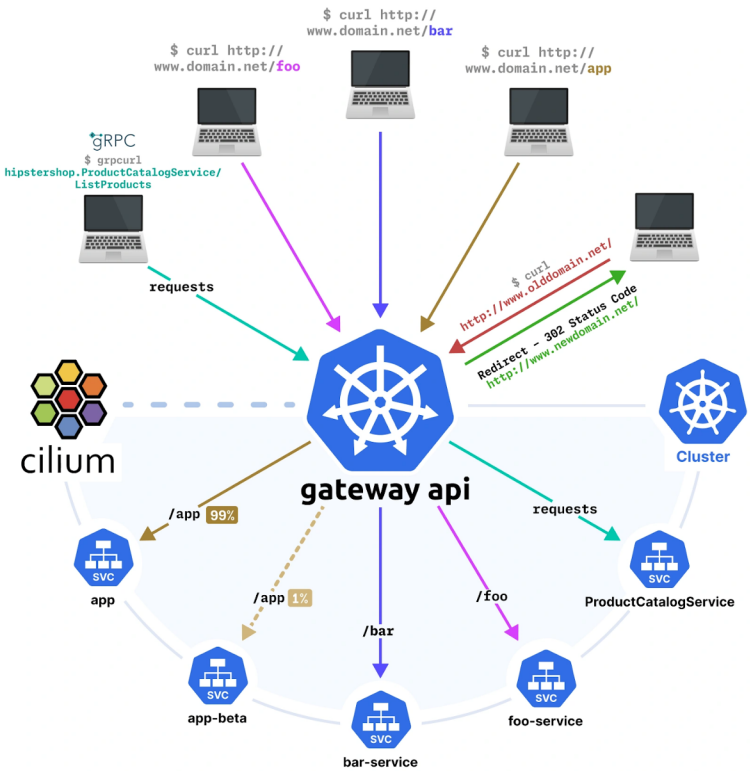
Release Highlight

Cilium is the third fastest-growing project in the CNCF, with a thriving community of over 900 developers. This year, Cilium had two major releases 1.15 and 1.16. Cilium 1.15 introduced support for Gateway API 1.0, doubled the scalability of Cluster Mesh, improved observability by correlating traffic to a Network Policy, and added many features to BGP to improve integration with the external world. Cilium 1.16's theme was "Faster, Stronger, Smarter" – faster for erasing virtual networking overhead with netkit, the new virtual network device, stronger for all the security and operational improvements, such as Network Policies Port Range support, and smarter for new traffic engineering features such as Kubernetes Service Traffic Distribution, multicast, and a 5x reduction in tail latency for DNS policies!

Cilium 1.15

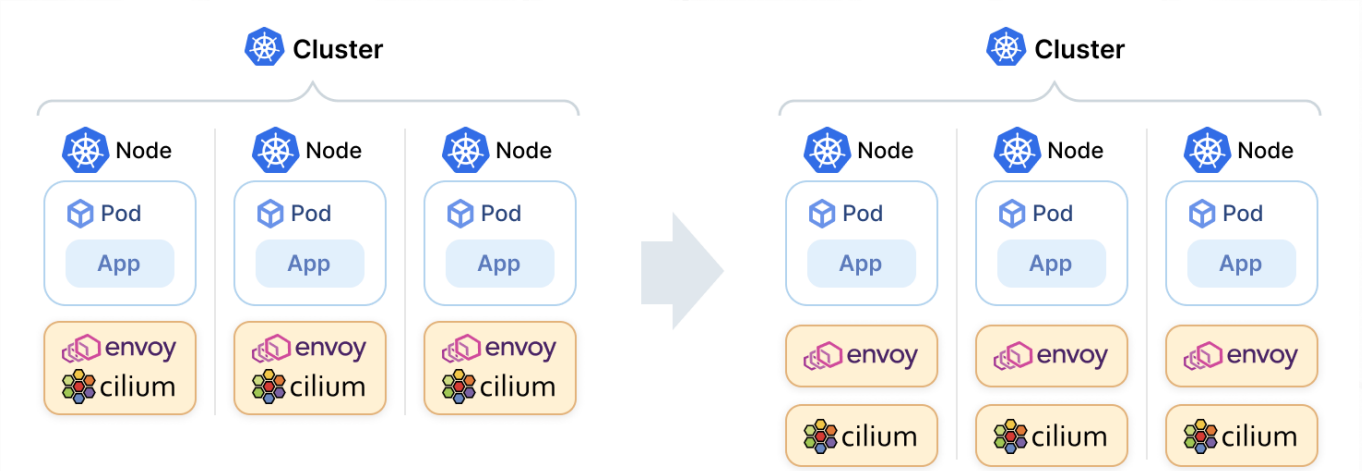
Gateway API

Cilium 1.15's implementation of Gateway API is fully compliant with the 1.0 version and supports, amongst other things, the following use cases: HTTP routing, HTTP traffic splitting and load-balancing, HTTP request and response header rewrite, HTTP redirect and path rewrites, HTTP mirroring, Cross-namespace routing, TLS termination and passthrough, and gRPC routing.



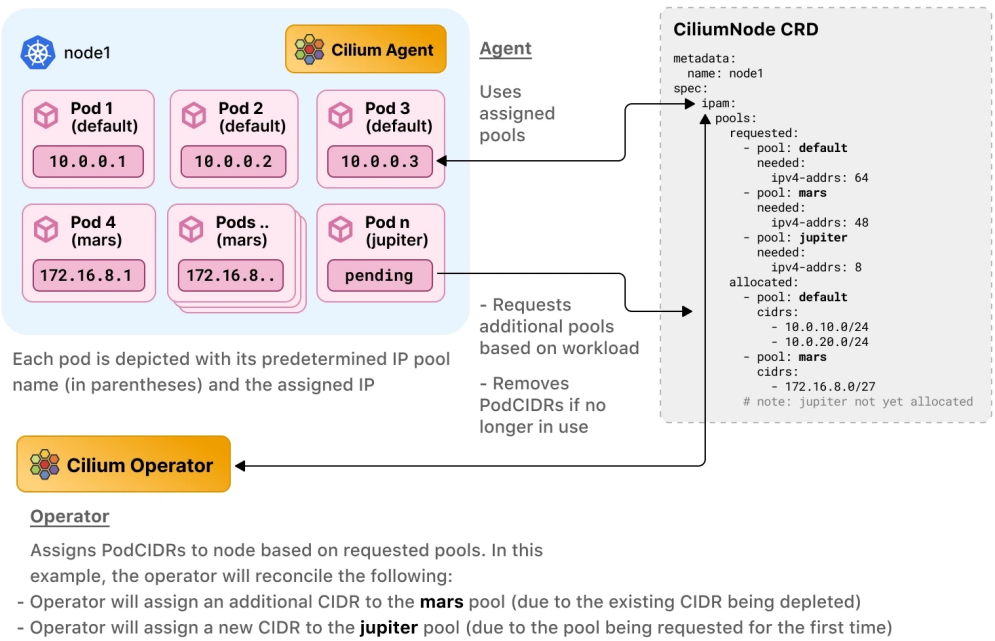
Gateway Security Enhancements for Envoy

Cilium 1.15 introduces a notable security improvement related to Envoy permissions at L7, significantly reducing the scope of capabilities allowed by Envoy processes. Cilium 1.14 introduced the option to run Envoy as a DaemonSet and is the default option in Cilium 1.16. Cilium 1.15 goes one step further: the process that is handling HTTP traffic no longer has privileges to access BPF maps or socket options directly. Meaning the blast radius of a potentially compromised Envoy proxy is greatly reduced.



BGP

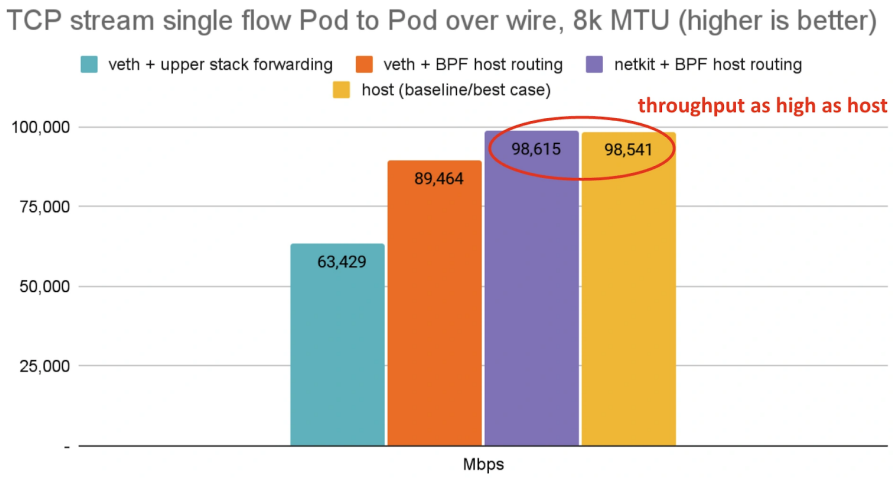
Integrating Kubernetes clusters with the rest of the network is best done using the Border Gateway Protocol (BGP). BGP support has been enhanced over multiple releases since its initial introduction in Cilium 1.10. Cilium 1.15 introduces support for much requested features like MD5-based password authentication, additional traffic engineering features such as support for BGP LocalPreference and BGP Communities, and better operational tooling to monitor and manage your BGP sessions.



Cilium 1.16

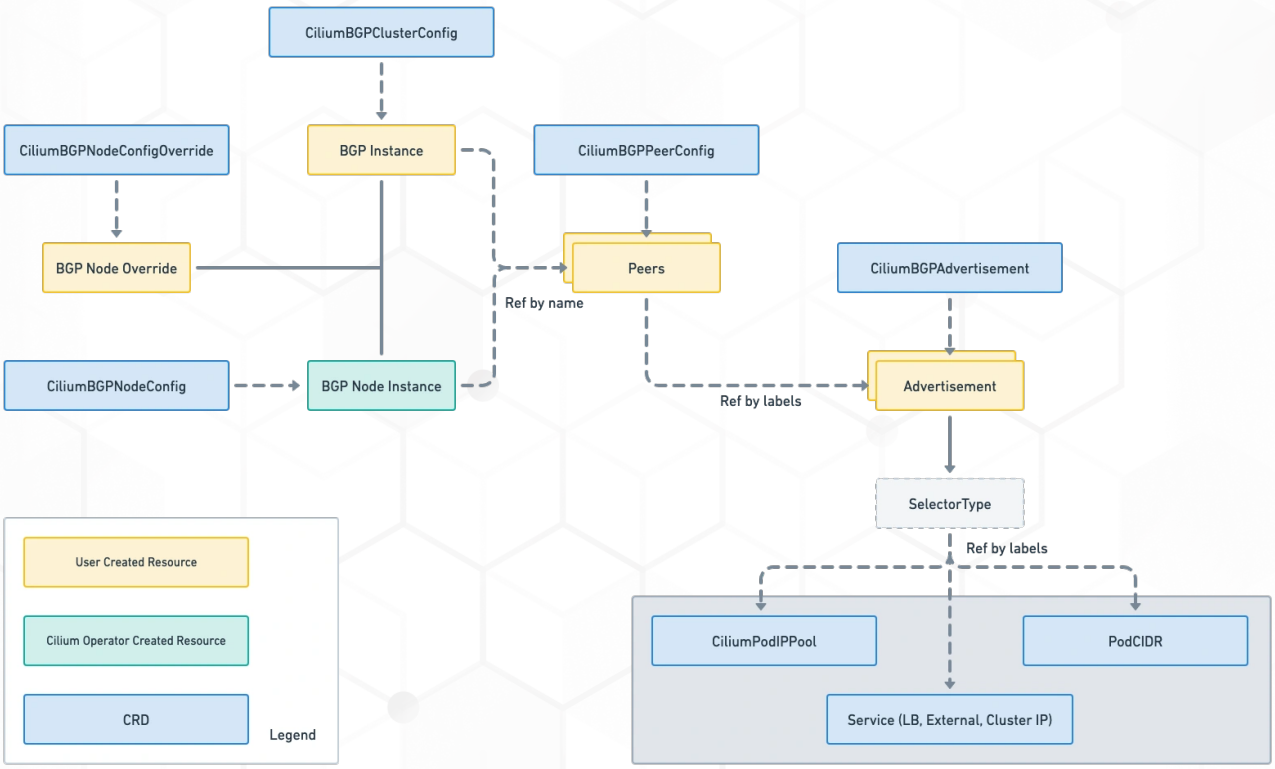
netkit

Containerization has always come at a performance cost, with the most visible one on networking velocity. A standard container networking architecture would result in a 35% drop in network performance compared to the host. With Cilium 1.16 and the introduction of Cilium netkit, you can finally achieve performance parity between host and container.



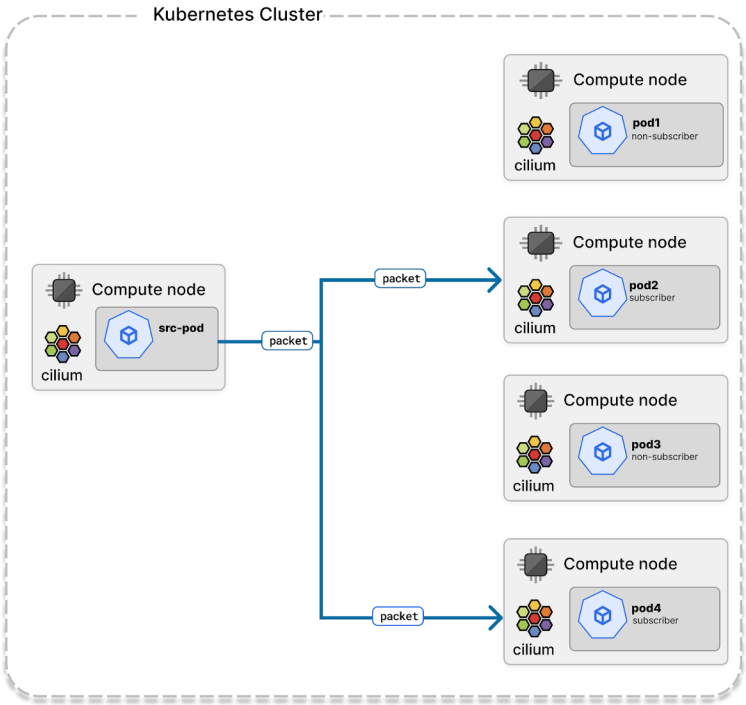
BGP

To provide users the flexibility they need, Cilium 1.16 introduced BGPv2 APIs. These new CRDs allow users to define complex network policies and configurations, making management more modular and scalable within Cilium.



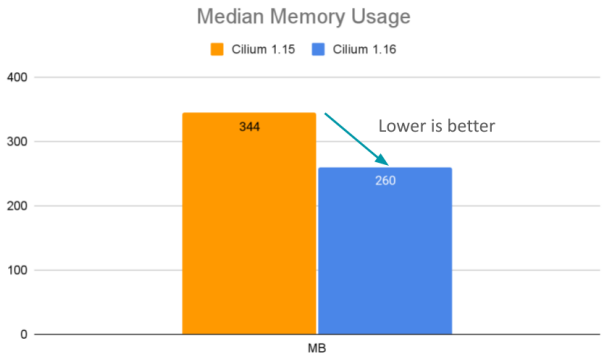
Multicast

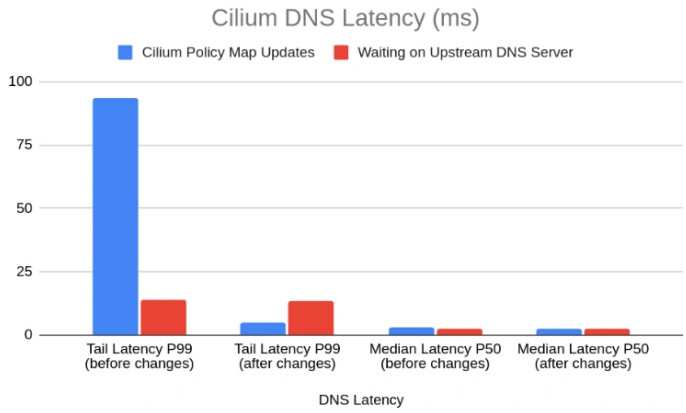
Multicast is a delivery mechanism popular in traditional IP networking. It provides a smarter and more economical method to deliver packets to a subset of interested parties. Perfect for publishers/subscribers-based applications, it is common for financial applications. Cilium 1.16 supports a multicast datapath, enabling Kubernetes users to deploy applications and benefit from multicast's efficiencies.

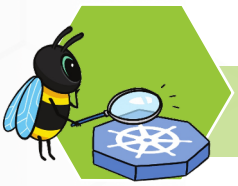


Day 2 Operations and Scale

Cilium 1.16 has significantly improved CPU and memory usage and, even more crucially, up to 5x reduction in tail latency.







User Survey

The Cilium User Survey 2024 highlighted the project's progression towards taking over the Kubernetes networking stack, with users putting features like Cluster Mesh, BGP, and Gateway API into production. The top ask from users was more service mesh features and Cilium is on the way to delivering them in 2025. Additionally, the survey revealed that 95% of respondents run multiple Kubernetes clusters, which makes sense when looking at the CNCF Tech Radar's finding of Cilium being the top multi-cluster management tool. These insights reflect Cilium's evolution to a comprehensive, industry-standard tool for a broad range of advanced use cases in cloud native networking, observability, and security.

Cilium in Production

Companies use Cilium to solve a wide range of challenges and 23 of them have shared their story with us this year. We are thankful to our users for speaking to us about how they use Cilium in their organizations. You can read the CNCF case studies on the website or see all of the Cilium case studies here.

Alibaba Cloud
CONFLUENT
DigitalOcean
ebay
FORM3
G DATA CyberDefense
Jar
kakao
Koyeb
nemlig.com DAGLIGVARER NÆR DET PASSER DIG
PostFinance
QINGCLOUD
Rabobank
reddit
Roche
SAMSUNG Ads
SEZNAM.CZ
Sicredi
SmartNews
SONY
SysEleven
The New York Times
WSO2

Community Quotes

Alibaba Cloud

With Cilium, I think our customers compare us differently with other managed Kubernetes providers now because our performance is much better. Latency is the biggest concern for our customers and Cilium gives us a good advantage there. The performance improvement is one of the biggest advantages that we've gotten from Cilium and it is great for our business. Cilium also provides many additional functionalities, like Hubble which gives our customers observability.

BoKang Li, Senior Engineer

DigitalOcean

Cilium enabled us to acquire more sophisticated customers. Once you enter the small and medium business market, where some companies must meet certain benchmarks, policies, and regulations, having specific performance, security, and observability features becomes critical for them even to consider your product.

Ingo Gottwald, Senior Engineer

Kakao

As an engineer, I can say that Cilium has lowered our costs for performance and network. Because we have so many clusters and nodes, we always need more machines for new services to be served. By reducing network costs or CPU consumption with Cilium, we can manage with fewer nodes. Compared to kube-proxy, Calico, or Flannel, Cilium offers more value in that aspect.

Kwang Hun Choi, Cloud Engineer

Nemlig

It is the obvious choice to use Cilium as the CNI because of its performance, the capabilities of eBPF, and Cilium network policies. Looking back over the past three years, Cilium exceeded my expectations of alleviating some of the pains of managing the network side of running Kubernetes clusters. And as time has gone on, there are many new features we benefit from.

Lars Bengtsson, Lead DevOps Engineer

Post Finance

What I like the most about Cilium at the moment is all of the potential it has. It integrates well into the whole cloud native landscape and adds features like ingress and Gateway API support to round out our Kubernetes platform.

Luana Cusseddu, Systems Engineer

Seznam

Using Cilium as our complete networking solution has made things easier for all our users, it's easier to implement network security policies without the need to know anything about IP addresses. They just need to care only about the labels and that's it. They are super happy that it works.

Ondřej Blažek, Software Engineer

Sicredi

Cilium Cluster Mesh gave us possibilities that we didn't have before. We can run the same application across our data centers and AWS. It provides us with a consistent networking experience wherever we need to go. Applications in different clusters can communicate with each other without needing to go through an ingress controller. We are expanding this capability for more applications because this value is already proven. Cluster Mesh works, it's fast, and it's reliable.

Matheus Morais, IT Infrastructure Analyst

Trip.com

Cilium is just stable. We have been running it in production for almost 5 years and we haven't had any major incidents in the dataplane which is very important for our applications. When you don't have a problem, you just don't notice it. We believe Cilium is not only production ready for large scale, but also one of the best candidates in terms of performance, features, and community.

Jaff Cheng, Senior Software Developer

WSO2

Cilium provides more than just a CNI, it's a complete service mesh solution. To us, Cilium is a single solution that covers many of our platform feature requirements. Before, we couldn't find a single solution to all of our challenges but when we used Cilium, it was a perfect match. It provided all the network level functionality, all of the observability requirements, as well as the service mesh functionality.

Lakmal Warusawithana, Senior Director – Cloud Architecture

eBPF Foundation

Threat Model and Security Audit

At Cilium + eBPF Day during KubeCon North America, the eBPF Foundation announced two significant research reports enhancing the security and operational guidance for eBPF based deployments, like Cilium.

1. eBPF Security Threat Model (by ControlPlane)

This report provides a threat model for eBPF, outlining potential risks and offering detailed mitigation strategies. It emphasizes eBPF's inherent security features, such as its verifier, while recommending best practices like adhering to the principle of least privilege, ensuring supply chain security, and that unprivileged eBPF is disabled by default.

> By safely enabling custom, kernel-level software without requiring kernel recompilation or reboot, it provides options for increased security over traditional approaches due to its rigorous validation of user-supplied code.

2. eBPF Verifier Code Audit (by NCC Group)

A thorough code review of the eBPF verifier identified its strengths and areas for improvement. The audit highlighted the verifier's role in safeguarding eBPF deployments and provided recommendations. The report also revealed and addressed a critical vulnerability, demonstrating the community's commitment to maintaining robust security.

> The eBPF verifier is the crucial gatekeeper in terms of the safety of eBPF programs. Over the past decade, a large amount of security vulnerability research has been carried out into the verifier and many bugs have been identified and fixed by the community.

The eBPF Foundation's focus on security, including its recent verifier code audit and threat model, underscores its commitment to fostering a safe and reliable ecosystem. These efforts directly support the Cilium ecosystem by ensuring the foundational technology remains secure, accelerating adoption and innovation across cloud native networking, observability, and security.

Community Events

Cilium + eBPF Day

Two Cilium + eBPF Days were hosted this year alongside KubeCon + CloudNativeCon in Paris and Salt Lake City. The events featured a diverse range of talks from contributors and end users, highlighting real-world use cases and new innovations in the project. From technical deep dives into Cilium's resilient architecture and improvements like increasing IPSec performance 400% to production examples like Roche linking 1000+ edge locations with Cluster Mesh, Reddit securing cat memes with Tetragon, or Confluent building multi cloud connectivity, the sessions showcased how Cilium and eBPF are solving complex challenges across industries and advancing the cutting edge of cloud native networking, observability, and security. The community's enthusiasm was palpable, with packed rooms and engaging discussions that reinforced Cilium's role as the standard for Kubernetes networking and beyond.

Cilium at KubeCon + Cilium & eBPF Day EU 2024

- Connecting Cloud Native: Cilium + eBPF Day
- Deep Dive Into Cilium Resilient Architecture - Jussi Mäki & Martynas Pumputis, Isovalent
- Lessons from Building Scalable Network Policy Enforcement with eBPF
- Falco, Tracee and Tetragon: eBPF Runtime Observability and Security Tools Differences
- Optimizing Cluster Workloads: Cilium Envoy on DPU
- Bee-Lieve in the Metadata: Pollenating Build Attestations on Kubernetes with Tetragon and EBPF
- Meshing It up Securely: How Roche Manages Network Connectivity for 1000+ Edge Clusters
- Revolutionizing Mesh Layers: Transitioning from Istio to Cilium at the New York Times
- Supercharge Kubernetes Networking with Cilium and IPv6
- Cilium Beyond Linux: Extending eBPF to Windows Infrastructure -
- Speedrun Through Splicing Sockets with Sockmap -
- Taming Noisy Network Neighbours with Cilium and eBPF
- Defending the Future: Cilium + eBPF Day Closing
- Unveiling 5 Essential Insights from Cilium Implementation in a Multi-Tenant Kubernetes Environment
- What Is Going on Within My Network? A Subtle Introduction to Cilium Hubble
- A Cilium Introduction: Back to Bee-Sics
- Cilium: Connecting, Observing, and Securing Service Mesh and Beyond with EBPF
- Dealing with eBPF's Observability Data Deluge
- Simplifying Multi-Cluster and Multi-Cloud Deployments with Cilium
- Brewing the Kubernetes Storm Center: Open Source Threat Intelligence for the Cloud Native Ecosystem
- eBPF's Abilities and Limitations: The Truth
- Cilium ClusterMesh in Action: Strengthening Security Across Distributed Kubernetes Clusters
- Running PCI-DSS Certified Kubernetes Workloads in the Public Cloud
- No 'Soup' for You! Enforcing Network Policies for Host Processes via eBPF
- At the Intersection of Cilium CNI and Service Mesh - Who Has the Right of Way?
- Comparing Sidecar-Less Service Mesh from Cilium and Istio

Cilium Talks at Kubecon NA 2024

- Confluent's Multi-Cloud Journey to Cilium: Pitfalls and Lessons Learned - Nimisha Mehta & Alvaro Aleman, Confluent
- Insightful Traffic Monitoring: Harnessing Cilium for Comprehensive Network Observability - Sudheendra Murthy & Adithya Yavanamanda, eBay
- Panel: Exploring eBPF Use Cases in Cloud-Native Security - Oshrat Nir, ARMO; Anna Kapuścińska, Isovalent, now part of Cisco; Whitney Lee, CNCF Ambassador; Maya Singh, Microsoft; Cortney Nickerson, Kubeshop
- Scaling Network Policy Enforcement Beyond the Cluster Boundary with Cilium - Hemanth Malla & Maxime Visonneau, Datadog
- How to Use XDP and eBPF to Accelerate IPSec Throughput by 400% - Ryan Drew, Isovalent, now part of Cisco
- Live Migrating Production Clusters From Calico to Cilium - Moh Ahmed & Raymond Maika, SamsungAds
- Hubble Beyond Cilium - Anubhab Majumdar & Mathew Merrick, Microsoft
- Lessons Learned Migrating to Modern Multi-Platform eBPF Programs - Dave Tucker, Red Hat
- Don't Get Blown up! Avoiding Configuration Gotchas for Tetragon Newbies - Pratik Lotia, Reddit
- Applying Cilium at Edge with KubeEdge - Tomoya Fujita, Sony Corporation of America
- Cilium, EBPF, WireGuard: Can We Tame the Network Encryption Performance Gap? - Daniel Borkmann & Anton Protopopov, Isovalent
- From Observability to Enforcement: Lessons Learned Implementing eBPF Runtime Security - Anna Kapuścińska & Kornilios Kourtis, Isovalent
- Cilium: Connecting, Observing, and Securing Kubernetes and Beyond with eBPF - Ahmed Bebars, The New York Times; Liz Rice, Isovalent @ Cisco; Joe Stevens, Ascend.io
- What Agent to Trust with Your K8s: Falco, Tetragon, or KubeArmor? - Henrik Rexed, Dynatrace
- Understanding Kubernetes Networking in 30 Minutes - Ricardo Katz, Broadcom & James Strong, Isovalent at Cisco
- Contribfest: Kickstart Your eBPF Journey with Tetragon
- Pick My Project! Lessons Learned from Interviewing 20+ End Users for Cloud Native Case Studies - Shedrack Akintayo & Bill Mulligan, Isovalent at Cisco
- Seeing Double? Implementing Multicast with eBPF and Cilium - Louis DeLosSantos, Isovalent at Cisco
- Seccomp and eBPF; What's the Difference? Why Do I Need to Know? - Natalia Reka Ivanko & Duffie Cooley, Isovalent @ Cisco
- The Key Value of Etcd Over Custom Resources: Scalability - Jef Spaleta, Isovalent at Cisco

Cilium Developer Summits

2024 also saw the first two Developer Summits in Paris and Salt Lake City. These events brought together contributors and committers to discuss the technical direction of the project. By enabling developers to talk face to face on the pressing needs of the project, the Developer Summits provide a way to build bonds across organizations and accelerate collaboration between people. You can find notes, slides, and recordings from the summits on GitHub. Participation came from a wide variety of companies including CoreWeave, Datadog, Elastic, Google, Isovalent, Independent, Microsoft, Palantir, Seznam.cz, and Solo.io. Special thanks to Datadog and Google for hosting the two Summits.

Looking forward to 2025

As we head into 2025, the momentum around Cilium shows no signs of slowing down. Platform engineering and consolidation trends are reshaping how organizations approach Kubernetes networking, and Cilium is at the center of this transformation. **My predictions for the upcoming year include an even greater consolidation of networking features under the Cilium stack, broader adoption of Tetragon for advanced security observability, and a deeper integration of external and legacy workloads into Kubernetes environments with the help of Cilium.**

Cilium's unified networking stack is already production proven and well positioned to tackle the complexity of modern cloud native architectures. Features like multi-cluster networking, network policy, and advanced observability tools are no longer optional—they are foundational. In 2025, **I expect more organizations to adopt Cilium not just as their CNI but as their complete Kubernetes networking solution**, replacing fragmented toolchains and simplifying operations. This consolidation will be key to addressing enterprise needs in the cloud native world.

Just as Cilium did for networking, Tetragon is set to redefine how cloud native security is done. Its ability to leverage eBPF for in-kernel filtering enables real-time insights into application behavior and security events, without the overhead of traditional tools. As more organizations focus on improving runtime security and compliance, Tetragon will continue to evolve, providing not only powerful detection capabilities but also actionable insights to respond to threats faster. In 2025, I expect usability enhancements and deeper integrations with other parts of the Cilium ecosystem to further accelerate its adoption. And based on hallway conversations at KubeCon, it is already deployed in more places than you think.

Finally, Cilium's hybrid and multi-cloud integrations will play a larger role in 2025. As organizations look to bridge the gap between Kubernetes-native and legacy systems, Cilium's support for external workloads, Layer 4 load balancing, and BGP enhancements will be instrumental. **The lines between cloud native and traditional infrastructure are blurring, and Cilium is the glue that enables seamless management of both.**

2025 promises to be a year of continued innovation and growth for Cilium. With increased and sustained participation and contributions from engineers from an ever-increasing number of companies, we have more people than ever on track to take up issues, pull requests, and leadership roles in the project over the coming months. As we advance, these developments will not only address the immediate needs of our users but also set the direction for the future of cloud native networking, observability, and security.

If all of this has gotten you excited about Cilium, there are many ways to get involved. The best way to start is by checking out the Cilium project on GitHub. There, you can find information about the project, as well as ways to get involved, such as reporting bugs, suggesting new features, or contributing code. To discuss specific features or talk with developers, consider joining the weekly Cilium developer meeting. The community is also active on GitHub Discussions, Slack, BlueSky, Reddit, and LinkedIn. If you want to just follow along for now, be sure to sign up for the newsletter. If you have any questions or comments please reach out to contribute@cilium.io. Happy New Year!

Bill Mulligan
Cilium Committer
ebpf.io Maintainer
ISOVALENT
now part of cisco

cilium

HUBBLE

tetragon