



Cilium Annual Report Year of Graduation



About this Report

The year 2023 has been an incredible one for the Cilium project! As we entered the 8th year since Cilium's first commit, the success of the project has grown beyond what I could even imagine. **What began as a small project between a group of friends has now become the de-facto industry standard for cloud native networking.** 2023 is the year of graduation because Cilium is now a graduated project in the CNCF, but graduation also speaks to so much more than just a label on the project. It highlights that Cilium is now ubiquitous— all major cloud providers, numerous Kubernetes distributions, and hundreds of public end user organizations rely on Cilium to navigate the intricate challenges of cloud native networking, observability, and security. **Graduation and standardization on Cilium means that we have come so much closer to our vision of bringing the power of eBPF to end users everywhere.**

**“ Graduation highlights that
Cilium is now ubiquitous ”**

Graduation isn't just about the project itself, but also about how end users are using it. 2022 was the year of the CNI and in 2023, we can really see that companies have moved beyond simple pod-to-pod connectivity. Feedback from the 2023 Cilium user survey highlights this maturing use of Cilium with people putting Tetragon and advanced features like service mesh and BGP into production. The cloud native ecosystem has graduated from just setting up clusters to solving problems like complex network topologies, scaling to tens of thousands of nodes, meshing clusters together across the globe, and providing security and compliance guardrails to these environments. **At the core of many of these platforms is Cilium, revolutionizing how cloud native networking, observability, and security is done** and defining what is possible across industries like telecommunications, financial services, media, software, e-commerce, and consulting.

Finally, Cilium graduated from just being a part of KubeCon + CloudNativeCon to holding two standalone CiliumCon events, which further underscores the importance and popularity of Cilium within the cloud native ecosystem.

While 2023 was a milestone year with Cilium's graduation, with Cilium now the standard everywhere, I'm even more excited about what we can build next. The purpose of this report is to share highlights of events, milestones, and feedback in the Cilium Project's 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.

Thomas Graf
Co-Creator, Cilium Project,
Co-founder & CTO
ISOVALENT
Creators of and



Cilium Graduation

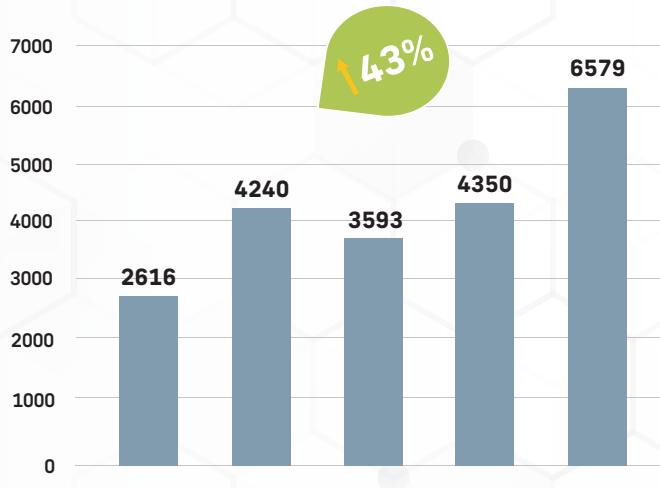
In 2022, Thomas Graf submitted Cilium's CNCF graduation application live on stage at KubeCon NA in Detroit. Since then, the Cilium community has been working hard to make sure we meet all the requirements for graduation. We are pleased to announce that Cilium is now a graduate project after going through a rigorous due diligence process from the CNCF Technical Oversight Committee. This is a huge milestone for the community as it further strengthens the confidence of the community and end users in the project. You can read more about Cilium's Graduation in the official announcement [by the CNCF](#).

Cilium's graduation gained a lot of attention from the cloud native community with reputable news outlets like [Cloud Native Now](#), [IT Ops Times](#), [Public Key](#), [SilliconANGLE](#), [TFIR](#), [The New Stack](#), and [The Register](#) covering it.



Project snapshot

Contributors



Since the 2022 report, Cilium has seen even more growth in the project and community. The following stats provide a quick insight into what has happened in the last year!

The top 10 contributors by PRs (merged and created) were **Tobias Klauser, Tam Mach, Julian Wiedmann, Michi Mutsuzaki, Korniliios Kourtis, Marco Hofsetter, Martynas Pumputis, Andre Martins, Paul Chaignon, Marco Iorio**. Thank you for all the hard work you have done for the project!

The number of new PRs created in all cilium repositories has increased by over 43% in the past year alone and over 138% in the past 5 years

The top contributing companies to Cilium by number of PRs

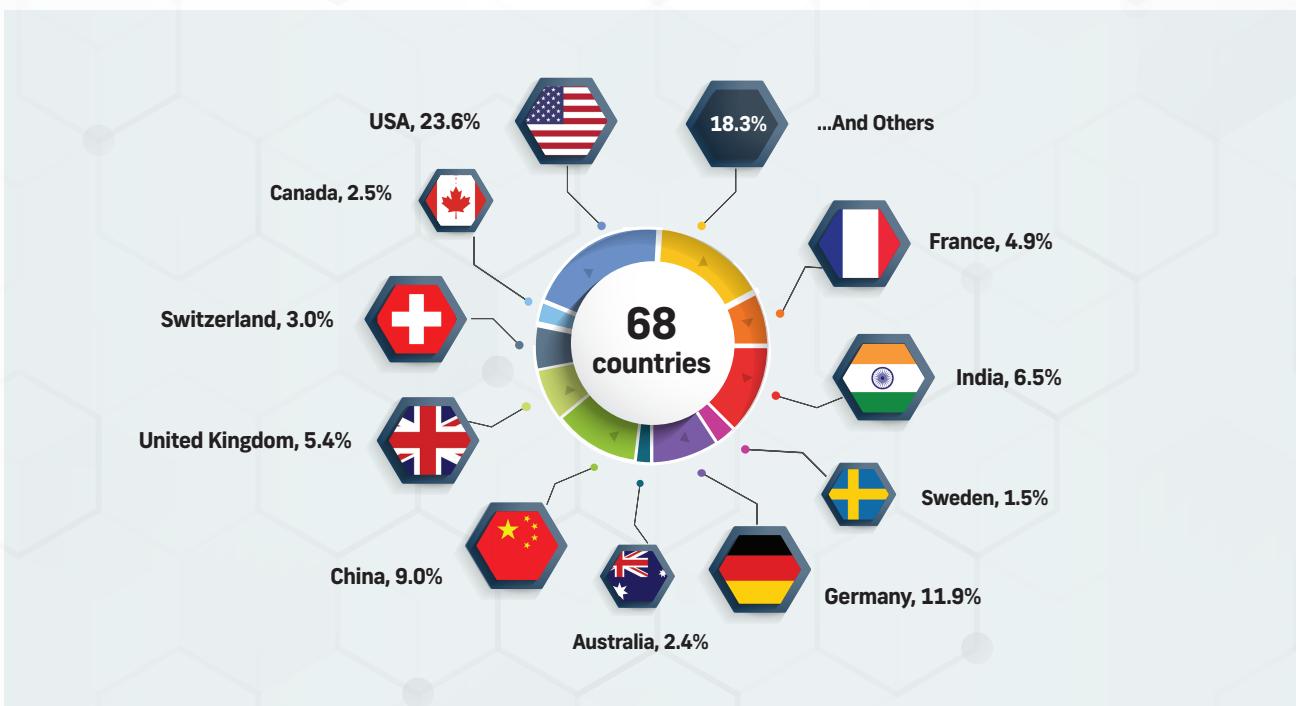


Users

The number of [public users](#) has increased from 91 to 121! Alongside that, Cilium [public case studies](#) have almost doubled, increasing from 28 in 2022 to 53 this year.

Geographic location of our contributors

We had contributors from over 68 countries with the most contributions coming from the US, Germany, China, India, and the UK.



Blog posts

The number of blogs (external and internal) produced by the community at <https://cilium.io/blog> increased by over 62% this year. It is fantastic to see this consistent excitement for Cilium in the community



Growth30k here we come!

Cilium

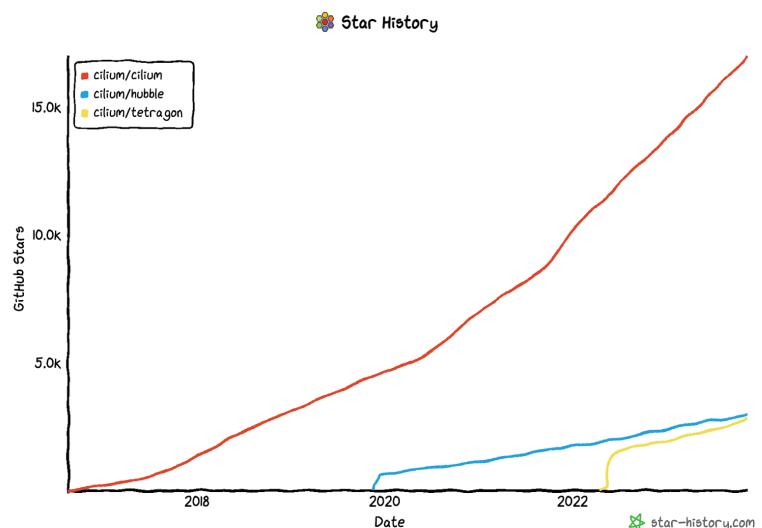
from 14055 stars to 16985

Hubble

from 2405 to 2952

Tetragon

2013 stars to 2859



Committers

Finally, we would like to thank the hard-working committers for all the time and effort they consistently put into the project. Cilium has welcomed 6 new committers in 2023, and we look forward to more people joining in 2024. Cilium [committers](#) come from the following companies:

- Isovalent
- Datadog
- AMD
- Google
- Palantir
- Deepfence



Release Highlights

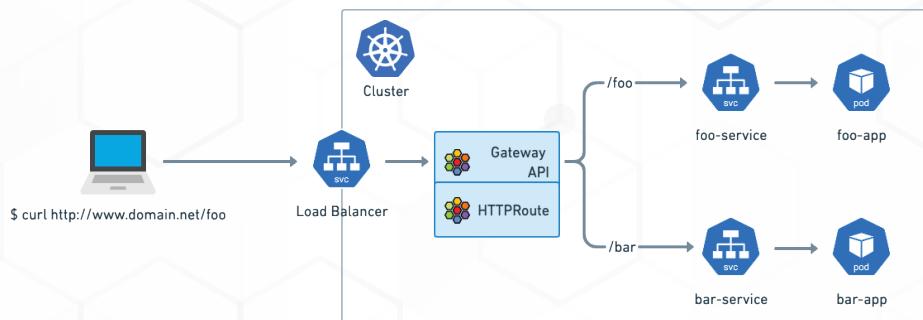
Cilium had two major releases this year. Cilium 1.13 was released in February and [made many improvements](#) across networking (especially service mesh), performance, and software supply chain security. Cilium 1.14 was released in July, which introduced a much-requested feature: mutual authentication alongside [major improvements like extending networking beyond Kubernetes](#). Tetragon 1.0 was released in October, which [came with major updates](#) and improvements to performance and overhead.

Let's review some of the major changes that shipped with all the releases.

Cilium 1.13

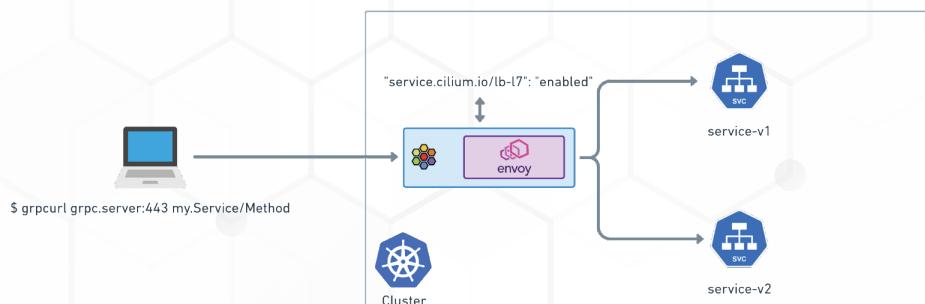
Gateway API

Cilium 1.13 shipped with a fully conformant implementation of the Gateway API. This API is the new standard for north-south load balancing and traffic routing to Kubernetes clusters and is the long-term successor to the Kubernetes Ingress API.



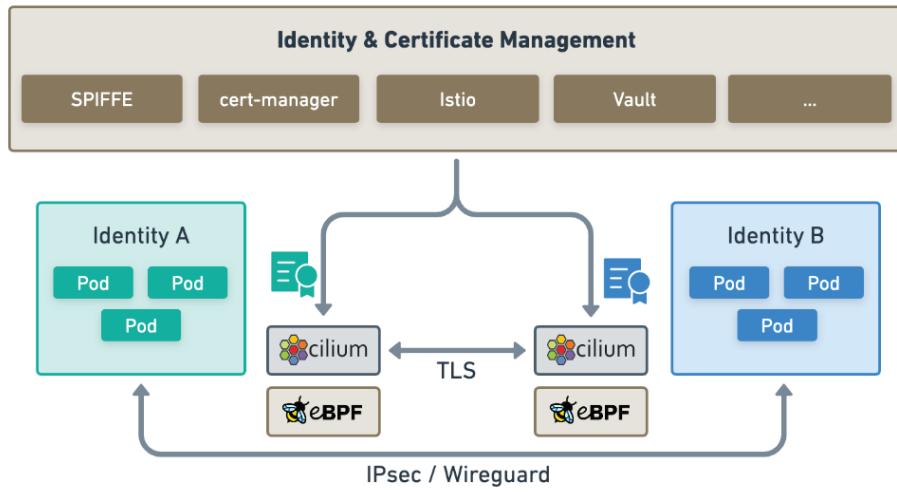
L7 Load-Balancing for Kubernetes Services with Annotation

Cilium 1.13 introduced the ability to use Cilium's embedded Envoy proxy to achieve L7 load-balancing for existing Kubernetes services by applying the following annotation: "service.cilium.io/lb-l7": "enabled".



Mutual Authentication Datapath - Beta

Mutual Authentication support has been added on the datapath level to enable Cilium to authenticate endpoints on peer nodes in the cluster and control data plane connectivity based on successful mutual authentication.



IPAM for LoadBalancer Services and BGP Services Advertisement

LoadBalancer IP Address Management (LB-IPAM) is a new feature that lets Cilium provision IP addresses for Kubernetes LoadBalancer Services. Cilium BGP was improved with the introduction of Service address advertisements. This feature works seamlessly with the LB-IPAM feature to help users advertise IP addresses of Kubernetes Services of the type LoadBalancer over BGP. This eliminates the need for MetalLB and helps simplify the networking stack.

Support for SCTP on Kubernetes

SCTP is a transport layer protocol often used in the telecommunications industry to support voice-over-IP (VoIP) and other real-time services. Cilium 1.13 introduced basic support for STCP and even supports visualization in Hubble.

Performance

Cilium introduced support for BIG TCP which provides enhanced network performance by improving throughput and reducing latency for nodes helping users scale to 100Gbps clusters and beyond.

Software Supply Chain Security

Hexagon Cilium and Tetragon container image signing using cosign

Cilium and Tetragon container images are now signed using cosign at creation. Leveraging image signing gives users confidence that the images they got from the container registry are the trusted code that the maintainer built and published.

Hexagon SBOMs

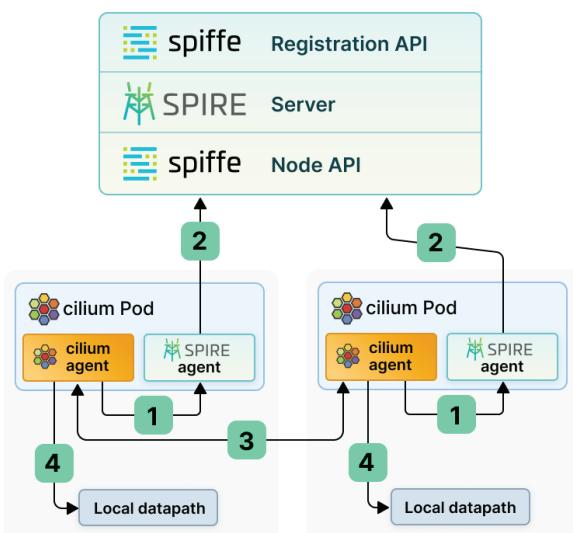
From version 1.13, Cilium and Tetragon images now include a [Software Bill of Material \(SBOM\)](#). This means that users can be assured that the components and dependencies used in Cilium are transparent and verifiable for potential vulnerabilities.

Cilium 1.14

Service Mesh and Mutual Authentication

Hexagon Mutual Authentication - Beta

Cilium 1.14 shipped with new mutual authentication support that is provided through SPIFFE (Secure Production Identity Framework for Everyone) and SPIRE (SPIRE is a production-ready implementation of the SPIFFE APIs). With this new support, Cilium can now be deployed with a SPIRE server to enable mutual authentication. This allows workloads to have their identities created and managed on the SPIRE server, which automatically manages and rotates certificates.

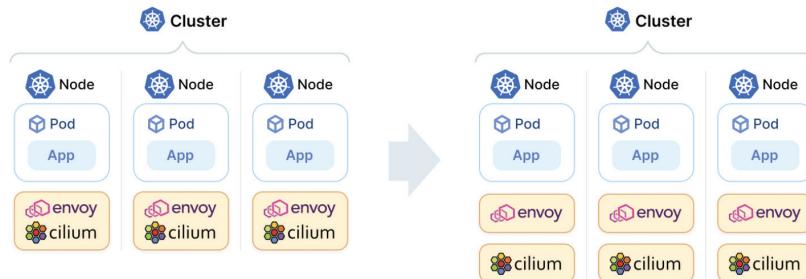


- 1 All cilium-agents running a workload mentioned in an mutual authentication-enabled policy connect to their local spire-agent, and ask for the relevant SVID.
- 2 The spire-agent passes the request back to the SPIRE server, retrieves the SVID, and passes it back to the cilium-agent.
- 3 The cilium-agent connects to the cilium-agent on the source node to perform the mutual authentication handshake. If it succeeds, then the workloads are authenticated.
- 4 The mutual authentication handlers in each cilium-agent then pass the auth success to their local dataplane, by telling it that Identity A is authenticated to Identity B for the lifetime of the certificates in the handshake.

For that lifetime, traffic between Identity A and Identity B will flow without further checks.

Envoy DaemonSet

Support for Envoy as a DaemonSet has been added. This means that the Envoy proxy no longer needs to run as a process within the Cilium agent pod, allowing for separate lifecycles, independent management, and the ability to limit the impact of issues to either the Envoy proxy or the Cilium agent.



WireGuard Node-to-Node encryption and Layer 7 Policies support

Cilium's encryption using WireGuard has been enhanced. Traffic between pods, from pods to nodes, and between nodes can now be encrypted, and support for applying L7 network policies to traffic encrypted with WireGuard has also been added.

Networking Beyond Kubernetes

L2 Announcements

Cilium 1.14 shipped with a new feature called L2 Announcement policy which allows Cilium to respond to ARP requests from local clients for ExternalIPs and/or LoadBalancer IPs.

BGP Enhancements

New features for Cilium's BGP implementation have been added. These features include:

- **BGP commands in Cilium CLI** - You can now display the BGP peering status of all nodes using the Cilium CLI
- **BGP Graceful Restart** - With the BGP graceful restart feature, your peers will be able to keep the routes in their routing table while you're restarting the agents.
- **eBGP Multi-Hop** - The eBGP multi-hop feature allows users to enable a neighbor connection between two EBGP peers that do not have a direct connection with an explicit TTL hop limit count.
- **Customized BGP Timers** - You can now customize the timers in your BGP session between Cilium and peers.

Cluster Mesh

Cilium Cluster Mesh in KVStoreMesh mode enables improved scalability and isolation and targets large-scale Cluster Mesh deployments supporting up to 50k nodes and **500k pods**.

Tetragon 1.0

Cilium Tetragon 1.0 was released with a major focus on improving performance and minimizing system overhead. It is a Kubernetes-native tool that applies policies and filtering through eBPF, ensuring deep observability with minimal performance impact. Tetragon tracks various activities like process execution, privilege escalations, file, and network activity, offering a range of out-of-the-box security observability policies.

Tetragon was designed as a Kubernetes native tool, it integrates seamlessly with Kubernetes to enhance security observability, enriching events with essential metadata for precise policy application. Its use of eBPF for event observation and filtering ensures minimal overhead and efficient performance, significantly reducing data transfer and eliminating delays in enforcement actions.

Its effectiveness is proven in benchmarking tests, with less than 2% overhead in process execution tracking and efficient file integrity monitoring even under high I/O conditions. Tetragon also has minimal impact on network performance, demonstrating its capability to observe network traffic effectively and efficiently.





User Surveys

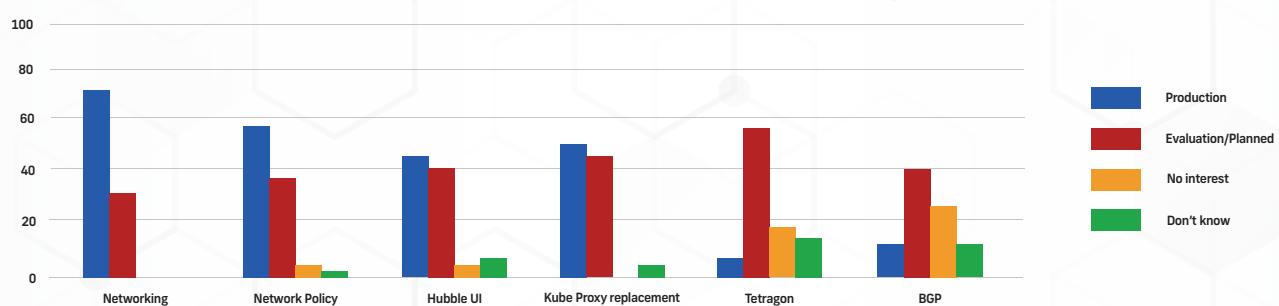
The Cilium User Survey 2023 highlights the project's development and progression towards advanced usage, reflecting the increasing sophistication of the community's needs. Users expressed a desire for diverse features, such as Tetragon, advanced service load-balancing, integrated ingress control, and service mesh, demonstrating Cilium's expansion beyond basic networking solutions to address complex, cloud native networking challenges. Additionally, the survey revealed varied multi-tenancy environments, from single-tenant to more than 50 tenants per cluster, underscoring Cilium's capability in managing diverse network policies and tenant separation. 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.

Networking, Hubble, Network Policy, and KPR are the most used features

Multi-cluster, Service Mesh, Tetragon, Transparent Encryption(wire guard), Ingress are the most evaluated/planned

BGP and Service Mesh in Production Today!

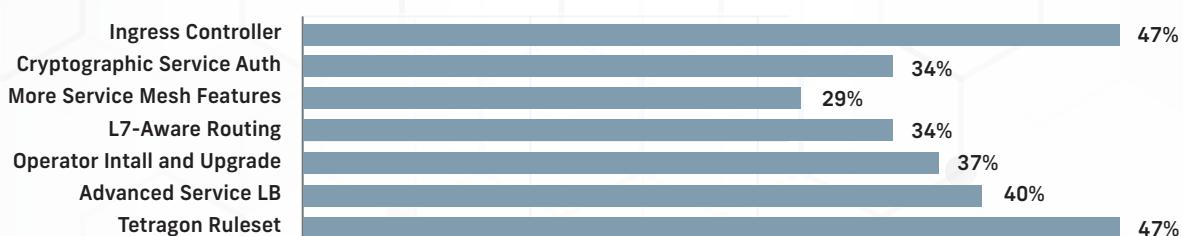
What features are you using? (%)



Service Mesh and Tetragon Rules Top Asks

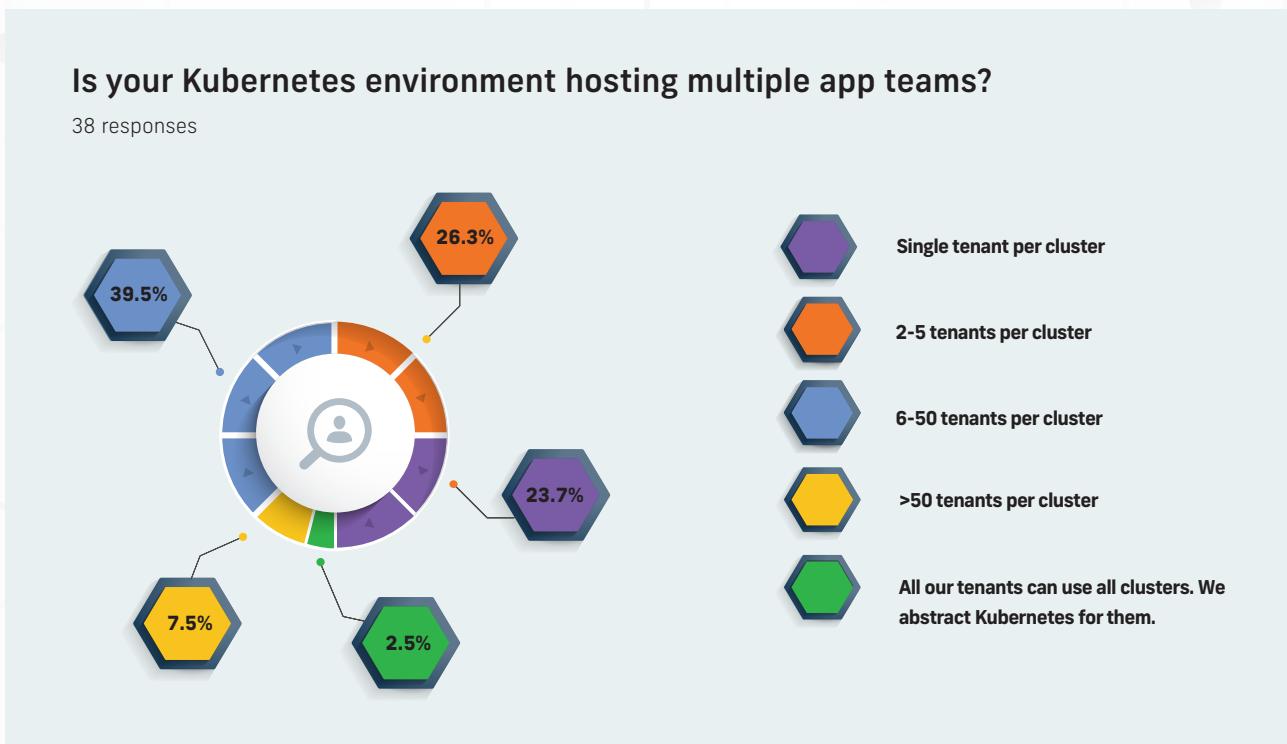
Pick some features you would love to see next

38 responses



The survey results indicate a keen interest in service mesh and Tetragon, aligning well with the recent release of Tetragon 1.0, a significant enhancement to Kubernetes security. The high demand for more service mesh features signals a pivotal stage in Cilium's evolution, as it increasingly addresses more complex and advanced challenges in the cloud native ecosystem.

Majority of clusters are multi-tenant



A significant number of users manage Kubernetes environments with varying degrees of multi-tenancy. This diversity, ranging from single-tenant to environments with over 50 tenants, underscores the importance of Cilium in implementing robust network policies and effective tenant separation. Cilium's ability to cater to these varied environments showcases its versatility and critical role in ensuring secure and efficient network management across different scales and complexities in Kubernetes deployments.

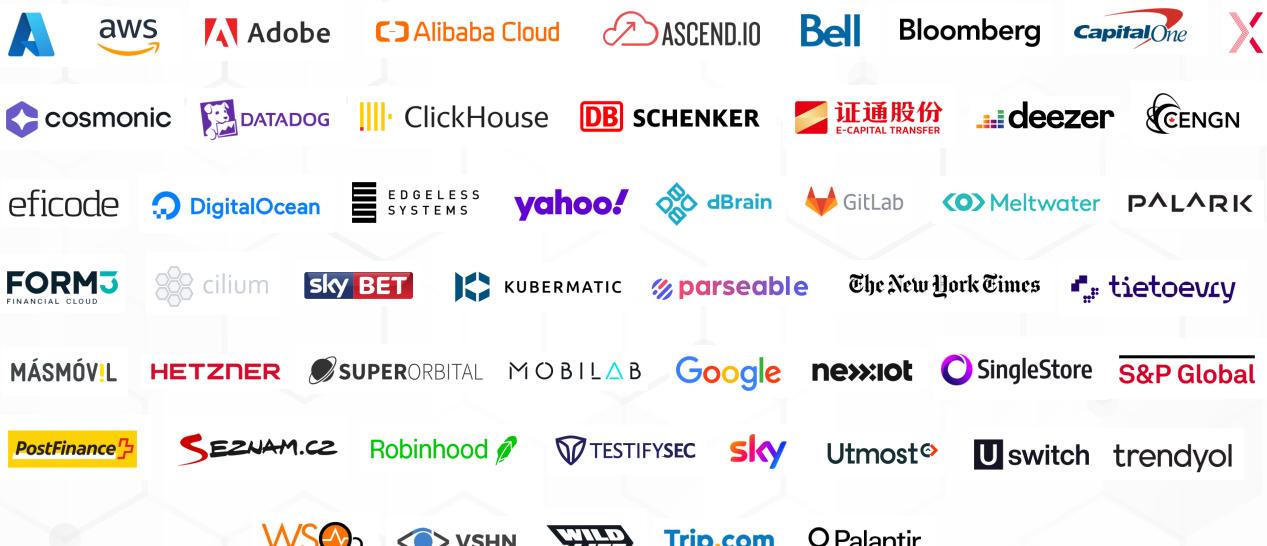


Cilium in Production

In 2023, Cilium's deployment and usage in production environments notably skyrocketed, from helping Bloomberg [create a scalable access control system](#) while building their own data sandbox storage solution to helping Trendyol [increase their network performance by over 40%](#). Its adoption as the default CNI by major cloud providers, numerous popular Kubernetes distributions, and many industries from financial services to media and entertainment is a testament to Cilium widespread adoption. This marks Cilium as the defacto standard for cloud native networking.

Adopters

Here are some of the organizations we know are using Cilium. If you're using Cilium and aren't on this list, please submit a pull request!



We also saw an increase in the number of user case studies for Cilium from 6 in 2022 to 15 in 2023. These case studies tell the story of how enterprises migrate from other solutions to use Cilium to solve problems they couldn't before and Cilium's ability to tackle cloud native networking, observability, and security challenges at any scale. Some of the companies that told their Cilium story in 2023 include:

- Ascend
- Bloomberg
- Trendyol
- Clickhouse
- Meltwater
- ilionx
- Trip.com Group

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](#).



Community Quotes

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 **Trip.com**

Microsoft

“ Our customers need a scalable, performant, and rich container networking solution to meet the demands of their rapidly expanding cloud native footprint. In collaboration with the CNCF community, we integrated the open source Cilium into our CNI to meet these needs. Cilium is based on eBPF and Microsoft has been working in collaboration with the robust eBPF community to make sure that eBPF works great for everyone. The response and adoption have been very positive amongst our customers. We are very excited for the CNCF Graduation of the project and looking forward to continued collaboration with the community.”

Deepak Bansal, corporate vice president and technical fellow 

Datadog

“ Datadog has been running Cilium in production for years, and it is our choice of CNI on all cloud providers because it provides a consistent experience for networking and network policy. eBPF and Cilium helped us to push the boundaries both within operations and also with product development. To do things safer, faster, and more easily than what we could have with traditional techniques like iptables.”

Hemanth Malla, Senior Software Engineer  **DATADOG**

Google

“ While it may have started as 'just a network plugin', Cilium has evolved into much more than that, with a broad feature set which speaks to many types of users from startups to major enterprises. I'm thrilled to see Cilium be successful – it's really a win for Kubernetes users everywhere.”

Tim Hockin, Distinguished Software Engineer 

Deutsche Bahn

“ Cilium was built natively on top of eBPF. In parallel, we saw wide adoption in the market and very feature-rich tooling and ecosystem around Cilium, like Tetragon for security observability and Hubble for network visibility. All of these factors together made the decision clear that we needed to migrate to Cilium to prepare our platform for the next steps in our cloud native journey.”

Amir Kheirkhahan, DevOps Specialist  **SCHENKER**

Ascend.io

“ A lot has changed since we first started adopting Cilium. The industry has become more clear with Cilium becoming the de facto networking layer for all three clouds. It allows us to know what we’re working with everywhere and we have the same networking layer in all three clouds. We can have that same Hubble experience, the same networking guarantees, and features, like encryption. Cilium is a unified network layer that solves a bunch of problems that we want to solve.”

Joe Stevens, Member of the Technical Staff  ASCEND.IO



Community Events

KubeCon

Cilium had a huge representation at both KubeCon EU and NA, it was surreal seeing the project garner so much attention. There were 15 talks about Cilium in Amsterdam and 25 talks in Chicago along with the official graduation announcement.

KubeCon Europe in Amsterdam

KubeCon + CloudNativeCon EU happened in Amsterdam, Netherlands on April 18th, 2023. Cilium was one of the most talked about projects at the event with a lot of presentations ranging from how Cilium is being used in production by large enterprises to other advanced use cases, like networking in multi-cloud environments and access control. This shows Cilium's evolution from just being used for basic pod to pod connectivity to being used for more complex workloads and scenarios.

CiliumCon Europe 2023

The first ever CiliumCon happened on April 18th, 2023 in Amsterdam, hosted by the CNCF and co-located with KubeCon Europe 2023. The line-up was absolutely incredible with talks from end-users like the New York Times, Bloomberg LP, Datadog, and Robinhood Markets. There were presentations on eBPF, using Cilium in multi-tenant environments, Cilium for security, and more! You can read more about these talks in this [blog post](#).

KubeCon NA in Chicago

At KubeCon NA Chicago, Cilium was celebrated and announced as a CNCF graduated project during the project updates keynote. Alongside the graduation, Cilium was featured in an impressive 25 talks, covering KubeCon, ArgoCon, and CiliumCon. You can read more about these talks in this [blog post](#).





eBPF Documentary

The documentary [eBPF: Unlocking the Kernel](#) premiered at KubeCon + CloudNativeCon NA on November 8th, 2023. The documentary told the story of how eBPF came to be and highlighted the importance of Cilium in bringing the capabilities of eBPF to end users. It features some notable names in the Cilium community including Daniel Borkmann, Liz Rice, and Thomas Graf.

CiliumCon NA 2023



CiliumCon serves as a venue to showcase all things Cilium and how the project is being used in production by the community. The second CiliumCon happened on November 6th, 2023 in Chicago as a KubeCon NA co-located event. At the event, we saw a huge presence from large enterprise end users like Adobe, Clickhouse, and Datadog. The turnout and enthusiasm at CiliumCon were remarkable, with the community uniting to share innovative applications of Cilium in various Cloud Native environments.

Meetups

In 2023, in-person meet-ups continued with full force and it was great to see the continuity with Cilium popping up in different countries and conversations. You can catch all of the videos on [YouTube](#).

Looking forward to 2024

As Cilium celebrates its graduation in 2023, the journey is far from over. With Cilium now as the de facto standard for cloud native networking, we can now start focusing on the next set of industry challenges together. **My predictions for the upcoming year include an increased deployment of service mesh in production, wider adoption of Tetragon, and an expansion of Cilium's usage beyond Kubernetes in hybrid and multi-cloud environments.**

With the addition of mutual authentication and Gateway API into Cilium Service Mesh, all of the top service mesh use cases are now covered by Cilium. Rather than having to learn and install a new tool, with Cilium features like meshing multiple clusters together, service to service authentication, and L7 load balancing are just a few YAML lines away. **Cilium sees service mesh as just another set of networking features in the platform** that should be as transparent and effortless to the end user as the rest of the stack. Being able to just flip on additional features from your CNI as needed will be a compelling story for a lot of platform teams.

Building on the momentum of Tetragon 1.0, the interest in Tetragon, as shown in our recent user survey, and the accelerating importance of security in cloud native, I see 2024 as a breakout year for Tetragon. **Security usually comes at a tradeoff with performance, but Tetragon, with eBPF and in-kernel event filtering, finally starts to break this cycle.** Being able to implement security observability without having to worry about the impact on the application will really help Tetragon grow. 1.0 already covers many of the major use cases and the next year will bring a lot of usability upgrades to make Tetragon easier to adopt and deploy.

Finally, external workloads will also be a key focus, as Cilium aims to streamline the integration and management of non-Kubernetes resources within the Kubernetes environment. This will be crucial for organizations looking to leverage the full potential of their hybrid and multi-cloud deployments. BGP improvements, L2 announcements, Cilium's Layer 4 load balancer, and Cilium Mesh will be major drivers of this legacy integration story. **Cloud native is coming to a datacenter, VM, and bare metal machines near you soon.**

As Cilium continues to evolve, these developments are not just reflections of our users' current needs but also an indication of the direction in which cloud native networking, observability, and security are headed. With Cilium as the standard, 2024 promises to be a year of significant advancements and innovation in the cloud native ecosystem. This is just the beginning of the next chapter for Cilium!

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. Additionally, Join the weekly [Cilium developer meeting](#), the community is also active on [Slack](#), [Twitter](#), 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.



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