



KubeCon



CloudNativeCon

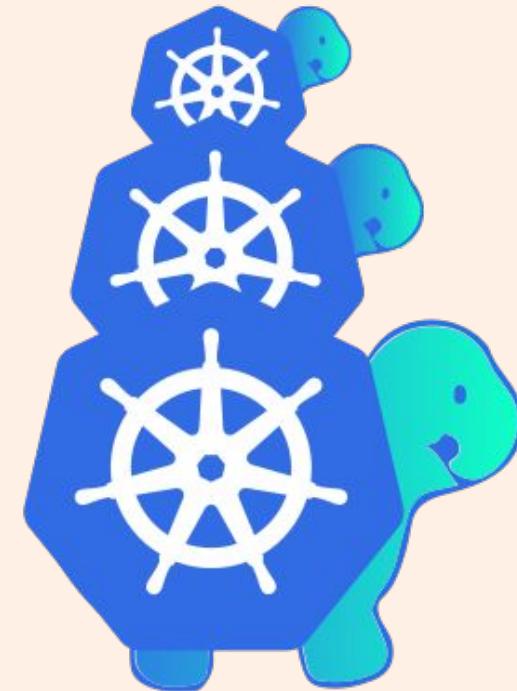
Europe 2022

WELCOME TO VALENCIA



Cluster API Intro & Deep Dive

Vince Prignano, VMware
Yuvaraj Kakaraparthi, VMware



About us



Vince Prignano
Staff Engineer II, VMware

 @vinceprignano



Yuvaraj Kakaraparthi
Member of Technical Staff, VMware

 @YuvarajBalajiK



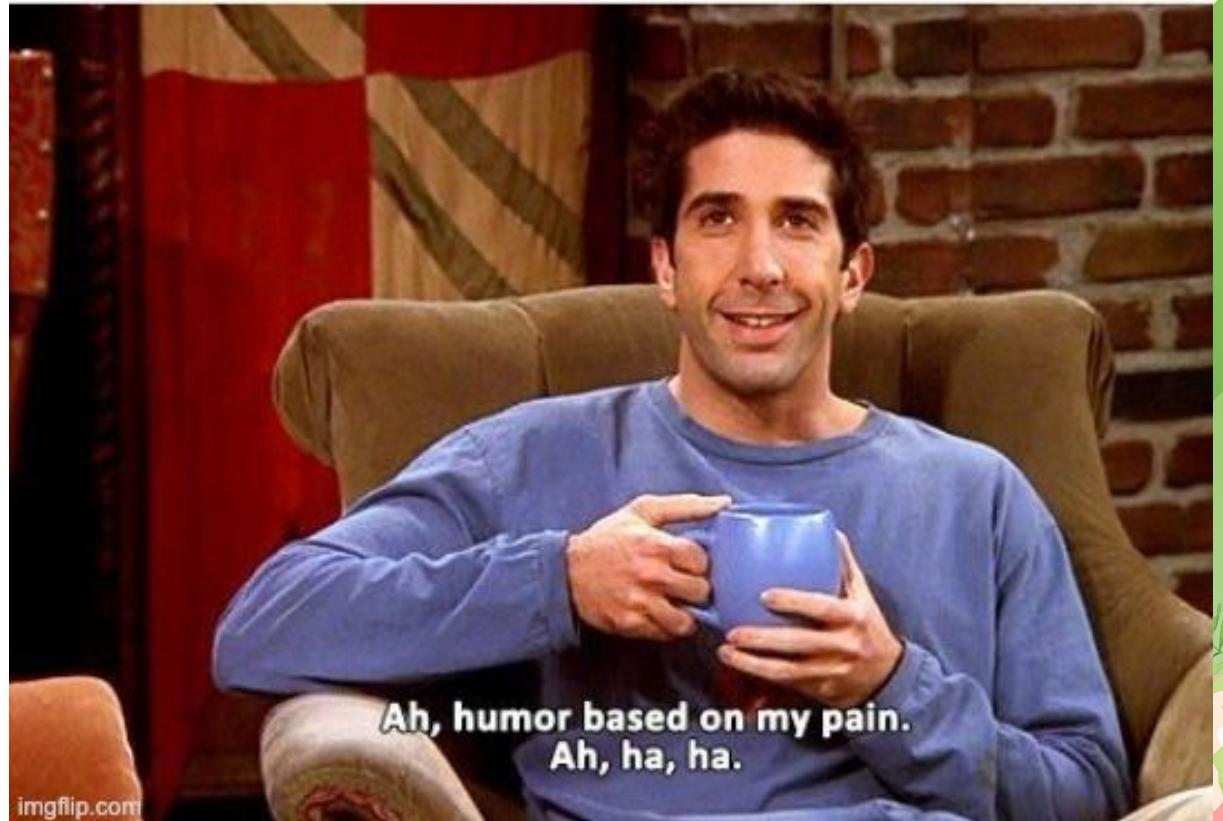
I haven't seen you since the plague.

What is Cluster API?

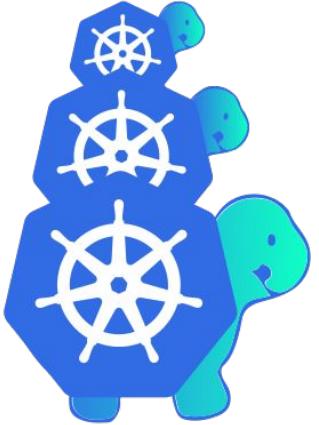


WHEN I SEE A KUBERNETES MEME ON TWITTER

What is Cluster API?

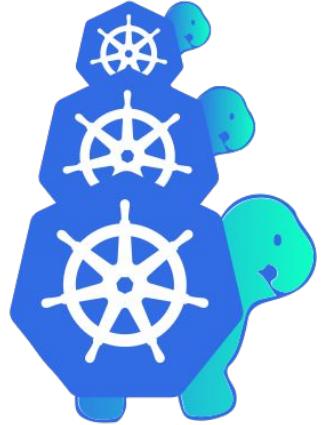


What is Cluster API?



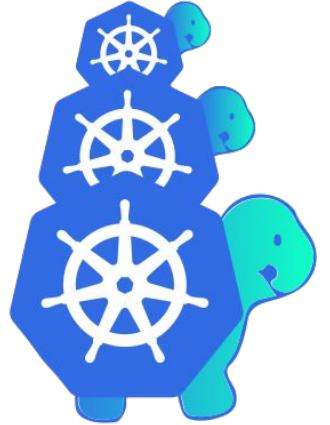
Cluster API uses Kubernetes-style APIs and patterns to automate cluster **creation, configuration** and **management** for platform operators.

What is Cluster API?



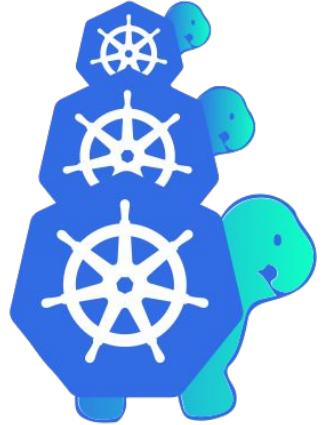
Making cluster lifecycle **boring**.

What is Cluster API?



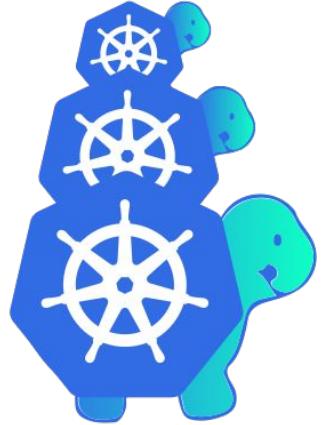
Extensibility is key.

What is Cluster API?



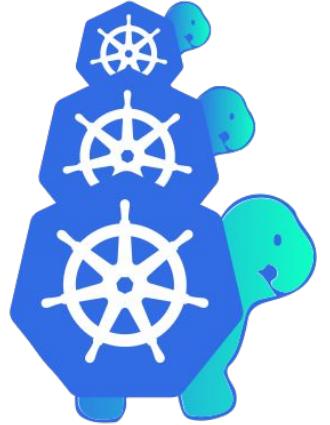
Batteries included but swappable.

What is Cluster API?



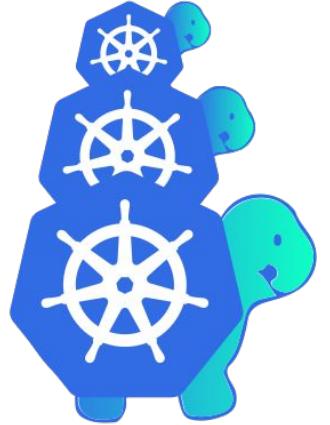
Focus on the 80% and make the rest possible.

What is Cluster API?



Cluster API is production ready.

What is Cluster API?



The **best feature** is the **community**.

Where are we?

[About](#)[Projects](#)[Training](#)[Community](#)[Blog & News](#)[Join](#)[BLOG / PROJECT POST](#)

Kubernetes Cluster API reaches production readiness with version 1.0

Posted on October 6, 2021

Where are we?

At Twilio we are leveraging Cluster API in production for our SendGrid email infrastructure. We run upwards of 100 production Kubernetes clusters on bare metal servers distributed across various geographic data centers.

We have found value in Cluster API's overall topology, specifically with the paradigm of having a management cluster. We take advantage of management clusters as our dedicated infrastructure on which the team can build, manage, and secure the suite of applications that manage our company's growing fleet of Kubernetes clusters.

We are excited for the v1.0 release of Cluster API, as it marks the beginning of our next phase of commitment to the project and yet even more contributions moving forward.

Twilio – Kris Nóva – Senior Principal Engineer

Twilio – J. Brandt Buckley – Principal Engineer



Where are we?

At Giant Swarm we decided to go all-in on Cluster API and replace our custom controllers and API with the upstream equivalents. We are integrating it with our distributed approach of management clusters to manage a fleet of hundreds of workload clusters, contributing our learnings to upstream along the way.

The modular architecture and declarative nature of Cluster API aligns perfectly with our principles and vision of how infrastructure should be managed, driving further the idea of Kubernetes as a platform of platforms. Joining the community in this effort and working together on a better cluster management future for everyone is a very motivating and rewarding experience.

We are very excited about the v1.0 release of Cluster API as we are in the process of making the Cluster API-based iteration of our product ready for a smooth transition for our customers on different providers by early next year.

Giant Swarm – Puja Abbassi – VP Product



Giant Swarm

Where are we?

Cluster API is one of the foundational open source components of our platform that enables our customers to manage any type of cluster, anywhere, at scale. As the requirements for enterprise-grade, production environments have changed, the need to manage Kubernetes infrastructure holistically is becoming a necessity. Cluster API is probably one of the most important projects for the community and the key to making not just Kubernetes, but the whole open source ecosystem more accessible and manageable.

We're beyond excited for the upcoming Cluster-API v1.0 release and look forward to more customers and vendors adopting it.

Spectro Cloud – Jun Zhou – Chief Architect



Where are we?

At Talos, we've been fans of Cluster API since day 1. We have several customers (ourselves included!) using CAPI to provision and maintain Talos clusters across a variety of bare metal and cloud environments.

The modularity and general forethought of the CAPI project has allowed us to build our own providers specific to Talos OS, helping to extend the Kubernetes declarative paradigm to cluster provisioning and the OS. In doing so, our use of CAPI allowed us the ability to build other projects on top of this solid base.

Having such a framework for handling Talos clusters has greatly improved the usability of our products.

We're very pleased to see the v1.0 release coming out as we continue our work on top of this awesome project!

Talos Systems – Spencer Smith – Senior Principal SW Engineer



Where are we?

Cluster API is an exciting piece of the Kubernetes cluster fleet management system at New Relic. This system helps our engineers better manage the lifecycle of many Kubernetes clusters deployed in public clouds. Cluster API enables us to simplify cluster fleet automation by providing a consistent, simple, and declarative API for creating, configuring, and upgrading Kubernetes clusters and their node pools. In addition to this, Cluster API makes it easier for us to provide a consistent, self-service interface for our engineers to manage their infrastructure. Because of Cluster API, our engineers rarely need to look at the underlying cloud provider consoles and APIs. Instead, they can manage the infrastructure directly in Kubernetes in the form of Cluster API resources. We are proud to have contributed to the Cluster API project and we are excited for the 1.0 release and beyond!

New Relic – Dane Thorsen – Lead Software Engineer



Where are we?

At Red Hat we have been involved with the Cluster API project since its earliest days, having incorporated the Machine API component into our Red Hat OpenShift 4 cluster autoscaling, node autorecovery and ephemeral/spot instance abilities. Building a core component of our OpenShift infrastructure management on this common upstream ancestry has been a successful experience, and we look forward to adding more of Cluster API's capabilities in the future through projects like HyperShift that empower our users to separate control plane and management concerns from production workloads. We are excited to see Cluster API reach 1.0 and congratulate all the contributors on reaching this milestone!

Red Hat – Michael McCune – Principal Software Engineer



Where are we?

At Deutsche Telekom Technik we are tasked with providing Kubernetes clusters for telco workloads like 4G/5G Core, IMS, FTTH, RAN, Edge and many more, and also a number of related management applications (OSS). These workloads not only require deployments at large data centers, but also at hundreds of small on-premise locations across Germany. From the very beginning in 2019 we were fully convinced that CAPI is the way to go for us and in early 2020 we went to production with v1alpha2, but switched soon to v1alpha3 which brought a major breakthrough in usability and manageability. We run our clusters mainly on vSphere (CAPV) and on Bare Metal (Metal3) using centralized management clusters.

ClusterAPI has helped us a lot making the task of managing widely varied Infrastructure in a lot of Data Centers possible and manageable with a small but dedicated SRE team. Especially the declarative approach, which pairs well with GitOps, has helped us a lot in that regard.

As we are putting more and more of critical telco services on a CAPI managed fleet, we are very happy to see ClusterAPI moving to stable. However, from our experience so far we can freely state that the experience in regards to software stability has been nothing but stellar. Many thanks to all folks involved!

Deutsche Telekom – Maximilian Rink – Senior SRE

Deutsche Telekom – Vuk Gojnic – Teamlead of Kubernetes Engine Squad



Where are we?

The Enterprise Cloud Management Agency under the Army CIO and the Army Software Factory are leveraging Cluster API in production for our upstream cluster automation. We run Kubernetes clusters across numerous impact levels and environments. We need a way to declare those clusters to meet compliant and secure defaults while also providing a regional control plane that can enforce those defaults.

We have found value in Cluster API with the management cluster, acting as this regional control plane, helping stand up additional clusters that different services and components can quickly be installed on. Cluster API serves as the basis for portions of the DoD Enterprise DevSecOps Reference Design Multi-Cluster CNCF Kubernetes for this reason.

ECMA and the Army Software Factory look forward to the v1.0 release of the Cluster API, which will allow us to scale and automate our processes to enable enterprise reach for Army customers.

US Army – Paul Puckett – Director, Enterprise Cloud Management Agency

US Army – LTC Vito Errico – Director, Army Software Factory



Where are we?

Microsoft's involvement in Cluster API started in earnest about 2 years ago with the intent of providing a better open source story for users of self-managed Kubernetes clusters everywhere, including Azure. In the infancy of Kubernetes on Azure, AKS Engine was the tool used to provision Kubernetes clusters. Its source code resides within the Azure GitHub organization, not in the CNCF. With AKS Engine, users were able to create self-managed clusters on Azure, but there was little congruence between the experience on Azure and other infrastructure providers. This all changed with Cluster API. Now, there is a shared interface for building infrastructure across providers.

Over the past year the Azure Container Upstream team has migrated its upstream Kubernetes tests to the Cluster API ecosystem so that validation for Azure Kubernetes scenarios uses only open source, CNCF tools.. This is a big win for both the community and for Microsoft. We are able to validate Kubernetes on Azure with tools that are community owned and maintained in collaboration. In the near future, all of the Kubernetes validation tests for Azure will be run using Cluster API.

Microsoft – David Justice – Principal Engineering Lead



Where are we?

One of the goals of Amazon EKS Anywhere is to enable customers to provision a Kubernetes cluster on an infrastructure provider of their choice, using Amazon EKS Distro. Another goal is to provide a declarative way of managing these clusters. Cluster API's tenets of being infrastructure agnostic, offering a pluggable model for adding new providers as needed, and its declarative approach for managing Kubernetes clusters and nodes aligned very well with our goals, and so we decided to use it in Amazon EKS Anywhere for cluster provisioning and life cycle management operations including scaling, upgrades and deletion.

For Amazon EKS Anywhere we were able to further leverage Cluster API's declarative style by providing Flux integration for a GitOps-driven cluster life cycle and configuration management. Interactions with the Cluster API community have been of great value while achieving these goals.

We are excited for the v1.0 release and look forward to collaborating more with the community and contributing to the project.

AWS – Chandler Hoisington – General Manager EKS Anywhere

AWS – Jackson West – Software Development Manager

AWS – Rajashree Mandaogane – Software Development Engineer II



Where are we?

D2iQ recognizes that cluster lifecycle management is a complex problem that requires a flexible, but reliable solution, and it recognizes that working toward both goals is best done within a community. Our software helps our customers manage large numbers of clusters across different infrastructures. We use multiple Cluster API Infrastructure Providers, and contribute back to community-maintained ones. Cluster API's architecture allows us to collaborate with the community on common problems, and to plug in specialized components where we need them.

To us, the v1.0 release confirms our own experience with Cluster API: its design has evolved over time and matured, its implementation is production-ready, and the project community is rich with expertise and diverse viewpoints. We look forward to this release, and to many more in the future.

D2iQ – Daniel Lipovetsky – Staff Software Engineer

D2iQ – Deepak Goel – Chief Technology Officer



Where are we?

Samsung SDS has been interested in the Cluster API Project since the early days and is currently using Cluster API as the core technology for the managed Kubernetes service in the SDS Cloud. We implemented our own provider to use the Cluster API in a way that is more suitable for SDS Cloud. Cluster API enables Kubernetes cluster provisioning to be consistent and scalable in various IaaS. We are trying to extend our service to provide Kubernetes service in a multi-hybrid cloud environment by taking these advantages.

We believe that Cluster API will become the foundation for managing cluster lifecycle in the cloud-native ecosystem following Kubernetes's path. The v1.0 release has given us confidence in the direction we are heading, and we sincerely thank everyone who contributed. We look forward to contributing much more through various activities in the community. Congratulations!

Samsung SDS – Hansol Park – Senior Engineer

Samsung SDS – Kangsub Song – Senior Engineer

Samsung SDS – Moonhyuk Choi – Senior Engineer



Where are we?

At SK Telecom, we are providing Kubernetes service as a part of our multi, hybrid cloud offering for large enterprise companies in financial, media, broadcasting sectors. From early 2019, we have believed that Cluster API is the right way to abstract the complex nature of cluster lifecycle management. We have fully leveraged Cluster API's Kubernetes-native and declarative nature with Kustomize, Helm, and Argo toolchains. Now, we are provisioning enterprise-ready Kubernetes clusters with add-on services via Argo CD in GitOps style on the public clouds. We are planning to extend it toward on-premise environments.

We are very excited for the v1.0 release. We have learned a lot from everyone in the community, and certainly will contribute back to the community as much as possible. We are looking forward to what we can do with this wonderful community!

SK Telecom – Jaesuk Ahn – Cloud Native Development Lead

SK Telecom – Seungkyu Ahn – Senior SW Engineer & Korea Kubernetes Community Lead



Where are we?

As platform team at **Mercedes-Benz Tech Innovation** we run and operate around 700 Kubernetes clusters and 3,500 machines all over the world in on-premise data centers. By migrating to Cluster API we replaced our legacy provisioning, consisting of Terraform, custom self-written tools and Kubernetes operators.

With the cloud native mindset in our heart, our ambition is to provide tons of fully managed Kubernetes clusters with great customer experience.

Cluster API enhances our portfolio by enabling the management of off-premise cloud providers. At the same time it simplifies the provisioning and upgrading of our existing infrastructure. Managing clusters the Kubernetes style feels like the most natural way and perfectly fits into the existing workflow.

After the migration of our on-premise clusters to Cluster API we are looking forward to taking the next step: the provisioning of clusters to other providers and a higher engagement with the Kubernetes community.

Mercedes-Benz Tech Innovation – Christian Schlotter – Software Engineer

Mercedes-Benz Tech Innovation – Tobias Giese – Software Engineer

Mercedes-Benz Tech Innovation – Sean Schneeweiss – Software Engineer



Where are we?

The Cluster API project is central to VMware's efforts to bring cloud native tools to a wider audience. VMware empowers its enterprise customers in their transformation journey, and Cluster API provides the consistent experience across infrastructure providers in a multi-cloud world. By working with a wide set of others in the community, we can, as that community, make it easy to deploy and manage Kubernetes clusters in a consistent way across all sorts of infrastructure — from vSphere to public cloud to bare metal. The newly released ClusterClass feature further simplifies things by providing a much simpler interface for defining and sharing cluster patterns. By creating a better toolset for platform teams, they can, in turn, provide even more automatic, fast and easy internal products to application teams. The end result is app teams shipping faster and safer.

VMware – Joe Beda – Principal Engineer – Tanzu

At VMware we believe that competition makes us individually better, but collaboration makes the world better. We are proud to have walked the journey with the Kubernetes community from CAPI's inception to its current production ready form. As a system it fundamentally redefines the model for deploying and maintaining Kubernetes clusters, bringing the power of Kubernetes control patterns to the world of infrastructure management at scale. Hearty congratulations to the community on the v1.0 release. We look forward to this project's future, not only as a fundamental part of our Tanzu product line but as an increasingly fundamental part of the vibrant Kubernetes ecosystem.

VMware – Craig McLuckie – Vice President – Modern Apps and Management



An ever growing momentum

- [Keynote: 7 Years of Running Kubernetes for Mercedes-Benz - Jens Erat, DevOps Engineer; Peter Mueller, Lead Expert; Sabine Wolz, Product Owner, Mercedes-Benz Tech Innovation](#)
- [Kubernetes is Your Platform: Design Patterns For Extensible Controllers - Rafael Fernández López, SUSE & Fabrizio Pandini, VMware](#)
- [Build Your Own Cluster API Provider the Easy Way - Anusha Hegde, VMware & Richard Case, Weaveworks](#)
- [How to Migrate 700 Kubernetes Clusters to Cluster API with Zero Downtime - Tobias Giese & Sean Schneeweiss, Mercedes-Benz Tech Innovation](#)

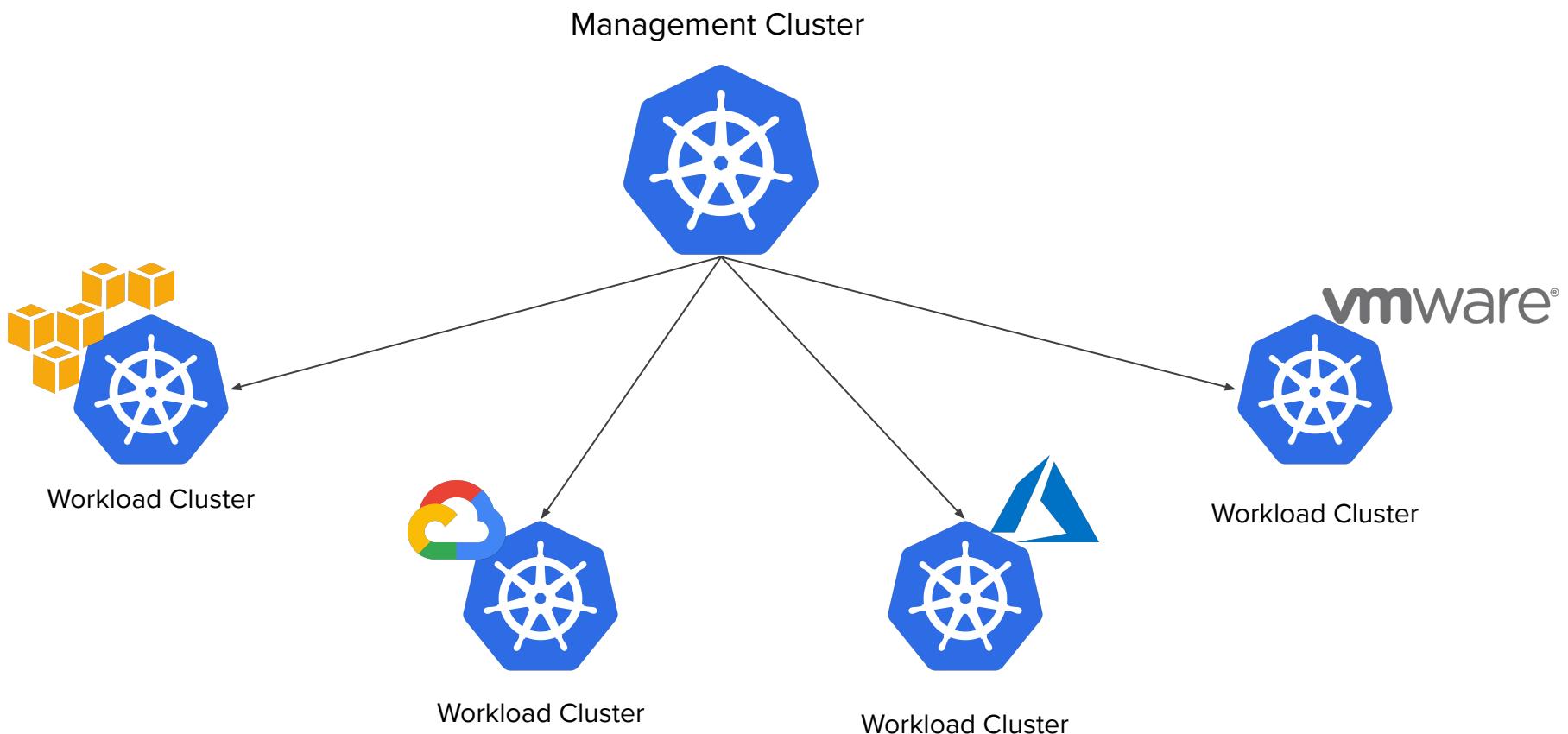
How does it work?



How does it work?



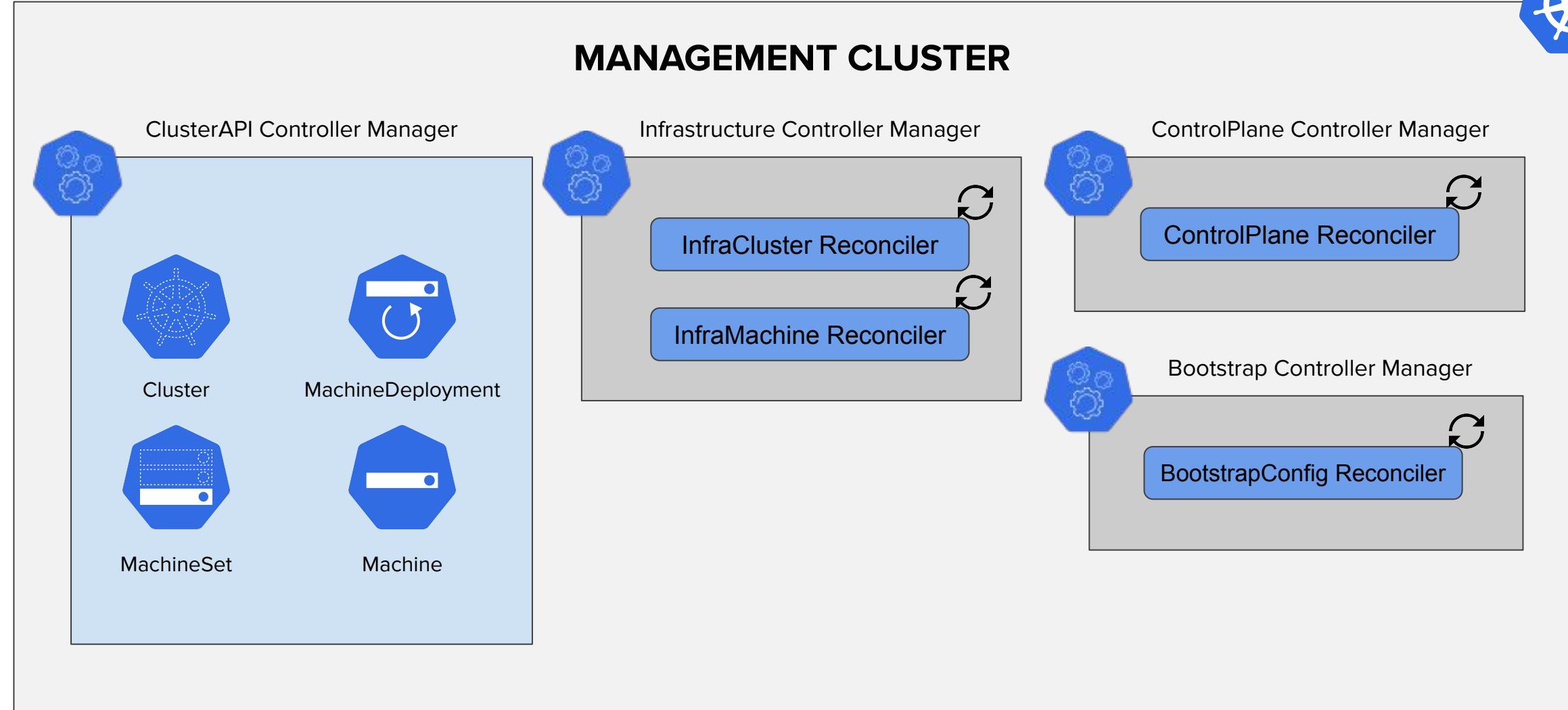
How does it work?



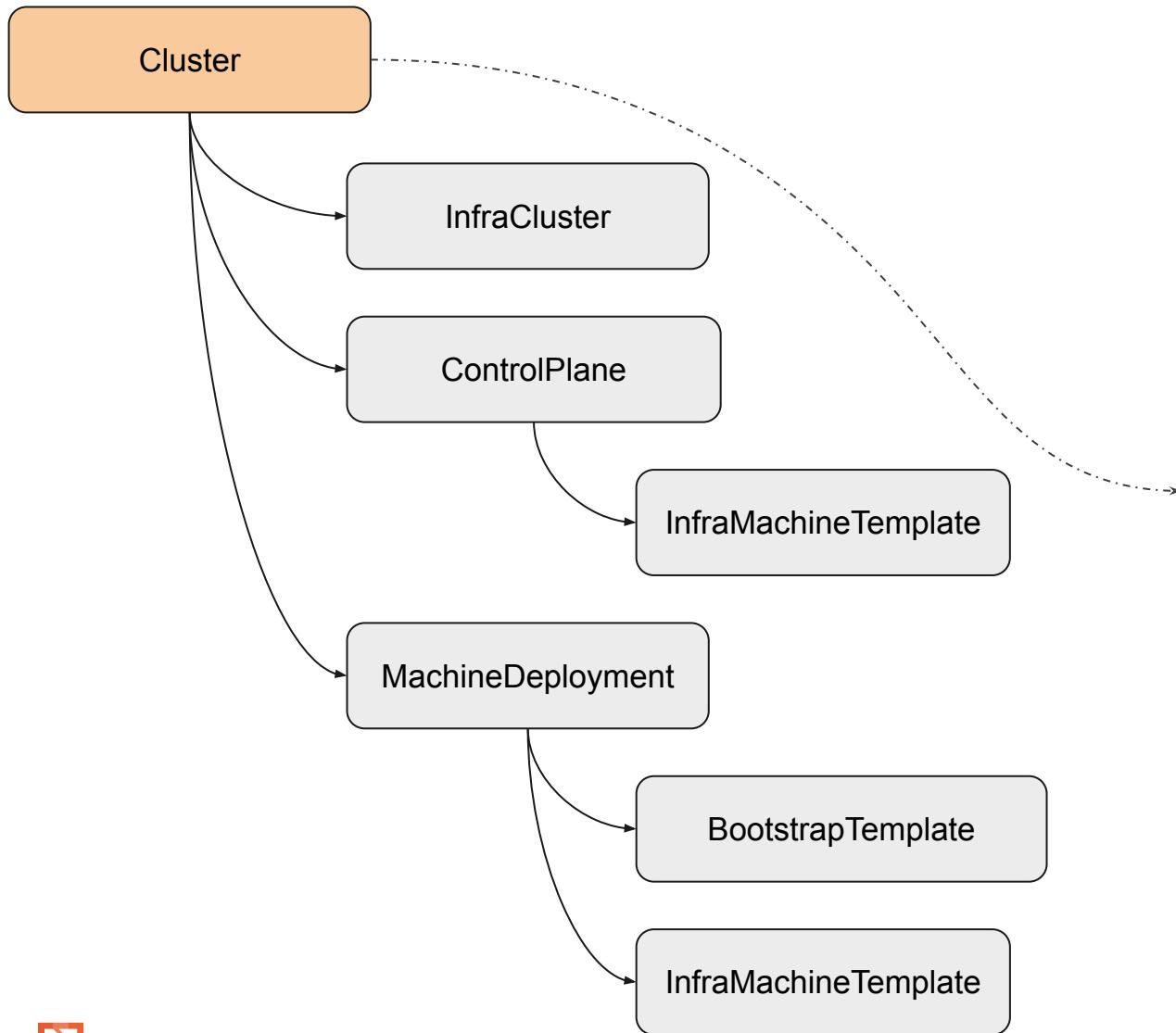
How does it work?



MANAGEMENT CLUSTER



CRDs and Spec



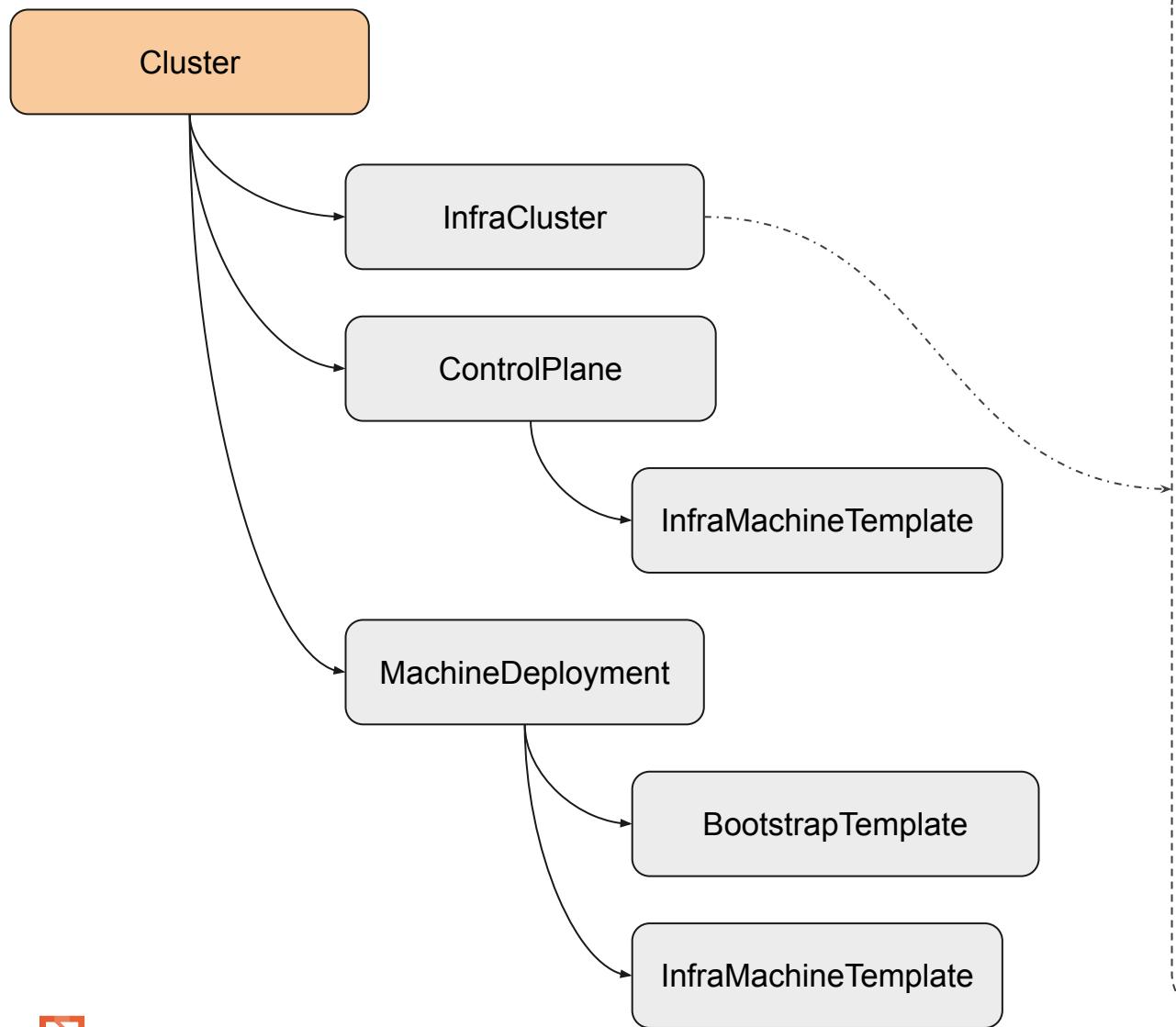
Cluster

Cluster-wide configuration.

Generic networking concepts like pods and service range or DNS domain.

```
apiVersion: cluster.x-k8s.io/v1beta1
kind: Cluster
metadata:
  name: example
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
        - 192.168.0.0/16
  controlPlaneRef:
    ...
  infrastructureRef:
    ...
  topology: # This is an alpha feature
    class: example-class
    version: v1.23.0
  controlPlane:
    replicas: 1
  workers:
    machineDeployments:
      - class: "example-worker"
        name: "md-0"
        replicas: 1
```

CRDs and Spec



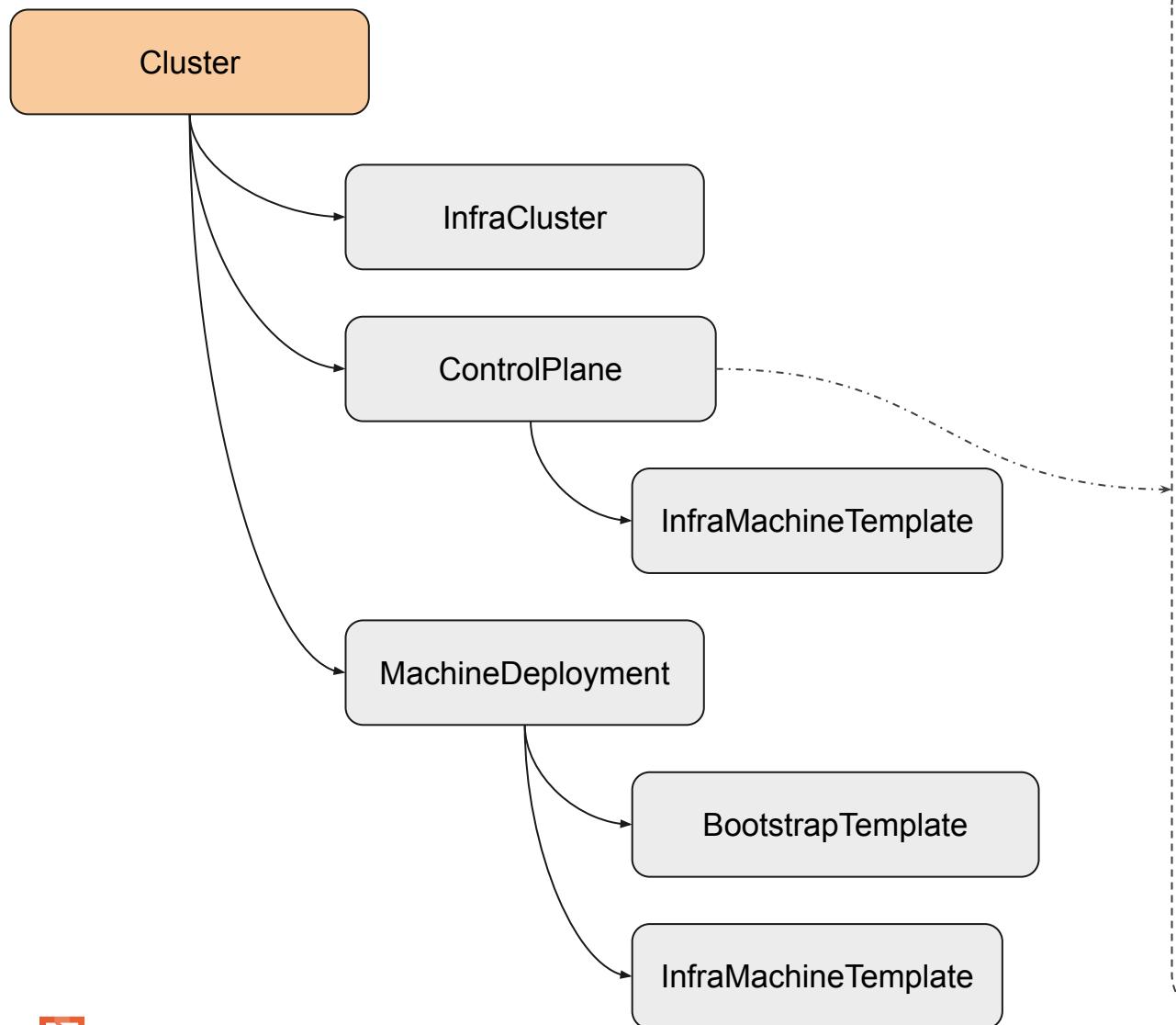
InfraCluster

Example: AWSCluster, AzureCluster, DockerCluster, etc.

Provider specific cluster configuration.

```
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: AWSCluster
metadata:
  name: example
  namespace: default
spec:
  region: us-west-2
  sshKeyName: example
```

CRDs and Spec



ControlPlane

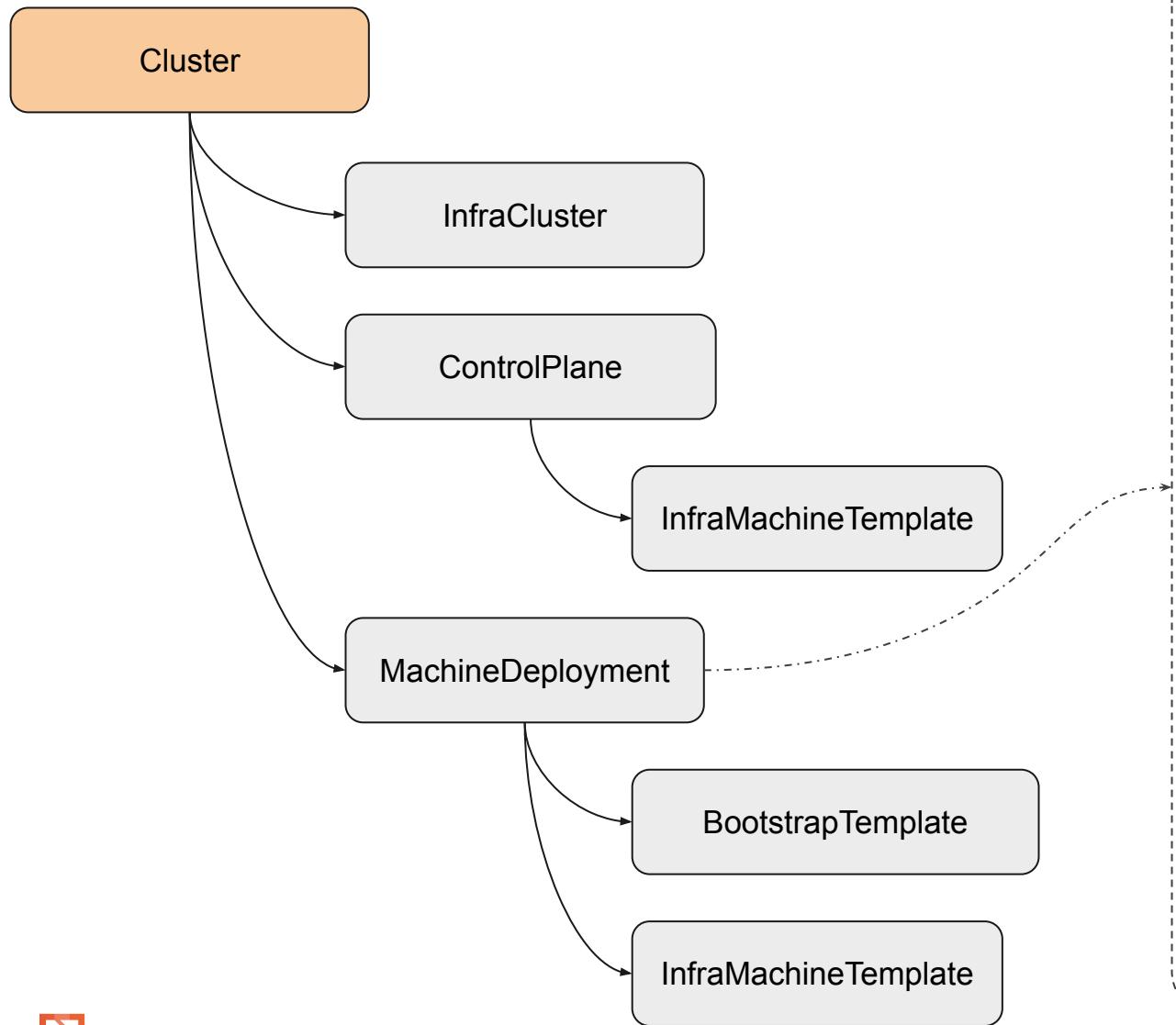
Example: Kubeadm Control Plane, EKS, AKS, etc.

Replicas for the desired number of control plane nodes.

Version for the target kubernetes version of the control plane nodes.

```
apiVersion: controlplane.cluster.x-k8s.io/v1beta1
kind: KubeadmControlPlane
metadata:
  name: example-control-plane
  namespace: default
spec:
  kubeadmConfigSpec:
    clusterConfiguration:
      ...
    initConfiguration:
      ...
    joinConfiguration:
      ...
  machineTemplate:
    infrastructureRef:
      apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
      kind: AWSMachineTemplate
      name: example-control-plane
  replicas: 1
  version: v1.23.0
```

CRDs and Spec



MachineDeployment

Declarative management of worker nodes of the kubernetes cluster.

Replicas for the desired number of machines.

Version for the target kubernetes version on machines.

```
apiVersion: cluster.x-k8s.io/v1beta1
kind: MachineDeployment
metadata:
  name: example-md-0
  namespace: default
spec:
  clusterName: example
  replicas: 0
  selector:
    matchLabels: null
  template:
    spec:
      bootstrap:
        configRef:
          apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
          kind: KubeadmConfigTemplate
          name: example-md-0
      clusterName: example
      infrastructureRef:
        apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
        kind: AWSMachineTemplate
        name: example-md-0
        version: v1.23.0
```

What's new?

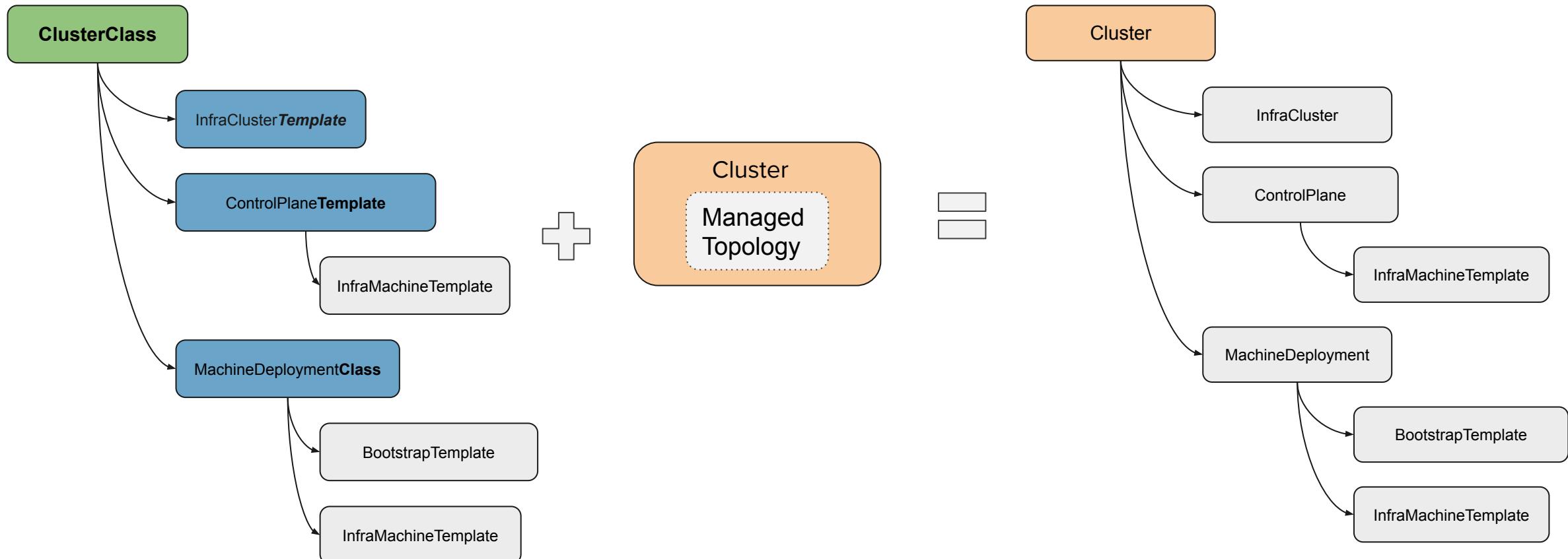


What's new?

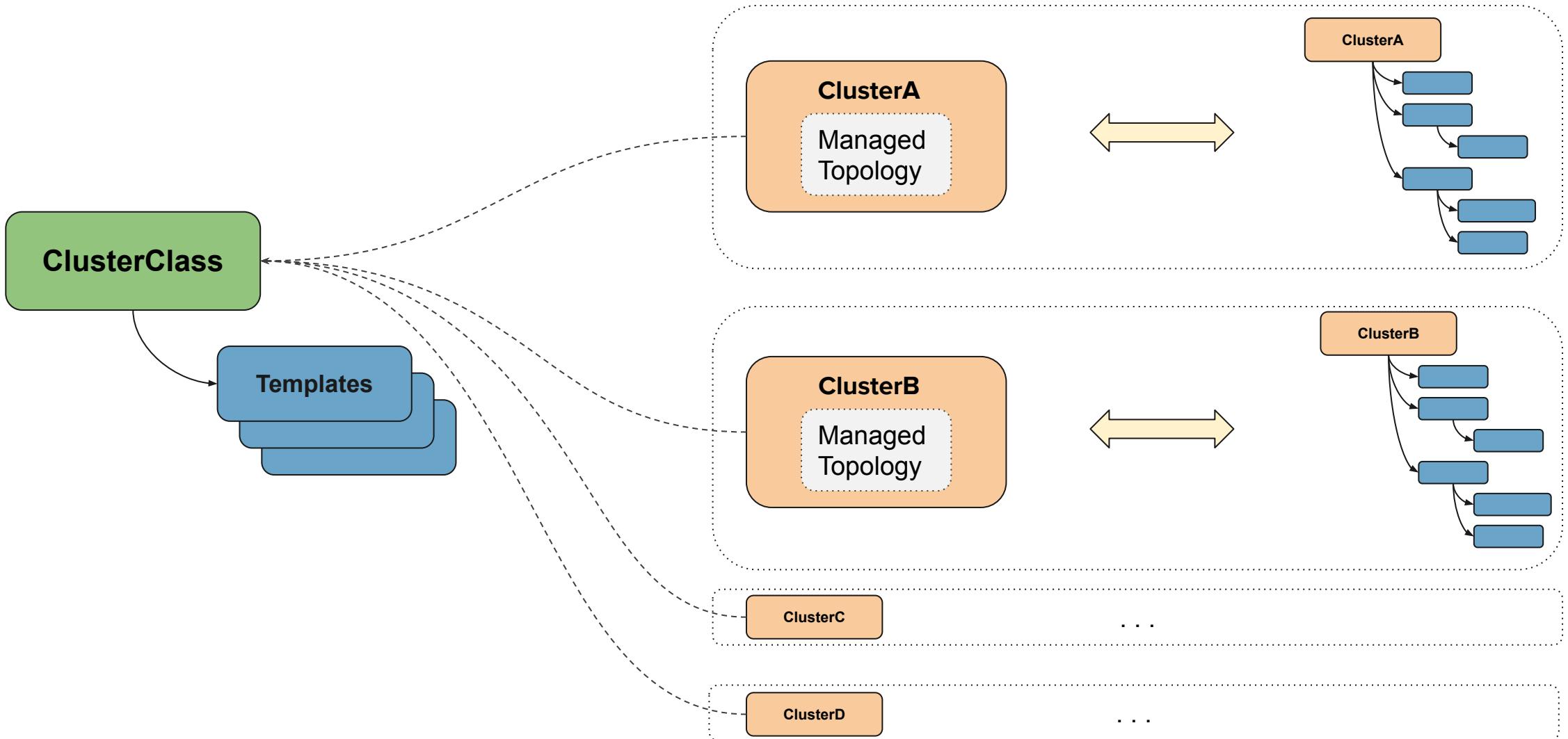
- Cluster API had a **milestone v1** release and the API moved to **v1beta1**.
- ClusterClass and Managed Topologies
- Ignition and Flatcar support
- clusterctl now available on windows
- ARM support for clusterctl
- Growing provider family:
 - IBM Cloud
 - Bring Your Own Host (BYOH)
 - Oracle Cloud
 - Nutanix
 - ... and more

ClusterClass & Managed Topologies

ClusterClass is a collection of templates that define a topology (control plane and machine deployments) to be used to continuously reconcile one or more Clusters.



ClusterClass & Managed Topologies



Demo



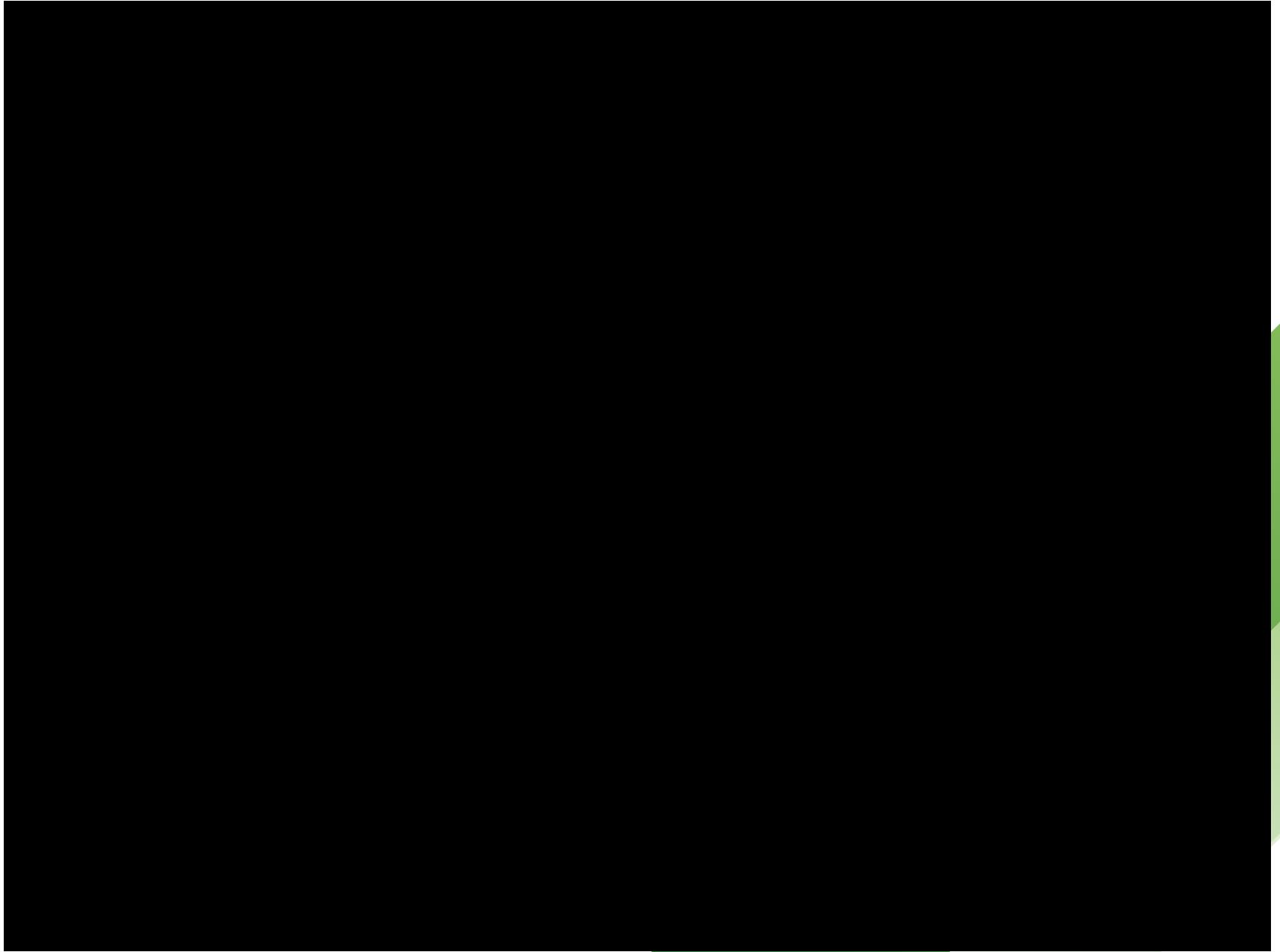
NOW WITNESS THE POWER OF THIS
FULLY OPERATIONAL



KUBERNETES CLUSTER

memegenerator.net

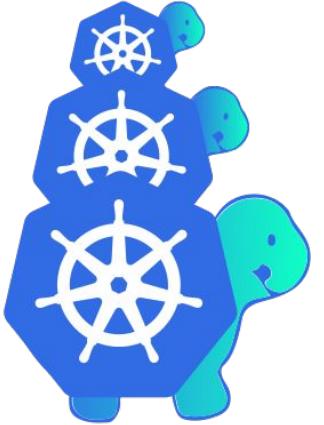




What's next?

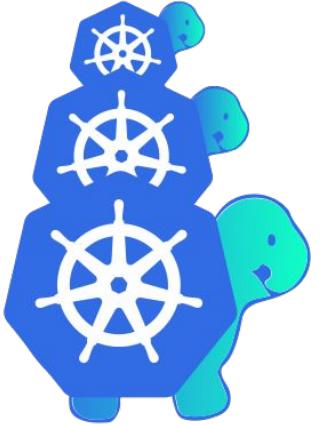


What's next?



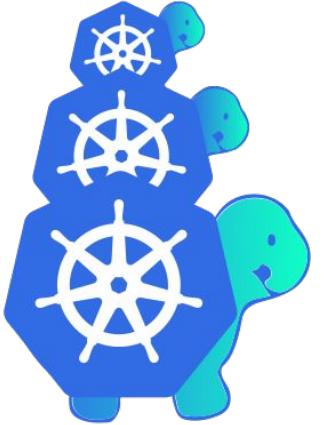
User **experience** and ease of use.

What's next?



Higher level OS and node bootstrapping **integration**.

What's next?



A deeper look at **bare metal** and **edge**.

What's next?

- [Runtime SDK](#)
- [Add-on Management and Add-on Orchestration](#)
- [Extended integration with Managed Kubernetes offerings](#)
- [Auto-scaling from and to zero](#)
- [Certificate Rotation](#)

How to get involved?



How to get involved?



Writing skills?

- Improve our [book](#): [quick start](#), [architecture diagrams](#), [contracts](#), [troubleshooting sections](#), and so on!



Product skills?

- Gather [use cases](#), compile user pulse surveys, draw roadmaps.
- Work with project's maintainers and the community to shape our product.
- Help with backlog grooming, [maintain milestones](#).



Coding skills?

- Review [pull requests](#), [become an approver](#).
- Search for [help wanted](#), or [good first issues](#) across our repositories.



Other skills? Have feedback, use cases, demos, or questions?

- Join [weekly community meetings](#), [slack](#), [mailing list](#).
- Open issues, bring the what and whys.



Thank You