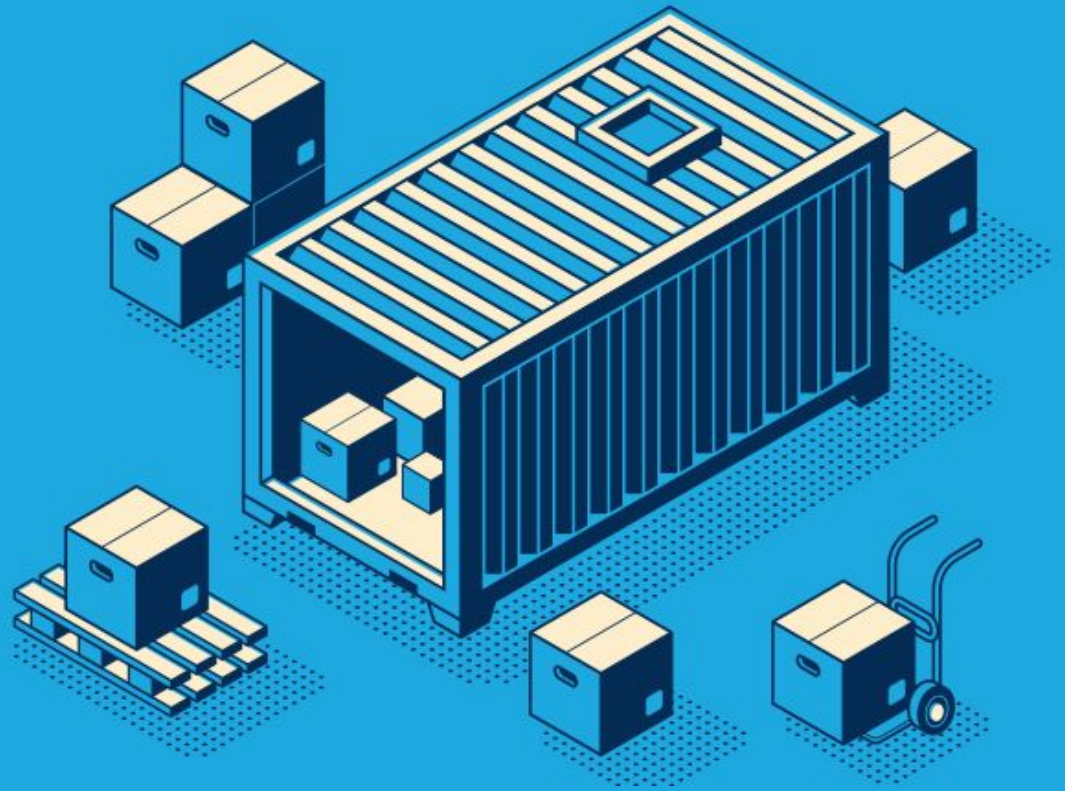
Kubernetes

Vertical Pod Autoscaler Operator



CS 6620 - Cloud Computing

The Team

Selen

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Sindhu

Mentors (Redhat)

Humair Khan & Anand Sanmukhani

What is Kubernetes ?

What is Kubernetes ?

- Containers are a good way to bundle and run your applications.
- In a production environment, you need to manage the containers that run the applications and ensure that there is no downtime.
- For example, if a container goes down, another container needs to start.
- Wouldn't it be easier if this behavior was handled by a system?

What is Kubernetes ?

- That's how Kubernetes comes to the rescue!
- Kubernetes provides you with a framework to run distributed systems resiliently.
- It takes care of scaling and failover for your application, provides deployment patterns, and more.
- For example, Kubernetes can easily manage a canary deployment for your system.

What is a POD?

What is a POD?

- Pods are the smallest, most basic deployable objects in Kubernetes.
- Pods contain one or more containers, such as Docker containers.
- When a Pod runs multiple containers, the containers are managed as a single entity and share the Pod's resources.
- Pods also contain shared networking and storage resources for their containers:

POD Resources

POD Resources

- When you create a Pod, you normally specify the storage and networking that containers share within that Pod.
- The Kubernetes scheduler will then look for nodes that have the resources required to run the Pod.

```
- name: cpu-request-limit-container
  image: images.example/app-image
  resources:
    requests:
      cpu: "500m"
    limits:
      cpu: "1500m"
```

Problem

Problem

- Now both forms of compute resources, CPU and Memory, are specified in similar ways, and are done so in a static manner.
- A human operator will first specify what compute resources this Pod will require to operate.
- Workloads demand more resources at peak times, while remaining mostly dormant during off peak hours.
- As one might expect, this results in either waste of compute resources or reduced pod performance.

Solution

Solution

- The solution here is to move away from manually specifying the compute resources for a pod that are static, and opt for a more automated scaling solution.

- The ideal solution would identify when a Pod requires additional resources, and adjust it’s requirements accordingly during the lifetime of the Pod.

Solution

- The Vertical Pod Autoscaler (VPA) was designed to specifically do this. The VPA will automatically scale the resources for a pod based on its usage trends.

- The goal of this project is to transform Operate First OCP clusters from manually specifying compute resource requirements for pods, and to instead use the VPA instead.

- Thus having all workloads automatically scale up/down their resources on a need basis.

Scope of the project

- Configure the VPA through GitOps in OpenShift cluster
- Monitor the CPU/memory utilization during fluctuating workload through grafana dashboard

Features of the project

- POC in MOC k8s namespace
  - Install VPA through OLM
  - Decide & Deploy an application on top of the cluster
- Deploy VPA in one live openshift cluster
  - Track CPU and memory utilization using grafana dashboard.
- Deploy VPA on all compute heavy openshift clusters.

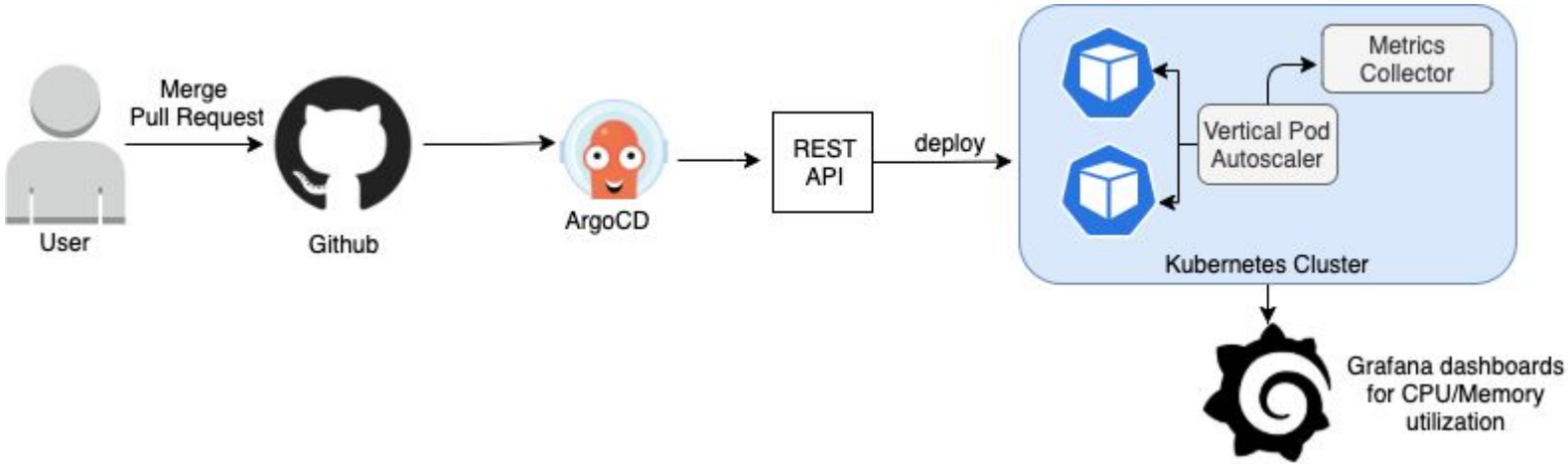
GitOps workflow

GitOps, uses Git repositories as single source of truth to deliver infrastructure as code.

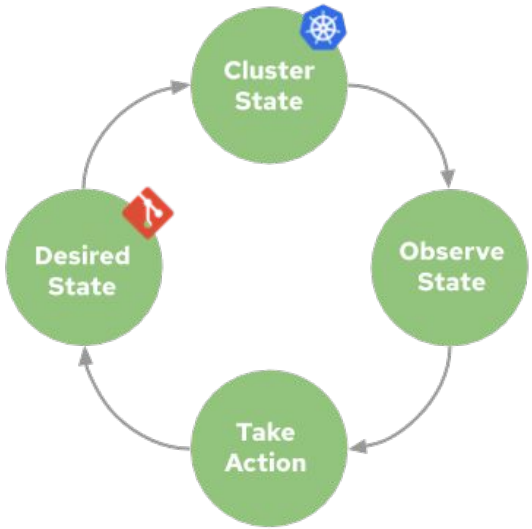
GitOps delivers:

- Improved reliability with visibility and version control through Git
- Consistency across any cluster, any cloud, and any on-prem environment
- Standard workflow for application development
- Increased security by setting application requirements up front

GitOps workflow



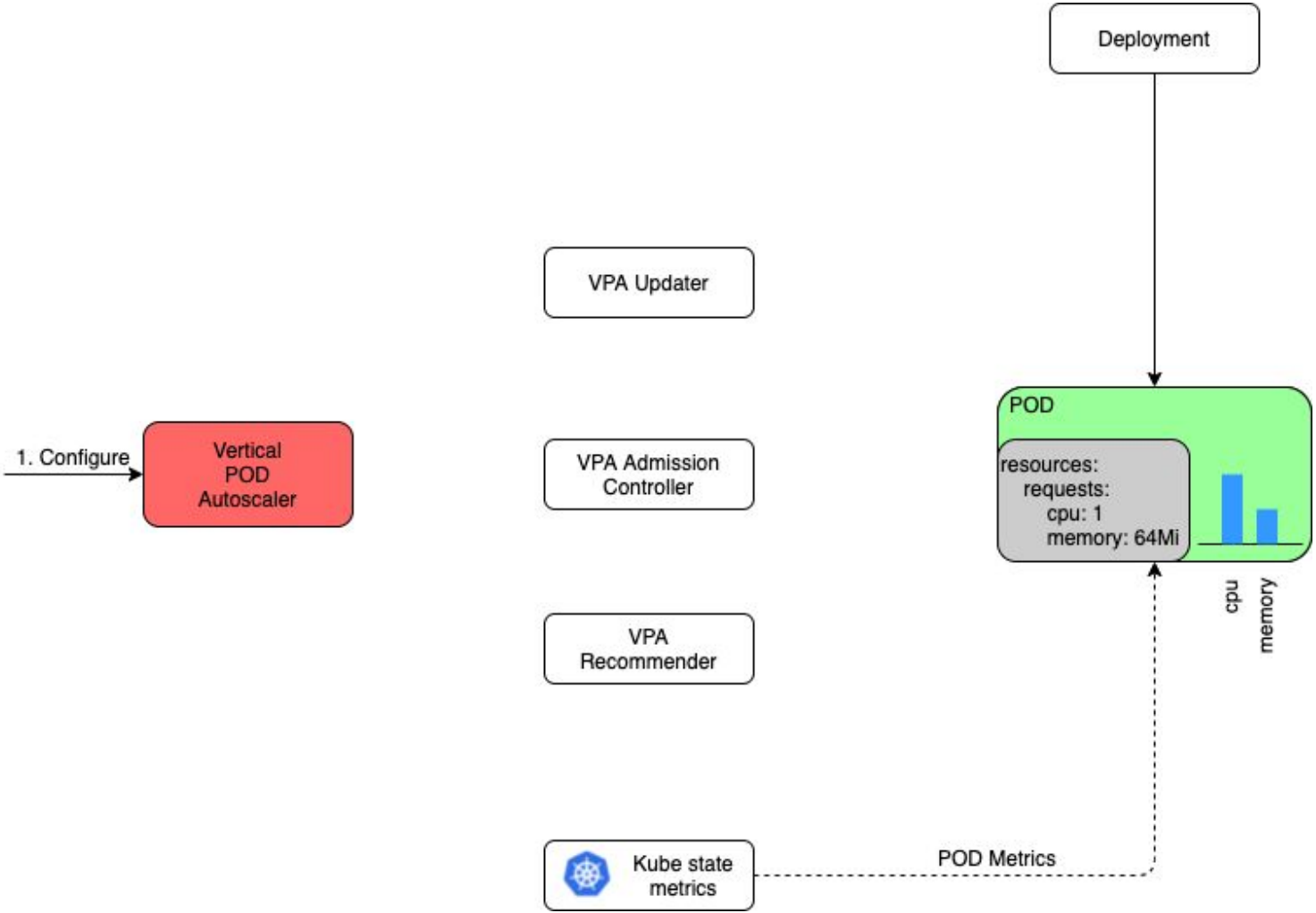
GitOps workflow

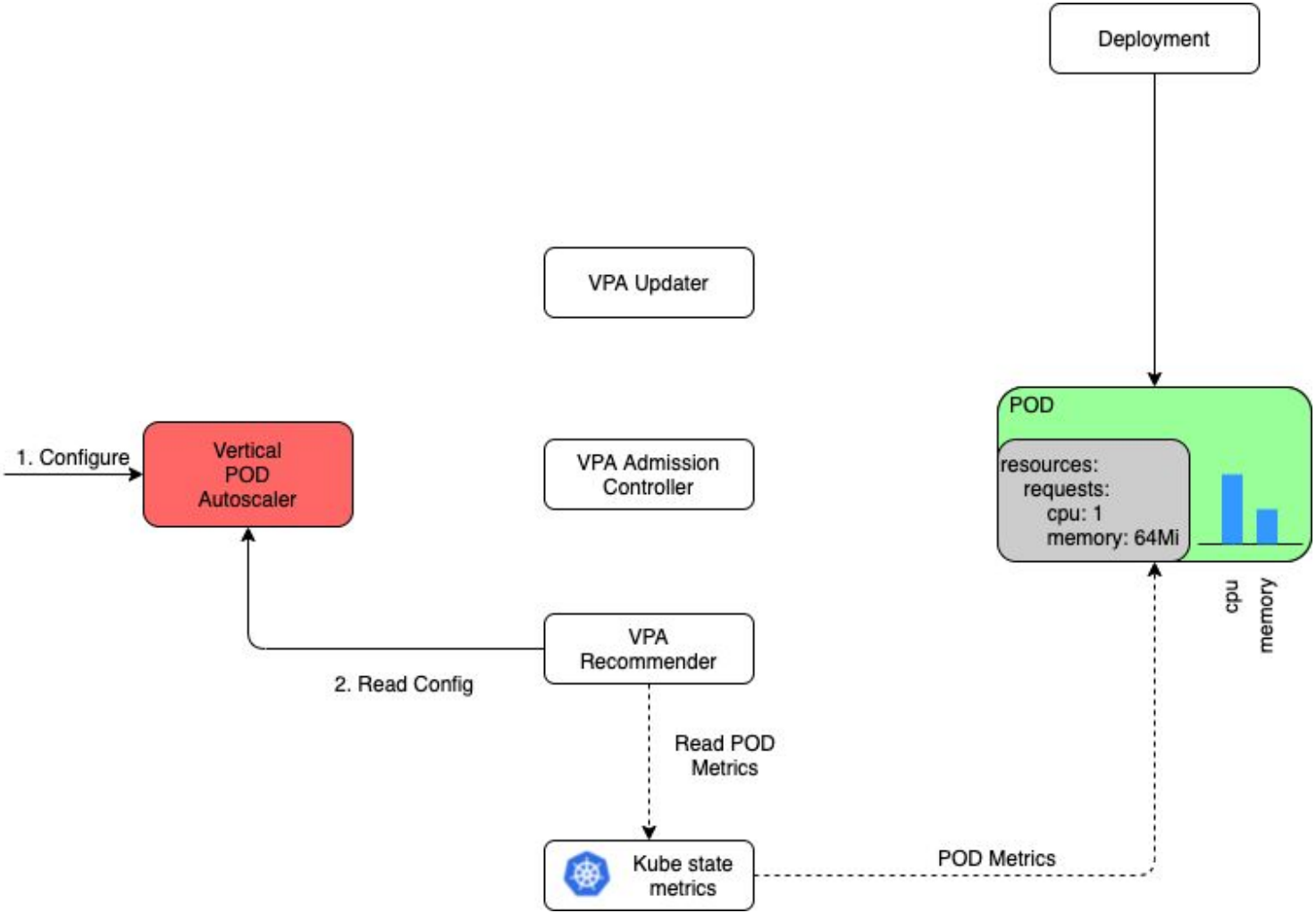


GitOps approach to Continuous Delivery on Kubernetes

(Image credits: https://cloud.redhat.com/learn/topics/gitops/)

How VPA works?


Deployment
VPA Updater
POD
1. Configure
Vertical
POD
Autoscaler
VPA Admission
Controller
resources:
requests:
cpu: 1
memory: 64Mi
cpu
memory
VPA
Recommender
Kube state
metrics
POD Metrics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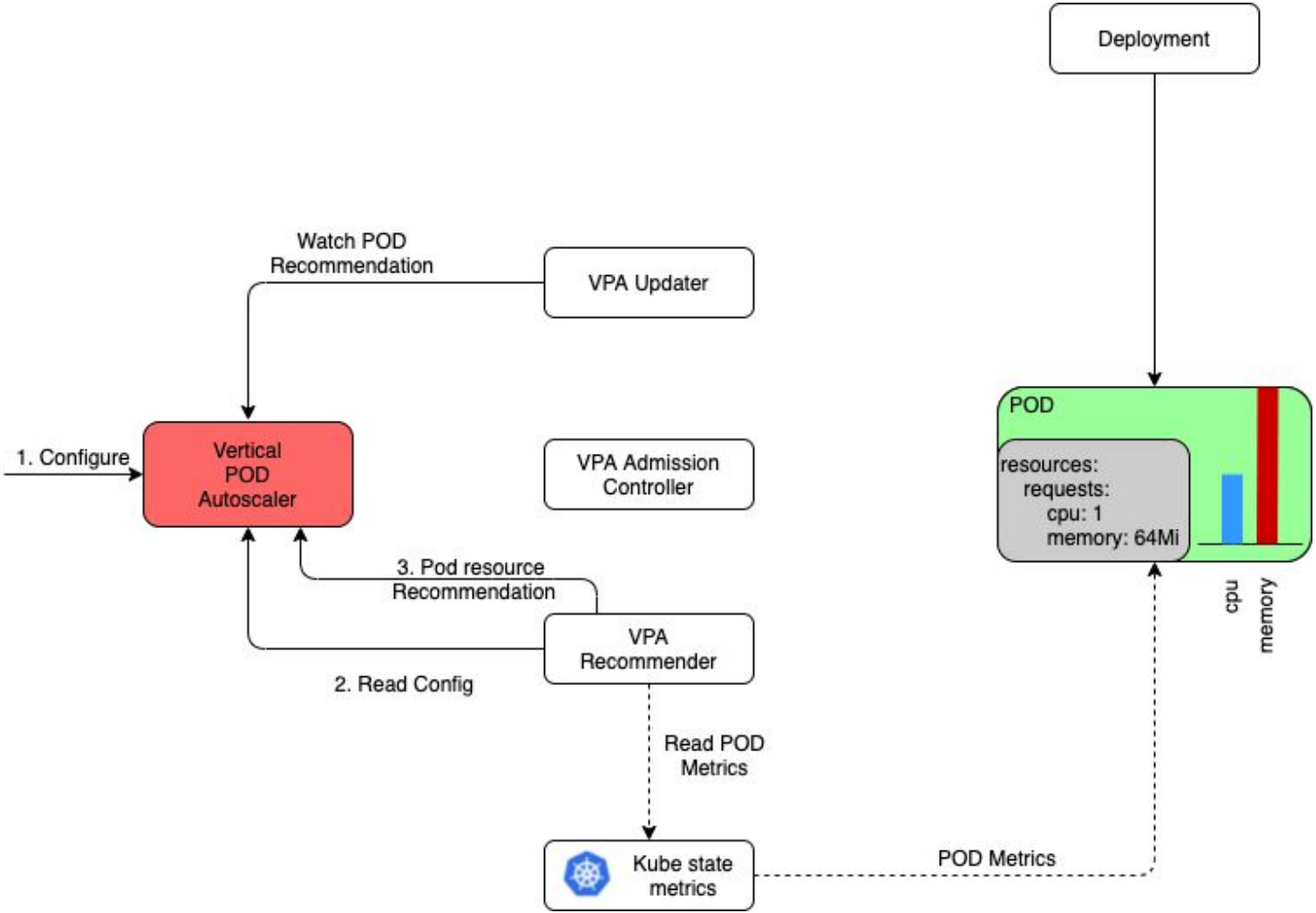
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Watch POD
Recommendation
VPA Updater
POD
resources:
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cpu
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1. Configure
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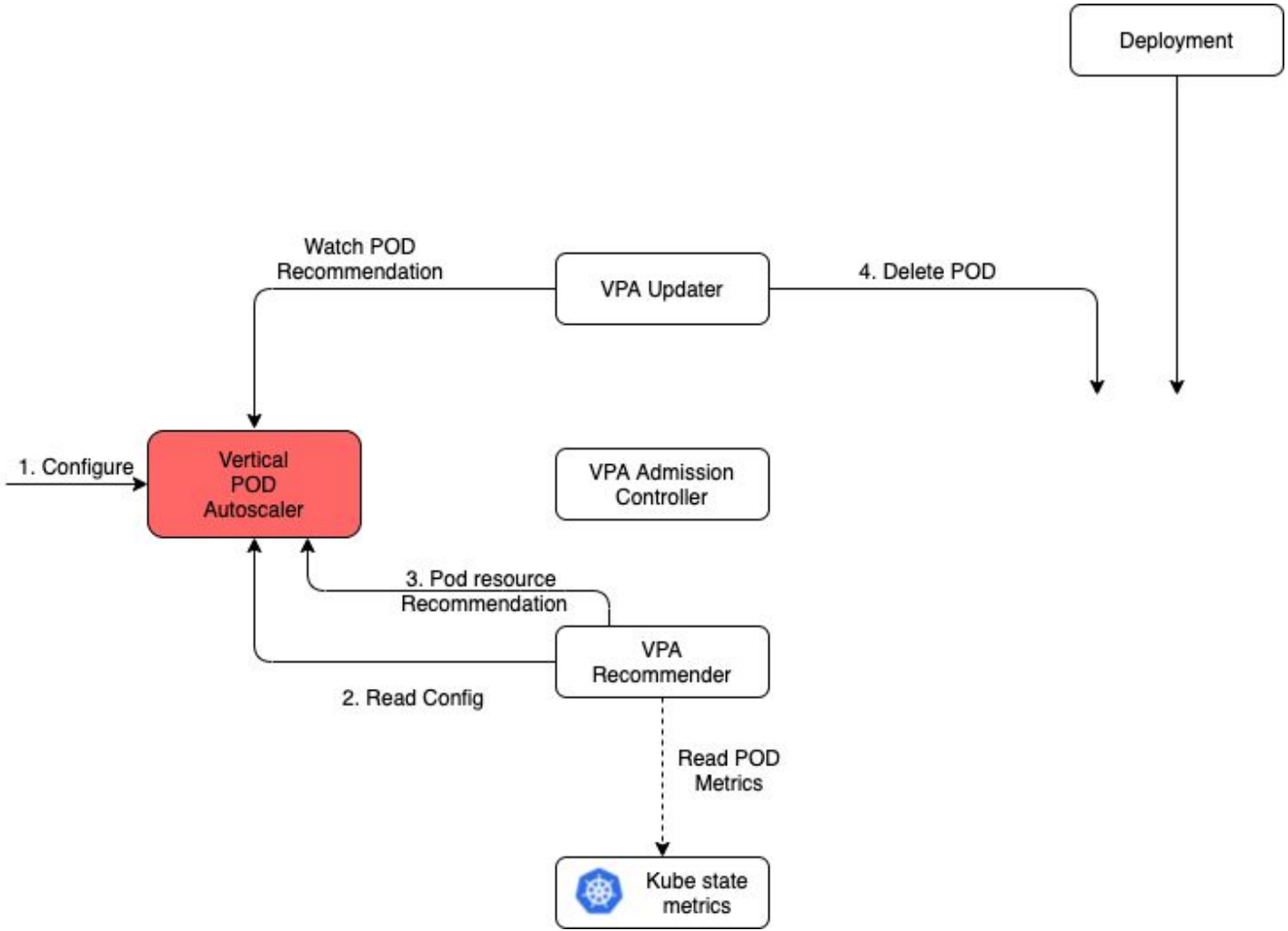
Deployment
Watch POD
Recommendation
VPA Updater
4. Delete POD
1. Configure
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Controller
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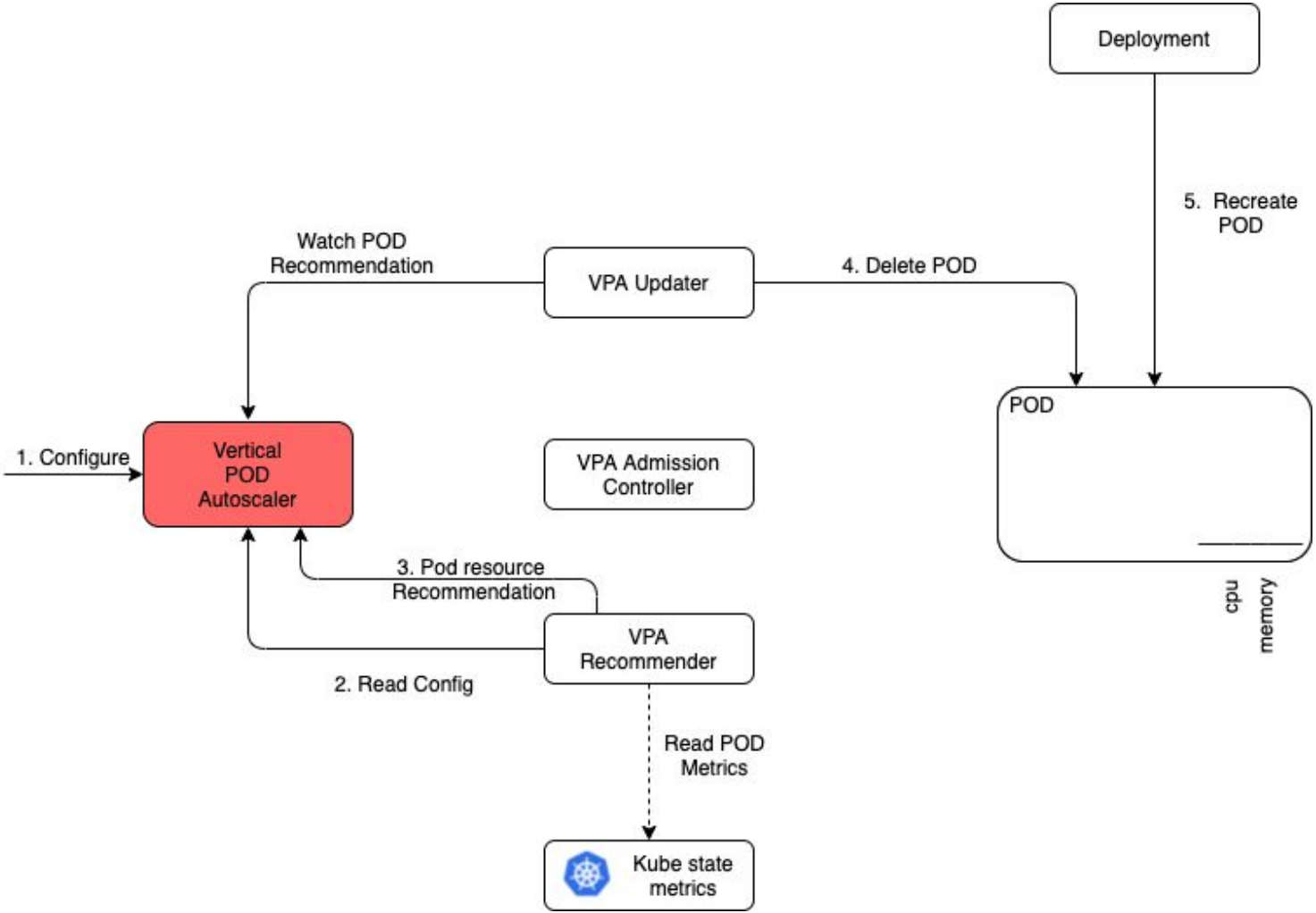
Recommendation
VPA
Recommender
2. Read Config
Read POD
Metrics
Kube state
metrics


Deployment
5. Recreate POD
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1. Configure
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2. Read Config
cpu
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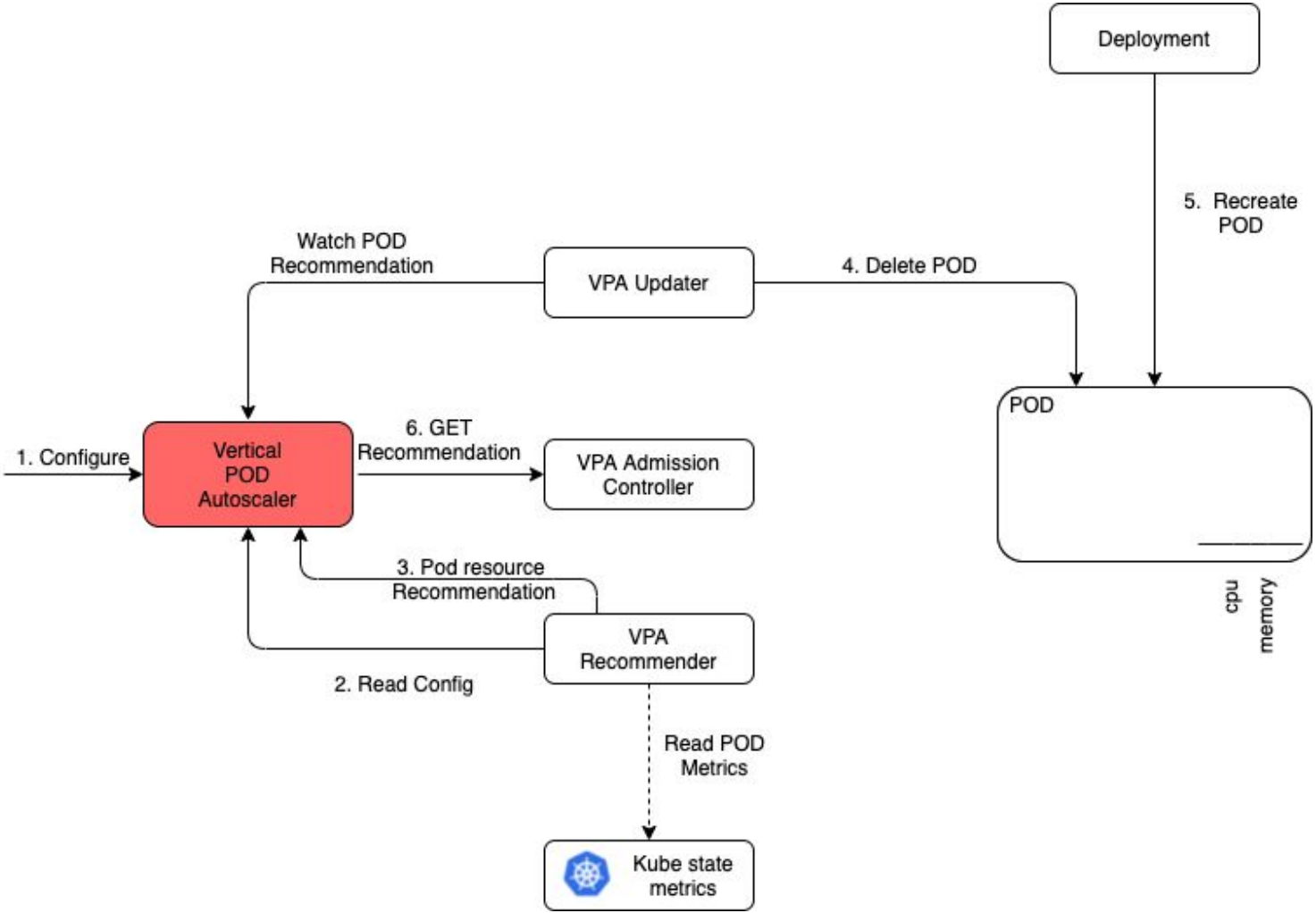
Read POD Metrics
Kube state metrics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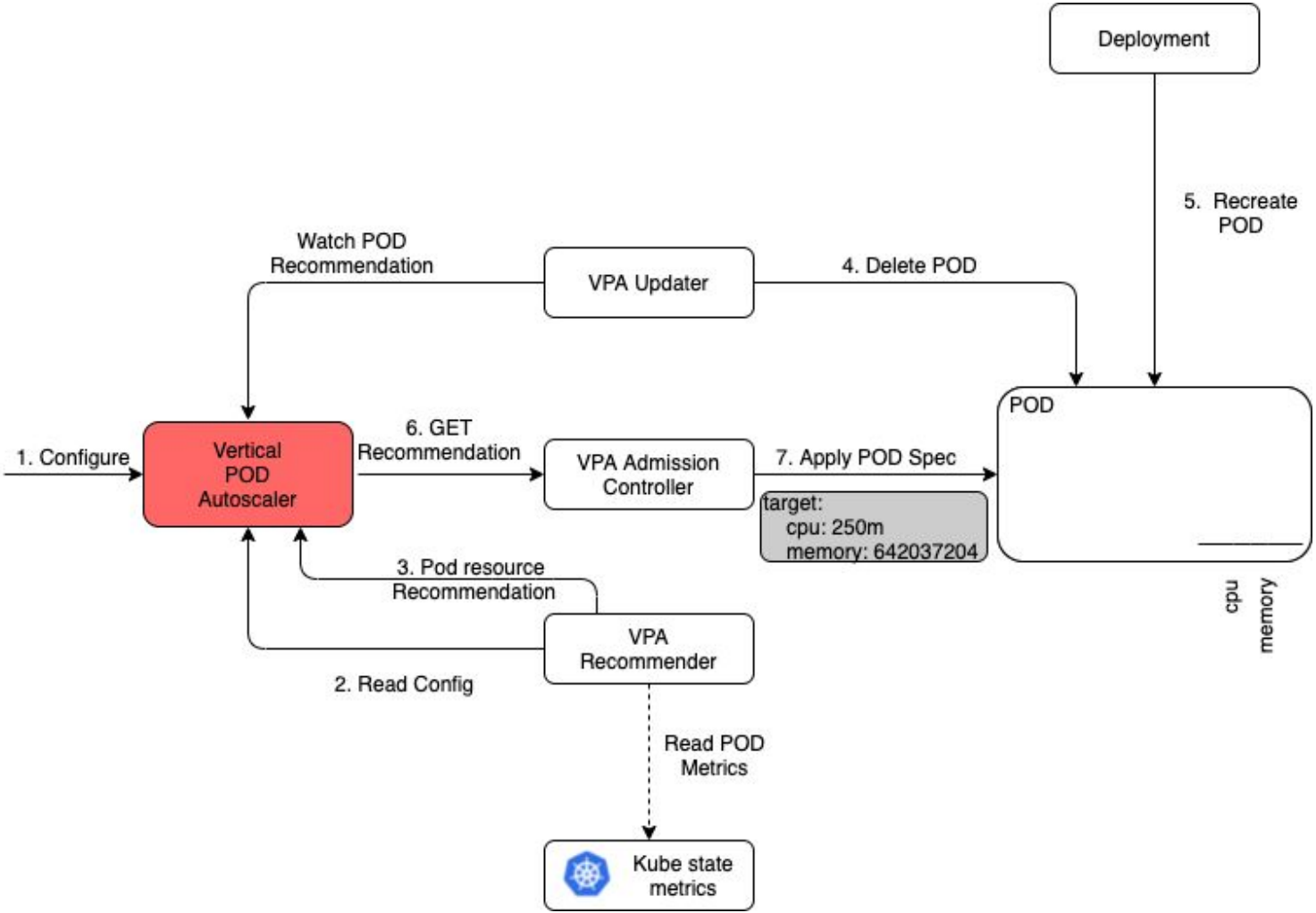
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1. Configure
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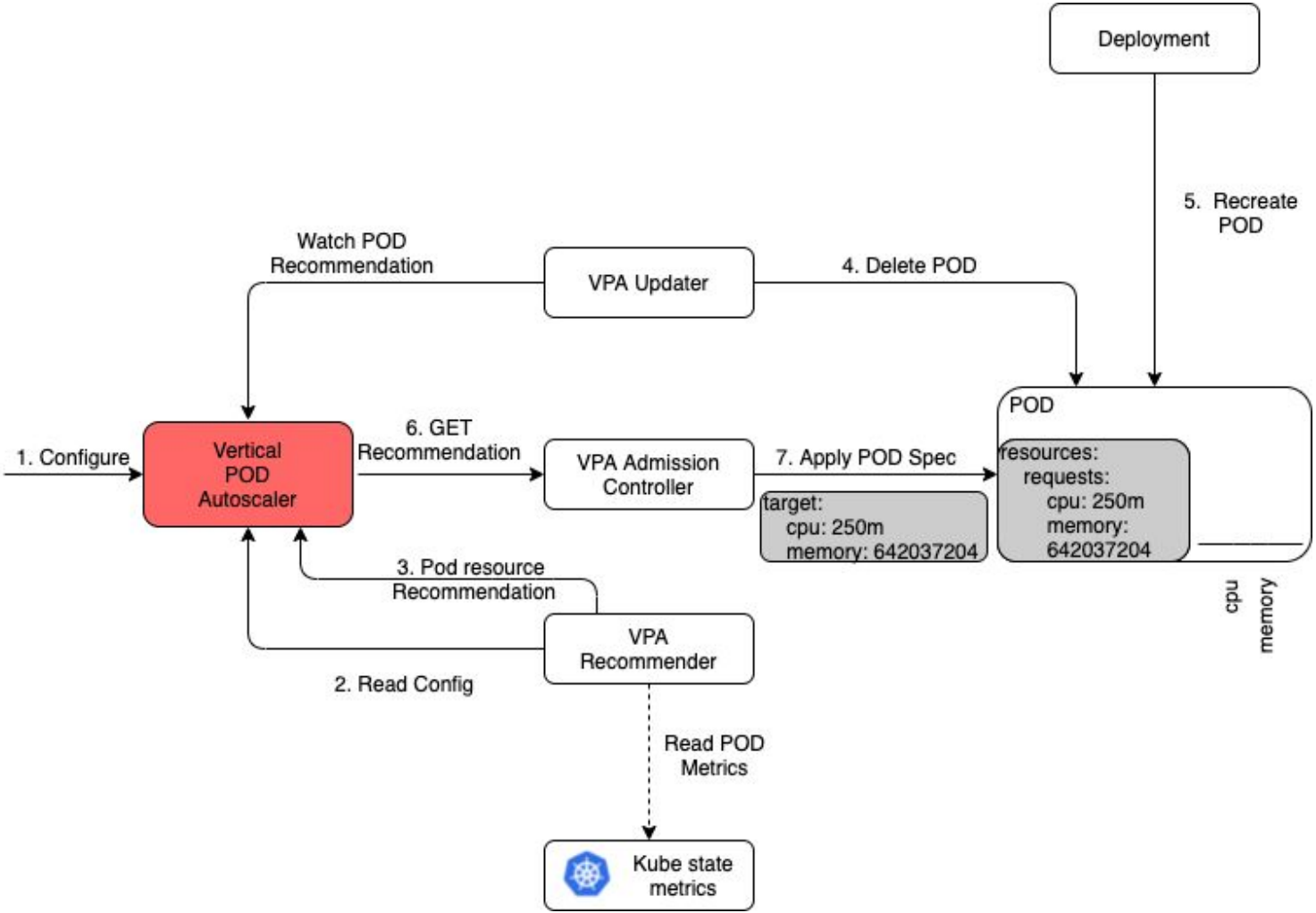
VPA Admission Controller
7. Apply POD Spec
target:
cpu: 250m
memory: 642037204
3. Pod resource Recommendation
VPA Recommender
2. Read Config
cpu
memory
Read POD Metrics
Kube state metrics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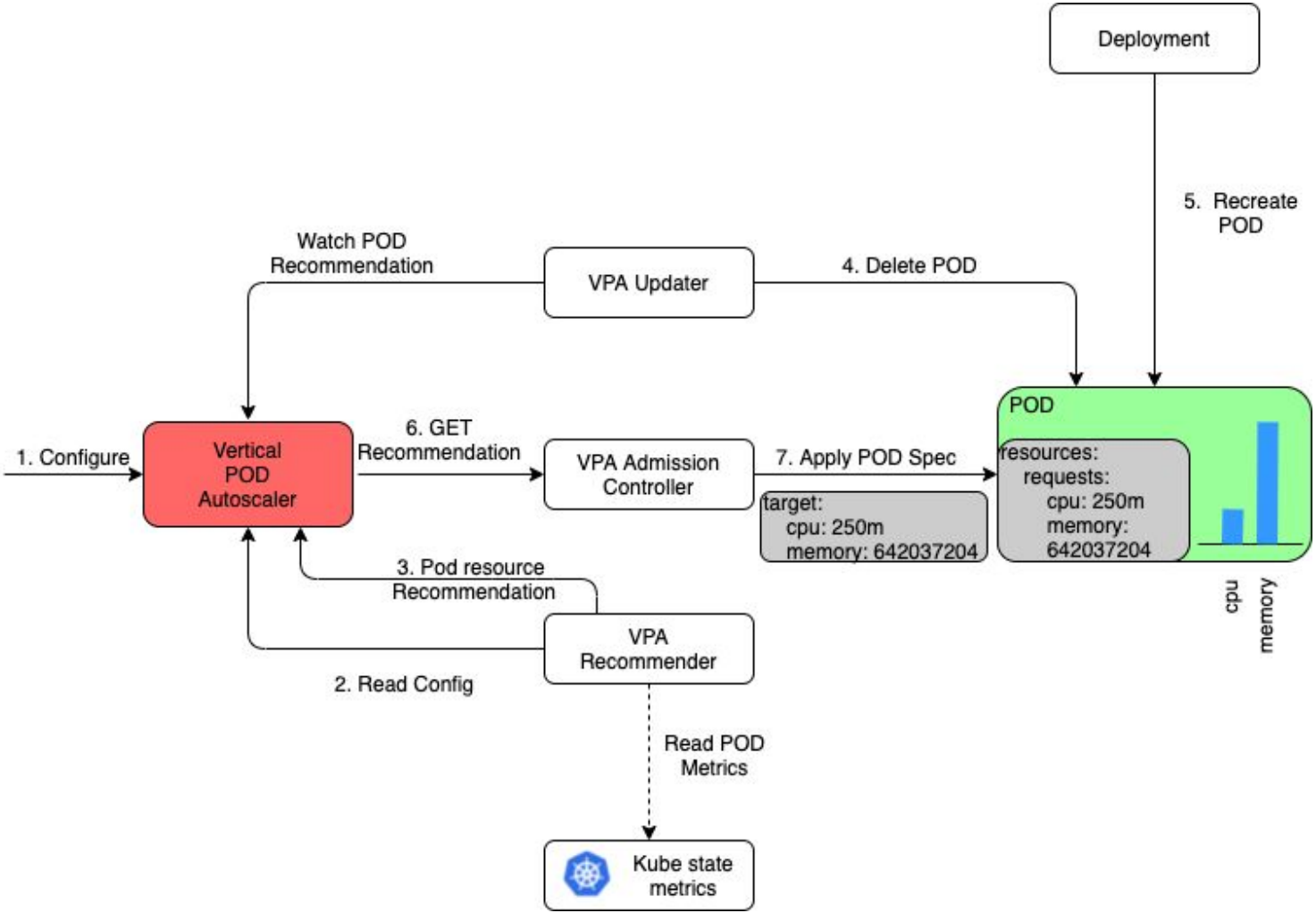
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Sprint Planning & Taiga

Taiga Setup

Modules:

- Epics
  - High level Project achievements
  - Great way to define broader value oriented goals that can be later split into proper user stories, and can be assigned to sprints.
  - Optional but Powerful.

Artifacts:

- Backlog
- User Stories
- Sprints

Sprint 1 - Sprint Amsterdam (DONE)

(13 Sep 2021 to 26 Sep 2021)

Goal:

- To gain conceptual understanding of how containers, k8s/OpenShift works.
- To finish the onboarding setup.

Tasks:

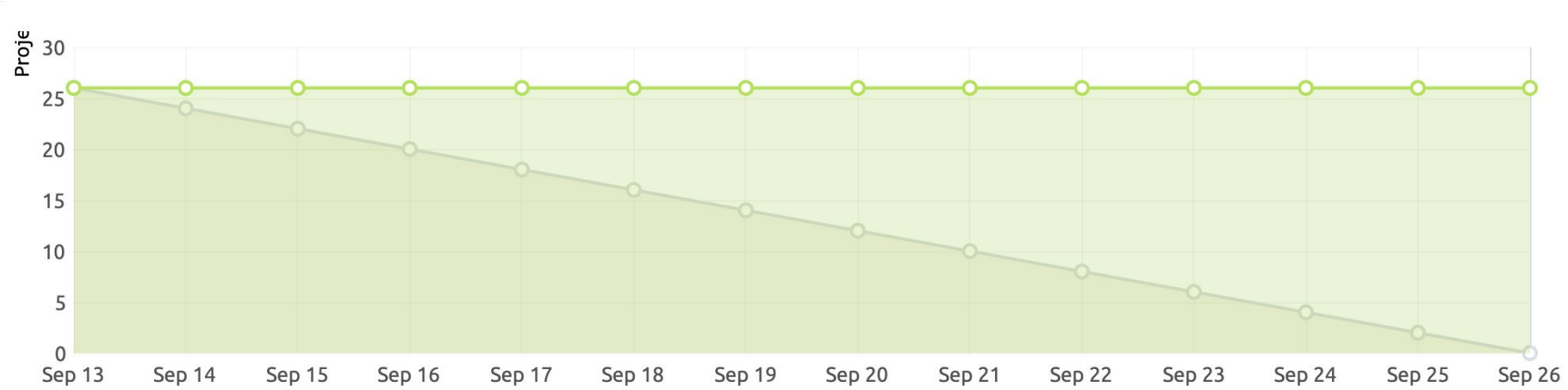
1. Revisit containers and openshift basics.
2. Write a project proposal.
3. Create a PR to access Operate First Github Repo.
4. Understand GitOps workflow.
5. Understand VPA architecture.

Outcome:

- All the team members are familiar with the fundamental concepts of containers, k8s/openshift, VPA, and GitOps.
- Successfully merged the PR and gained access to the Operate First Repo.
- Finished Project Proposal.

Sprint Amsterdam - Burndown

Dedicated 26 hours/points for this sprint.



Sprint 2 - Sprint Boston (IN PROGRESS)

(27 Sep 2021 to 11 Oct 2021)

Tasks:

1. Gain access to create an OCP cluster in MOC (In Progress).
2. SPIKE: Investigate various options to simulate fluctuating workload (New).
3. Configure and create a Deployment with a POC app with default/manual resource requests. (New).
4. Create a demo video for Sprint 1 (Ready for test).