



Kubernetes Extension Points

With Deep Dive into Custom Resource Definitions

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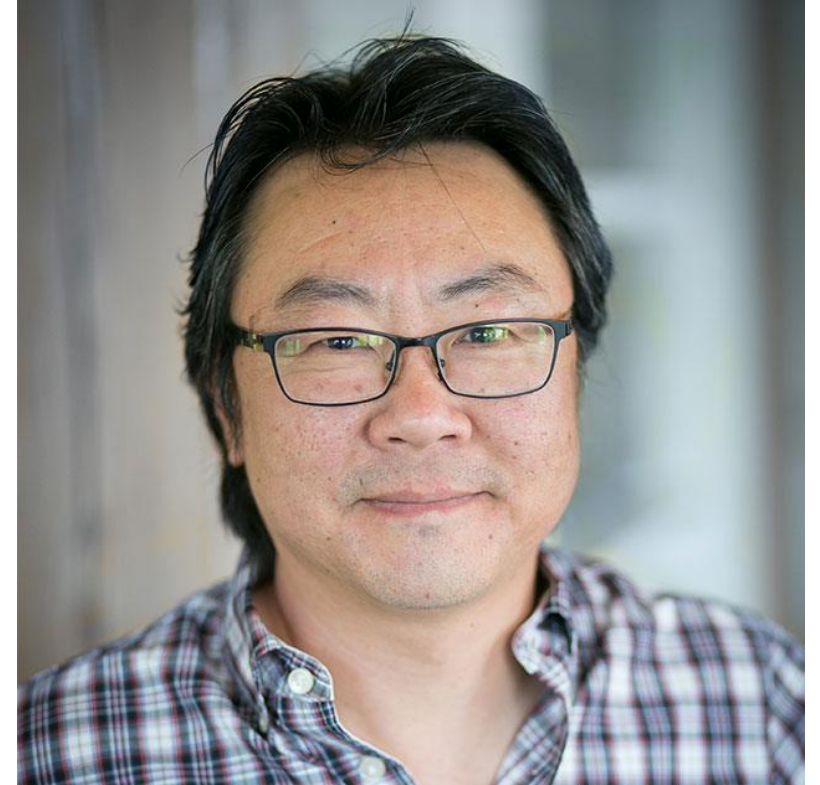
ARCHITECH

In ~~90~~ 60 minutes...

- Quick overview of Kubernetes extensions points then focus on Custom Resource Definitions (CRDs) and Custom Controllers
- Deep dive into CRDs, the basis for “Operators”
 - Use-cases from the community
 - Prometheus Operator
 - Roll your own example to get the concept
 - Using Kubebuilder
 - Using Operator SDK

<https://github.com/jungho/k8s-crds>

<https://github.com/jungho/k8s-bootcamp-ms>



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GitHub: @jungho

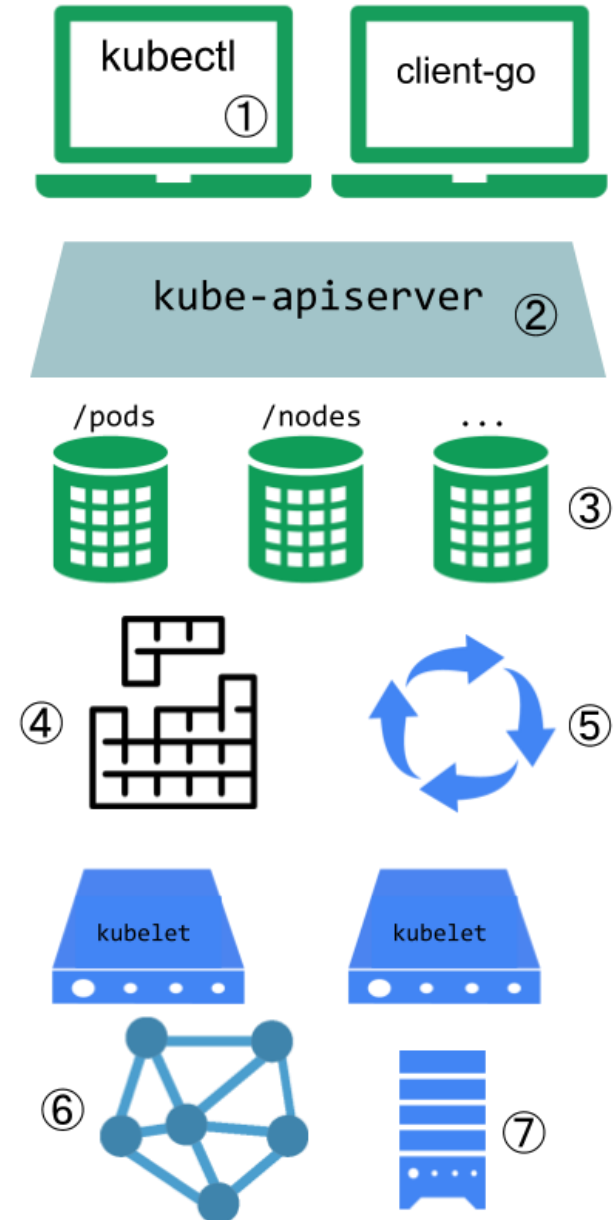
Desired Outcome

- Learn how extensible K8S can be
- Understand better the inner workings of Kubernetes
- Spark your imagination to leverage Kubernetes in more powerful ways
- Start your journey to becoming Kubernetes ninjas!



Kubernetes Extension Points

- K8S is incredibly extensible
- Designed with well-defined extension points to extend/customize the platform
 1. Plugins for kubectl to add additional kubectl commands (you can't overwrite existing commands)
 2. Authn/Authr, Webhooks, Admission Controllers, Dynamic Admission Control, API Aggregation
 3. **Custom Resource Definitions**
 4. Scheduler extensions. You can replace the default scheduler, use multiple schedulers, extend scheduler behaviours via webhooks
 5. **Controllers that reconciles current-state to desired state.**
 6. Network Plugins e.g. Container Network Interface (CNI) plugins such as Celium, Calico, Azure CNI
 7. Storage Plugins e.g. Flex Volumes



<https://bit.ly/2r6qKTp>

Custom Resource Definitions

- Means to define new API resources to model your domain
- Can leverage kubectl, helm to work with your CRDs

```
apiVersion: apiextensions.k8s.io/v1beta1
kind: CustomResourceDefinition
metadata:
  #the name must be the plural form + api group
  name: websites.extensions.example.com
spec:
  # Can be namespaced or cluster scope
  scope: Namespaced
  #All resources have a version and are part of an api group
  group: extensions.example.com
  version: v1
  # The names of the resource when using kubectl
  names:
    kind: Website
    singular: website
    plural: websites
    shortNames: ['ws']
```

```
apiVersion: extensions.example.com/v1
kind: Website
metadata:
  name: kubia
spec:
  gitRepo: https://github.com/luksa/kubia-website-example.git
```

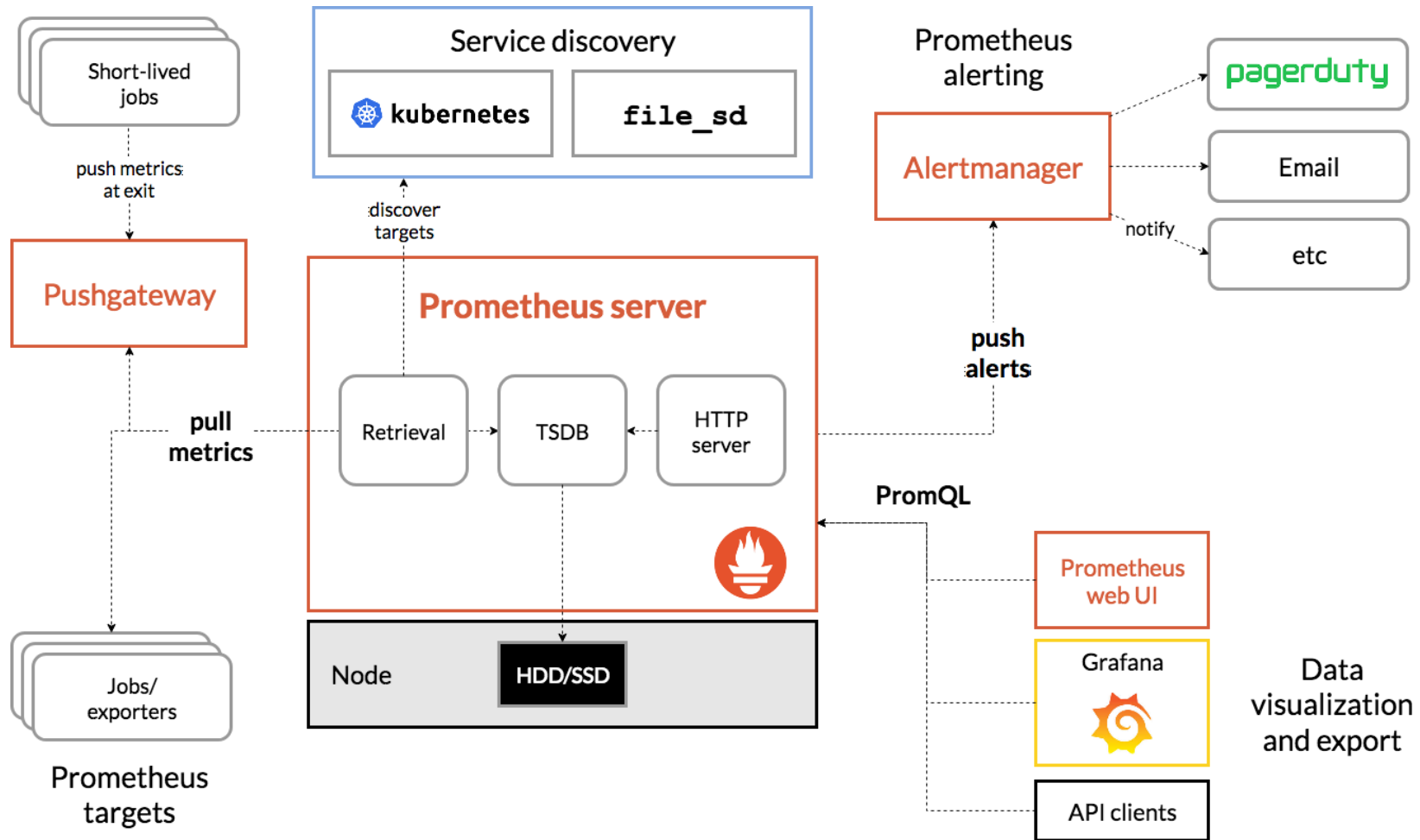
 The CRD


Instance of CRD

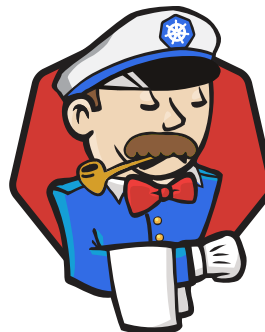
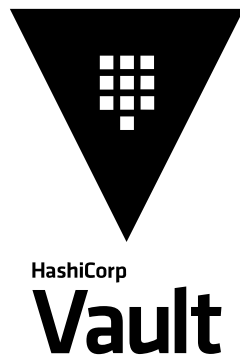
Custom Controllers

- CRDs alone don't do anything
- Something needs to consume instances of a CRD and take action, that is the **Controller**
- In simple terms, a controller is responsible for:
 - Watching for specific resource types e.g. Website
 - Reconciling the desired state, and doing so continuously (this is what makes K8S so resilient!!)

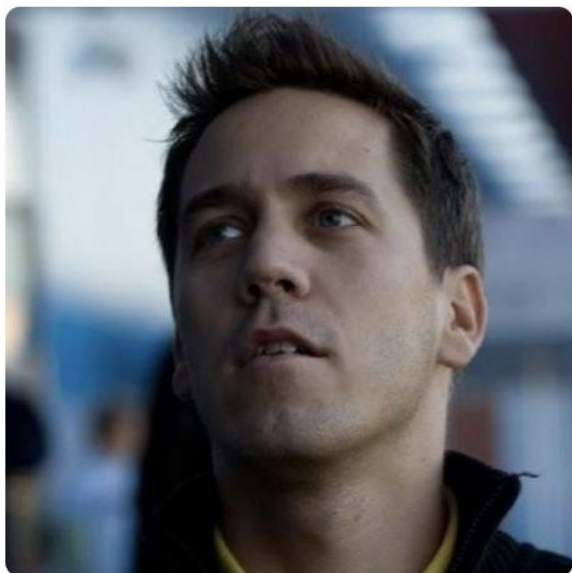
Prometheus



Operators



First CRD Example.... Thank You Lukša!



Marko Lukša

luksa

Software engineer at Red Hat.
Author of Kubernetes in Action.

Overview

Repositories 105

Stars 36

Fol

Popular repositories

[kubernetes-in-action](#)

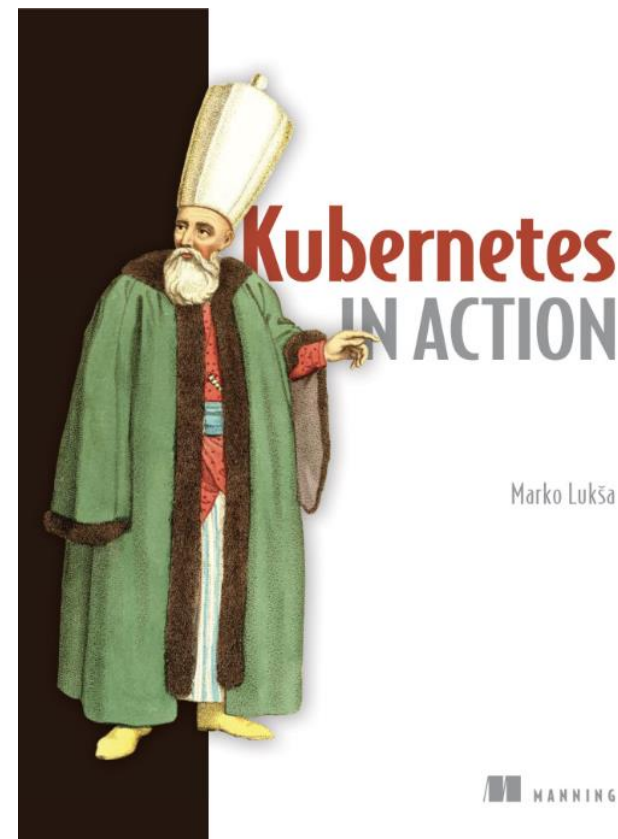
Code from the Kubernetes in Action book

JavaScript ★ 146 🔗 106

[k8s-website-controller](#)

A barely working example of a Kubernetes controller

Go ★ 11 🔗 2



<https://github.com/luksa/k8s-website-controller>

Kubebuilder

- Part of the apimachinery SIG (Special Interest Group)
 - <https://github.com/kubernetes-sigs>
- GA version v1.0.5, so stable
- Excellent documentation at <https://book.kubebuilder.io/>
- Provides scaffolding to quickly get started including:
 - Generate CRD, CRD instance, webhooks
 - Golang code for Controller, Manager, CRD Types, Reconciler, tests
 - Deployment manifests
 - RBAC manifests
 - Makefile to build, test, deploy your CRD and custom controller
 - Annotations to generate CRDs OpenAPI v3 schema validation to generate RBAC Roles



Kubebuilder Workflow

#Must run within \$GOPATH

```
kubebuilder init --domain architech.ca --owner "Jungho Kim"
```

#You will be asked the following, answer 'y'.

```
Run `dep ensure` to fetch dependencies (Recommended) [y/n]?
```

#Now create a new API resource and Controller

#answer 'y' to both Resource and Controller

```
kubebuilder create api --group example --version v1beta1 --kind Website
```

Kubebuilder Workflow

#Modify the generated yaml and go lang code then to run locally

make test

make install

make run

kubectl create -f config/samples **#Deploy our CRD instance**

#To deploy the controller to K8S

export IMG=architechbootcamp/website-kubebuilder-controller:1.0.0

Make docker-build

Make docker-deploy

kubectl create -f config/samples

Operator SDK

- Created by the CoreOS team that coined "Operator"
- Still "alpha" but used for many published operators
- Supports both go and Ansible implementations
- Leverages controller-runtime package which is a sub-project of kubebuilder
- Excellent documentation here <https://bit.ly/2U8RXct>
- Provides scaffolding to quickly get started including:
 - Generate CRD, CRD instance
 - Go code for Controller, Manager, CRD Types, Reconciler
 - Deployment manifests
 - RBAC manifests
- Does not provide a nice Makefile to help with workflow so you need to write some scripts



Operator SDK Workflow

#Create new project, will generate website-operator-sdk directory

```
operator-sdk new website-operator-sdk --skip-git-init
```

#Create API, will generate types and deployment yaml files

```
operator-sdk add api
  --api-version=example.architech.ca/v1beta1
  --kind=Website
```

#Add a controller

```
operator-sdk add controller
  --api-version=example.architech.ca/v1beta1
  --kind=Website
```

Operator SDK Workflow

#Modify the generated go code and yaml files.

#Execute within the website-operator-sdk directory

```
operator-sdk build $image
```

#Create API, will generate types and deployment yaml files

```
kubectl create -f ./deploy/crds/example_v1beta1_website_crd.yaml
```

#To run the controller locally

```
export OPERATOR_NAME="$operatorName"
```

```
operator-sdk up local --namespace "$default"
```

Which One?

- Kubebuilder for workflow and general stability
- It also supports creating custom Webhooks and Admission Controllers
- Operator-SDK if you want to implement your Controllers using Ansible
- If you cannot use Golang, then there is also MetaController which allows you to use the programming language of your choice. <https://metacontroller.app/>

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“ We’re trying to become an organization that’s constantly rethinking the problems we’re solving in the market today and looking to bring new value to clients in ways that they haven’t thought of yet. Architech is instrumental to us throughout this journey.

Hugh Cumming, Chief Technology Officer, Finastra (\$2B+ fintech)

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