Kubernetes Extension Points

With Deep Dive into Custom Resource Definitions

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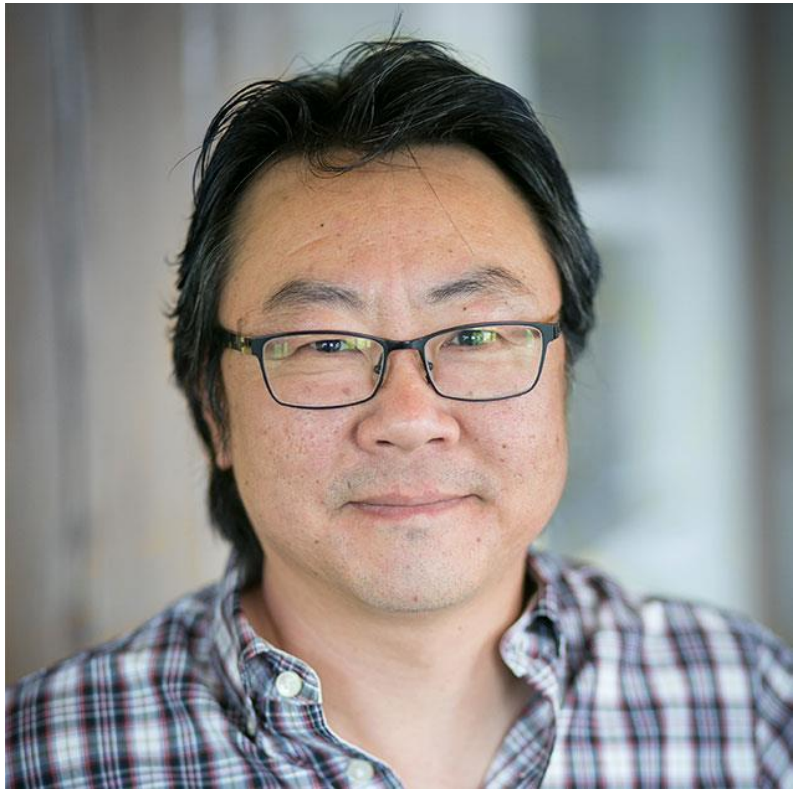
ARCHITECH

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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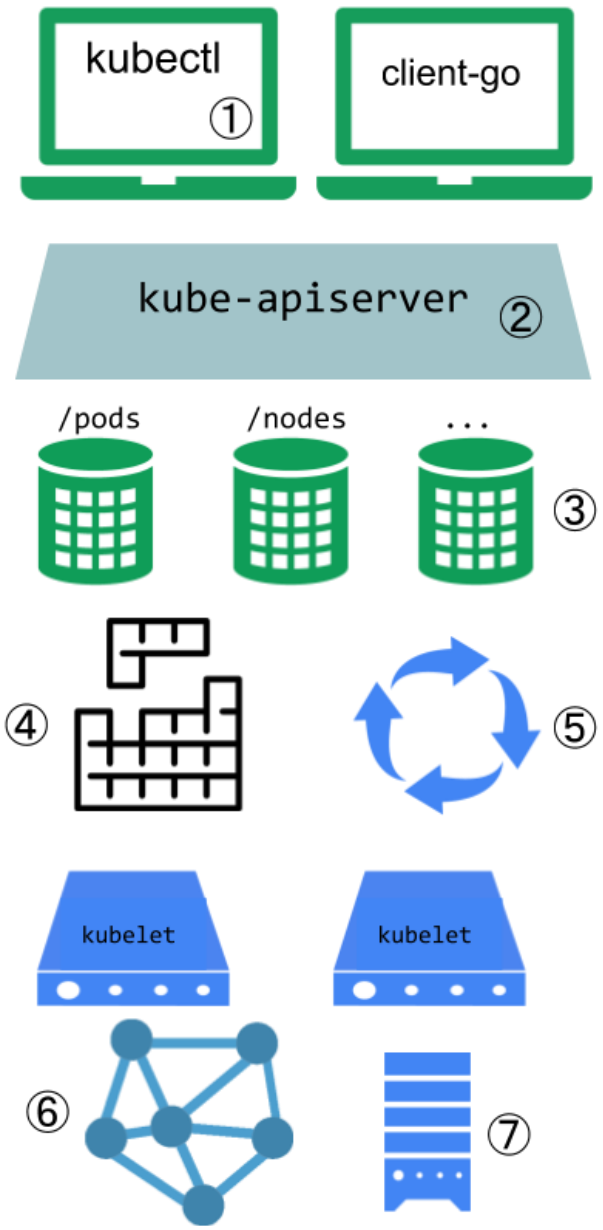
Desired Outcome

- 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

```yaml
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']
```

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

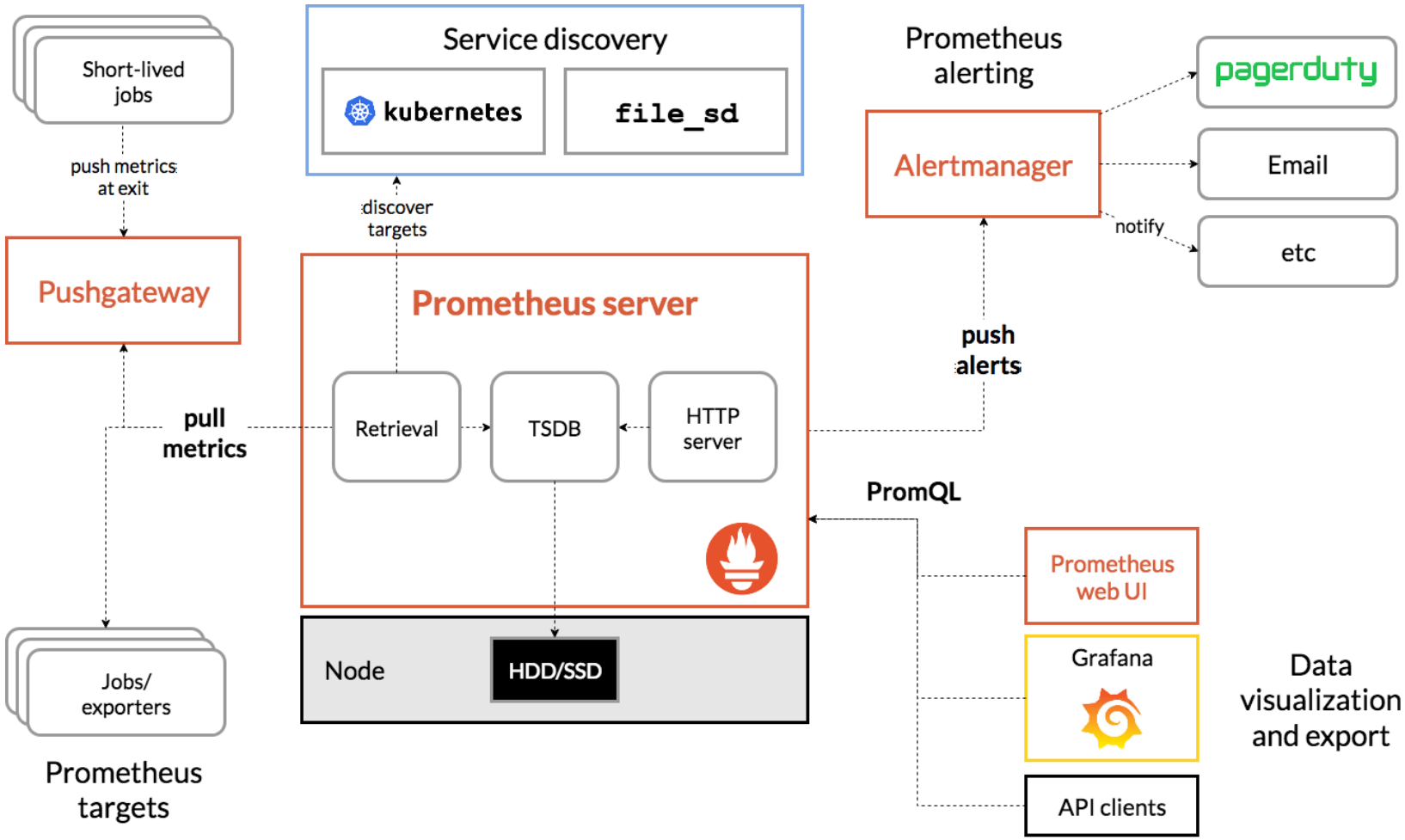
Instance of CRD

The CRD

Custom Controllers

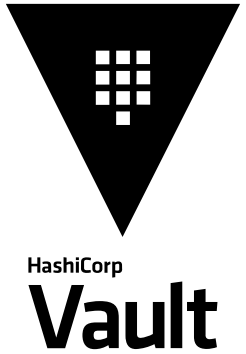
- CRDs alone don’t do anything
- Something needs to consume instances of a CRD and take action, that is the **Controller**
- In simple terms, a controller is responsible for:
  - Watching for specific resource types e.g. Website
  - Reconciling the desired state, and doing so continuously (this is what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

Prometheus



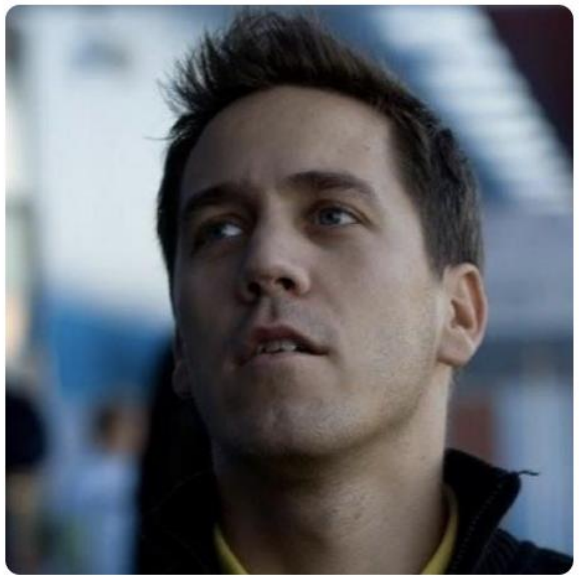
https://prometheus.io/docs/introduction/overview/

Operators



https://github.com/operator-framework/awesome-operators

First CRD Example…. Thank You Lukša!



Marko Lukša
luksa

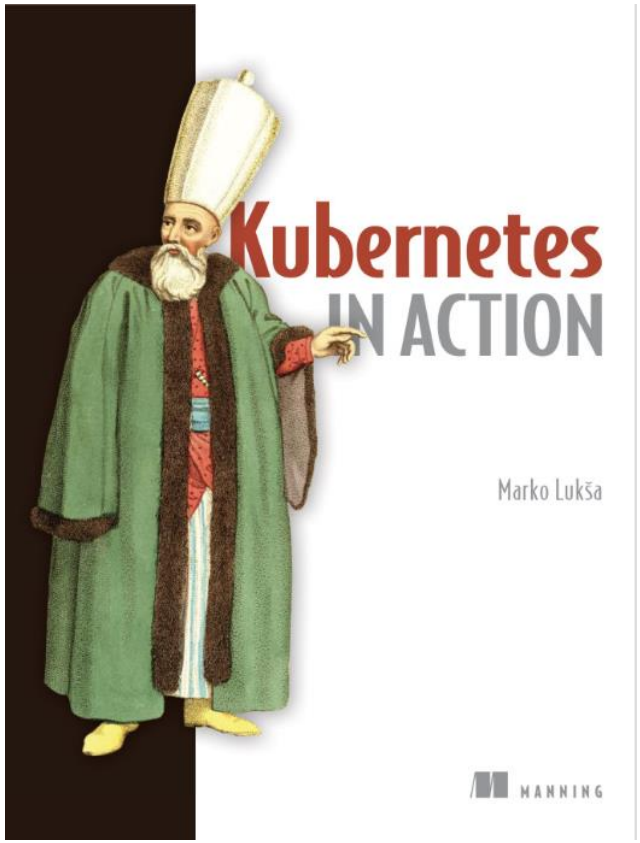
Software engineer at Red Hat.
Author of Kubernetes in Action.

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 golang 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 golang 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
  - Golang 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

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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