

Building container images on your cluster with Knative Build

Gareth Rushgrove





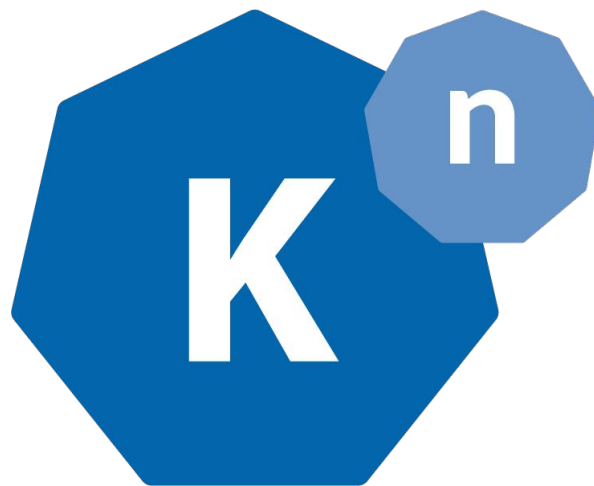
@garethr

Docker

This talk

What will we cover in this session

- Why build on your cluster?
- The power of Custom Resources
- Knative Build
- Higher-level interfaces
- The future



Why build on your cluster?



CI systems are production too

A compromise of your build infrastructure is **BAD**



Why maintain separate build machines?

Less variation makes for lower operations overhead



Build is a scheduling problem

And Kubernetes is a pretty handy scheduler



The power of Custom Resources



Concepts

Concepts

- ▶ Overview
- ▶ Kubernetes Architecture
- ▶ Containers
- ▶ Workloads
- ▶ Services, Load Balancing, and Networking
- ▶ Storage
- ▶ Configuration
- ▶ Policies
- ▶ Cluster Administration
- ▼ Extending Kubernetes
 - Extending your Kubernetes Cluster
 - ▼ Extending the Kubernetes API
 - Extending the Kubernetes API with the aggregation layer
 - Custom Resources**
 - ▶ Compute, Storage, and Networking Extensions
 - Service Catalog

Custom Resources



This page explains *custom resources*, which are extensions of the Kubernetes API, including when to add a custom resource to your Kubernetes cluster and when to use a standalone service. It describes the two methods for adding custom resources and how to choose between them.

- [Custom resources](#)
- [Adding custom resources](#)
- [CustomResourceDefinitions](#)
- [API server aggregation](#)
- [Preparing to install a custom resource](#)
- [Accessing a custom resource](#)
- [What's next](#)

Custom resources

A *resource* is an endpoint in the [Kubernetes API](#) that stores a collection of [API objects](#) of a certain kind. For example, the built-in *Pods* resource contains a collection of Pod objects.

A *custom resource* is an extension of the Kubernetes API that is not necessarily available on every Kubernetes cluster. In other words, it represents a customization of a particular Kubernetes installation.

Custom resources can appear and disappear in a running cluster through dynamic registration, and cluster admins can update

The importance of extensions

Solving specific problems as well as general ones

- Features that not everyone needs can still run on Kubernetes
- Not everything needs to be in the core API
- Adoption of extensions will help Kubernetes stand the test of time



Knative Build



Knative Build is a CRD which adds primitives to Kubernetes for modelling the software build process



Code

Issues 51

Pull requests 7

ZenHub

Projects 1

Insights

A Kubernetes-native Build resource.

containers

kubernetes

build

289 commits

5 branches

4 releases

39 contributors

Apache-2.0

Branch: master

New pull request

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mattmoor-sockpuppet and knative-prow-robot Format markdown (#496) ...

Latest commit 3a8c1cc 2 days ago

| | | |
|----------------------------------|---|--------------|
| .github | Format markdown (#486) | 6 days ago |
| cmd | Remove builder interface, linearize pod creation and watching (#464) | 13 days ago |
| config | Tweak the columns to show the Succeeded condition, reason, start, and... | 2 months ago |
| hack | Format markdown (#492) | 4 days ago |
| images | Revert "Use gcr.io/distroless/base for the build-base image (#425)" (#... | 2 months ago |
| pkg | Support users to specify custom pod annotations (#482) | 9 days ago |
| test | Format markdown (#490) | 5 days ago |
| third_party | update deps and link git head file to kodata (#465) | a month ago |
| vendor | Update test-infra to include latest features of release.sh (#491) | 4 days ago |
| .gitattributes | Exclude /test and /vendor from code coverage (#455) | a month ago |
| .gitignore | Remove builder interface, linearize pod creation and watching (#464) | 13 days ago |
| .ko.yaml | Publish nightly knative/build releases to knative-nightly (#479) | 11 days ago |
| .ko.yaml.release | Publish nightly knative/build releases to knative-nightly (#479) | 11 days ago |
| AUTHORS | add Red Hat to Authors (#255) | 5 months ago |
| CONTRIBUTING.md | Format markdown (#486) | 6 days ago |
| DEVELOPMENT.md | Format markdown (#496) | 2 days ago |



Installing Knative Build

```
$ kubectl apply -f https://storage.googleapis.com/knative-releases/build/latest/release.yaml
namespace "knative-build" created
clusterrole.rbac.authorization.k8s.io "knative-build-admin" created
serviceaccount "build-controller" created
clusterrolebinding.rbac.authorization.k8s.io "build-controller-admin" created
customresourcedefinition.apiextensions.k8s.io "builds.build.knative.dev" created
customresourcedefinition.apiextensions.k8s.io "buildtemplates.build.knative.dev" created
customresourcedefinition.apiextensions.k8s.io "clusterbuildtemplates.build.knative.dev" created
customresourcedefinition.apiextensions.k8s.io "images.caching.internal.knative.dev" created
service "build-controller" created
service "build-webhook" created
configmap "config-logging" created
deployment.apps "build-controller" created
deployment.apps "build-webhook" created
```

What did we just install?

```
$ kubectl get pods --namespace knative-build
```

| NAME | READY | STATUS | RESTARTS | AGE |
|---------------------------------------|-------|---------|----------|-----|
| pod/build-controller-5bf486fb95-dm446 | 1/1 | Running | 0 | 2m |
| pod/build-webhook-7b8f64b77c-k7k5j | 1/1 | Running | 0 | 2m |

| NAME | TYPE | CLUSTER-IP | EXTERNAL-IP | PORT(S) | AGE |
|--------------------------|-----------|---------------|-------------|----------|-----|
| service/build-controller | ClusterIP | 10.96.253.190 | <none> | 9090/TCP | 2m |
| service/build-webhook | ClusterIP | 10.105.50.131 | <none> | 443/TCP | 2m |

| NAME | DESIRED | CURRENT | UP-TO-DATE | AVAILABLE | AGE |
|----------------------------------|---------|---------|------------|-----------|-----|
| deployment.apps/build-controller | 1 | 1 | 1 | 1 | 2m |
| deployment.apps/build-webhook | 1 | 1 | 1 | 1 | 2m |

| NAME | DESIRED | CURRENT | READY | AGE |
|---|---------|---------|-------|-----|
| replicaset.apps/build-controller-5bf486fb95 | 1 | 1 | 1 | 2m |
| replicaset.apps/build-webhook-7b8f64b77c | 1 | 1 | 1 | 2m |

What makes up Knative Build

What are the new API primitives?

- A `Build` can include multiple steps where each step specifies a `Builder`.
- A `Builder` is a type of container image that you create to accomplish any task, whether that's a single step in a process, or the whole process itself.
- A `BuildTemplate` can be used to defined reusable templates.
- Authenticate with `ServiceAccount` using Kubernetes Secrets.



Warning

Knative Build is for tool builders

Hello Build

```
apiVersion: build.knative.dev/v1alpha1
kind: Build
metadata:
  name: date
spec:
  steps:
  - name: date
    image: debian:stable-slim
    args: ['/bin/date']
```

Thanks @sebgoa

Running the build

```
$ kubectl apply -f date.yaml  
build.build.knative.dev "date" created
```

```
$ kubectl get build  
NAME      AGE  
date      9s
```

```
$ kubectl get pods  
NAME                                READY   STATUS    RESTARTS   AGE  
date-pod-c9b010                     0/1     Init:1/2   0           41s
```

```
$ kubectl logs date-pod-c9b010  
Build successful
```

<> Code

🔔 Issues 15

🔗 Pull requests 8

Z ZenHub

📁 Projects 0

📊 Insights

A library of build templates.

kubernetes

build

template

containers

📄 47 commits

🌿 8 branches

📦 0 releases

👤 13 contributors

📄 Apache-2.0

Branch: master


















New pull request

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| | |
|--|---|
|  adrcunha and knative-prow-robot Update the vendored test-infra dir (#80) ... | Latest commit 1cab6fa 9 days ago |
|  bazel | Use revision instead of branch (#31) 5 months ago |
|  buildah | Fix buildah build-template (#73) 2 months ago |
|  buildkit | add BuildKit build template (#70) 2 months ago |
|  buildpack | Update buildpack.yaml (#53) 4 months ago |
|  ecr_helper | add Amazon ECR helper (#72) a month ago |
|  gcr_helper | Use openssl base64 for gcr_helper (#40) 5 months ago |
|  hack | Update the vendored test-infra dir (#80) 9 days ago |
|  jib | Adds CACHE to Jib templates to make builds run faster. (#64) 3 months ago |
|  kaniko | Use revision instead of branch (#31) 5 months ago |
|  test | Vendor the test-infra scripts (#52) 4 months ago |
|  vendor/github.com/knative/test-infra | Update the vendored test-infra dir (#80) 9 days ago |
|  CONTRIBUTING.md | readme cleanup before opening repo (#35) 5 months ago |
|  Gopkg.lock | Update the vendored test-infra dir (#80) 9 days ago |
|  Gopkg.toml | Update the vendored test-infra dir (#80) 9 days ago |
|  LICENSE | Initial commit 8 months ago |
|  OWNERS | Add OWNERS (#2) 7 months ago |



Existing build templates

Mainly generic build tool templates, but lots of potential

- Bazel
- Buildah
- Buildkit
- Buildpacks
- Jib
- Kaniko

Imagine higher-level templates for...



Installing build templates

```
$ kubectl apply -f  
https://raw.githubusercontent.com/knative/build-templates/master/kaniko/kaniko.yaml  
buildtemplate.build.knative.dev "kaniko" created
```

```
$ kubectl get buildtemplates  
NAME      AGE  
kaniko    2m
```

Parameters

```
apiVersion: build.knative.dev/v1alpha1
kind: BuildTemplate
metadata:
  name: kaniko
spec:
  parameters:
    - name: IMAGE
      description: The name of the image to push
    - name: DOCKERFILE
      description: Path to the Dockerfile to build.
      default: /workspace/Dockerfile
  steps:
    - name: build-and-push
      image: gcr.io/kaniko-project/executor
      args:
        - --dockerfile=${DOCKERFILE}
        - --destination=${IMAGE}
```

Steps

```
apiVersion: build.knative.dev/v1alpha1
kind: BuildTemplate
metadata:
  name: kaniko
spec:
  parameters:
    - name: IMAGE
      description: The name of the image to push
    - name: DOCKERFILE
      description: Path to the Dockerfile to build.
      default: /workspace/Dockerfile
  steps:
    - name: build-and-push
      image: gcr.io/kaniko-project/executor
      args:
        - --dockerfile=${DOCKERFILE}
        - --destination=${IMAGE}
```


Describing a build

```
apiVersion: build.knative.dev/v1alpha1
kind: Build
metadata:
  name: kubeval-build
spec:
  source:
    git:
      url: https://github.com/garethr/kubeval.git
      revision: master
  template:
    name: kaniko
    arguments:
      - name: IMAGE
        value: garethr/kubeval
```

Running a build

```
$ kubectl apply -f kubeval.yaml
build.build.knative.dev "kubeval-build" created

$ kubectl get build kubeval-build -o yaml -w
# grab the pod identifier

$ kubectl logs -f kubeval-build-pod-8fd6e4 -c build-step-build-and-push
INFO[0000] Downloading base image golang:1.8-alpine
2018/12/09 16:50:14 No matching credentials were found, falling back on anonymous
INFO[0002] Executing 0 build triggers
INFO[0002] Unpacking rootfs as cmd RUN apk --no-cache add make git requires it.
INFO[0137] Taking snapshot of full filesystem...
INFO[0138] Skipping paths under /builder/home, as it is a whitelisted directory
INFO[0138] Skipping paths under /dev, as it is a whitelisted directory
INFO[0138] Skipping paths under /kaniko, as it is a whitelisted directory
INFO[0138] Skipping paths under /proc, as it is a whitelisted directory
INFO[0138] Skipping paths under /sys, as it is a whitelisted directory
INFO[0138] Skipping paths under /var/run, as it is a whitelisted directory
```

Higher-level interfaces



Remember

Knative Build is for tool builders

The Kubernetes community is an interesting mix of systems engineers and end users

This is both a strength and a weakness



If Knative is for tool builders, what about end users?

The pros and cons of low-level APIs



Experimenting with template UI

```
$ knt inspect kaniko
```

```
kaniko
```

```
https://raw.githubusercontent.com/knative/build-templates/master/kaniko/kaniko.yaml
```

| Parameters (2) | Description | Default |
|----------------|----------------------------------|-----------------------|
| IMAGE | The name of the image to push | |
| DOCKERFILE | Path to the Dockerfile to build. | /workspace/Dockerfile |

| Steps (1) | Image | Command | Args |
|----------------|--------------------------------|---------|--|
| build-and-push | gcr.io/kaniko-project/executor | | --dockerfile=\${DOCKERFILE} --destination=\${IMAGE} |

[Code](#)[Issues](#) 18[Pull requests](#) 0[ZenHub](#)[Insights](#)

Knative CLI

[kubernetes](#)[knative](#)[serverless](#)[app](#)[containers](#)[function](#)[faas](#)[paas](#)[cli](#)[k8s](#)

262 commits

3 branches

11 releases

7 contributors

Apache-2.0

Branch: master

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cppforlife Merge pull request #47 from philippthun/patch-1

Latest commit d8b6f62 2 days ago

| | | |
|--------------------|--|--------------|
| ci | remove namespace create cmd; use kubectl create ns name instead | 2 months ago |
| cmd/knctl | add NamespaceNameFlag for more dynamic namespace lookup (default to k... | 4 months ago |
| docs | Remove non-existing secret | 2 days ago |
| hack | quote "\$@" for good health and long life | 12 days ago |
| pkg/knctl | add build flag '--template-kind cluster' to use ClusterBuildTemplate ... | 12 days ago |
| test/e2e | simplify presentation of route traffic | 25 days ago |
| vendor | add omitempty to one of the build status fields to potentially fix a bug | a month ago |
| .gitignore | add windows binary | 25 days ago |
| AUTHORS | init | 4 months ago |
| Gopkg.lock | bump to knative 0.2.1 and kube 1.11.3 libs | a month ago |
| Gopkg.toml | bump to knative 0.2.1 and kube 1.11.3 libs | a month ago |
| LICENSE | init | 4 months ago |
| OWNERS | init | 4 months ago |
| README.md | mention ibm developer youtube talk | 3 days ago |
| code-of-conduct.md | init | 4 months ago |



TriggerMesh CLI to work with knative objects <https://triggermesh.com>

156 commits 3 branches 6 releases 2 contributors Apache-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

tzununbekov Registry as default source type, #48 Latest commit 3d9104a 6 days ago

| | | |
|-----------------------|--|--------------|
| 📁 .circleci | Temporarily commenting out tests, removed copy command | a month ago |
| 📁 cmd | Registry as default source type, #48 | 6 days ago |
| 📁 pkg | CLI version 0.0.6 | 6 days ago |
| 📁 script | Go validation fixes | a month ago |
| 📁 vendor | Channels CRUD, #42 | 13 days ago |
| 📄 .gitignore | Uitable vendored | 4 months ago |
| 📄 Dockerfile | move tm to usr bin | 3 months ago |
| 📄 Gopkg.lock | Channels CRUD, #42 | 13 days ago |
| 📄 Gopkg.toml | Update knative components to v0.2 | 24 days ago |
| 📄 LICENSE | add license file in root | 2 months ago |
| 📄 Makefile | Go validation fixes | a month ago |
| 📄 README.md | Buildtemplate deploy command fix | 27 days ago |
| 📄 cloudbuild-tag.yaml | add a cloudbuild for specific git tags | a month ago |
| 📄 cloudbuild.yaml | Added "latest" tag to iamge | 3 months ago |
| 📄 main.go | License added, #24 | 2 months ago |

📄 README.md

Examples with TriggerMesh tm

```
$ tm deploy build kubeval --source https://github.com/garethr/kubeval.git \  
--buildtemplate docker --args IMAGE=garethr/kubeval
```

```
$ tm get build kubeval
```

```
"stepStates": [  
  {  
    "terminated": {  
      "exitCode": 0,  
      "reason": "Completed",  
      "startedAt": "2018-12-12T01:42:48Z",  
      "finishedAt": "2018-12-12T01:46:41Z",  
      "containerID": "docker://45913da527d4ee1160d9f0cce0119ec4ddcd920470a086beae7b4a6170f850bb"  
    }  
  }  
],  
"stepsCompleted": [  
  "build-step-build"  
],
```



Jenkins X is a CI/CD solution for modern cloud applications on Kubernetes

[Get Started!](#)

This project is being proposed as a sub project of the Jenkins Foundation

Dockerfile to Knative Build

```
FROM test-base AS Test
RUN pytest --black
```

```
FROM test-base AS Check
RUN safety check
```

```
FROM app AS Security
ARG MICROSCANNER
RUN wget -O /microscanner https://get.aquasec.com/microscanner && chmod +x /microscanner
RUN /microscanner $MICROSCANNER --full-output
```

```
FROM release
CMD ["gunicorn", "-b", ":5000", "app:app"]
```

Generate steps from Dockerfile stages

```
steps:
- name: test
  image: 'docker:18.09'
  args: ['build', '--target', 'test', '-t', "${IMAGE}:test", '.']
- name: check
  image: 'docker:18.09'
  args: ['build', '--target', 'check', '-t', "${IMAGE}:check", '.']
- name: security
  image: 'docker:18.09'
  args: ['build', '--target', 'security', '-t', "${IMAGE}:check", '.']
- name: build
  image: 'docker:18.09'
  args: ['build', '-t', "${IMAGE}", '.']
```

Example repository to accompany my talk at Velocity 2018

Edit

Manage topics

2 commits

1 branch

0 releases

1 contributor

View license

Branch: master

New pull request

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garethr added a README and LICENCE file

Latest commit ea09d37 7 minutes ago

| | | |
|----------------------|-----------------------------------|---------------|
| src | example multi-stage build project | 4 hours ago |
| .gitignore | example multi-stage build project | 4 hours ago |
| Dockerfile | example multi-stage build project | 4 hours ago |
| LICENCE | added a README and LICENCE file | 7 minutes ago |
| Makefile | added a README and LICENCE file | 7 minutes ago |
| Pipfile | example multi-stage build project | 4 hours ago |
| Pipfile.lock | example multi-stage build project | 4 hours ago |
| README.md | added a README and LICENCE file | 7 minutes ago |
| structure-tests.yaml | example multi-stage build project | 4 hours ago |

README.md

Multi-stage build example for Velocity 2018

This repository contains a working example for the talk at Velocity 2018 in London on *Advanced Docker image build patterns*. The focus is on the Dockerfile, with other tooling or code included to make that example actually work. The application is written in Python, but hopefully the ideas should be pretty generally applicable. The Makefile is included as much as



Demo



The future



[Code](#)[Issues 53](#)[Pull requests 4](#)[ZenHub](#)[Projects 1](#)[Insights](#)

A K8s-native Pipeline resource.

306 commits

1 branch


0 releases


















19 contributors

Apache-2.0

Branch: master

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 **mattmoor-sockpuppet** and **knative-prow-robot** Format markdown ... Latest commit 7b18fba 2 days ago

| | | |
|---|--|--------------|
|  .github | Adjust issue template formatting. | 6 days ago |
|  cmd | Add ClusterTask new CRD | 3 days ago |
|  config | Cleanup of clusterTask type and config yaml | 3 days ago |
|  docs | Format markdown | 2 days ago |
|  examples | Remove default namespace from samples 🤔 | 4 days ago |
|  hack | Format markdown | 5 days ago |
|  pkg | Properly finish reconciling for TaskRuns as well | 2 days ago |
|  test | Switch to a separate unit test, tweak Helm test error handling again | 2 days ago |
|  third_party | Use knative-nightly build releases to get the build fix in 🐛 | 9 days ago |
|  vendor | Add more vendored deps required for 'dep-collector' 🤔 | 6 days ago |
|  .gitattributes | No kubebuilder (#66) | 2 months ago |
|  .gitignore | No kubebuilder (#66) | 2 months ago |
|  CONTRIBUTING.md | Format markdown | 5 days ago |
|  DEVELOPMENT.md | Format markdown | 5 days ago |
|  Gopkg.lock | Add dep-collector to the list of required tools in Gopkg.toml | 6 days ago |
|  Gopkg.toml | Add dep-collector to the list of required tools in Gopkg.toml | 6 days ago |
|  LICENSE | No kubebuilder (#66) | 2 months ago |



Other things that might happen

Commence speculation

- A unified backend for different CI systems on Kubernetes?
- Custom scheduling algorithms for build?
- Decouple description from consumption of build information?
- Convertors for popular formats?
- Opinionated per-language/framework builders, including full pipelines?



Conclusion



Conclusions

If all you remember is...

- **Knative Build is for tool builder**

But if you're building CI and building tooling then you should join the conversation

- **Knative Build needs folks experimenting with UI**

Low level bits are important, but not as important as end user solutions

- **Custom Resources in Kubernetes are great**

Expect further commoditization of parts of the software delivery toolchain



Questions?

