



KubeCon



CloudNativeCon

— North America 2018 —

CNCF Cross-cloud CI Project Intro

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Project Intro

CNCF Cross-Cloud CI tests Kubernetes (K8s) and projects running on K8s across multiple cloud providers.

Project Intro - 35 minutes

- History of the Project
- Why and What
- Project Overview
- Technology Overview
- Lessons Learned
- What's Next
- Q&A

Cross-cloud CI Intro: History

History and why the project exists:

The project started from as an idea in early 2016 to test the compatibility of Kubernetes versions on cloud providers along with applications running on those clusters.

This was before the K8s Conformance Group, Cluster API project and well before a GA version of kubeadm existed. At that time there were very few cloud providers offering K8s as a service, such as Google Kubernetes Engine (GKE).

Cross-cloud CI Intro: What is it?



What? The Cross-cloud CI project consists of a composable base CI system, a status repository server and a dashboard.

The underlying CI testing system has 3 components (build pipeline, multi-cloud provisioner cross-cloud, cross-project) that continually **validate the interoperability of each CNCF project for any commit on stable and head across all supported cloud providers**.

The testing system can reuse artifacts from a project's existing CI system or generate new build artifacts. The status repository server collects the test results and the dashboard displays them.

Goal: to target CNCF projects

Graduated



Incubating



SANDBOX



Cross-cloud CI Intro: cncf.ci



Sean Kerner @ #Kubecon @TechJournalist · 6h

How @CloudNativeFdn Is Growing the Cloud Landscape at #KubeCon
#CloudNativeCon
eweek.com/cloud/how-cncf...

CNCF started with one project (@kubernetesio) it now has 31 &
@cra tells me that by 2020 there could be 60 projects!



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Goal: to target non-CNCF projects

Implemented



↪ VULK COOP @KubeCon | Seattle, WA and 1 other Retweeted



cross-cloud ci @crosscloudci · Mar 14

Attending [@OpenNetSummit](#) this month? Join us at the **#CNCF** booth #22 to experience [@ONAP](#) and [@kubernetesio](#) demoed together on [cncf.ci](#). There's still time to register 

Goal: to target public, bare metal & private clouds



Google Cloud



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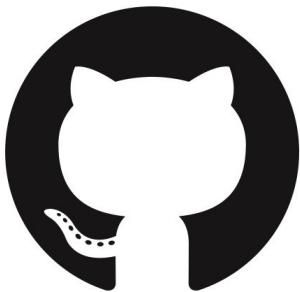
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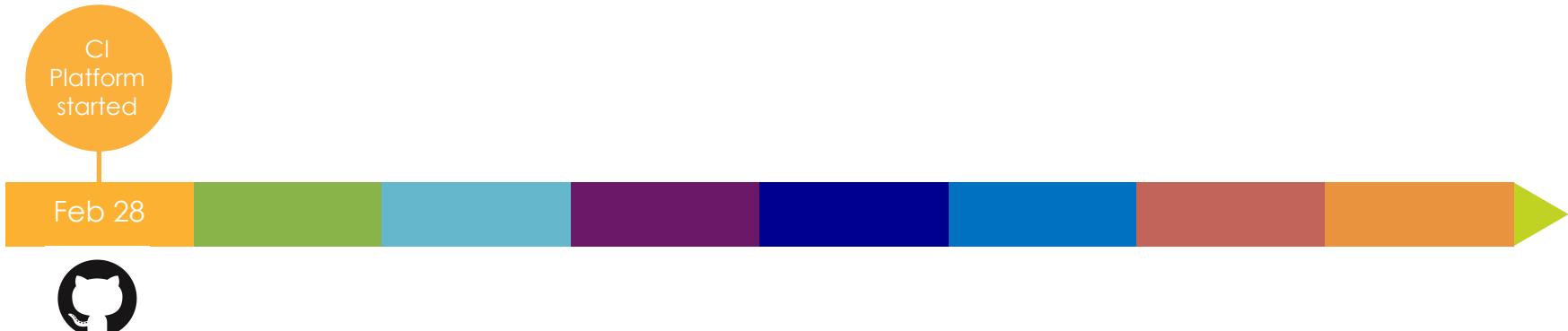
Alibaba Cloud

packet
+ arm

CNCF CI Platform started (Feb 28, 2017)



- Feb 1st, 2017: CNCF CI Goals posted to mailing list
- Feb 28, 2017: CI Platform started



CI Dashboard Greenlight (Sept 22nd, 2017)



- Greenlight to start implementation of CI Dashboard
- Granted during Open Source Summit in Los Angeles



Cncf.ci v1.0.0 Release (Jan 26th, 2018)



- Cncf.ci v1.0.0 released to production
- Included the Dashboard, Status API server, 4 active projects and 5 active clouds
- Projects: K8s, Prometheus, CoreDNS, Linkerd
- Clouds: AWS, Azure, GCE, GKE, Packet



Cncf.ci v1.1+ Releases (March, 2018)



- Cncf.ci v1.1.0 released
 - Added Fluentd and IBM Cloud
- Cncf.ci v1.2.0 released
 - Added ONAP SO project
- Cncf.ci v1.3.0 released
 - Added OpenStack



Cncf.ci v1.5.0 Release (Sept 7, 2018)



- Cncf.ci v1.5.0 released to production
- Added Envoy to projects



Cncf.ci v1.6.0 Release (Oct 31, 2018)



- Cncf.ci v1.6.0 released to production
- Added OCI to deployments



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CI Status Dashboard Overview



CI Dashboard Overview:

- Overview of cncf.ci
 - Shows status of 3 pipeline stages: Build, Provision and App Deployments
 - Refreshes at 3:00am Eastern Time every day
 - Supports dynamically adding/removing active clouds and projects
 - Clicking on Build status badge opens CI system build job URL
 - Clicking on Release Name opens project's GitHub commit URL
 - Clicking on Deployment status badge opens “provisioning/app-deploy” job URL

⏲ Last updated 16 hours ago

Project	Build	Release	Deployments								
			Status	Stable Head	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack	VMware vSphere
 Kubernetes Orchestration	 v1.12.2 dde084f	 v2.4.3 8b91d39									
											
 Prometheus Monitoring	 v1.25 95c9e14	 v1.2.6 3dabdc5									
											
 CoreDNS Service Discovery	 v1.2.5 95c9e14	 v1.2.6 3dabdc5									
											
 Fluentd Logging	 v1.5.1 36dc2c9	 v1.2.6 3dabdc5									
											
 Linkerd Service Mesh	 v1.8.0 0ebe247	 v1.1.1 9a3841e									
											
 Envoy Service Mesh	 v1.8.0 0ebe247	 v1.1.1 9a3841e									
											
 ONAP Network Automation	 v1.1.1 9a3841e	 v1.1.1 9a3841e									
											

Last updated 16 hours ago

Project	Build	Release	Deployments							
	Status	Stable Head	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack	VMware vSphere	Oracle Cloud Infrastructure
 Kubernetes Orchestration	 SUCCESS 	v1.12.2	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	dde084f	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 Prometheus Monitoring	 SUCCESS 	v2.4.3	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	8b91d39	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 CoreDNS Service Discovery	 SUCCESS 	v1.2.5	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	95c9e14	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 Fluentd Logging	 SUCCESS 	v1.2.6	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	3dabdc5	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 Linkerd Service Mesh	 SUCCESS 	1.5.1	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	36dc2c9	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 Envoy Service Mesh	 SUCCESS 	v1.8.0	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	0ebe247	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
 ONAP Network Automation	 SUCCESS 	v1.1.1	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 
	 SUCCESS 	9a3841e	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 	 SUCCESS 

1. Build projects from source

Last updated 16 hours ago

Project	Build	Release	Deployments							
			Stable Head	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack	VMware vSphere
 Kubernetes Orchestration	 SUCCESS  SUCCESS	v1.12.2	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		dde084f	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 Prometheus Monitoring	 SUCCESS  SUCCESS	v2.4.3	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		8b91d39	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 CoreDNS Service Discovery	 SUCCESS  SUCCESS	v1.2.5	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		95c9e14	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 Fluentd Logging	 SUCCESS  SUCCESS	v1.2.6	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		3dabdc5	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 Linkerd Service Mesh	 SUCCESS  SUCCESS	1.5.1	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		36dc2c9	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 Envoy Service Mesh	 SUCCESS  SUCCESS	v1.8.0	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		0ebe247	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
 ONAP Network Automation	 SUCCESS  SUCCESS	v1.1.1	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS
		9a3841e	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS

1. Build projects from source

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			Status	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack	VMware vSphere	Oracle Cloud Infrastructure
 Kubernetes Orchestration	v1.12.2 dde084f		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 Prometheus Monitoring	v2.4.3 8b91d39		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 CoreDNS Service Discovery	v1.2.5 95c9e14		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 Fluentd Logging	v1.2.6 3dabdc5		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 Linkerd Service Mesh	1.5.1 36dc2c9		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 Envoy Service Mesh	v1.8.0 0ebe247		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
 ONAP Network Automati	v1.1.1 9a3841e		SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS
			SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS	SUCCESS

2. Provision w/ cross-cloud

Last updated 16 hours ago

Project	Build	Release	Deployments							
			Status	Stable Head	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack
 Kubernetes Orchestration	 	v1.12.2	 	 	 	 	 	 	 	 
 Prometheus Monitoring	 	v2.4.3	 	 	 	 	 	 	 	 
 CoreDNS Service Discovery	 	v1.2.5	 	 	 	 	 	 	 	 
 Fluentd Logging	 	v1.2.6	 	 	 	 	 	 	 	 
 Linkerd Service Mesh	 	1.5.1	 	 	 	 	 	 	 	 
 Envoy Service Mesh	 	v1.8.0	 	 	 	 	 	 	 	 
 ONAP Network Automation	 	v1.1.1	 	 	 	 	 	 	 	 

3. Deploy w/ cross-project

CI Status: Sometimes things fail



- See dashboard snapshot
 - From Monday, December 10, 2018

⌚ Last updated 18 hours ago

Project	Build	Release	Deployments								
			Status	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack	VMware vSphere	Oracle Cloud Infrastructure
 Kubernetes Orchestration		Stable Head v1.12.2 27fca55	 SUCCESS	 SUCCESS	 SUCCESS	 FAILED	 SUCCESS	 FAILED	 SUCCESS	 SUCCESS	 FAILED
			 SUCCESS	 SUCCESS	 FAILED	 SUCCESS	 SUCCESS	 FAILED	 SUCCESS	 SUCCESS	 FAILED
 Prometheus Monitoring		v2.4.3 56cda56	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 SUCCESS	 FAILED
			 FAILED	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A
 CoreDNS Service Discovery		v1.2.5 95c9e14	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 SUCCESS	 FAILED
			 SUCCESS	 SUCCESS	 FAILED	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 SUCCESS	 FAILED
 Fluentd Logging		v1.2.6 c037e41	 FAILED	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 SUCCESS	 FAILED
			 FAILED	 SUCCESS	 FAILED	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 SUCCESS	 FAILED
 Linkerd Service Mesh		1.5.1 68b200b	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 SUCCESS	 FAILED	 FAILED	 FAILED	 FAILED
			 FAILED	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A	 N/A

Project Configuration

```
164   envoy:
165     order: 6
166     active: true
167     logo_url: "https://raw.githubusercontent.com/cncf/artwork/ab42c9591f6e0fdccc62c7b88f353d3fdc825734/envoy/icon/co
168       lor/envoy-icon-color.png"
169     display_name: Envoy
170     sub_title: Service Mesh
171     gitlab_name: envoy
172     project_url: "https://github.com/envoyproxy/envoy"
173     repository_url: "https://github.com/envoyproxy/envoy"
174     timeout: 2100
175     stable_ref: "v1.7.1"
176     head_ref: "master"
177     stable_chart: "stable"
178     head_chart: "stable"
179     app_layer: true
NORMAL ←integration ↑cross-cloud.yml ⇝
1 line less; before #1 21 seconds ago
unix ↓utf-8 ↓yaml ↴ 95% ↴ 170:1
```

Cloud Configuration

```
[tmux: 0]@dev.vulk.co: vim
15      - "container"
16      - "compile"
17
18 clouds:
19   aws:
20     active: true
21     display_name: AWS
22     order: 1
23   azure:
24     active: true
25     display_name: Azure
26     order: 2
27   gce:
28     active: true
29     display_name: GCE
30     order: 3
31   gke:
32     active: false
33     display_name: GKE
34     order: 4
35   ibmcloud:
36     active: true
37     display_name: IBM Cloud
38     order: 6
39   packet:
40     active: true
41     display_name: Bare Metal (Packet)
42     order: 8
NORMAL ←integration →cross-cloud.yml ⇵
unix ↴utf-8 ↴yaml ↵ 10% ↵ 19:1
```

Refresh triggered

```
=====
= Cross-Cloud CI Trigger Client"
=====
*Quick start => type default_connect

To use defaults and get a client run: default_connect
- @tc is the trigger client.
- @c is the ciservice client (also @tc.ciservice)
  => Use @c as outlined in docs/usage_from_irb.mkd

## Manual setup
To change the data store, set the @store_file variable to use a differnt store file (default: db/datastore-<CR>
CI_ENV>.yml)
Trigger client can be created with @tc = CrossCloudCi::TriggerClient.new({store_file: @store_file})
Ci service client is available as @tc.ciservice and @c
Set debugging level with @tc.logger.level and @tc.ciservice.logger.level

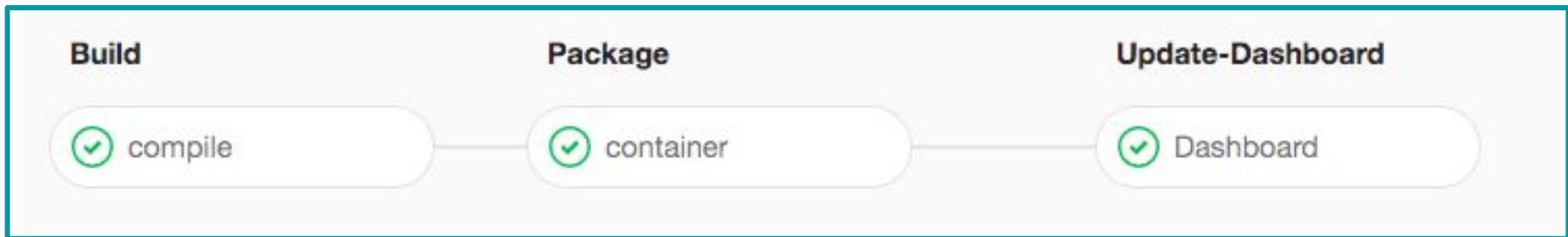
## Type trigger_help for more
Environment: prod
2.1.7 :001 > default_connect
I, [2018-10-19T14:35:08.332855 #21176] INFO -- : [CiService] Loading active projects
I, [2018-10-19T14:35:08.332985 #21176] INFO -- : [CiService] Loading GitLab project data
I, [2018-10-19T14:35:11.130718 #21176] INFO -- : [CiService] Creating data mappings
I, [2018-10-19T14:35:11.131012 #21176] INFO -- : [TriggerClient] Dashboard API: devapi.cncf.ci
```

Testing System Overview

- **Build Pipeline per project** (optional, can use project's build artifacts)
- **Cloud Provisioning Pipeline** (cross-cloud)
- **App Deployment Pipeline** (cross-project)

Build Pipeline Stage

- 1. Build:** Compile binaries and e2e tests
- 2. Package:** Create containers, create artifact pinning config and push to registry
- 3. Update-Dashboard:** Update build status badges



Cloud Provisioning Pipeline Stage



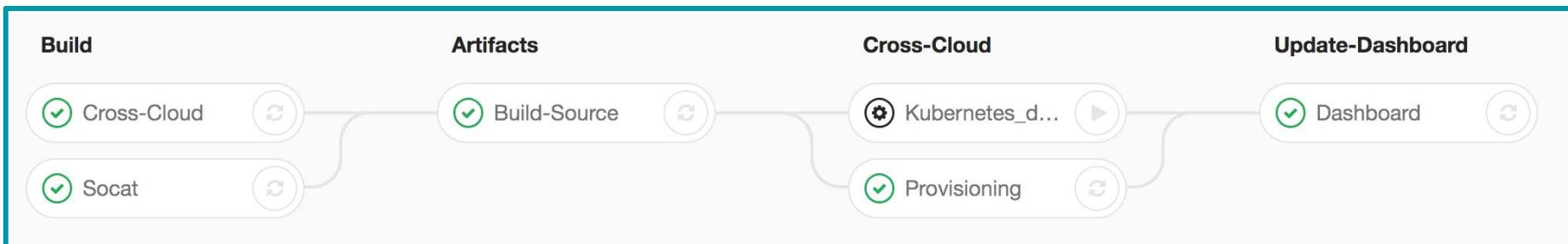
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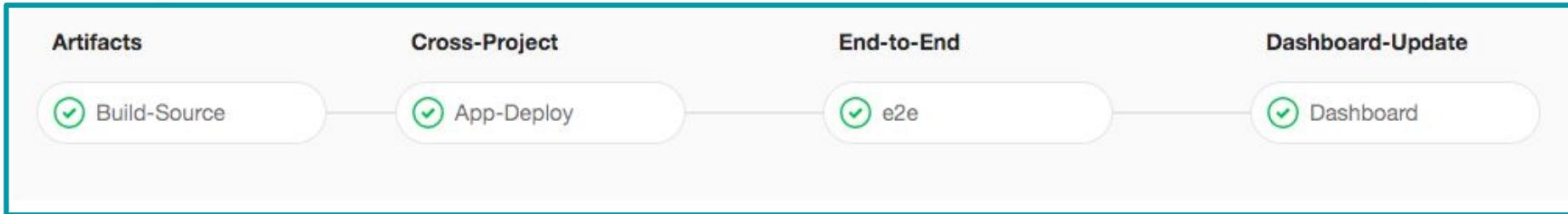
North America 2018

- 1. Build:** Prepare provisioning software from the cross-cloud project
- 2. Artifacts:** Collect K8s artifact pinnings from the previous K8s builds
- 3. Cross-Cloud:** Deploy K8s onto each cloud using cross-cloud provisioner
- 4. Update-Dashboard:** Update deployment badges



App Deployment Pipeline Stage

- Artifacts:** Collect project artifact pinnings from the previous build stages
- Cross-Project:** Use Helm charts to deploy each project
- End-to-End:** Run e2e tests for each project
- Dashboard-Update:** Update deployment status badges



Technology Overview

CI System Technology Overview



- **Unified CI/CD platform:** GitLab
- **Cross-cloud provisioning:** Terraform, Cloud-init, and per cloud K8s configuration
- **App deployments:** K8s manifest management with Helm
- **E2e tests:** Custom containers + Helm
- **Automated builds and deployments:** Git + per project yaml configuration

Dashboard Technology Overview



- **Frontend:** Vue.js
- **Status repository:** Elixir and Erlang
- **Automated builds and deployments:** Git + per project yaml configuration

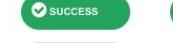
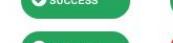
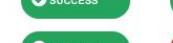
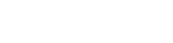
Lessons Learned

Lessons Learned

Starting with the end-user interface is advised

- Serve one audience as your focus
- Simplify what you are communicating
- Graceful failures in the Web UI

⌚ Last updated 18 hours ago

Project	Build	Release	Deployments							
			Status	Stable Head	AWS	Azure	GCE	IBM Cloud	Bare Metal (Packet)	OpenStack
 Kubernetes Orchestration	 	v1.12.2	 	 	 	 	 	 	 	
	 	27fca55	 	 	 	 	 	 	 	
 Prometheus Monitoring	 	v2.4.3	 	 	 	 	 	 	 	
	 	56cda56	 	 	 	 	 	 	 	
 CoreDNS Service Discovery	 	v1.2.5	 	 	 	 	 	 	 	
	 	95c9e14	 	 	 	 	 	 	 	
 Fluentd Logging	 	v1.2.6	 	 	 	 	 	 	 	
	 	c037e41	 	 	 	 	 	 	 	
 Linkerd Service Mesh	 	1.5.1	 	 	 	 	 	 	 	
	 	68b200b	 	 	 	 	 	 	 	

Lessons Learned

Don't start tightly coupled to an existing CI platform

- API, pipeline, event hooks
- Mixing CI for the software components with implementation
- Supporting existing project CI systems

Lessons Learned

Design for projects and cloud providers to help from the start

- The entire system should be reproducible by others
- Support composable portions from the start (eg. kubeadm)

What's Next?

What's next for Cross-cloud CI?

Cross-Group Collaboration:

- OpenCI community
- OPNfv collaboration
- Network Service Mesh collaboration
- Gathering feedback from End Users, CNCF Projects and K8s Community on next iteration of cncf.ci Status Dashboard

What's next for Cross-cloud CI?



Adding More CNCF Projects:

- Jaeger
- Notary
- Vitess
- etc

What's next for Cross-cloud CI?

Adding New Features:

- **Automate** project release updates
- **API** for history of builds, deployments and end-to-end tests
- **Rollback** to previous working release
- **Integrate** with other test platforms
- **New screens TBD:** Per Project, Per Deployment, etc

Upcoming Events

CNCF Cross-cloud CI Deep Dive at KubeCon North America 2018

- Day: Wednesday, December 12
- Time: 10:50am - 11:25am Pacific Time
- Location: Tahoma 5 @ TCC *The Conference Center (TCC)*

CI WG Public Meetings

- Day: 4th Tuesday of month
- Time: 11:00am Pacific Time (US and Canada)
- Location: <https://zoom.us>

How to Collaborate

- **Attend CI WG meetings:**
 - <https://github.com/cncf/wg-ci>
- **Subscribe to the CNCF CI public mailing list:**
 - <https://lists.cncf.io/g/cncf-ci-public>
- **Create issues on GitHub:**
 - <https://github.com/crosscloudci/crosscloudci/issues>

Connect with the team



@crosscloudci



@crosscloudci



#cnfc-ci slack channel



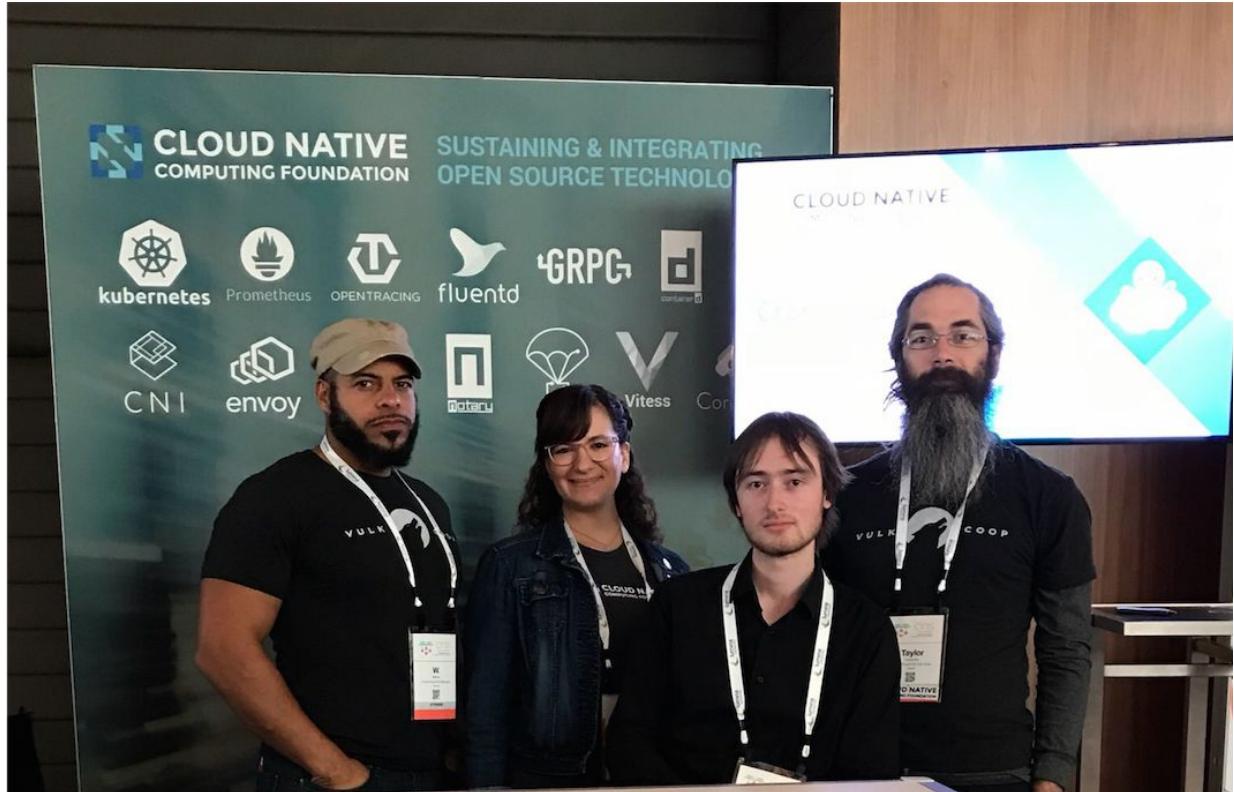
crosscloudci@vulk.coop

Q&A



Thank you for your feedback!

- **W. Watson**
[@wavell](https://twitter.com/wavell)
- **Lucina Stricko**
[@lixuna](https://twitter.com/lixuna)
- **Denver Williams**
[@denverwilliams](https://twitter.com/denverwilliams)
- **Taylor Carpenter**
[@taylor](https://twitter.com/taylor)





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