Using and Managing vRealize Automation Code Stream

14 December 2022

vRealize Automation 8.0

vmware®

You can find the most up-to-date technical documentation on the VMware website at:

https://docs.vmware.com/

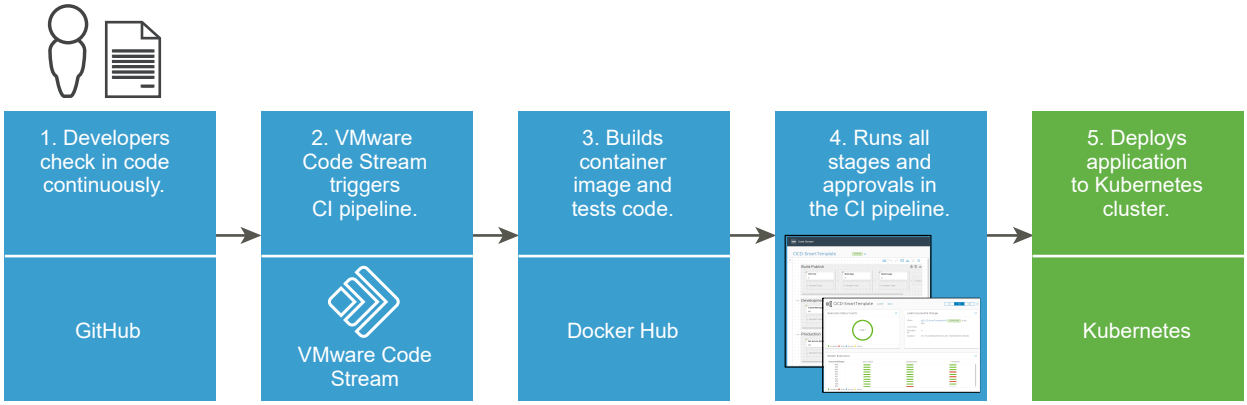
VMware, Inc.
3401 Hillview Ave.
Palo Alto, CA 94304
www.vmware.com

Contents

What is vRealize Automation Code Stream and how does it work

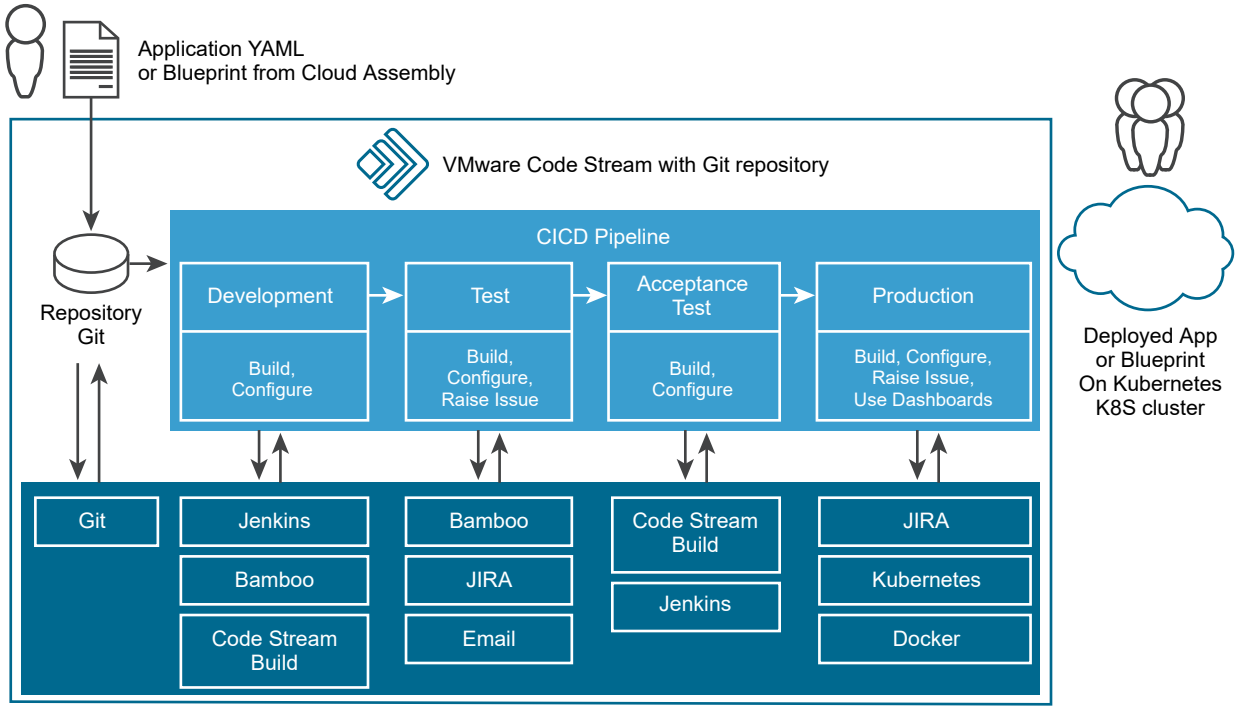
1

vRealize Automation Code Stream™ is a continuous integration and continuous delivery (CICD) tool that you use to build pipelines that model the software release process in your DevOps lifecycle. By creating pipelines, you build the code infrastructure that delivers your software rapidly and continuously.



When you use vRealize Automation Code Stream to deliver your software, you integrate two of the most important parts of your DevOps lifecycle: your release process and your developer tools. After the initial setup, which integrates vRealize Automation Code Stream with your existing development tools, the pipelines automate your entire DevOps lifecycle.

You create a pipeline that builds, tests, and releases your software. vRealize Automation Code Stream uses that pipeline to progress your software from the source code repository, through testing, and on to production.



You can learn more about planning your continuous integration and continuous delivery pipelines at Chapter 4 Planning to natively build, integrate, and deliver your code in vRealize Automation Code Stream .

How DevOps Administrators use vRealize Automation Code Stream

As a DevOps administrator, you create endpoints and ensure that working instances are available for developers. You can create, trigger, and manage pipelines, and more. You have the `Administrator` role.

Table 1-1. DevOps Administrators who use vRealize Automation Code Stream

To support developers...	Here's what you can do...
Provide and manage environments.	Create environments for developers to test and deploy their code. ■ Track status and send email notifications. ■ Keep your developers productive by ensuring that their environments continuously work. To find out more, see More resources for vRealize Automation Code Stream Administrators and Developers. Also see Chapter 3 Ways to use vRealize Automation Code Stream.
Provide endpoints.	Ensure that developers have working instances of endpoints that can connect to their pipelines.
Provide integrations with other services.	Ensure that integrations to other services are working. To find out more, see vRealize Automation documentation.

Table 1-1. DevOps Administrators who use vRealize Automation Code Stream (continued)

To support developers...	Here's what you can do...
Create pipelines.	Create pipelines that model release processes. To find out more, see Chapter 6 Creating and using pipelines in vRealize Automation Code Stream.
Trigger pipelines.	Ensure that pipelines run when events occur. ■ To trigger a standalone, continuous delivery (CD) pipeline whenever a build artifact is created or updated, use the Docker trigger. ■ To trigger a pipeline when a developer commits changes to their code, use the Git trigger. ■ To trigger a pipeline when developers review code, merge, and more, use the Gerrit trigger. ■ To run a standalone continuous delivery (CD) pipeline whenever a build artifact is created or updated, use the Docker trigger. To find out more, see Chapter 7 Triggering pipelines in vRealize Automation Code Stream.
Manage pipelines and approvals.	Stay up-to-date on pipelines. ■ View pipeline status, and see who ran the pipelines. ■ View approvals on pipeline executions, and manage approvals for active and inactive pipeline executions. To find out more, see What are user operations and approvals in vRealize Automation Code Stream. Also, see How do I track key performance indicators for my pipeline in vRealize Automation Code Stream.
Monitor developer environments.	Create custom dashboards that monitor pipeline status, trends, metrics, and key indicators. Use the custom dashboards to monitor pipelines that pass or fail in developer environments. You can also identify and report on under used resources, and free up resources. You can also see: ■ How long a pipeline ran before it succeeded. ■ How long a pipeline waited for approval, and notify the user who must approve it. ■ Stages and tasks that fail most often. ■ Stages and tasks that take the most time to run. ■ Releases that development teams have in progress. ■ Applications that succeeded in being deployed and released. To find out more, see Chapter 8 Monitoring pipelines in vRealize Automation Code Stream.
Troubleshoot problems.	Troubleshoot and resolve pipeline failures in developer environments. ■ Identify and resolve problems in continuous integration and continuous delivery environments (CICD). ■ Use the pipeline dashboards and create custom dashboards to see more. See Chapter 8 Monitoring pipelines in vRealize Automation Code Stream. Also, see Chapter 2 Setting up vRealize Automation Code Stream to model my release process.

vRealize Automation Code Stream is part of vRealize Automation. vRealize Automation Code Stream integrates with:

- Use vRealize Automation Cloud Assembly to deploy blueprints.

For other things you can do, see VMware vRealize Automation Documentation.

How Developers Use vRealize Automation Code Stream

As a developer, you use vRealize Automation Code Stream to build and run pipelines, and monitor pipeline activity on the dashboards. You have the `User` role.

After you run a pipeline, you'll want to know:

- Did my code succeed through all stages of the pipeline? Look at the results in **Executions**.
- What do I do if the pipeline failed, and what caused the failure? Look at the top errors that occurred in **Dashboards**.

Table 1-2. Developers who use vRealize Automation Code Stream

To integrate and release your code...	Here's what you do...
Build pipelines.	Test and deploy your code. Update your code when a pipeline fails.
Connect your pipeline to endpoints.	Connect the tasks in your pipeline to endpoints, such as a GitHub repository.
Run pipelines.	Add a user operation approval task so that another user can approve your pipeline at specific points.
View dashboards.	View the results on the pipeline dashboard. You can see trends, history, failures, and more.

For more information to get started, see Getting Started with VMware Code Stream.

Find more documentation in the In-product Support panel

If you don’t find the information you need here, you can get more help in the product. 

- Click and read the signposts and tooltips in the user interface to get the context-specific information that you need where and when you need it.
- Open the In-product support panel and read the topics that appear for the active user interface page. You can also search in the panel to get answers to questions.

Setting up vRealize Automation Code Stream to model my release process

2

To model your release process, you create a pipeline that represents the stages, tasks, and approvals that you normally use to release your software. vRealize Automation Code Stream then automates the process that builds, tests, approves, and deploys your code.

Now that you have everything in place to model your software release process, here's how you do it in vRealize Automation Code Stream.

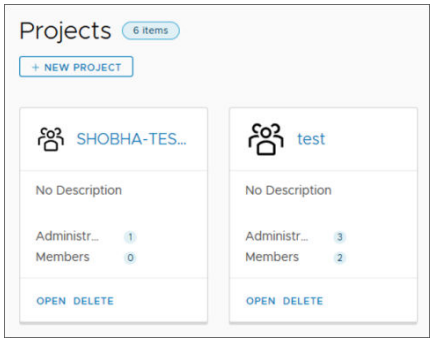
Prerequisites

- Verify whether any endpoints are already available. In vRealize Automation Code Stream, click **Endpoints**.
- Learn about native ways to build and deploy your code. See Chapter 4 Planning to natively build, integrate, and deliver your code in vRealize Automation Code Stream .
- Determine whether some of the resources that you will use in your pipeline must be marked as restricted. See How do I manage user access and approvals in VMware Code Stream.
- If you have the user role or viewer role instead of the administrator role, determine who is the administrator for your vRealize Automation Code Stream instance.

Procedure

1. Examine the projects available in vRealize Automation Code Stream and select one that is right for you.
   - If no projects are listed, ask a vRealize Automation Code Stream administrator to create a project and make you a member of the project. See How do I add a project in vRealize Automation Code Stream.

- If you are not a member of any projects listed, ask a vRealize Automation Code Stream administrator to add you as a member of a project.



2 Add any new endpoints that you need for your pipeline.

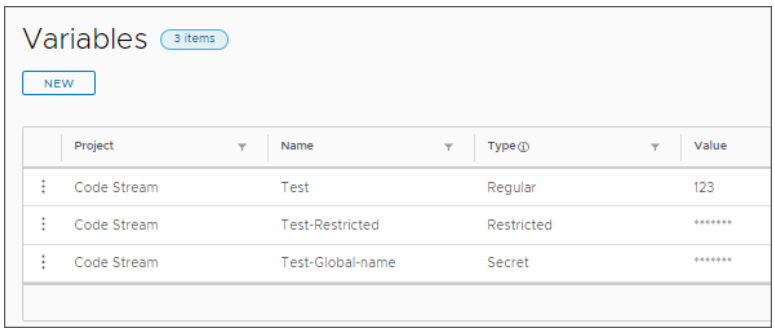
For example, you might need Git, Jenkins, Code Stream Build, Kubernetes, and Jira.

3 Create variables so that you can reuse values in your pipeline tasks.

Use restricted variables to constrain the resources used in your pipelines, such as a host machine. You can restrict the pipeline from continuing to run until another user explicitly approves it.

Administrators can create secret variables and restricted variables. Users can create secret variables.

You can reuse a variable as many times as you want across multiple pipelines. For example, a variable that defines a host machine might be defined as `HostIPAddress`. Then, to use the variable in a pipeline task you enter `${var.HostIPAddress}`.



4 If you are an administrator, mark any endpoints and variables that are vital to your business as restricted resources.

When a user who is not an administrator attempts to run a pipeline that includes a restricted resource, the pipeline stops at the task that uses the restricted resource. Then, an administrator must resume the pipeline.

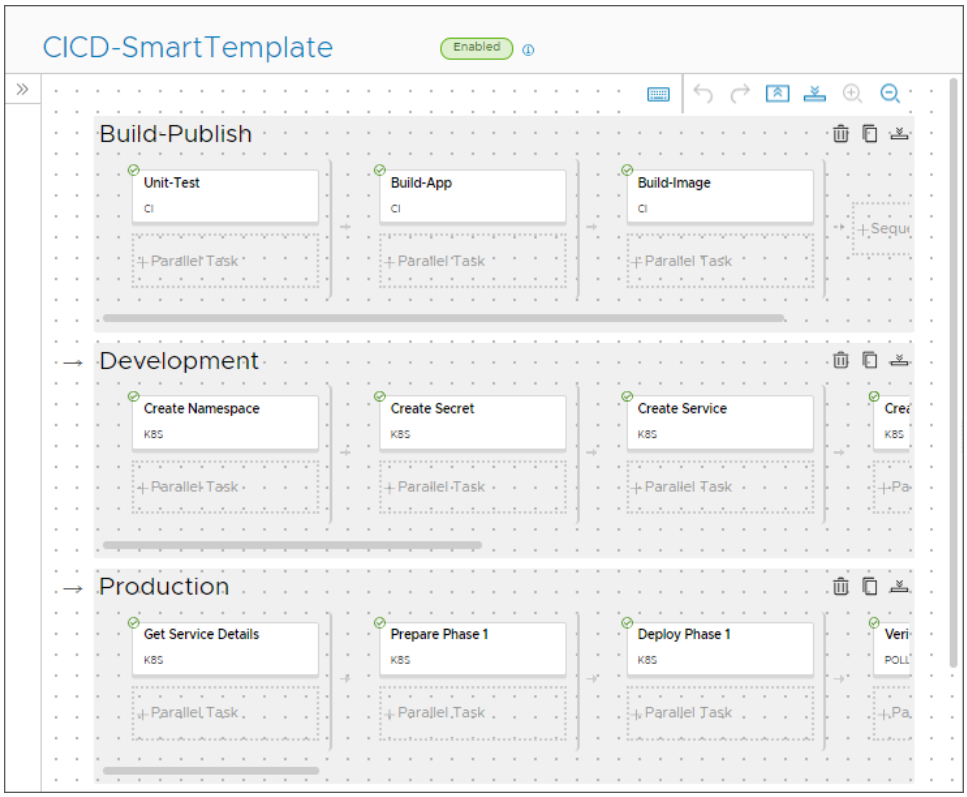
5 Plan the build strategy for your native CICD, CI, or CD pipeline.

Before you create a pipeline that continuously integrates (CI) and continuously deploys (CD) your code, plan your build strategy. The build plan helps you determine what vRealize Automation Code Stream needs so that it can natively build, integrate, test, and deploy your code.

How to create a vRealize Automation Code Stream native build...	Results in this build strategy...
Use one of the smart templates.	■ Builds all the stages and tasks for you. ■ Clones the source repository. ■ Builds and tests your code. ■ Containerizes your code for deployment. ■ Populates the pipeline task steps based on your selections.
Add stages and tasks manually.	You add stages and tasks, and enter the information that populates them.

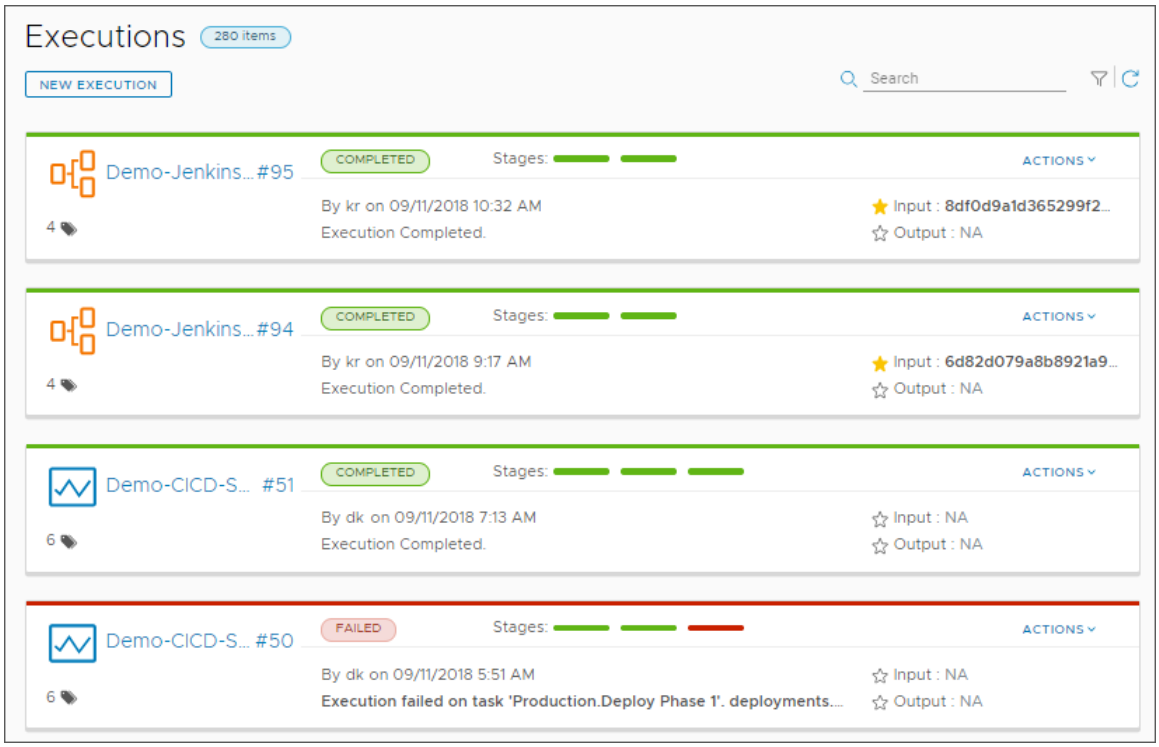
6 Create your pipeline by using a smart template, or by manually add stages and tasks to the pipeline.

Then, you mark any resources as restricted. Add approvals where needed. Apply any regular, restricted, or secret variables. Add any bindings between tasks.

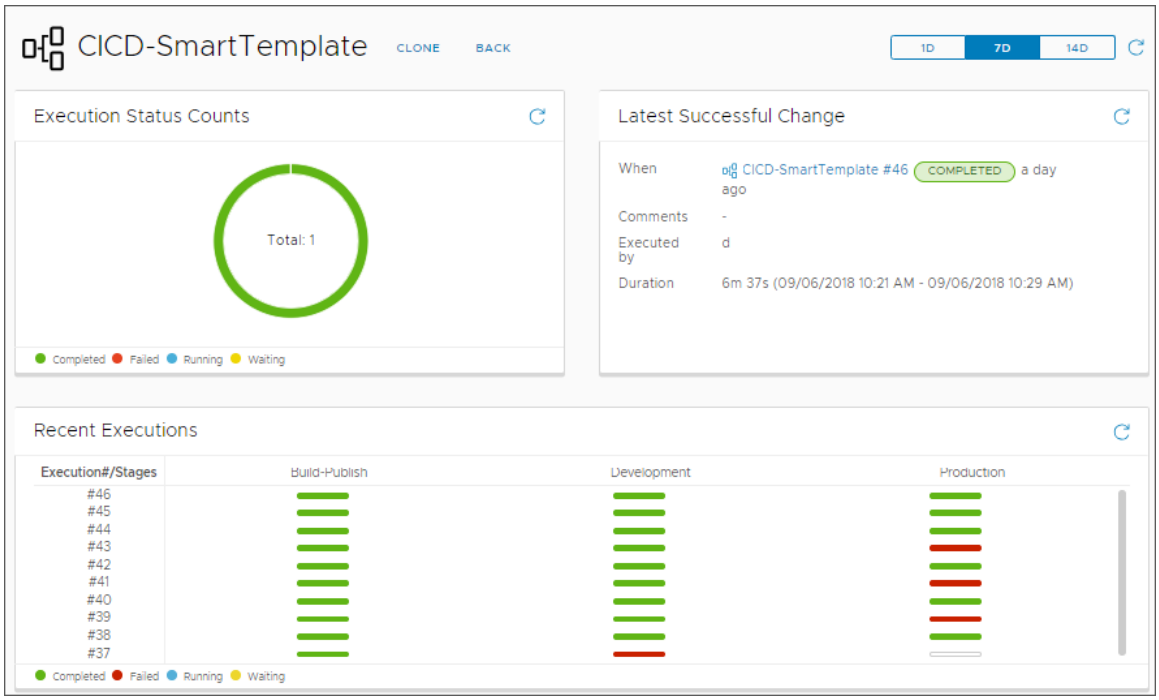


7 Validate, enable, and run your pipeline.

8 View the pipeline executions.



9 To track status and KPIs, use the pipeline dashboards, and create any custom dashboards.



Results

You created a pipeline that you can use in the selected project.

You can also export your pipeline YAML to import and reuse in other projects.

What to do next

Learn about use cases that you might want to apply in your environment. See Chapter 3 Ways to use vRealize Automation Code Stream.

How do I add a project in vRealize Automation Code Stream

You create a project to which you add administrators and members so that the project members can use features such as creating a pipeline and adding an endpoint. To create, delete, or update a project for a development team, you must be a vRealize Automation Code Stream administrator.

A project must exist before you can create a pipeline. When you create a pipeline, you select the project to associate it with so that all your pipeline information is grouped together. Endpoint and variable definitions also depend on an existing project.

Prerequisites

- Verify that you have the vRealize Automation Code Stream administrator role. See What are Roles in vRealize Automation Code Stream.

  If you do not have the vRealize Automation Code Stream administrator role, but you have vRealize Automation Cloud Assembly administrator role, you can create, update, or delete projects in the vRealize Automation Cloud Assembly UI. See "How do I add a project for my vRealize Automation Cloud Assembly development team" in *Using and Managing vRealize Automation Cloud Assenbly*.
- If you are adding Active Directory groups to projects, verify that you configured Active Directory groups for your organization. See "How do I edit group role assignments in vRealize Automation" in *Administering vRealize Automation*. If the groups are not synchronized, they are not available when you try to add them to a project.

Procedure

1. Select **Projects**, and click **New Project**.
2. Enter the project name.
3. Click **Create**.
4. Select the card for the newly created project and click **Open**.
5. Click the **Users** tab and add users with assigned roles.
   - The project administrator can add members.
   - The project member who has a service role can use services.
6. Click **Save**.

What to do next

Add endpoints and pipelines that use the project. See and Chapter 5 Connecting vRealize Automation Code Stream to endpoints and Chapter 6 Creating and using pipelines in vRealize Automation Code Stream.

How do I manage user access and approvals in vRealize Automation Code Stream

vRealize Automation Code Stream provides several ways to ensure that users have the appropriate authorization and consent to work with pipelines that release your software applications.

Each member on a team has an assigned role, which gives specific permissions on pipelines, endpoints, and dashboards, and the ability to mark resources as restricted.

User operations and approvals allow you to control when a pipeline runs and must stop for an approval. Your role determines whether you can resume a pipeline, and run pipelines that include restricted endpoints or variables.

What are Roles in vRealize Automation Code Stream

Depending on your role in vRealize Automation Code Stream, you can perform certain actions and access certain areas. For example, your role might allow you to create, update, and run pipelines. Or, you might only have permission to view pipelines.

Table 2-1. Permissions and roles in vRealize Automation Code Stream

Permission	Administrator role	User role	Executor role	Viewer role
View pipelines.	Yes	Yes	Yes	Yes
Create pipelines.	Yes	Yes		
Update pipelines.	Yes	Yes		
Run pipelines. Resume, pause, and cancel pipeline executions.	Yes	Yes	Yes	
Delete pipelines.	Yes	Yes		
View endpoints.	Yes	Yes	Yes	Yes
Create endpoints.	Yes	Yes		
Update endpoints.	Yes	Yes		
Delete endpoints.	Yes	Yes		
View pipeline executions.	Yes	Yes	Yes	Yes
View dashboards.	Yes	Yes	Yes	Yes
Create dashboards.	Yes	Yes		

Table 2-1. Permissions and roles in vRealize Automation Code Stream (continued)

Permission	Administrator role	User role	Executor role	Viewer role
Update dashboards.	Yes	Yes		
Delete dashboards.	Yes	Yes		
Mark an endpoint or variable as restricted.	Yes			
Run pipelines that include restricted endpoints or variables.	Yes			
Resume pipelines that stop for approval on restricted resources.	Yes			

If you have the Administrator role

As an administrator, you can create integration endpoints, triggers, new pipelines, and dashboards.

Projects allow pipelines to access infrastructure resources. Administrators create projects so that users can group pipelines, endpoints, and dashboards together. Users then select the project in their pipelines. Each project includes an administrator and users with assigned roles.

With the Administrator role, you can mark endpoints and variables as restricted resources in a pipeline, and you can run pipelines that use restricted resources. A restricted endpoint or variable that a pipeline uses requires an approval to keep the pipeline running. Otherwise, the pipeline stops at the task where the restricted variable is used until approval is granted, at which point an administrator must resume the pipeline to run. When a pipeline task includes a restricted resource, the task in the pipeline displays an icon that indicates the resource is restricted.

If you have the User role

You can work with pipelines like an administrator can, except that you cannot work with restricted endpoints or variables.

If you run a pipeline that uses restricted endpoints or variables, the pipeline only runs up to the task that uses the restricted resource. Then, it stops. You must then get approval for the pipeline task, and have an administrator resume the pipeline.

If you have the Viewer role

You can see pipelines, endpoints, pipeline executions, and dashboards, but you cannot create, update, or delete them.

If you have the Executor role

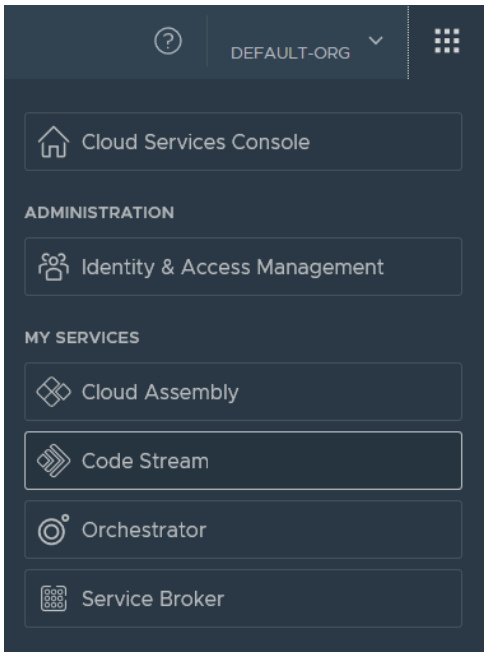
You can run pipelines and take action on user operation tasks. You can also resume, pause, and cancel pipeline executions. But, you cannot modify pipelines.

How do I assign and update roles

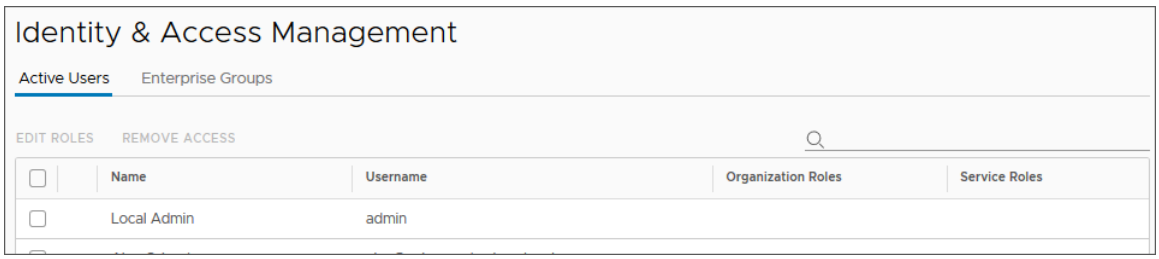
To assign and update roles for other users, you must be an administrator.

1 To see the active users and their roles, in vRealize Automation, click the nine dots at the upper-right.

2 Click **Identity & Access Management**.



3 To display user names and roles, click **Active Users**.



4 To add roles for a user, or change their roles, click the check box next to the user name, and click **Edit Roles**.

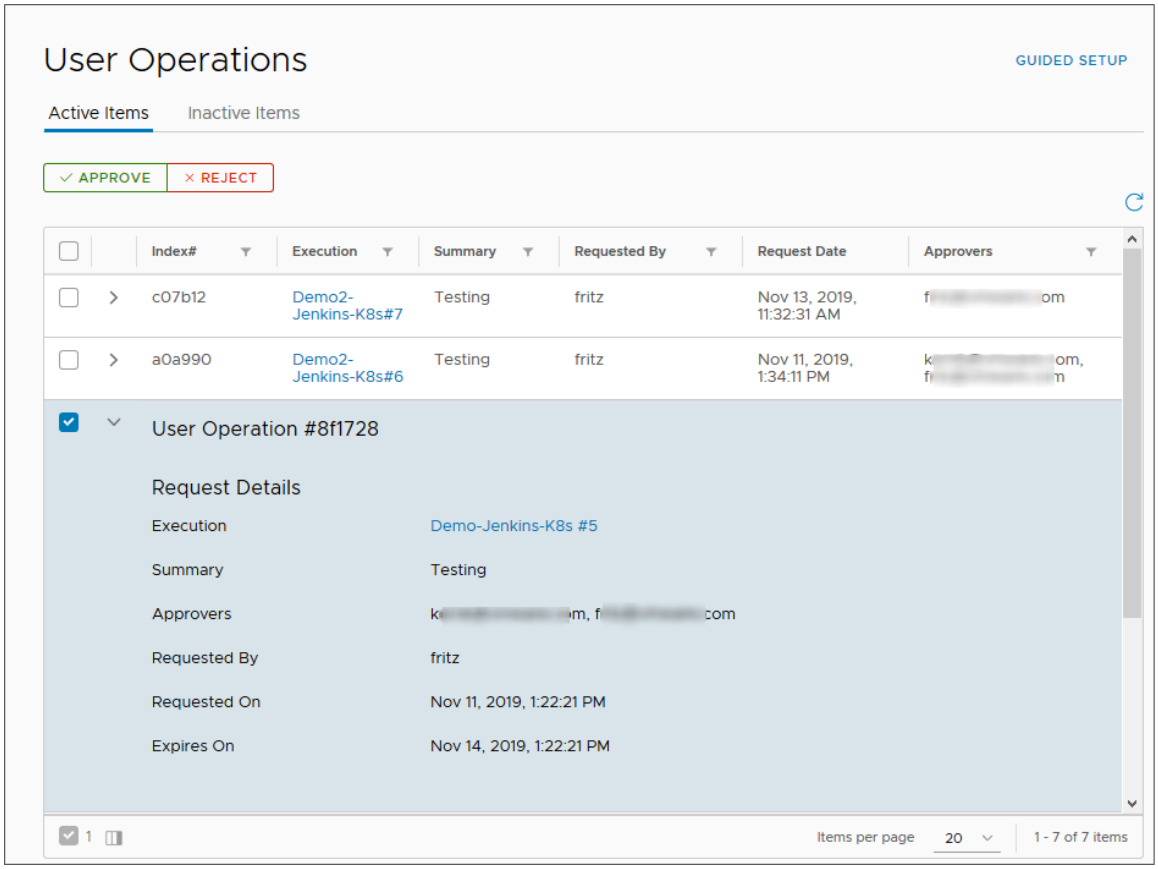
5 When you add or change user roles, you can also add access to services.

6 To save your changes, click **Save**.

What are user operations and approvals in vRealize Automation Code Stream

The User Operations area displays pipeline runs that need approval. The required user can either approve or reject the pipeline run.

Approvals on a pipeline task might be especially important if the pipeline will release software to production. The user that the pipeline task identifies for approval has the required permission or expertise to know whether to approve it so that the pipeline continues.



User operations appear as either active or inactive.

- Active items need review. The pipeline status appears as waiting for user action.
- Inactive items were approved or rejected. If another user rejected a pipeline, or if the approval timed out, you cannot approve it.

Each user operation maps to a user operation task in a pipeline. A task might need approval because it uses a resource that an administrator marked as restricted.

The user operation index is a unique six alphanumeric character string that you can use as a filter to search for a particular approval.

If your pipeline is in a wait state, another user needs to approve your pipeline task. If you are a user who is on the approver list, you can expand the user operation row and use the accept or reject buttons on that row to take action.

When you create a pipeline, you might need to add an approval to a pipeline if:

- A team member needs to review your code.
- Another user needs to confirm a build artifact.
- You must ensure that all testing is complete.

Pipeline approvals also appear in the Executions area. Pipelines that are waiting for approval indicate their status as waiting. Other states include queued, completed, and failed.

Ways to use vRealize Automation Code Stream

3

Use vRealize Automation Code Stream to model and support your DevOps release lifecycle and continuously test and release your applications.

You already set up everything you need so that you can use vRealize Automation Code Stream. See Chapter 2 Setting up vRealize Automation Code Stream to model my release process.

Now, you can create pipelines that automate the build and test of developer code before you release it to production. You can have vRealize Automation Code Stream deploy container-based or traditional applications.

Table 3-1. Using vRealize Automation Code Stream in your DevOps lifecycle

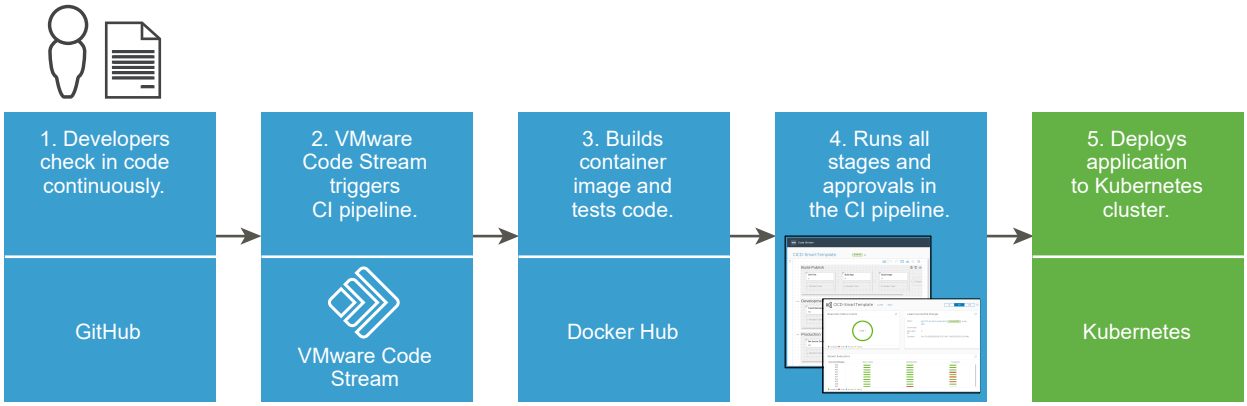
Using features...	Examples of what you can do...
Use the native build capability in vRealize Automation Code Stream.	Create CICD, CI, and CD pipelines that continuously integrate, containerize, and deliver your code. ■ Use a smart template to create a pipeline for you. ■ Manually add stages and tasks to a pipeline.
Release your applications, and automate releases.	Integrate and release your applications in various ways. ■ Continuously integrate your code in GitHub or GitLab into your pipeline. ■ Automate the deployment of your application by using a YAML blueprint. ■ Automate the deployment of your application to a Kubernetes cluster. ■ Release your application to a Blue-Green deployment. ■ Integrate vRealize Automation Code Stream with your own build, test, and deploy tools. ■ Use a REST API that integrates vRealize Automation Code Stream with other applications.
Track trends, metrics, and KPIs.	Create custom dashboards and gain insight about the performance of your pipelines.
Resolve problems.	When a pipeline execution fails, have vRealize Automation Code Stream create a JIRA ticket.

This chapter includes the following topics:

- How do I automate the release of an application in vRealize Automation Code Stream to a Kubernetes cluster
- How do I deploy my application in vRealize Automation Code Stream to my Blue-Green deployment
- How do I integrate my own build, test, and deploy tools with vRealize Automation Code Stream
- How do I use a REST API to integrate vRealize Automation Code Stream with other applications

How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream

As a developer, you want to continuously integrate your code from a GitHub or GitLab Enterprise repository. Whenever your developers update their code and commit changes to the repository, vRealize Automation Code Stream can listen for those changes, and trigger the pipeline.



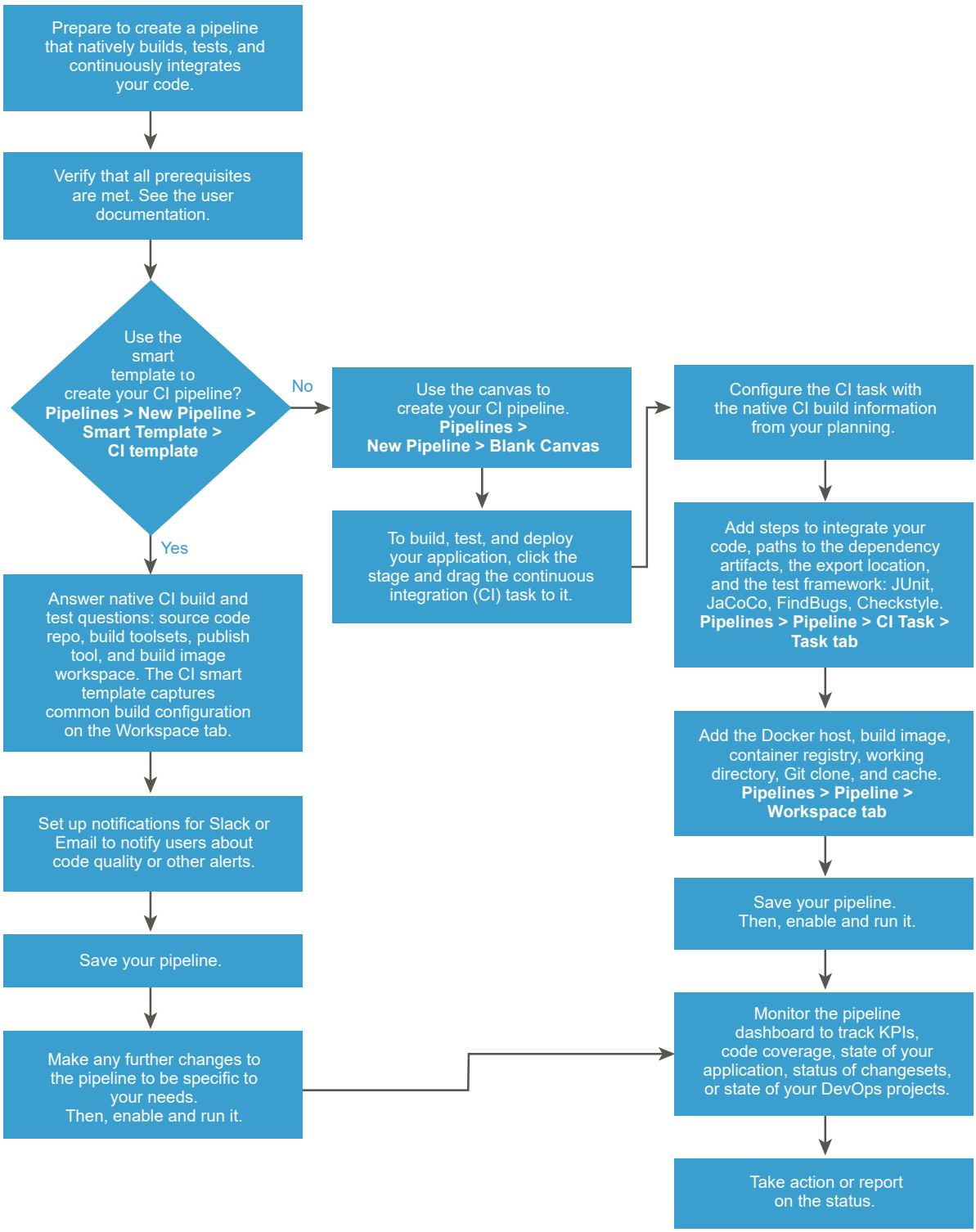
To have vRealize Automation Code Stream trigger your pipeline on code changes, you will use the Git trigger. vRealize Automation Code Stream will trigger your pipeline every time you commit changes to your code.

To build your code, you'll use a Docker host. You use JUnit and JaCoCo as your test framework tools, which run unit tests and code coverage, and you will include them in your pipeline.

Then you will use the continuous integration (CI) smart template to create a CI pipeline that builds, tests, and deploys your code to your project team's Kubernetes cluster on AWS. You will use a cache to store the code dependency artifacts for your CI task, which will save time in code builds.

In the pipeline task that builds and tests your code, you will include several continuous integration steps. These steps will reside in the same working directory where the source code is cloned when the pipeline triggers.

To deploy your code to the Kubernetes cluster, you will use a Kubernetes task in your pipeline. You will enable and run your pipeline. Then, make a change to your code in the repository, and watch the pipeline trigger. You will then monitor and report on your pipeline trends after your pipeline runs, you'll use the dashboards.



In this example, you'll use the continuous integration (CI) smart template to create a CI pipeline so that you can continuously integrate your code into your pipeline.

Optionally, you can manually create the pipeline, and add stages and tasks to it. For more information about planning a continuous integration build and manually creating the pipeline, see Planning a CICD native build in vRealize Automation Code Stream before manually adding tasks.

Prerequisites

- Plan for your continuous integration build. See Planning a CI native build in vRealize Automation Code Stream before using the smart template, and the section on planning the continuous integration (CI) stage.
- Verify that a GitLab source code repository exists. For help, see your vRealize Automation Code Stream administrator.
- Add a Git endpoint. For an example, see How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.
- To have vRealize Automation Code Stream listen for changes in your GitHub or GitLab repository, and trigger a pipeline when changes occur, add a webhook. For an example, see How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.
- Add a Docker host endpoint, which creates a container for the CI task, which multiple CI tasks can use. For more information about endpoints, see What are Endpoints in vRealize Automation Code Stream .
- Obtain the image URL, build host, and build image URL. For help, see your vRealize Automation Code Stream administrator.
- Verify that you use JUnit and JaCoCo for your test framework tools.
- Set up an external instance for your CI build: Jenkins, TFS, or Bamboo. The Kubernetes plug-in will deploy your code. For help, see your vRealize Automation Code Stream administrator.

Procedure

1. Follow the prerequisites.
2. To create the pipeline by using the smart template, open the CI smart template and fill out the form.
   a. Click **Pipelines > New Pipeline > Smart Template > Continuous Integration**.
   b. Answer the questions in the template about your source code repository, build toolsets, publishing tool, and the build image workspace.
   c. Add Slack or Email notifications for your team.
   d. To have the smart template create the pipeline, click **Create**.
   e. To make any further changes to the pipeline, click **Edit**, make your changes, and click **Save**.
   f. Enable the pipeline and run it.

3 To create the pipeline manually, add stages and tasks to the canvas, and have your native CI build information ready to configure the continuous integration (CI) task.

   a Click **Pipelines > New Pipeline > Blank Canvas**.

   b Click the stage, then drag the several CI tasks from the navigation pane to the stage.

   c To configure the CI task, click it, and click the **Task** tab.

   d Add the steps that continuously integrate your code.

   e Include the paths to the dependency artifacts.

   f Add the export location.

   g Add the test framework tools that you'll use.

   h Add the Docker host and build image.

   i Add the container registry, working directory, and cache.

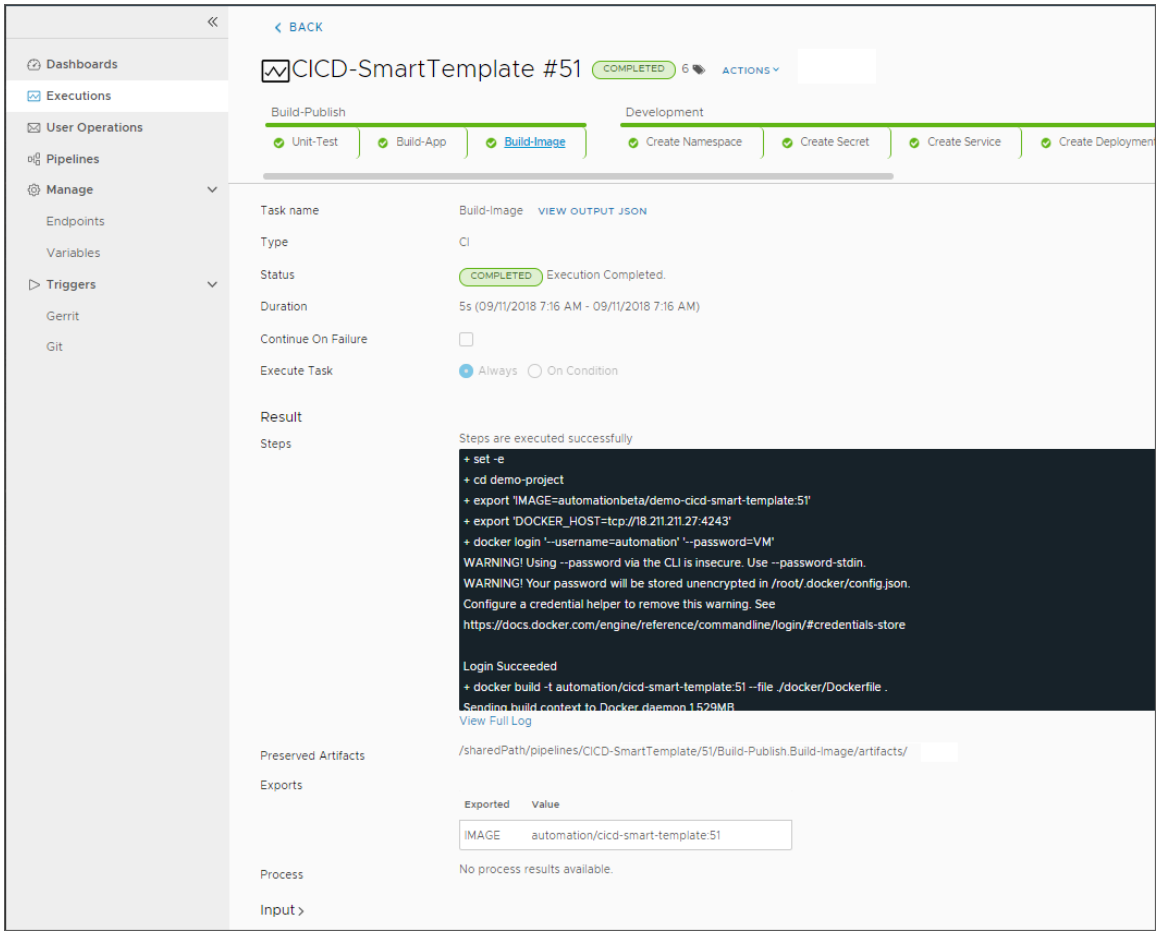
   j Save the pipeline, then enable it.

4 Make a change to your code in your GitHub or GitLab repository.

   The Git trigger activates your pipeline, which starts to run.

5 To verify that the code change triggered the pipeline, click **Triggers > Git > Activity**.

6 To view the execution for your pipeline, click **Executions**, and verify that the steps created and exported your build image.



7 To monitor the pipeline dashboard so that you can track KPIs and trends, click **Dashboards > Pipeline Dashboards**.

Results

Congratulations! You created a pipeline that continuously integrates your code from a GitHub or GitLab repository into your pipeline, and deploys your build image.

What to do next

To learn more, see More resources for vRealize Automation Code Stream Administrators and Developers.

How do I automate the release of an application that I deploy from a YAML blueprint in vRealize Automation Code Stream

As a developer, you need a pipeline that fetches an automation blueprint from an on-premises GitHub instance every time you commit a change. You need the pipeline to deploy a WordPress

application to either Amazon Web Services (AWS) EC2 or a data center. vRealize Automation Code Stream calls the blueprint from the pipeline and automates the continuous integration and continuous delivery (CICD) of that blueprint to deploy your application.

To create and trigger your pipeline, you'll need a blueprint.

For **Blueprint source** in your blueprint task, you can select either:

- **Cloud Assembly Blueprints** as the source control. In this case, you do not need a GitLab or GitHub repository.
- **Source Control** if you use GitLab or GitHub for source control. In this case, you must have a Git webhook and trigger the pipeline through the webhook.

If you have a YAML blueprint in your GitHub repository, and want to use that blueprint in your pipeline, here's what you'll need to do.

1 In vRealize Automation Cloud Assembly, push the blueprint to your GitHub repository.

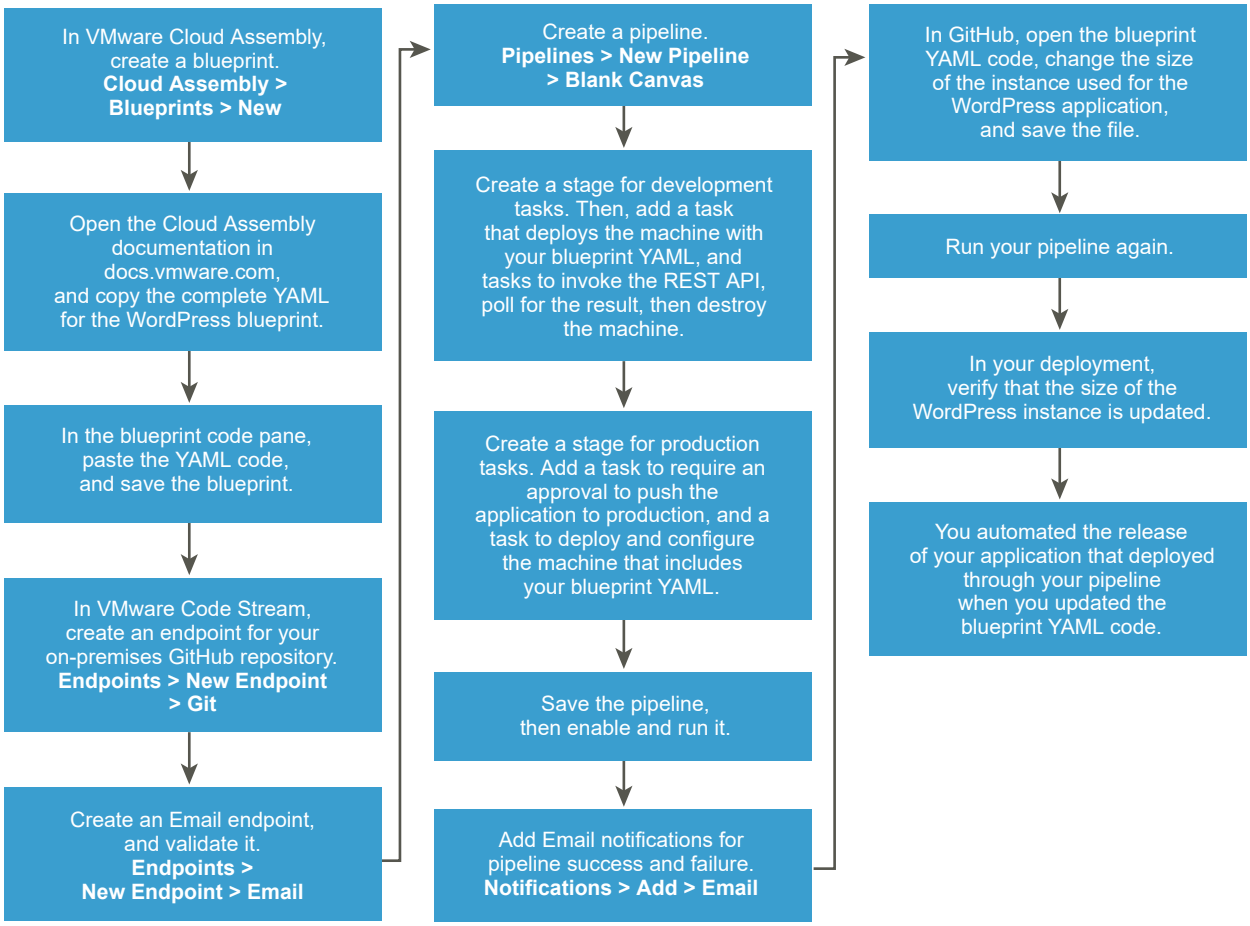
2 In vRealize Automation Code Stream, create a Git endpoint. Then, create a Git webhook that uses your Git endpoint and your pipeline.

3 To trigger your pipeline, update any file in your GitHub repository and commit your change.

If you don't have a YAML blueprint in your GitHub repository, and want to use a blueprint from source control, use this procedure to learn how. It shows you how to create a blueprint for a WordPress application, and trigger it from an on-premises GitHub repository. Whenever you make a change to the YAML blueprint, the pipeline triggers and automates the release of your application.

- In vRealize Automation Cloud Assembly, you'll add a cloud account, add a cloud zone, and create the blueprint.
- In vRealize Automation Code Stream, you'll add an endpoint for the on-premises GitHub repository that hosts your blueprint. Then, you'll add the blueprint to your pipeline.

This use case example shows you how to use a blueprint from an on-premises GitHub repository.



Prerequisites

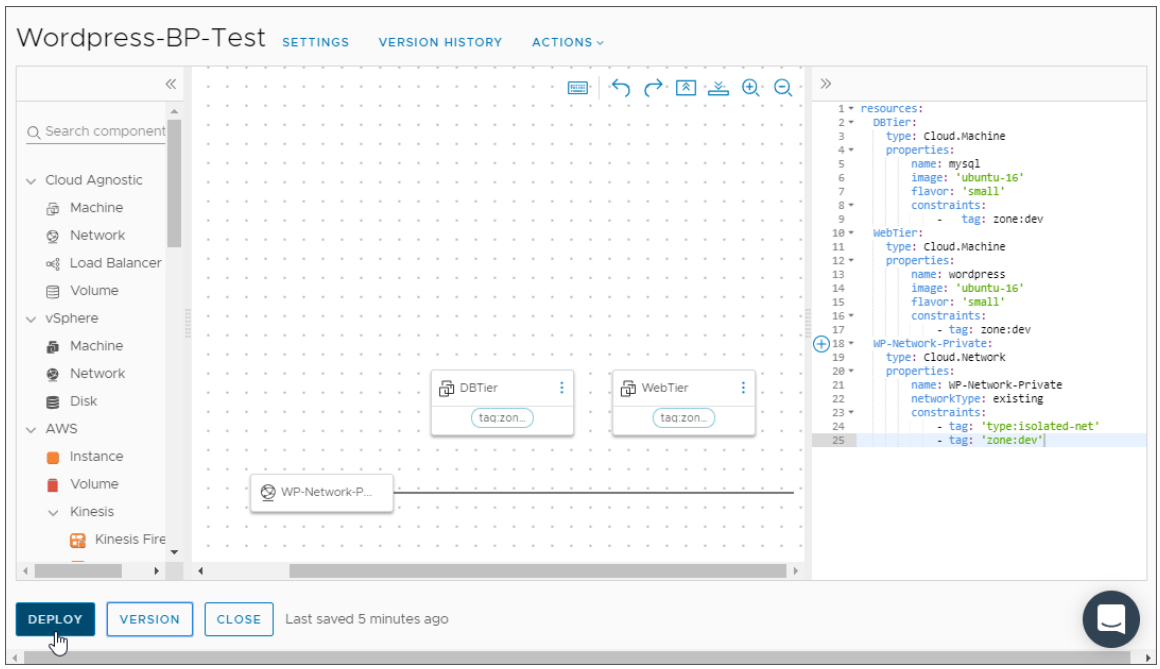
- Add a cloud account and a cloud zone in your vRealize Automation Cloud Assembly infrastructure. See the vRealize Automation Cloud Assembly documentation.
- To create your blueprint in the following procedure, copy the WordPress YAML code to your clipboard. See the blueprint YAML code in the WordPress use case in the vRealize Automation Cloud Assembly documentation.
- Add the YAML code for the WordPress application to your GitHub instance.
- Add a webhook for the Git trigger so that your pipeline can pull your YAML code whenever you commit changes to it. In vRealize Automation Code Stream, click **Triggers > Git > Webhooks for Git**.
- To work with a blueprint task, you must have any of the vRealize Automation Cloud Assembly roles.

Procedure

1 In vRealize Automation Cloud Assembly, follow these steps.

   a Click **Blueprints**, then create a blueprint and a deployment for the WordPress application.

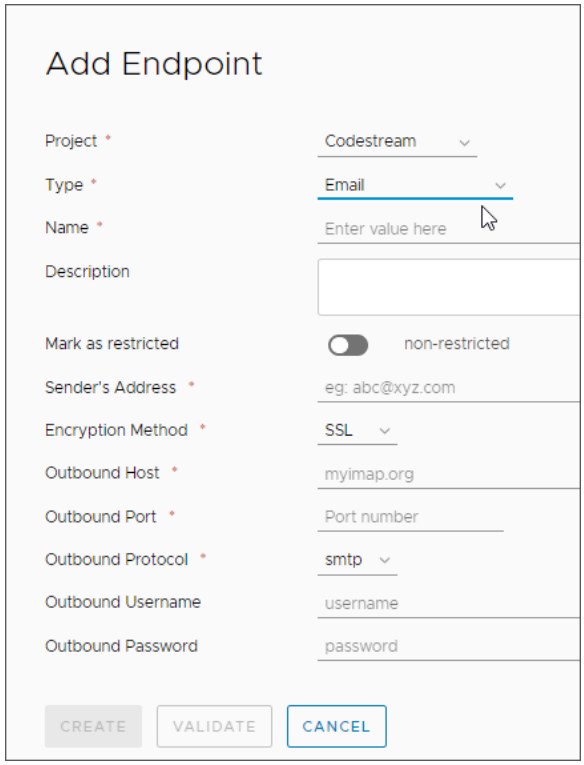
   b Paste the WordPress YAML code that you copied to your clipboard into your blueprint, and deploy it.



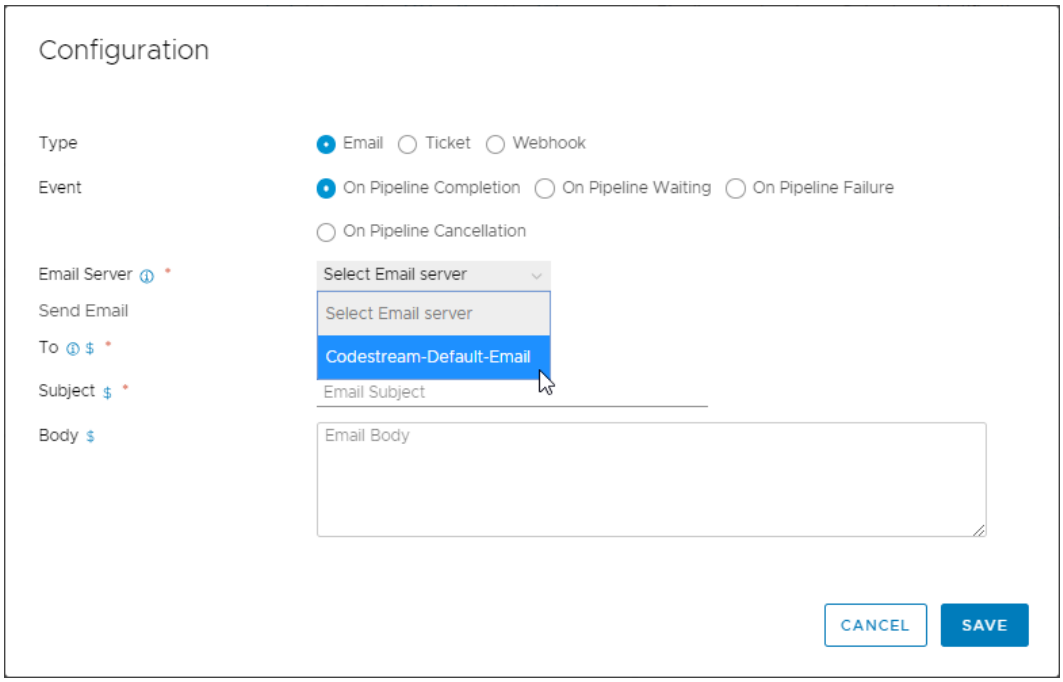
2 In vRealize Automation Code Stream, create endpoints.

a Create a Git endpoint for your on-premises GitHub repository where your YAML file resides.

b Add an Email endpoint to notify users about the pipeline status when it runs.



3 Create a pipeline, and add notifications for pipeline success and failure.



4 Add a stage for development, and add blueprint, REST, and POLL tasks.

a Add a Blueprint task that deploys the machine, and configure it to use the blueprint YAML for the Wordpress application.

```
resources:
  DBTier:
    type: Cloud.Machine
    properties:
        name: mysql
        image: 'ubuntu-16'
        flavor: 'small'
        constraints:
            -   tag: zone:dev
  WebTier:
    type: Cloud.Machine
    properties:
        name: wordpress
        image: 'ubuntu-16'
        flavor: 'small'
        constraints:
            - tag: zone:dev
 WP-Network-Private:
    type: Cloud.Network
    properties:
        name: WP-Network-Private
        networkType: existing
        constraints:
            - tag: 'type:isolated-net'
            - tag: 'zone:dev'
```

b Add a REST task that invokes the REST API, and runs a test on the machine that you deployed.

c Add a POLL task that sets the Poll REST API, and polls for the result of the test on the machine.

d Add a Blueprint task that destroys the machine to free up resources.

5 Add a stage for production, and include approval and deployment tasks.

a Add a User Operation task to require approval to push the Wordpress application to production.

b Add a Blueprint task to deploy the machine and configure it with the blueprint YAML for the Wordpress application.

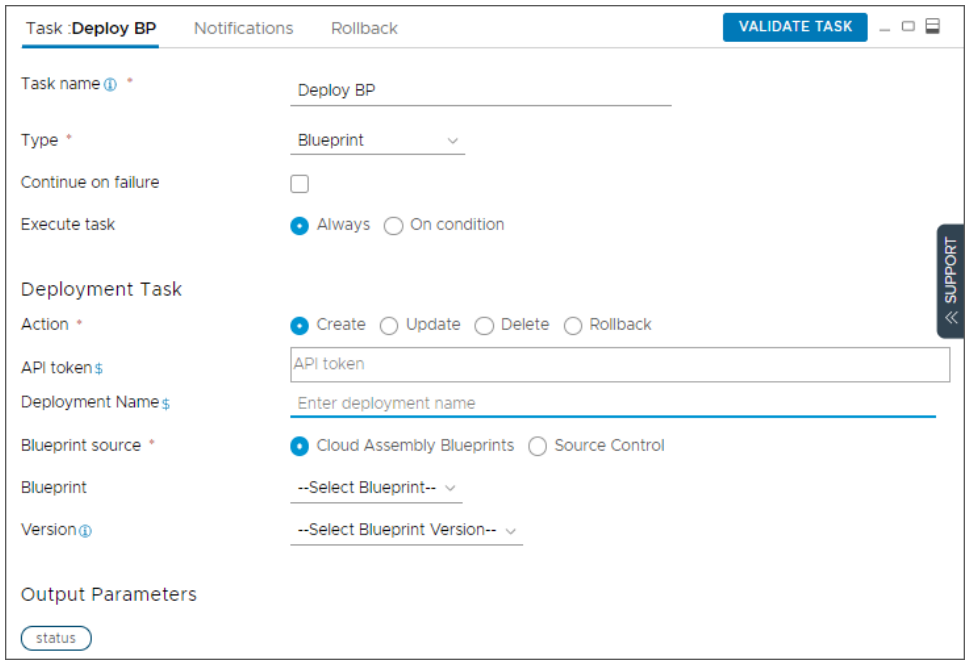
When you select **Create**, the deployment name must be unique. If you leave the name blank, vRealize Automation Code Stream will assign it a unique random name.

Here's what you need to know if you select **Rollback** in your own use case: If you select the **Rollback** action and enter a **Rollback Version**, the version must be in the form of **`n-X`**. For example, **`n-1`**, **`n-2`**, **`n-3`**, and so on. If you create and update the deployment in any location other than vRealize Automation Code Stream, rollback will not be allowed.

When you log in to vRealize Automation Code Stream, it gets a user token, which is valid for 30 minutes. For long-running pipeline durations, when the task prior to the blueprint task takes 30 minutes or more to run, the user token expires. As a result, the blueprint task fails.

To ensure that your pipeline can run longer than 30 minutes, you can enter an optional API token. When vRealize Automation Code Stream invokes the blueprint, the API token persists and the blueprint task continues to use the API token.

When you use the API token as a variable, it is encrypted. Otherwise, it is used as plain text.



6 Run the pipeline and verify that the tasks succeed.

7 In GitHub, modify the flavor of the Wordpress server instance from `small` to `medium`.

When you commit changes, the pipeline triggers. It pulls your updated code from the GitHub repository and builds your application.

```
WebTier:
    type: Cloud.Machine
    properties:
        name: wordpress
        image: 'ubuntu-16'
        flavor: 'medium'
        constraints:
            - tag: zone:dev
```

8 Run the pipeline again, verify that it succeeded, and that it changed the flavor of the Wordpress instance from `small` to `medium`.

Results

Congratulations! You automated the release of your application that you deployed from a YAML blueprint.

What to do next

To learn more about how you can use vRealize Automation Code Stream, see Chapter 3 Ways to use vRealize Automation Code Stream.

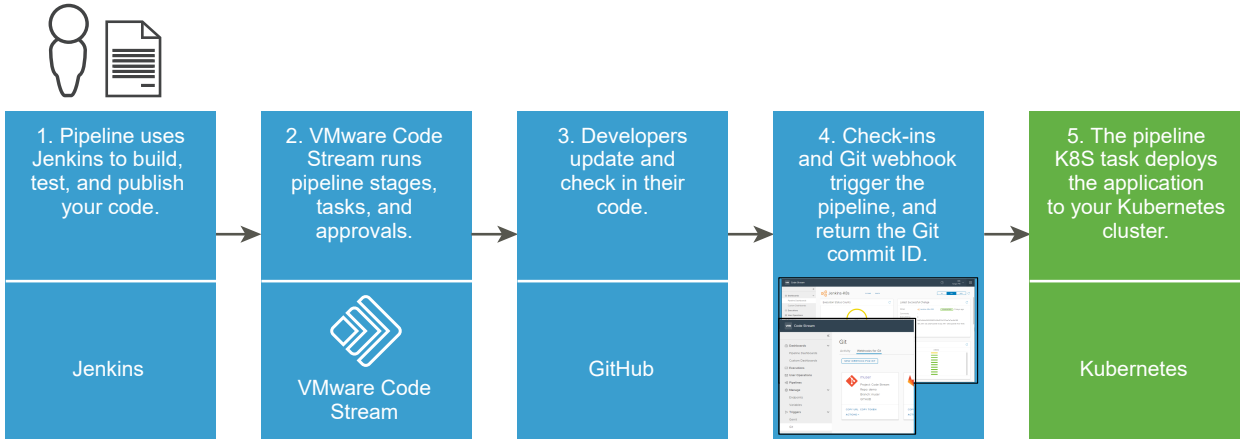
For additional references, see More resources for vRealize Automation Code Stream Administrators and Developers.

How do I automate the release of an application in vRealize Automation Code Stream to a Kubernetes cluster

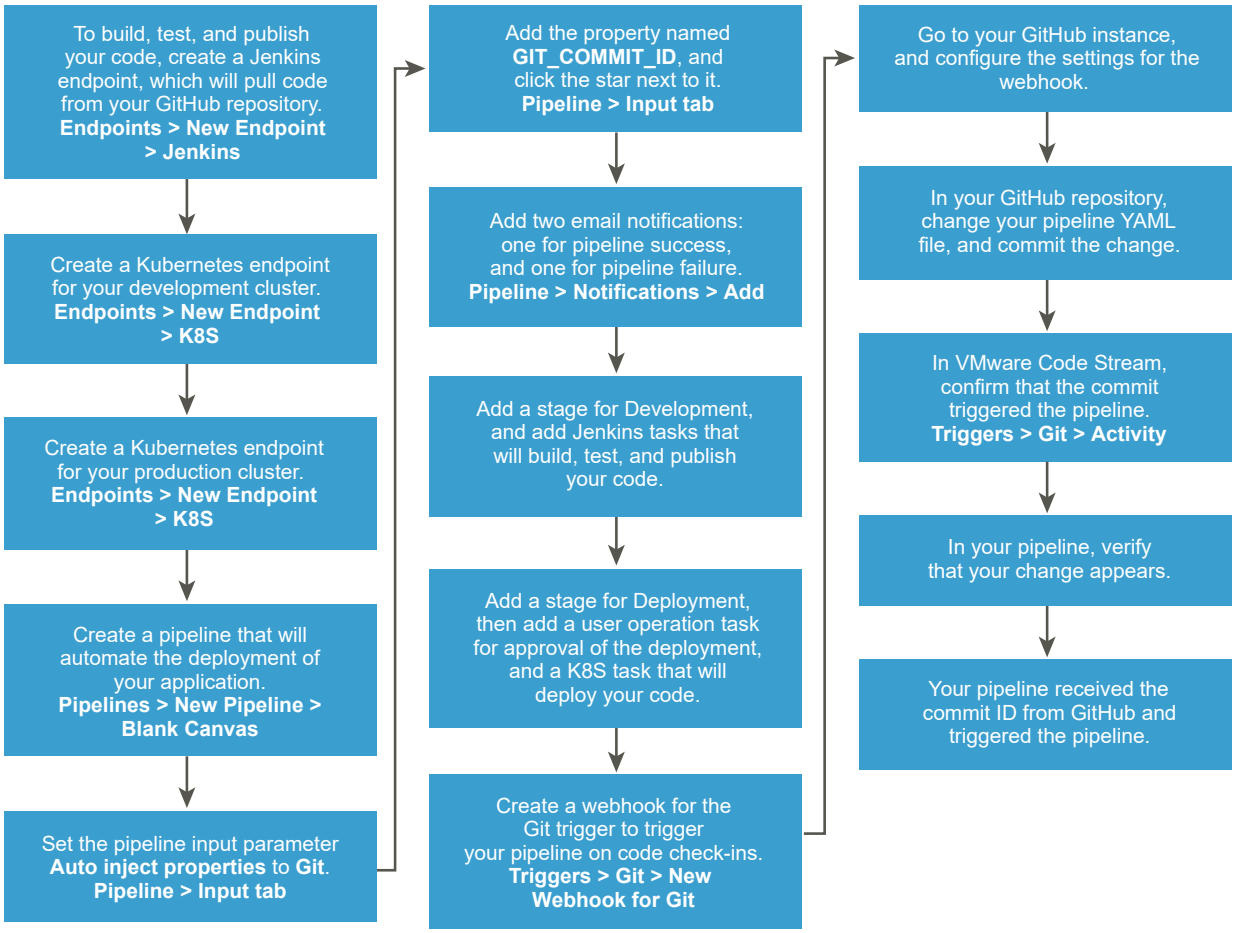
As a DevOps Administrator or developer, you can use vRealize Automation Code Stream and VMware Cloud PKS to automate the deployment of your software applications to a Kubernetes cluster. This use case mentions other methods that you can use to automate the release of your application.

In this use case, you will create a pipeline that includes two stages, and will use Jenkins to build and deploy your application.

- The first stage is for development. It uses Jenkins to pull your code from a branch in your GitHub repository, then build, test, and publish it.
- The second stage is for deployment. It runs a user operation task that requires approval from key users before the pipeline can deploy your application to your Kubernetes cluster.



The development tools, deployment instances, and pipeline YAML file must be available so that your pipeline can build, test, publish, and deploy your application. The pipeline will deploy your application to development and production instances of Kubernetes clusters on AWS.



Other methods that automate the release of your application:

- Instead of using Jenkins to build your application, you can use the vRealize Automation Code Stream native build capability and a Docker build host.

- Instead of deploying your application to a Kubernetes cluster, you might deploy it to an Amazon Web Services (AWS) cluster.

For more information about using the vRealize Automation Code Stream native build capability and a Docker host, see:

- Planning a CICD native build in vRealize Automation Code Stream before using the smart template
- Planning a CICD native build in vRealize Automation Code Stream before manually adding tasks

Prerequisites

- Verify that the application code to be deployed resides in a working GitHub repository.
- Verify that you have a working instance of Jenkins.
- Verify that you have a working email server.
- In vRealize Automation Code Stream, create an email endpoint that connects to your email server.
- Set up two Kubernetes clusters on Amazon Web Services (AWS), for development and production, where your pipeline will deploy your application.
- Verify that the GitHub repository contains the YAML code for your pipeline, and alternatively a YAML file that defines the metadata and specifications for your environment.

Procedure

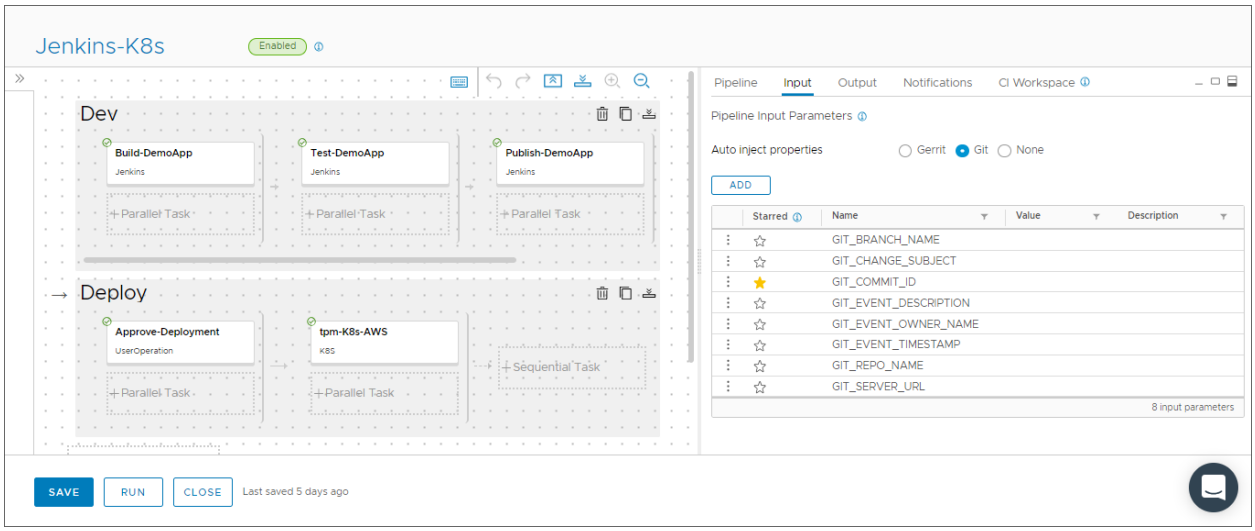
1. In vRealize Automation Code Stream, click **Endpoints > New Endpoint**, and create a Jenkins endpoint that you will use in your pipeline to pull code from your GitHub repository.
2. To create Kubernetes endpoints, click **New Endpoint**.
   a. Create an endpoint for your development Kubernetes cluster.
   b. Create an endpoint for your production Kubernetes cluster.

3 Create a pipeline that deploys a container of your application, such as Wordpress, to your development Kubernetes cluster, and set the input properties for the pipeline.

a To allow your pipeline to recognize a code commit in GitHub that will trigger the pipeline, in the pipeline click the **Input** tab and select **Auto inject properties**.

b Add the property named **GIT_COMMIT_ID**, and click the star to it.

When the pipeline runs, the pipeline execution will display the commit ID that the Git trigger returns.

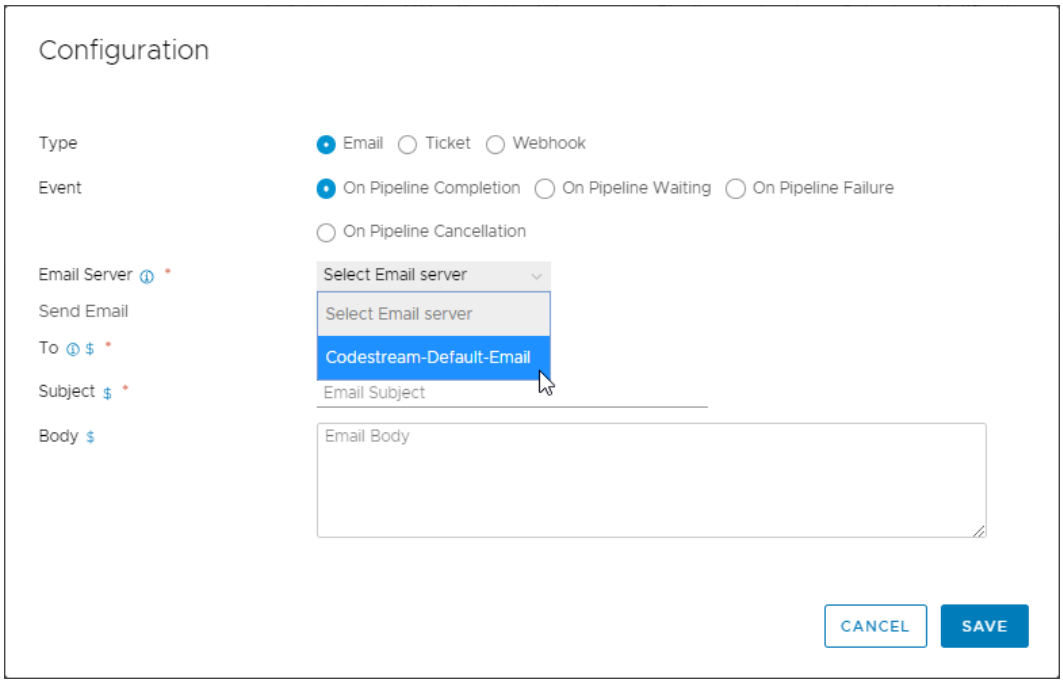


4 Add notifications to send an Email when the pipeline succeeds or fails.

a In the pipeline, click the **Notifications** tab, and click **Add**.

b To add an email notification when the pipeline finishes running, select **Email**, and select **On Pipeline Completion**. Then, select the email server, enter email addresses, and click **Save**.

c To add another email notification for a pipeline failure, select **On Pipeline Failure**, and click **Save**.

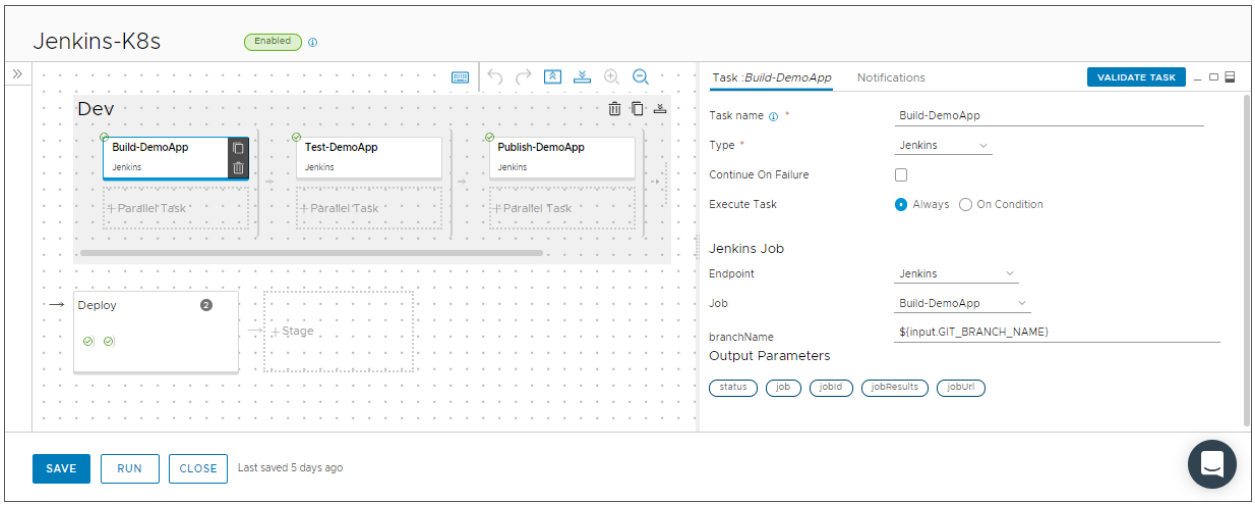


5 Add a development stage to your pipeline, and add tasks that build, test, and publish your application. Then, validate each task.

a To build your application, add a Jenkins task that uses the Jenkins endpoint, and runs a build job from the Jenkins server. Then, for the pipeline to pull your code, enter the Git branch in this form: **`${input.GIT_BRANCH_NAME}`**

b To test your application, add a Jenkins task that uses the same Jenkins endpoint, and runs a test job from the Jenkins server. Then, enter the same Git branch.

c To publish your application, add a Jenkins task that uses the same Jenkins endpoint, and runs a publish job from the Jenkins server. Then, enter the same Git branch.

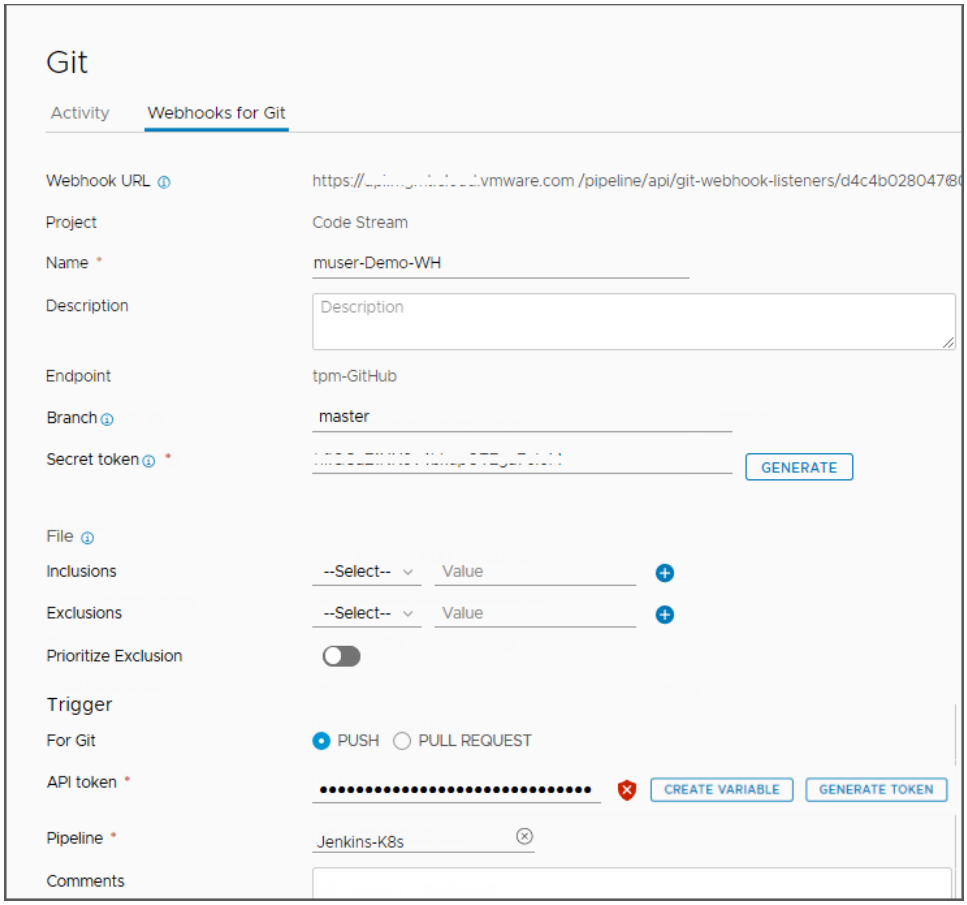


6 Add a deployment stage to your pipeline, then add a task that requires an approval for deployment of your application, and another task that deploys the application to your Kubernetes cluster. Then, validate each task.

a To require an approval on the deployment of your application, add a User Operation task, add Email addresses for the users who must approve it, and enter a message. Then, enable **Send email**.

b To deploy your application, add a Kubernetes task. Then, in the Kubernetes task properties, select your development Kubernetes cluster, select the **Create** action, and select the **Local Definition** payload source. Then select your local YAML file.

7 Add a Git webhook that enables vRealize Automation Code Stream to use the Git trigger, which triggers your pipeline when developers commit their code.



8 To test your pipeline, go to your GitHub repository, update your application YAML file, and commit the change.

a In vRealize Automation Code Stream, verify that the commit appears.

a Click **Triggers > Git > Activity**.

b Look for the trigger of your pipeline.

c Click **Dashboards > Pipeline Dashboards**.

d On your pipeline dashboard, find the GIT_COMMIT_ID in the latest successful change area.

9 Check your pipeline code and verify that the change appears.

Results

Congratulations! You automated the deployment of your software application to your Kubernetes cluster.

Example: Example pipeline YAML that deploys an application to a Kubernetes cluster

For the type of pipeline used in this example, the YAML resembles the following code:

```
apiVersion: v1
kind: Namespace
metadata:
  name: ${input.GIT_BRANCH_NAME}
  namespace: ${input.GIT_BRANCH_NAME}
---
apiVersion: v1
data:
  .dockercfg:
eyJzeW1waG9ueS10YW5nby1iZXRhMi5qZnJvZy5pbyI6eyJ1c2VybmFtZSI6InRhbmdvLWJldGEyIiwicGFzc3dvcmQiOi
JhRGstcmVOLW1UQi1IejciLCJlbWFpbCI6InRhbmdvLWJldGEyQHZtd2FyZS5jb20iLCJhdXRoIjoiZEdGdVoyOHRZbVYw
WVRJNllVUnJMWEpsVGkxdFZFSXRTSG8zIn19
kind: Secret
metadata:
  name: jfrog
  namespace: ${input.GIT_BRANCH_NAME}
type: kubernetes.io/dockercfg
---
apiVersion: v1
kind: Service
metadata:
  name: codestream
  namespace: ${input.GIT_BRANCH_NAME}
  labels:
    app: codestream
spec:
  ports:
    - port: 80
  selector:
    app: codestream
    tier: frontend
  type: LoadBalancer
---
apiVersion: extensions/v1
kind: Deployment
metadata:
  name: codestream
  namespace: ${input.GIT_BRANCH_NAME}
  labels:
    app: codestream
spec:
  selector:
    matchLabels:
      app: codestream
      tier: frontend
  strategy:
    type: Recreate
  template:
    metadata:
```

```
      labels:
        app: codestream
        tier: frontend
    spec:
      containers:
      - name: codestream
        image: cas.jfrog.io/codestream:${input.GIT_BRANCH_NAME}-${Dev.PublishApp.output.jobId}
        ports:
        - containerPort: 80
          name: codestream
      imagePullSecrets:
      - name: jfrog
```

What to do next

To deploy your software application to your production Kubernetes cluster, perform the steps again and select your production cluster.

To learn more about integrating vRealize Automation Code Stream with Jenkins, see How do I integrate vRealize Automation Code Stream with Jenkins.

How do I deploy my application in vRealize Automation Code Stream to my Blue-Green deployment

Blue-Green is a deployment model that uses two Docker hosts that you deploy and configure identically in a Kubernetes cluster. With the Blue and Green deployment model, you reduce the downtime that can occur in your environment when your pipelines in vRealize Automation Code Stream deploy your applications.

The Blue and Green instances in your deployment model each serve a different purpose. Only one instance at a time accepts the live traffic that deploys your application, and each instance accepts that traffic at specific times. The Blue instance receives the first version of your application, and the Green instance receives the second.

The load balancer in your Blue-Green environment determines which route the live traffic takes as it deploys your application. By using the Blue-Green model, your environment remains operational, users don't notice any downtime, and your pipeline continuously integrates and deploys your application to your production environment.

The pipeline that you create in vRealize Automation Code Stream represents your Blue-Green deployment model in two stages. One stage is for development, and the other stage is for production.

Table 3-2. Development stage tasks for Blue-Green deployment

Task type	Task
Kubernetes	Create a namespace for your Blue-Green deployment.
Kubernetes	Create a secret key for Docker Hub.

Table 3-2. Development stage tasks for Blue-Green deployment (continued)

Task type	Task
Kubernetes	Create the service used to deploy the application.
Kubernetes	Create the Blue deployment.
Poll	Verify the Blue deployment.
Kubernetes	Remove the namespace.

Table 3-3. Production stage tasks for Blue-Green deployment

Task type	Task
Kubernetes	Green gets the service details from Blue.
Kubernetes	Get the details for the Green replica set.
Kubernetes	Create the Green deployment, and use the secret key to pull the container image.
Kubernetes	Update the service.
Poll	Verify that the deployment succeeded on the production URL.
Kubernetes	Finish the Blue deployment.
Kubernetes	Remove the Blue deployment.

To deploy your application in your own Blue-Green deployment model, you create a pipeline in vRealize Automation Code Stream that includes two stages. The first stage includes the Blue tasks that deploy your application to the Blue instance, and the second stage includes Green tasks that deploy your application to the Green instance.

You can create your pipeline by using the CICD smart template. The template creates your pipeline stages and tasks for you, and includes the deployment selections.

If you create your pipeline manually, you must plan your pipeline stages. For an example, see Planning a CICD native build in vRealize Automation Code Stream before manually adding tasks.

In this example, you use the CICD smart template to create your Blue-Green pipeline.

Prerequisites

- Verify that you can access a working Kubernetes cluster on AWS.
- Verify that you set up a Blue-Green deployment environment, and configured your Blue and Green instances to be identical.
- Create a Kubernetes endpoint in vRealize Automation Code Stream that deploys your application image to the Kubernetes cluster on AWS.
- Familiarize yourself with using the CICD smart template. See Planning a CICD native build in vRealize Automation Code Stream before using the smart template.

Procedure

1 Click **Pipelines > New Pipeline > Smart Templates > CI/CD template**.

2 Enter the information for the CI portion of the CICD smart template, and click **Next**.

For help, see Planning a CICD native build in vRealize Automation Code Stream before using the smart template.

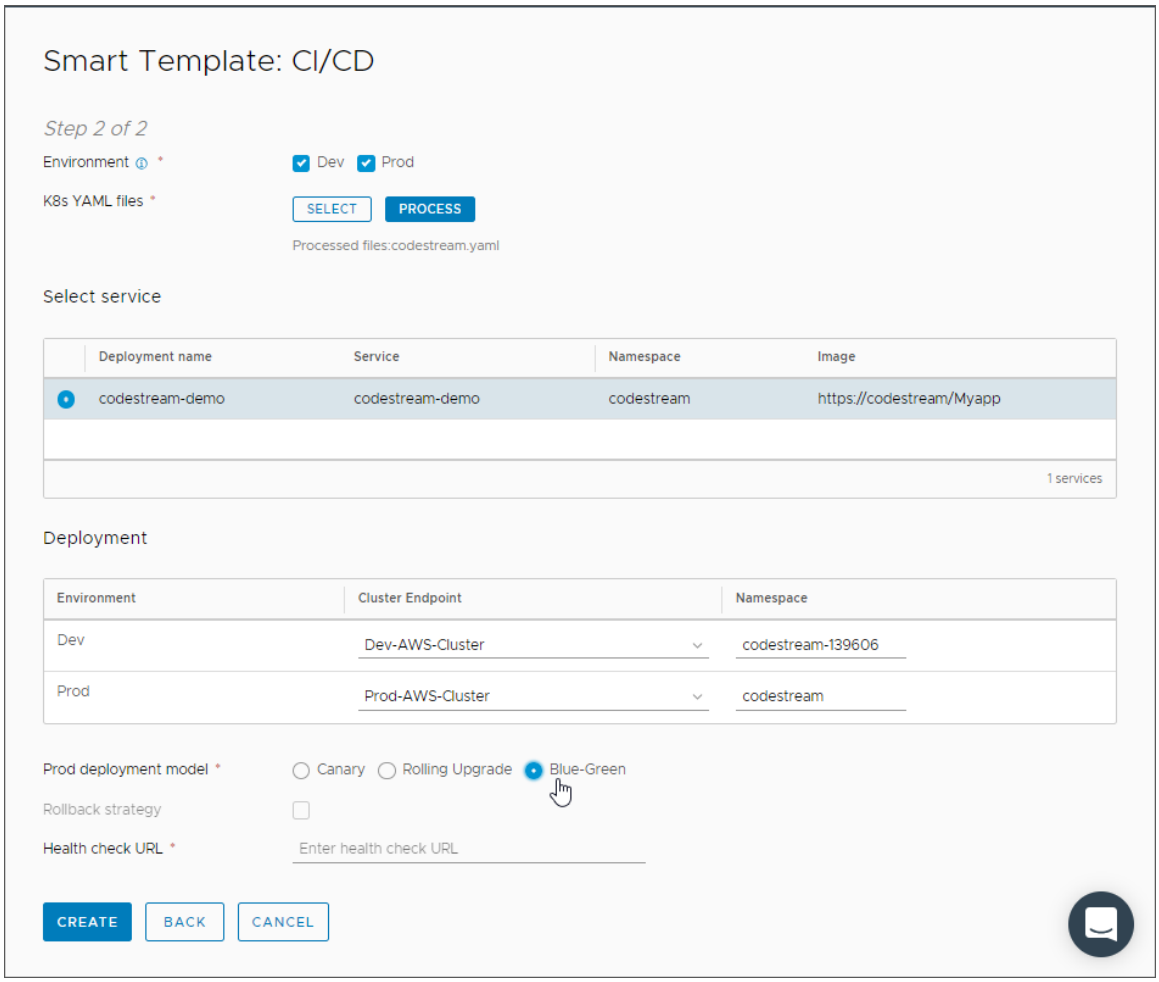
3 Complete the CD portion of the smart template

a Select the environments for your application deployment. For example, **Dev** and **Prod**.

b Select the service that the pipeline will use for the deployment.

c In the Deployment area, select the cluster endpoint for the Dev and Prod environments.

d For the Production deployment model, select **Blue-Green**, and click **Create**.



Results

Congratulations! You used the smart template to create a pipeline that deploys your application to your Blue-Green instances in your Kubernetes production cluster on AWS.

Example: Example YAML code for some Blue-Green Deployment Tasks

The YAML code that appears in Kubernetes pipeline tasks for your Blue-Green deployment might resemble the following examples. After the smart template creates your pipeline, you can modify the tasks as needed for your own deployment.

YAML code to create an example namespace:

```
apiVersion: v1
kind: Namespace
metadata:
  name: codestream-82855
  namespace: codestream-82855
```

YAML code to create an example service:

```
apiVersion: v1
kind: Service
metadata:
  labels:
    app: codestream-demo
  name: codestream-demo
  namespace: bluegreen-799584
spec:
  minReadySeconds: 0
  ports:
  - port: 80
  selector:
    app: codestream-demo
    tier: frontend
  type: LoadBalancer
```

YAML code to create an example deployment:

```
apiVersion: extensions/v1
kind: Deployment
metadata:
  labels:
    app: codestream-demo
  name: codestream-demo
  namespace: bluegreen-799584
spec:
  minReadySeconds: 0
  replicas: 1
  selector:
    matchLabels:
      app: codestream-demo
      tier: frontend
  template:
    metadata:
      labels:
        app: codestream-demo
        tier: frontend
```

```
    spec:
      containers:
      - image: ${input.image}:${input.tag}
        name: codestream-demo
        ports:
        - containerPort: 80
          name: codestream-demo
      imagePullSecrets:
      - name: jfrog-2
      minReadySeconds: 0
```

What to do next

To learn more about how you can use vRealize Automation Code Stream, see Chapter 3 Ways to use vRealize Automation Code Stream.

To roll back a deployment, see How do I roll back my deployment in vRealize Automation Code Stream.

For additional references, see More resources for vRealize Automation Code Stream Administrators and Developers.

How do I integrate my own build, test, and deploy tools with vRealize Automation Code Stream

As a DevOps administrator or developer, you can create custom scripts that extend the capability of vRealize Automation Code Stream. With your script, you can integrate vRealize Automation Code Stream with your own Continuous Integration (CI) and Continuous Delivery (CD) tools and APIs that build, test, and deploy your applications. Custom scripts are especially useful if you do not expose your application APIs publicly.

Your custom script can do almost anything you need to integrate with your build, test, and deploy tools. For example, it can work with the workspace in your pipeline to support CI tasks that build and test your application, and CD tasks that deploy your application. It can send a message to Slack when a pipeline finishes, and much more.

You write your custom script in one of the supported languages. In the script, you include your business logic, and define inputs and outputs. Output types can include number, string, text, and password.

You have your pipeline run your script in a custom task. The scripts that you create reside in your vRealize Automation Code Stream instance.

When a pipeline uses a custom integration, if you attempt to delete the custom integration, an error message appears and indicates that you cannot delete it.

Table 3-4. What you do after you write your custom script

What you do...	More information about this action...
Add a custom task to your pipeline.	The custom task: ■ Runs on the same container as other CI tasks in your pipeline. ■ Includes input and output variables that your script populates before the pipeline runs the custom task. ■ Supports multiple data types and various types of meta data that you define as inputs and outputs in your script.
Select your script in the custom task.	You declare the input and output properties in the script.
Save your pipeline, then enable and run it.	When the pipeline runs, the custom task calls your script and runs the business logic in it, which integrates your build, test, and deploy tool with vRealize Automation Code Stream.
After your pipeline runs, look at the executions.	Verify that the pipeline delivered the results you expected.

This example creates a custom integration that connects vRealize Automation Code Stream to your Slack instance, and posts a message to a Slack channel.

Prerequisites

- To write your custom script, verify that you have one of these languages: Python 2, Python 3, Node.js, or any of these shell languages: Bash, sh, or zsh.
- Generate a container image by using the Node.js or Python runtime that is installed.

Procedure

1 Create the custom integration.

   a Click **Custom Integrations > New**, and enter a relevant name.

   b Select the preferred runtime environment.

   c Click **Create**.

   Your script opens, and displays the code, which includes the required runtime environment. For example, `runtime: "nodejs"`. The script must include the runtime, which the builder image uses, so that the custom task that you add to your pipeline succeeds when the pipeline runs. Otherwise, the custom task fails.

2 Declare the input properties in your script by using the available data types and meta data.

   The input properties are passed in as context to your script in the `code:` section of the YAML.

Table 3-5. Supported data types and meta data for custom scripts

Supported data types	Supported meta data for input
■ String ■ Text ■ List: as a list of any type ■ Map: as map[string]any ■ Secure: rendered as password text box, encrypted when you save the custom task ■ Number ■ Boolean: appears as text boxes ■ URL: same as string, with additional validation ■ Selection, radio button	■ type: One of String | Text ... ■ default: Default value ■ options: List or a map of options, to be used with selection or radio button ■ min: Minimum value or size ■ max: Maximum value or size ■ title: Detailed name of the text box ■ placeHolder: UI placeholder ■ description: Becomes a tool tip

For example:

```
inputProperties:
        - name: message
          type: text
          title: Message
          placeHolder: Message for Slack Channel
          defaultValue: Hello Slack
          bindable: true
          labelInfo: true
          labelMessage: This message is posted to the Slack channel link provided in the
code
```

3 Declare the output properties in your script.

The script captures output properties from the business logic `code:` section of your script, where you declare the context for the output.

When the pipeline runs, you can enter the response code for the task output. For example, **200**.

For example:

```
outputProperties:
  - name: statusCode
    type: label
    title: Status Code
```

4 To interact with the input and output of your custom script, get an input property or set an output property by using **`context`**.

For an input property: `(context.getInput("key"))`

For an output property: `(context.setOutput("key", "value"))`

For Node.js:

```
var context = require("./context.js")
var message = context.getInput("message");
//Your Business logic
context.setOutput("statusCode", 200);
```

For Python:

```
from context import getInput, setOutput
message = getInput('message')
//Your Business logic
setOutput('statusCode', '200')
```

For Shell:

```
# Input, Output properties are environment variables
echo ${message} # Prints the input message
//Your Business logic
export statusCode=200 # Sets output property statusCode
```

5 In the `code:` section, declare all the business logic for your custom integration.

For example, with the Node.js runtime environment:

```
code: |
    var https = require('https');
    var context = require("./context.js")

    //Get the entered message from task config page and assign it to message var
    var message = context.getInput("message");
    var slackPayload = JSON.stringify(
        {
            text: message
        });

    const options = {
        hostname: 'hooks.slack.com',
        port: 443,
        path: '/YOUR_SLACK_WEBHOOK_PATH',
        method: 'POST',
        headers: {
            'Content-Type': 'application/json',
            'Content-Length': Buffer.byteLength(slackPayload)
        }
    };

    // Makes a https request and sets the output with statusCode which
    // will be displayed in task result page after execution
    const req = https.request(options, (res) => {
        context.setOutput("statusCode", res.statusCode);
    });

    req.on('error', (e) => {
```

```
        console.error(e);
    });
    req.write(slackPayload);
    req.end();
```

6 Before you version and release your custom integration script, download the context file for Python or Node.js and test the business logic that you included in your script.

   a Place the cursor in the script, then click the context file button at the top of the canvas. For example, if your script is in Python click **CONTEXT.PY**.

   b Modify the file and save it.

   c On your development system, run and test your custom script with the help of the context file.

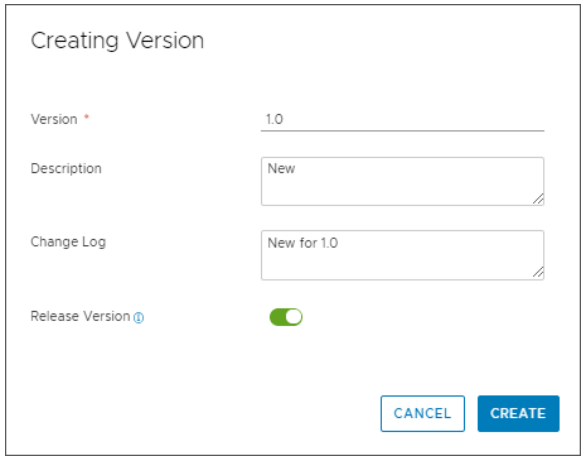
7 Apply a version to your custom integration script.

   a Click **Version**.

   b Enter the version information.

   c Click **Release Version** so that you can select the script in your custom task.

   d To create the version, click **Create**.

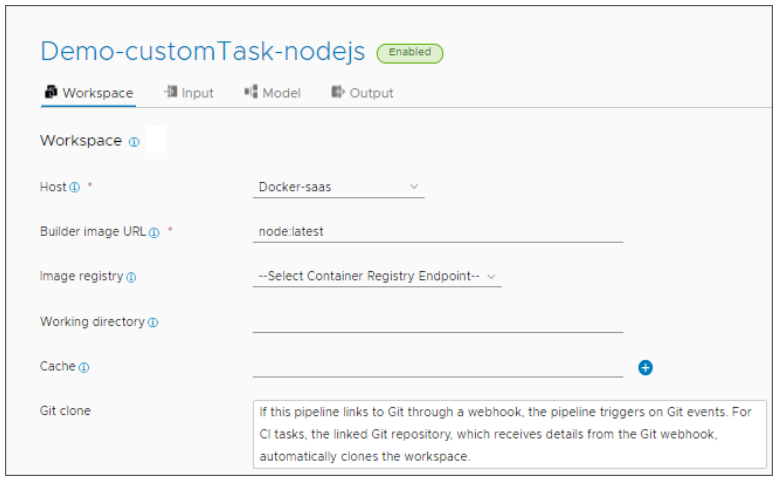


8 To save the script, click **Save**.

9 In your pipeline, configure the workspace.

a Click the **Workspace** tab.

b Select the Docker host and the builder image URL.



10 Add a custom task to your pipeline, and configure it.

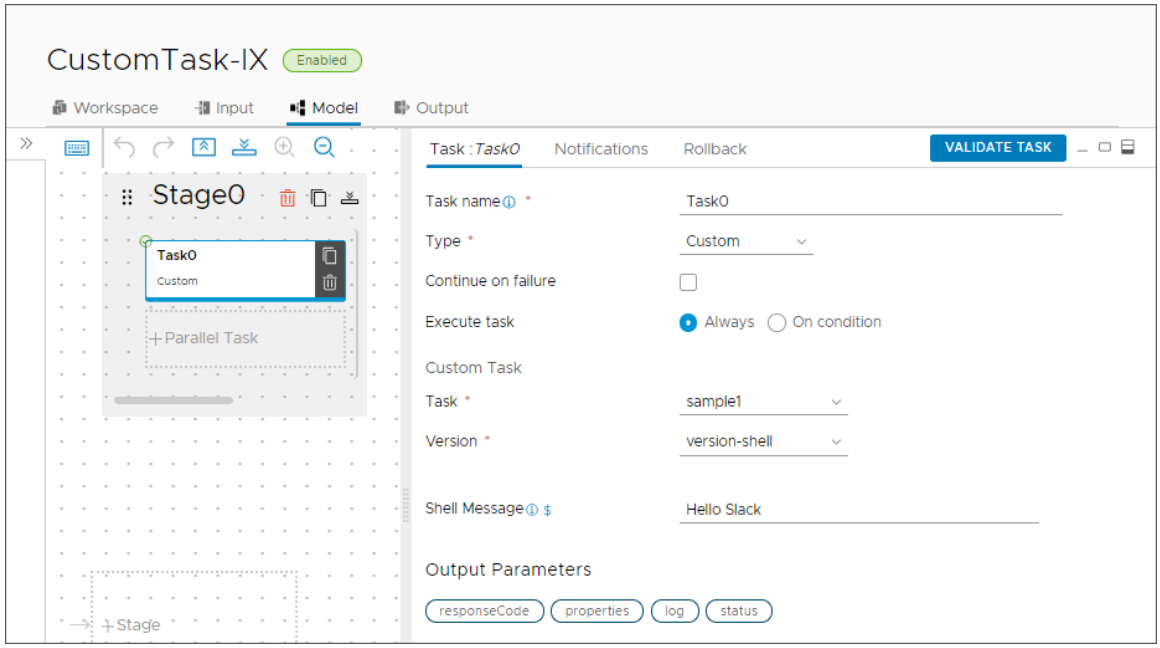
a Click the **Model** tab.

b Add a task, select the type as **Custom**, and enter a relevant name.

c Select your custom integration script and version.

d To display a custom message in Slack, enter the message text.

Any text you enter overrides the `defaultValue` in your custom integration script. For example:



11 Save and enable your pipeline.

a Click **Save**.

b On the Pipeline tab, click **Enable pipeline** so that the circle moves to the right.

12 Run your pipeline.

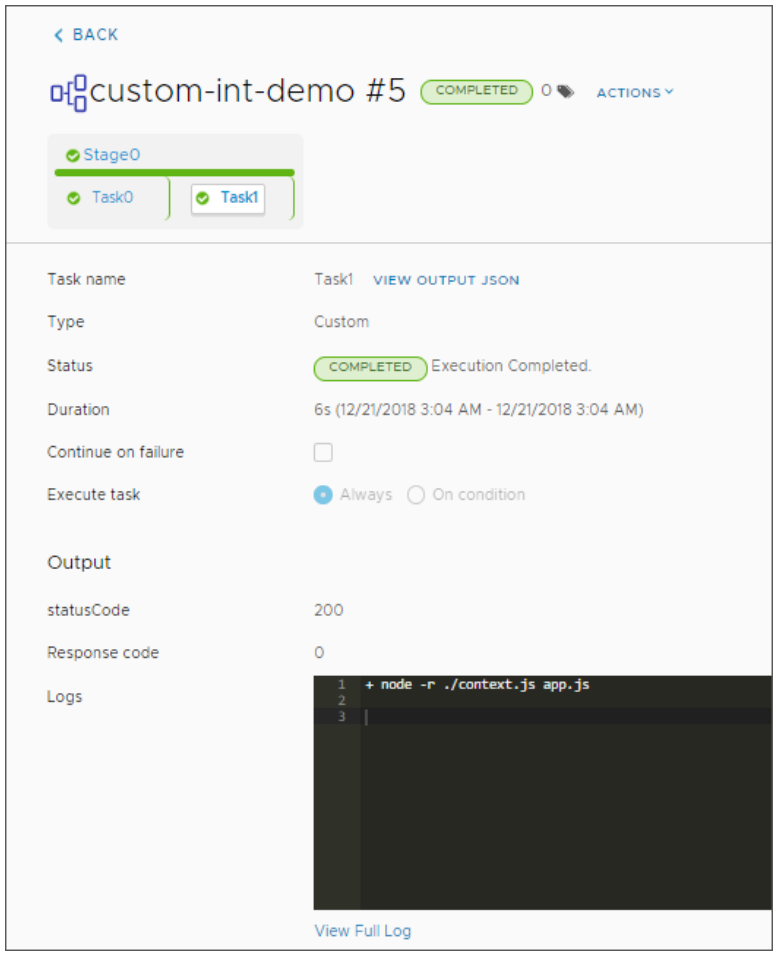
a Click **Run**.

b Look at the pipeline execution.

c Confirm that the output includes the expected status code, response code, status, and declared output.

You defined **statusCode** as an output property. For example, a **statusCode** of `200` might indicate a successful Slack post, and a **responseCode** of `0` might indicate that the script succeeded without error.

d To confirm the output in the execution logs, click **Executions**, click the link to your pipeline, click the task, and look at the logged data. For example:



13 If an error occurs, troubleshoot the problem and run the pipeline again.

For example, if a file or module in the base image is missing, you must create another base image that includes the missing file. Then, provide the Docker file, and push the image through the pipeline.

Results

Congratulations! You created a custom integration script that connects vRealize Automation Code Stream to your Slack instance, and posts a message to a Slack channel.

What to do next

Continue to create custom integrations to support using custom tasks in your pipelines, so that you can extend the capability of vRealize Automation Code Stream in the automation of your software release lifecycle.

How do I use a REST API to integrate vRealize Automation Code Stream with other applications

vRealize Automation Code Stream provides a REST plug-in, which allows you to integrate vRealize Automation Code Stream with other applications that use a REST API so that you can continuously develop and deliver software applications that must interact with each other. The REST plug-in invokes an API, which sends and receives information between vRealize Automation Code Stream and another application.

With the REST plug-in, you can:

- Integrate external REST API-based systems into a vRealize Automation Code Stream pipeline.
- Integrate a vRealize Automation Code Stream pipeline as part of the flow of external systems.

The REST plug-in works with any REST API, and supports GET, POST, PUT, PATCH, and DELETE methods to send or receive information between vRealize Automation Code Stream and other applications.

Table 3-6. Preparing a pipeline to communicate over the REST API

What you do...	What happens...
Add a REST task to your pipeline.	The REST task communicates information between applications, and can provide status information for a successive task in the pipeline stage.
In the REST task, select the REST action and include the URL.	The pipeline task calls the URL when the pipeline runs. For POST, PUT, and PATCH actions, you must include a payload. In the payload, you can bind your pipeline and task properties when the pipeline runs.
Consider this example.	Example use of the REST plug-in: You can add a REST task to create a tag on a Git commit for a build, and have the task post a request to get the check-in ID from the repository. The task can send a payload to your repository and create a tag for the build, and the repository can return the response with the tag.

Similar to using the REST plug-in to invoke an API, you can include a Poll task in your pipeline to invoke a REST API and poll it until it completes and the pipeline task meets the exit criteria.

You can also use REST APIs to import and export a pipeline, and use the example scripts to run a pipeline.

This procedure gets a simple URL.

Procedure

1 To create a pipeline, click **Pipelines > New Pipeline > Blank Canvas**.

2 In your pipeline stage, click **+ Sequential Task**.

3 In the task pane, add the REST task:

   a Enter a name for the task.

   b In the Type drop-down menu, select **REST**.

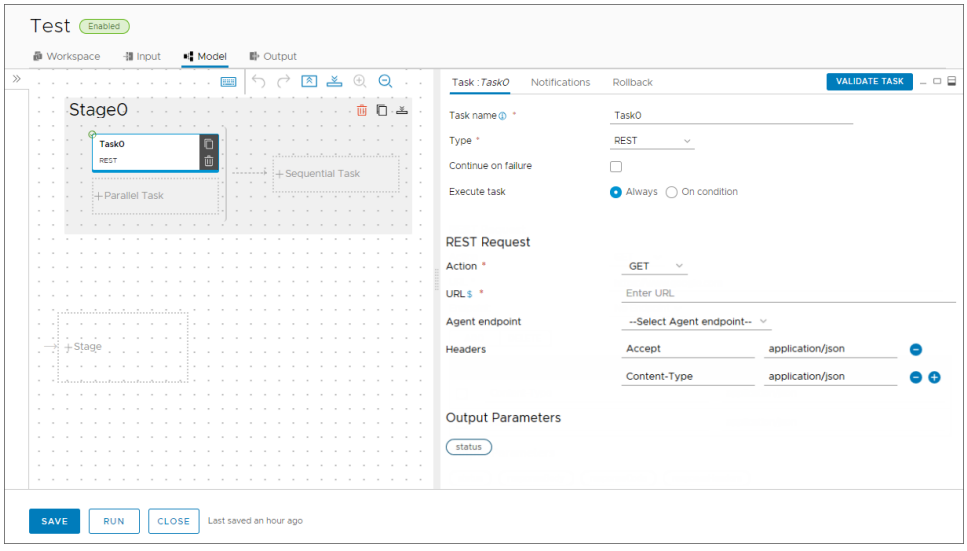
   c In the REST Request area, select **GET**.

   To have the REST task request data from another application, you select the GET method. To send data to another application, you select the POST method.

   d Enter the URL that identifies the REST API endpoint. For example, `https://www.google.com`.

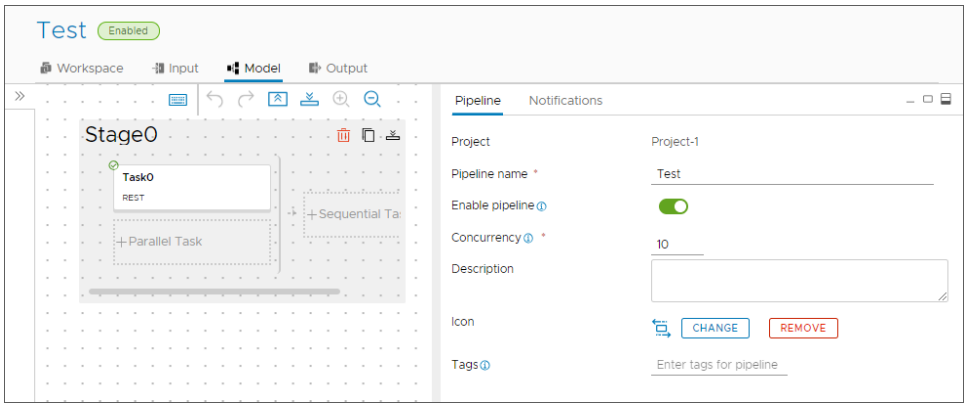
   For a REST task to import data from another application, you can include the payload variable. For example, for an import action, you can enter `${Stage0.export.responseBody}`. If the response data size exceeds 5 MB, the REST task might fail.

   e To provide authorization for the task, click **Add Headers** and enter a header key and value.



4 To save your pipeline, click **Save**.

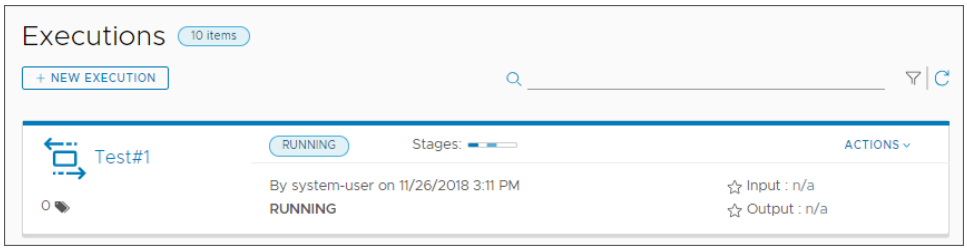
5 On the pipeline tab, click **Enable pipeline**.



6 Click **Save**, then click **Close**.

7 Click **Run**.

8 To watch the pipeline run, click **Executions**.



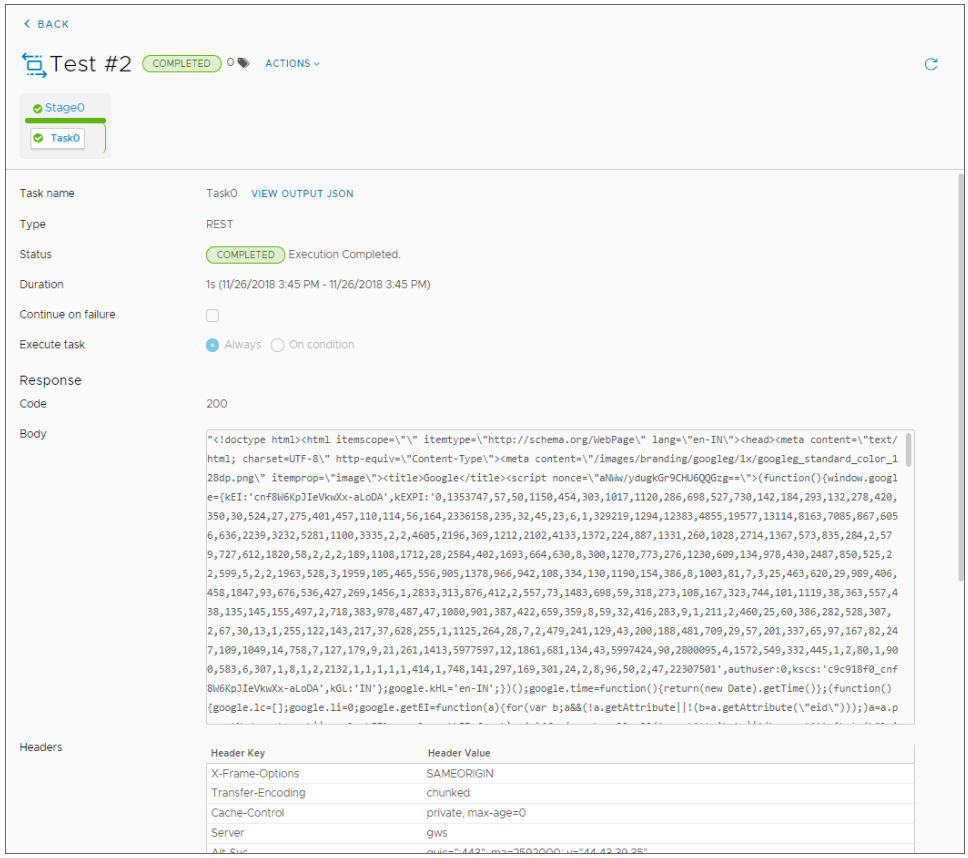
9 To verify that the REST plug-in returns the information you expect, examine the pipeline execution and the task results.

a After the pipeline completes, to confirm that the other application returned the data you requested, click the link to the pipeline execution.

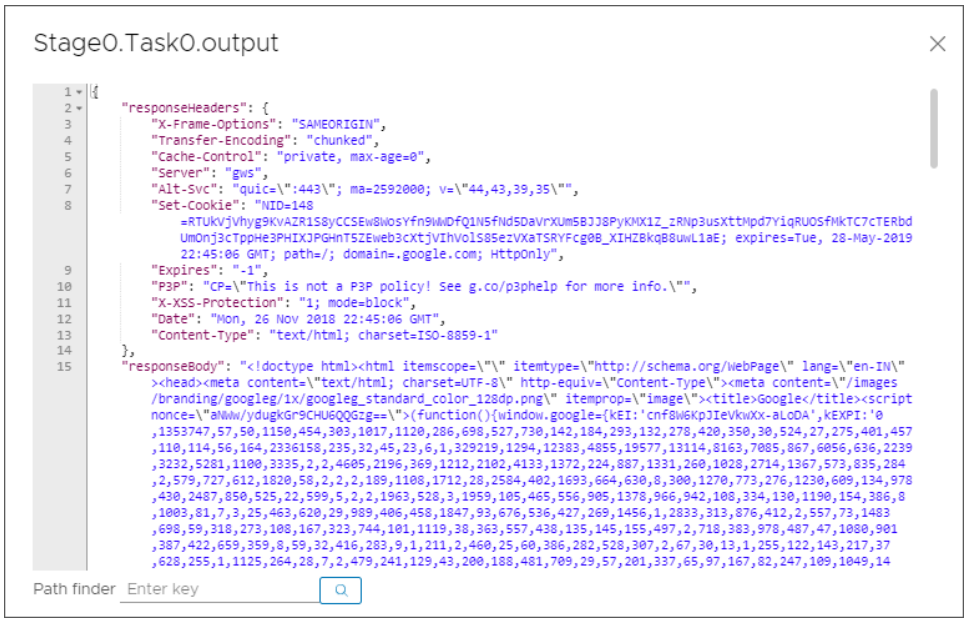
b Click the REST task in the pipeline.

c In the pipeline execution, click the task, look at the task details, and verify that the REST plug-in returned the expected results.

The task details display the response code, body, header keys, and values.



10 To see the JSON output, click **VIEW OUTPUT JSON**.



Results

Congratulations! You configured a REST task that invoked a REST API and sent information between vRealize Automation Code Stream and another application by using the REST plug-in.

Example: Using curl commands with your pipeline

You can use curl commands in your pipeline.

This example provides the request and response for a curl command that runs a pipeline. It requires an API token, which is also called a Bearer token. Comments and input parameters are passed as payload.

To obtain the API token, ensure that both curl and the jq command-line JSON processor are installed in your environment. Then enter the following commands with the HOSTNAME of your instance, your user name and password.

```
$ identity_service_url='https://<HOSTNAME>'
$ username='<your_username>'
$ password='<your_password>'
$ access_token=`curl -X POST \
  "$identity_service_url/csp/gateway/am/api/login?access_token" \
  -H 'Content-Type: application/json' \
  -d '{
  "username": "'"$username"'",
  "password": "'"$password"'"
}' | jq -r .access_token`
```

Use the value of the access token as the Bearer token in the header of your API requests.

Request:

```
curl -X POST \
  https://api.your-url.com/pipeline/api/pipelines/d53a5783f3b2fa7557b9251497eb0/executions \
  -H 'Authorization: Bearer <TOKEN>' \
  -H 'Content-Type: application/json' \
  -d '{"comments":"Test run via CURL", "input":{"input1":"test"}}'
```

Response:

```
{
    "comments": "",
    "input": {
        "input1": "test"
    },
    "executionLink": "/pipeline/api/executions/c159a3c13ef2b87557bc605ff5d62",
    "tags": []
}
```

This example provides the request and response for a curl command that displays the status of a pipeline. It requires an API token, which is also called a Bearer token. Comments and input parameters are passed as payload.

To obtain the API token, ensure that both curl and the jq command-line JSON processor are installed in your environment. Then enter the following commands with the HOSTNAME of your instance, your user name and password.

```
$ identity_service_url='https://<HOSTNAME>'
$ username='<your_username>'
$ password='<your_password>'
$ access_token=`curl -X POST \
  "$identity_service_url/csp/gateway/am/api/login?access_token" \
  -H 'Content-Type: application/json' \
  -d '{
  "username": "'"$username"'",
  "password": "'"$password"'"
}' | jq -r .access_token`
```

Use the value of the access token as the Bearer token in the header of your API requests.

Request:

```
curl -X GET \
  https://api.your-url.com/pipeline/api/executions/c159a3c13ef2b87557bc605ff5d62 \
  -H 'Authorization: Bearer <TOKEN>' \
  -H 'Cache-Control: no-cache' \
  -H 'Content-Type: application/json'
```

Response:

```
{
    "index": 3,
    "comments": "",
    "icon": "organization,left, is-pink",
    "starred": {},
    "input": {
        "input1": "test"
    },
    "output": {},
    "stageOrder": [
        "Stage0"
    ],
    "stages": {
        "Stage0": {
            "status": "COMPLETED",
            "statusMessage": "COMPLETED",
            "taskOrder": [
                "Task0"
            ],
        ……..
        ……..
}
```

What to do next

Continue to use REST tasks in your pipelines to run commands and integrate vRealize Automation Code Stream with other applications so that you can develop and deliver your software applications. Consider using poll tasks to poll the API until it completes and the pipeline task meets the exit criteria.

Planning to natively build, integrate, and deliver your code in vRealize Automation Code Stream

4

Before you have vRealize Automation Code Stream build, integrate, and deliver your code by using the native capability that creates a CICD, CI, or CD pipeline for you, plan your native build. Then, you can create your pipeline by using one of the smart templates, or by manually adding stages and tasks.

We've provided several examples that show you how to plan for your continuous integration and delivery build. These plans describe the prerequisites you'll need to do, and overviews to help you prepare to use the native build capability effectively to build your pipelines.

This chapter includes the following topics:

Planning a CICD native build in vRealize Automation Code Stream before using the smart template

To create a continuous integration and continuous delivery (CICD) pipeline in vRealize Automation Code Stream, you can use the CICD smart template. To plan your CICD native build, you'll gather the information you need to fill out the smart template before you use it to create the pipeline in this example plan.

After you enter the information in the smart template and save it, the template creates a pipeline that includes stages and tasks. It also indicates where to deploy your image based on the environment types you select, such as Dev and Prod. The pipeline will publish your Docker image, and perform the actions required to run it. After your pipeline runs, you can monitor trends across the pipeline executions.

To create a CICD pipeline, you need to plan for both the continuous integration (CI) and continuous delivery (CD) stages of your pipeline.

Planning the Continuous Integration (CI) stage

To plan the CI stage of your pipeline, you'll set up the external and internal requirements, and determine the information to enter in the CI portion of the smart template. Here is a summary.

Endpoints and repositories that you'll need:

- A Git source code repository where your developers check in code. vRealize Automation Code Stream pulls the latest code into the pipeline when developers commit changes.
- A Git endpoint for the repository where the developer source code resides.
- A Docker endpoint for the Docker build host that will run the build commands inside a container.
- A Kubernetes endpoint so that vRealize Automation Code Stream can deploy your image to a Kubernetes cluster.
- A Builder image that creates the container on which the continuous integration tests run.
- An Image Registry endpoint so that the Docker build host can pull the builder image from it.

You'll need access to a project. The project groups all your work, including your pipeline, endpoints, and dashboards. Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.

You'll need a Git webhook that enables vRealize Automation Code Stream to use the Git trigger to trigger your pipeline when developers commit code changes. See How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.

Your build toolsets:

- Your build type, such as Maven.
- All the post-process build tools that you use, such as JUnit, JaCoCo, Checkstyle, and FindBugs.

Your publishing tool:

- A tool such as Docker that will deploy your build container.
- An image tag, which is either the commit ID or the build number.

Your build workspace:

- A Docker build host, which is the Docker endpoint.
- An Image Registry. The CI part of the pipeline pulls the image from the selected registry endpoint. The container runs the CI tasks, and deploys your image. If the registry needs credentials, you must first create an Image Registry endpoint, then select it here so that the host can pull the image from the registry.

- URL for the builder image that creates the container on which the continuous integration tasks run.

Planning the Continuous Delivery (CD) stage

To plan the CD stage of your pipeline, you'll set up the external and internal requirements, and determine the information to enter in the CD portion of the smart template.

Endpoints that you'll need:

- A Kubernetes endpoint so that vRealize Automation Code Stream can deploy your image to a Kubernetes cluster.

Environment types and files:

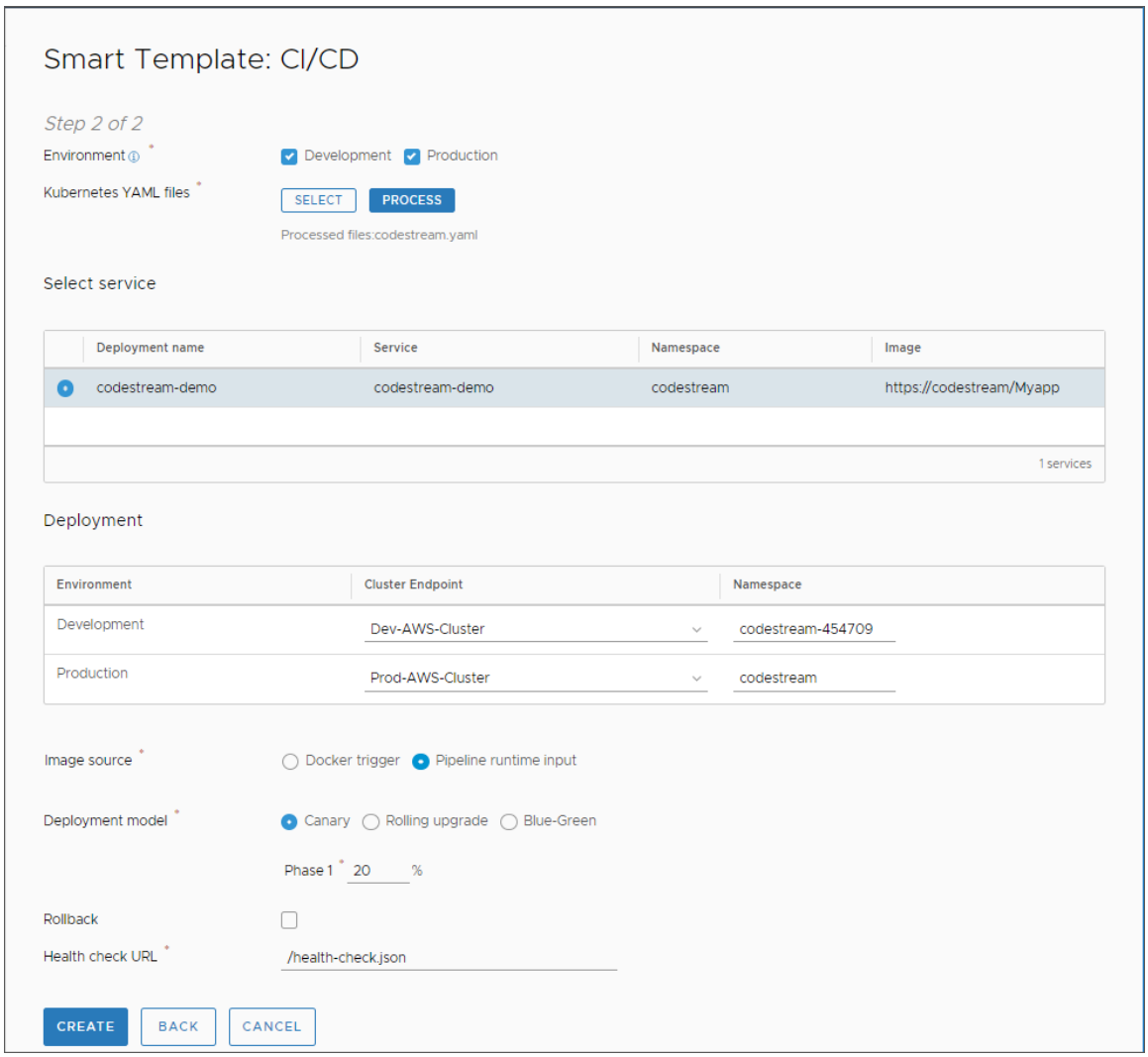
- All the environment types where vRealize Automation Code Stream will deploy your application, such as Dev and Prod. The smart template creates the stages and tasks in your pipeline based on the environment types you select.

  Table 4-1. Pipeline stages that the CICD smart template creates

Pipeline content	What it does
Build-Publish stage	Builds and tests your code, creates the builder image, and publishes the image to your Docker host.
Development stage	Uses a development Amazon Web Services (AWS) cluster to create and deploy your image. In this stage, you can create a namespace on the cluster, and create a secret key.
Production stage	Uses a production version of the VMware Cloud PKS to deploy your image to a production Kubernetes cluster.

- A Kubernetes YAML file that you select in the CD section of the CICD smart template.

  To apply the file, you click **Select**, select the Kubernetes YAML file, and click **Process**. The smart template displays the available services and deployment environments. You select a service, the cluster endpoint, and the deployment strategy. For example, to use the Canary deployment model, select **Canary** and enter a percentage for the deployment phase.

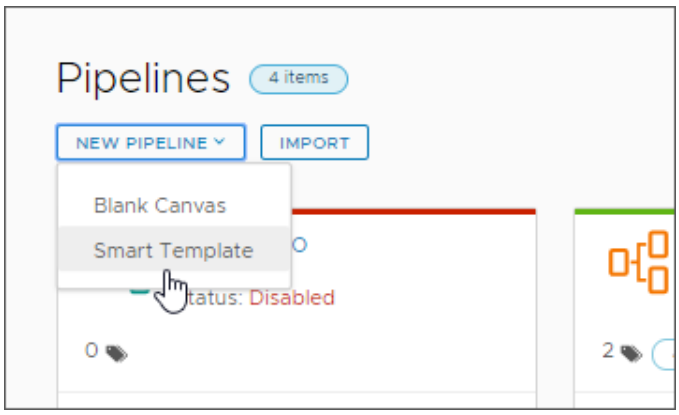


To see an example of using the smart template to create a pipeline for a Blue-Green deployment, see How do I deploy my application in vRealize Automation Code Stream to my Blue-Green deployment.

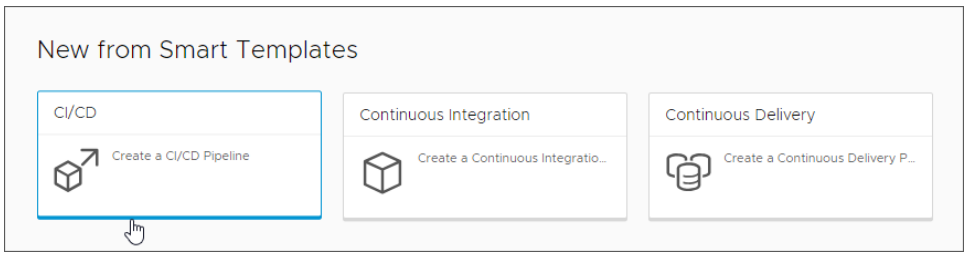
How you'll create the CICD pipeline by using the smart template

After you gather all the information and set up what you need, here's how you'll create a pipeline from the CICD smart template.

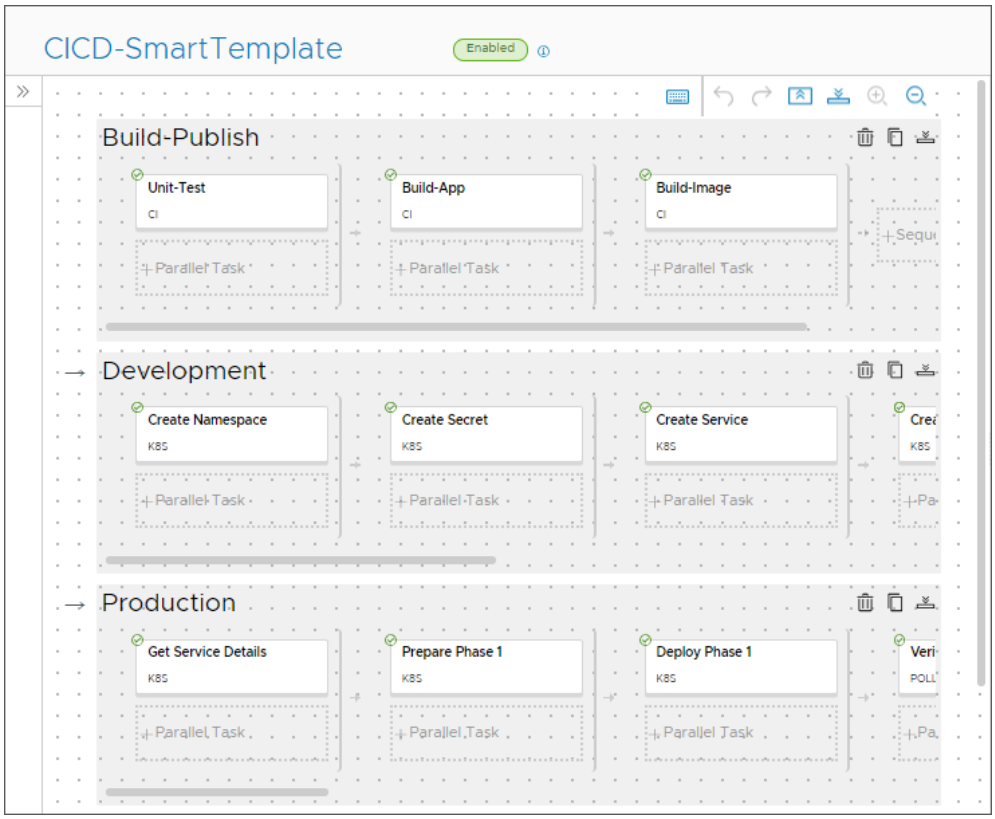
In Pipelines, you'll select **New Pipeline > Smart Templates**.



You'll select the CICD smart template.



You will fill out the template, and save the pipeline with the stages that it creates. If you need to make any final changes, you can edit the pipeline and save it.



Then, you will enable the pipeline and run it. After it runs, here are some things that you can look for:

- Verify that your pipeline succeeded. Click **Executions**, and search for your pipeline. If it failed, correct any errors and run it again.
- Verify that the Git webhook is operating correctly. The Git **Activity** tab displays the events. Click **Triggers > Git > Activity**.
- Look at the pipeline dashboard and examine the trends. Click **Dashboards**, and search for your pipeline dashboard. You can also create a custom dashboard to report on additional KPIs.

For a detailed example, see How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream.

Planning a CI native build in vRealize Automation Code Stream before using the smart template

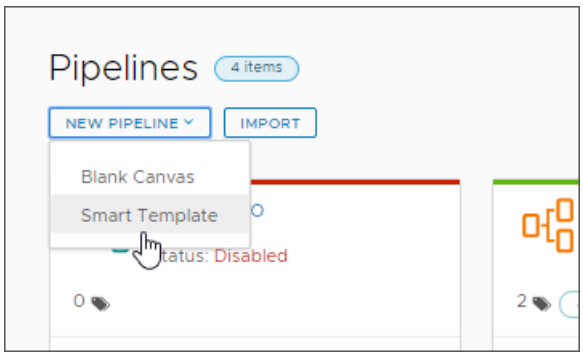
To create a continuous integration (CI) pipeline in VMware Code Stream, you can use the CI smart template. To plan your CI native build, you'll gather the information you need to fill out the smart template before you use it to create the pipeline in this example plan.

When you fill out the smart template, it creates a CI pipeline in your repository, and performs the actions required to run it. After your pipeline runs, you can monitor trends across the pipeline executions.

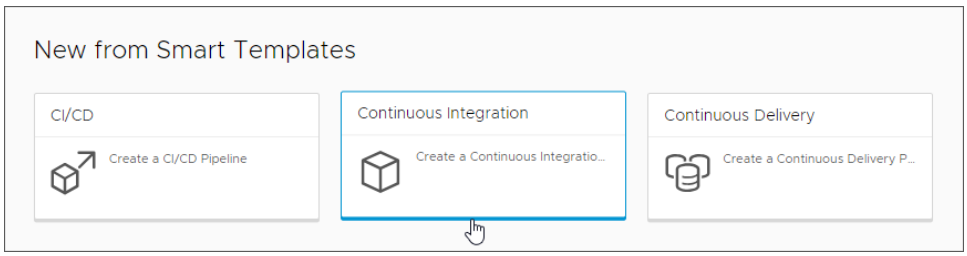
To plan your build before you use the CI smart template, you'll gather the information for your build, then follow the CI portion of Planning a CICD native build in vRealize Automation Code Stream before using the smart template.

After you gather all the information and set up what you need, here's how you'll create a pipeline from the CI smart template.

In Pipelines, you'll select **Smart Templates**.



You'll select the CI smart template.



You will fill out the template, and click **Create** to save the pipeline with the stages that it creates.

You can edit the pipeline to make any final changes that you might need. Then, you can enable the pipeline and run it. After the pipeline runs, here are some things to look for:

- Verify that your pipeline succeeded. Click **Executions**, and search for your pipeline. If it failed, correct any errors and run it again.
- Verify that the Git webhook is operating correctly. The Git **Activity** tab displays the events. Click **Triggers > Git > Activity**.
- Look at the pipeline dashboard and examine the trends. Click **Dashboards**, and search for your pipeline dashboard. You can also create a custom dashboard to report on additional KPIs.

For a detailed example, see How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream.

Planning a CD native build in vRealize Automation Code Stream before using the smart template

To create a continuous delivery (CD) pipeline in vRealize Automation Code Stream, you can use the CD smart template. To plan your CD native build, you'll gather the information you need to fill out the smart template before you use it to create the pipeline in this example plan.

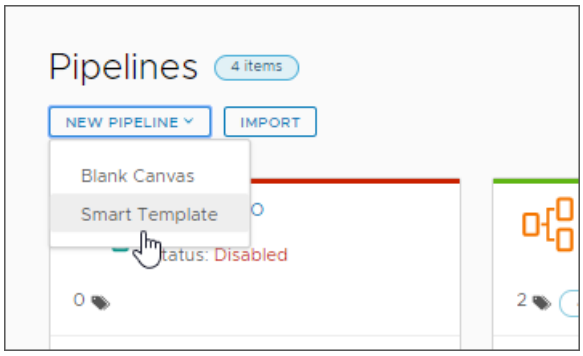
When you fill out the smart template, it creates a CD pipeline in your repository, and performs the actions required to run it. After your pipeline runs, you can monitor trends across the pipeline executions.

To plan your build before you use the CD smart template, you will:

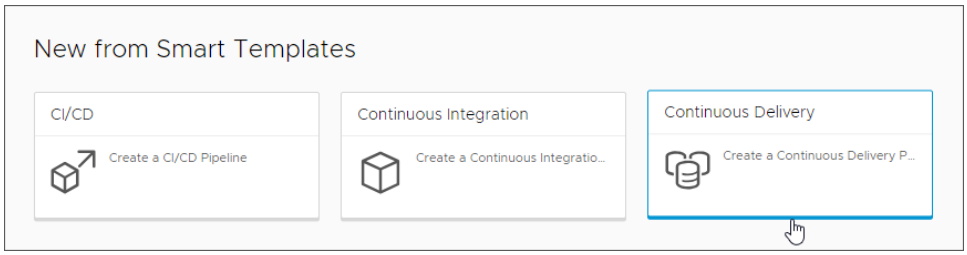
- Gather the information for your build, then follow the CD portion of Planning a CICD native build in vRealize Automation Code Stream before using the smart template.
- Add a Kubernetes endpoint where vRealize Automation Code Stream will deploy the container.
- Identify a project that will group all your work, including your pipeline, endpoints, and dashboards.

After you gather all the information and set up what you need, here's how you'll create a pipeline from the CD smart template.

In Pipelines, you'll select **Smart Templates**.



You'll select the CD smart template.



You'll fill out the template, and enter a name for the pipeline, then click **Create** to save the pipeline with the stages that it creates.

You can edit the pipeline to make any final changes that you might need. Then, you can enable the pipeline and run it. After the pipeline runs, here are some things to look for:

- Verify that your pipeline succeeded. Click **Executions**, and search for your pipeline. If it failed, correct any errors and run it again.
- Verify that the Git webhook is operating correctly. The Git **Activity** tab displays the events. Click **Triggers > Git > Activity**.
- Look at the pipeline dashboard and examine the trends. Click **Dashboards**, and search for your pipeline dashboard. You can also create a custom dashboard to report on additional KPIs.

For a detailed example, see How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream.

Planning a CICD native build in vRealize Automation Code Stream before manually adding tasks

To create a continuous integration and continuous delivery (CICD) pipeline in vRealize Automation Code Stream, you can manually add stages and tasks. To plan your CICD native build, you'll gather the information you need, then create a pipeline and manually add stages and tasks to it.

You will need to plan for both the continuous integration (CI) and continuous delivery (CD) stages of your pipeline. After you create your pipeline and run it, you can monitor trends across the pipeline executions.

To plan the CI and CD stages of your pipeline, you'll verify that all the requirements are met before you create your pipeline.

Planning the external and internal requirements

To create a pipeline from this example plan, you will use a Docker host, a Git repository, Maven, and several post-process build tools.

Endpoints and repositories that you'll need:

- A Git source code repository where your developers check in code. vRealize Automation Code Stream pulls the latest code into the pipeline when developers commit changes.
- A Docker endpoint for the Docker build host that will run the build commands inside a container.
- A Kubernetes endpoint so that vRealize Automation Code Stream can deploy your image to a Kubernetes cluster.
- A Builder image that creates the container on which the continuous integration tests run.
- An Image Registry endpoint so that the Docker build host can pull the builder image from it.

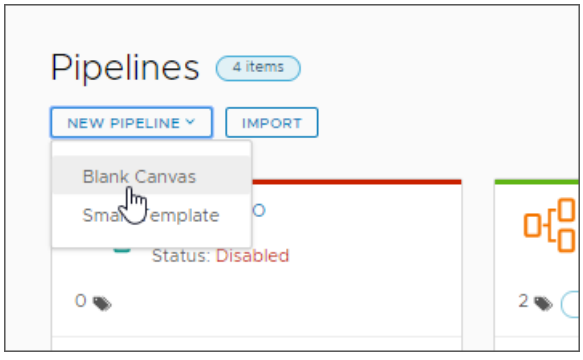
You'll need access to a project. The project groups all your work, including your pipeline, endpoints, and dashboards. Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.

You'll need a Git webhook that enables vRealize Automation Code Stream to use the Git trigger to trigger your pipeline when developers commit code changes. See How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.

How you'll create the CICD pipeline and configure the workspace

You'll need to create the pipeline, then configure the workspace, pipeline input parameters, and tasks.

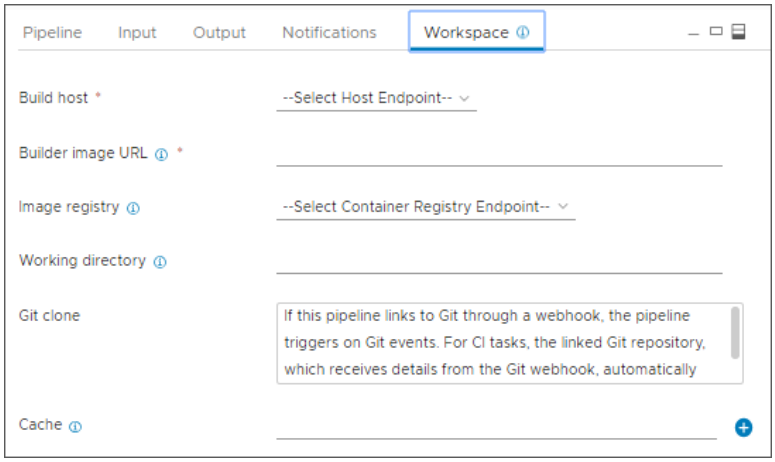
To create the pipeline, you'll click **Pipelines > New Pipeline > Blank Canvas**.



On the Workspace tab, enter the continuous integration information:

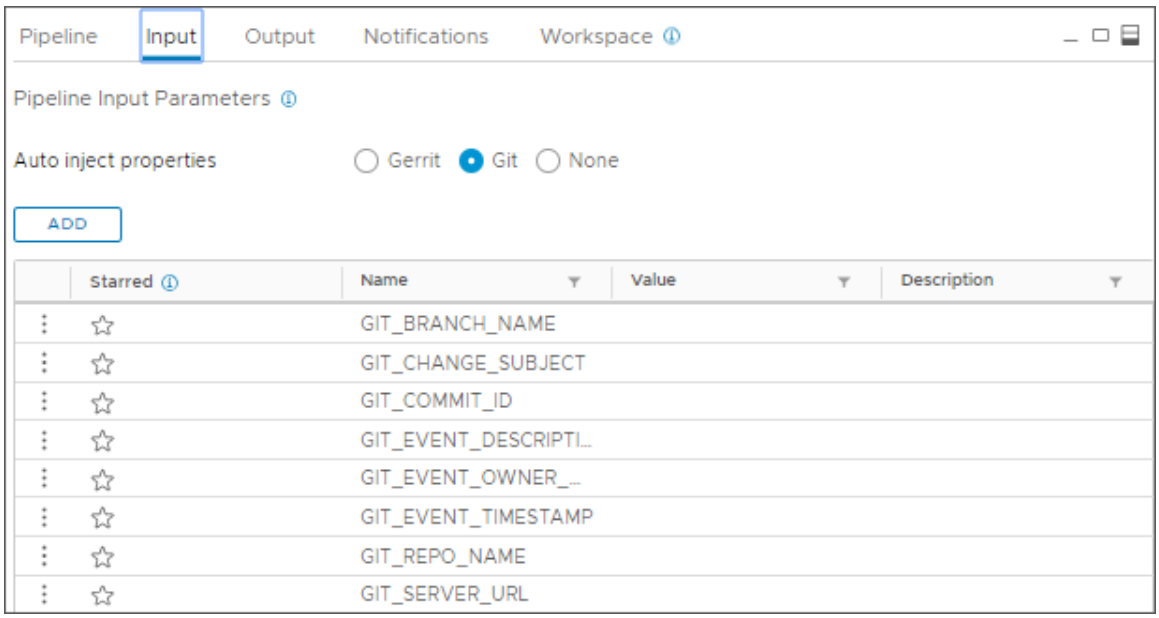
- Include your Docker build host.

- Enter the URL for your builder image.
- Select the image registry endpoint so that the pipeline can pull the image from it. The container runs the CI tasks and deploys your image. If the registry needs credentials, you must first create the Image Registry endpoint, then select it here so that the host can pull the image from the registry.
- Add the artifacts that must be cached. For a build to succeed, artifacts such as directories are downloaded as dependencies. The cache is the location where these artifacts reside. For example, dependent artifacts can include the `.m2` directory for Maven, and the `node_modules` directory for Node.js. These directories are cached across pipeline executions to save time during builds.



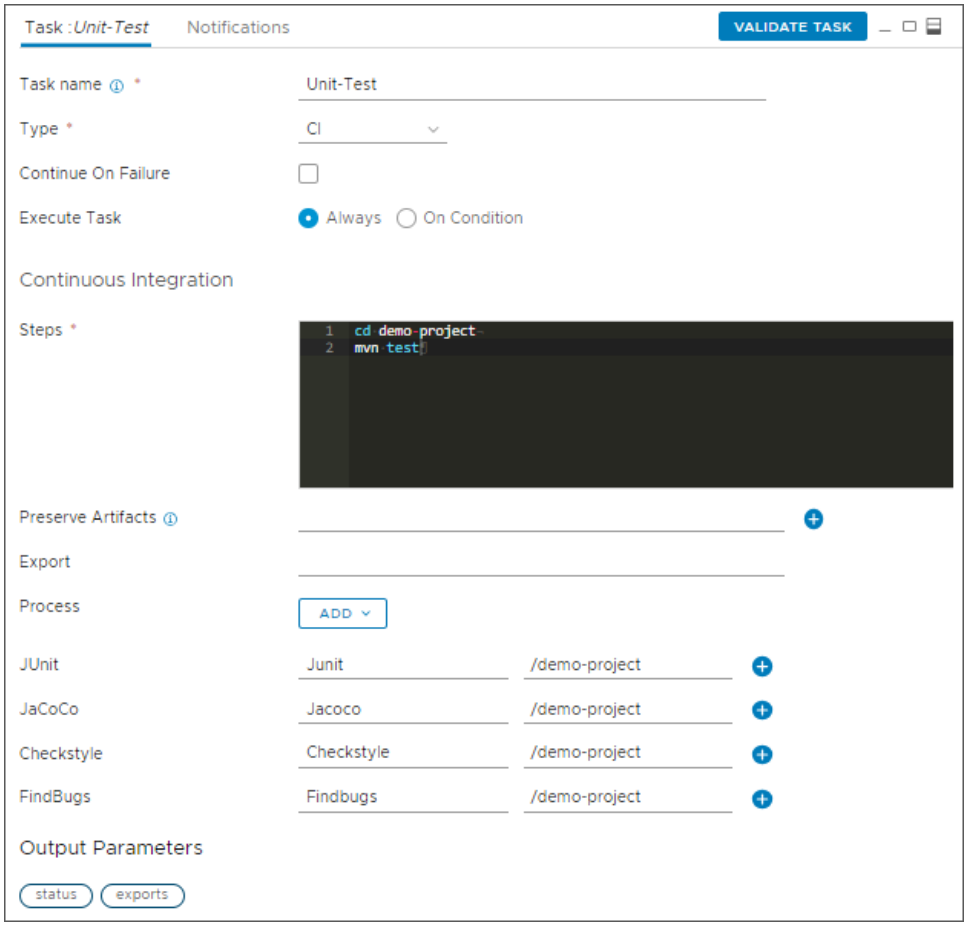
On the Input tab, configure the pipeline input parameters.

- If your pipeline will use input parameters from a Git, Gerrit, or Docker trigger event, select the trigger type for Auto inject parameters. Events can include Change Subject for Gerrit or Git, or Event Owner Name for Docker. If your pipeline will not use any input parameters passed from the event, leave Auto inject parameters set to **None**.
- To apply a value and description to a pipeline input parameter, click the three vertical dots, and click **Edit**. The value you enter is used as input to tasks, stages, or notifications.
- To add a pipeline input parameter, click **Add**. For example, you might add `approvers` to display a default value for every execution, but which you can override with a different approver at runtime.
- To add or remove an injected parameter, click **Add/Remove Injected Parameter**. For example, remove an unused parameter to reduce clutter on the results page and only display the input parameters that are used.



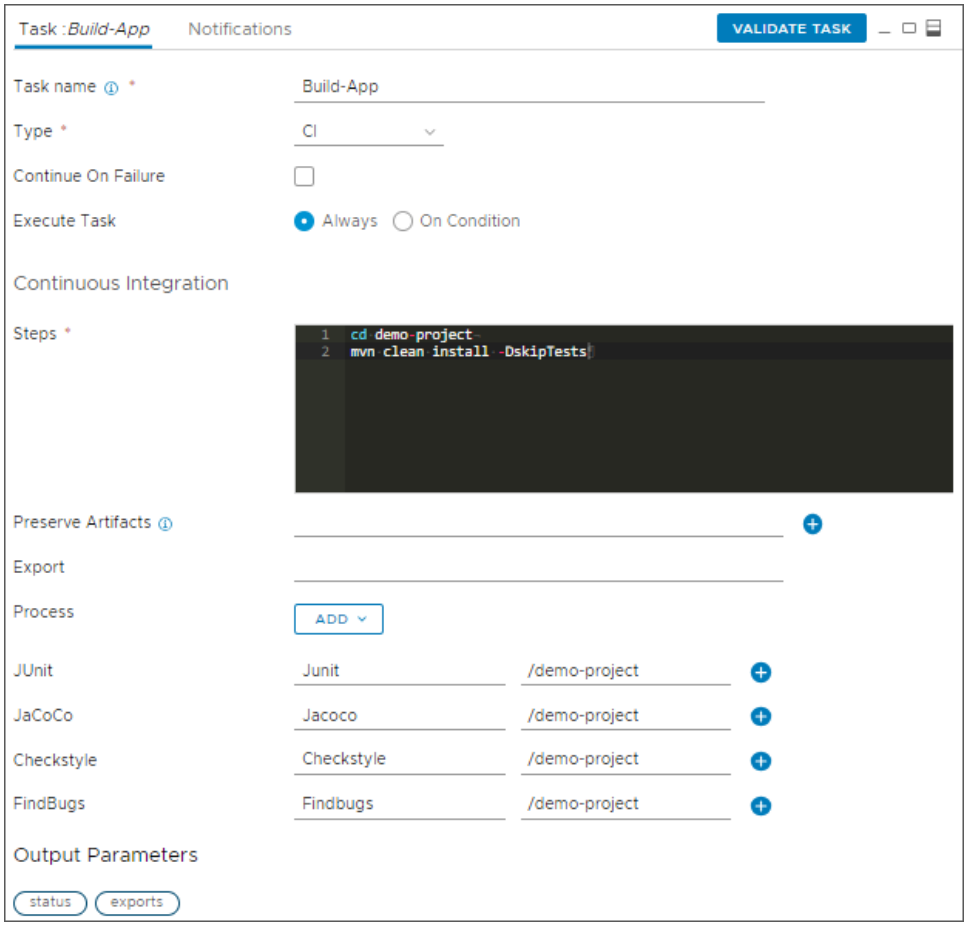
Configure the pipeline to test your code:

- Add and configure a CI task.
- Include steps to run `mvn test` on your code.
- Run post-process build tools, such as JUnit and JaCoCo, FindBugs, and Checkstyle to identify any problems after the task runs.



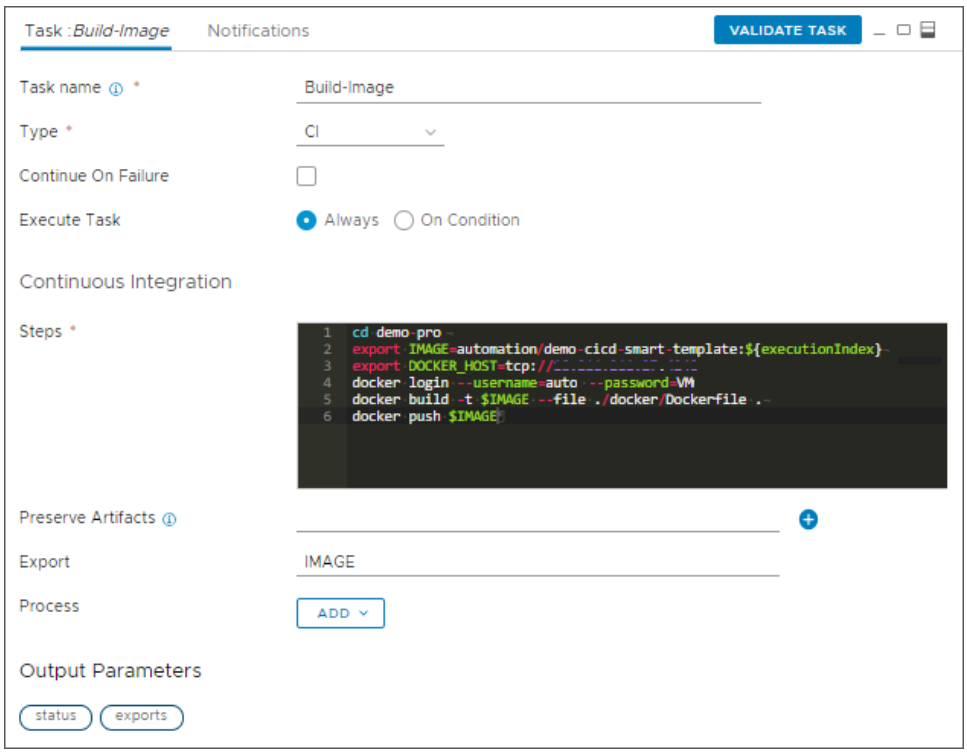
Configure the pipeline to build your code:

- Add and configure a CI task.
- Include steps to run `mvn clean install` on your code.
- Include the location and the JAR filename so that it preserves your artifact.



Configure the pipeline to publish your image to your Docker host:

- Add and configure a CI task.
- Add steps that will commit, export, build, and push your image.
- Add the export key of `IMAGE` for the next task to consume.



After you configure the workspace, input parameters, test tasks, and build tasks, save your pipeline.

How to enable and run your pipeline

After you configure your pipeline with stages and tasks, you can save and enable the pipeline.

Then, wait for the pipeline to run and finish, then verify that it succeeded. If it failed, correct any errors and run it again.

After the pipeline succeeds, here are some things you might want to confirm:

- Examine the pipeline execution and view the results of the task steps.
- In the workspace of the pipeline execution, locate the details about your container and the cloned Git repository.
- In the workspace, look at the results of your post-process tools and check for errors, code coverage, bugs, and style issues.
- Confirm that your artifact is preserved. Also confirm that the image was exported with the IMAGE name and value.
- Go to your Docker repository and verify that the pipeline published your container.

For a detailed example that shows how vRealize Automation Code Stream continuously integrates your code, see How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream.

Planning for rollback in vRealize Automation Code Stream

In the event of a pipeline execution failure, you can use rollback to return your environment to a previously stable state. To use rollback, you should plan a rollback flow and understand how to implement it.

A rollback flow prescribes the steps required to reverse a failure in deployment. The flow takes the form of a rollback pipeline that includes one or more sequential tasks which vary depending on the type of deployment that executed and failed. For example, the deployment and rollback of a traditional application is different from the deployment and rollback of a container application.

To return to a good deployment state, a rollback pipeline typically includes tasks to:

- Clean up states or environments.
- Run a user-specified script to revert changes.
- Deploy a previous revision of a deployment.

To add rollback to an existing deployment pipeline, you attach the rollback pipeline to the tasks or stages in the deployment pipeline that you want to roll back before you run your deployment pipeline.

How do I configure rollback

To configure rollback in your deployment, you need to:

- Create a deployment pipeline.
- Identify potential failure points in the deployment pipeline that will trigger rollback so that you can attach your rollback pipeline. For example, you might attach your rollback pipeline to a condition or poll task type in the deployment pipeline that checks whether a previous task completed successfully. For information on condition tasks, see How do I continue or stop a pipeline in vRealize Automation Code Stream based on task output.
- Determine the scope of failure that will trigger the rollback pipeline such as a task or stage failure. You can also attach rollback to a stage.
- Decide what rollback task or tasks to execute in the event of a failure. You'll create your rollback pipeline with those tasks.

You can manually create a rollback pipeline, or vRealize Automation Code Stream can create one for you.

- Using a blank canvas, you can manually create a rollback pipeline that follows a flow in parallel to an existing deployment pipeline. Then you attach the rollback pipeline to one or more tasks in the deployment pipeline that trigger rollback on failure.
- Using a smart template, you can configure a deployment pipeline with the rollback action. Then, vRealize Automation Code Stream automatically creates one or more default rollback pipelines with predefined tasks that roll back the deployment on failure.

For a detailed example on how to configure a CD pipeline with rollback using a smart template, see How do I roll back my deployment in vRealize Automation Code Stream.

What happens if my deployment pipeline has multiple tasks or stages with rollback

If you have multiple tasks or tasks and stages with rollback added, be aware that the rollback sequence varies.

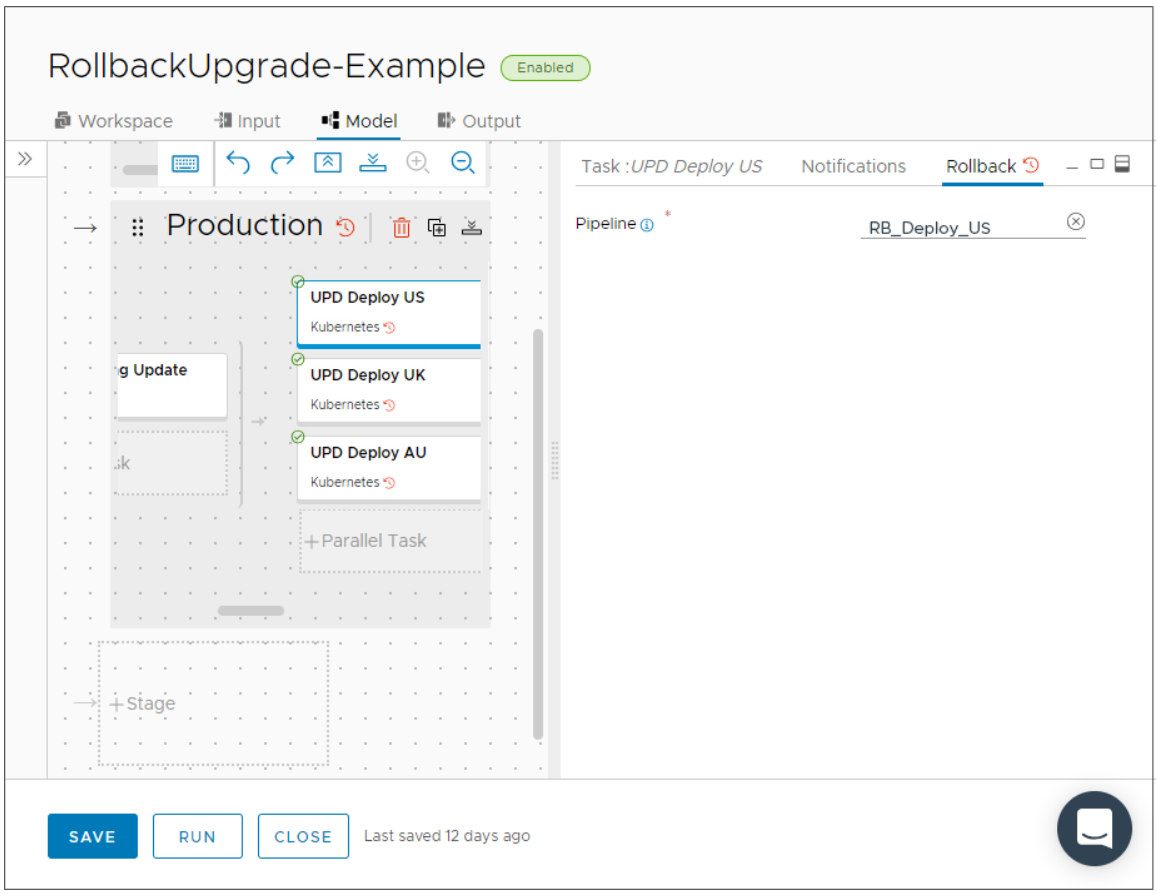
Table 4-2. Determining rollback sequence

If you add rollback to...	When does roll back occur...
Parallel tasks	If one of the parallel tasks fails, roll back for that task occurs after all the parallel tasks have completed or failed. Rollback does not occur immediately after the task fails.
Both the task within a stage, and the stage	If a task fails, the task rollback runs. If the task is in a group of parallel tasks, the task rollback runs after all the parallel tasks have completed or failed. After the task rollback completes or fails to complete, the stage rollback runs.

Consider a pipeline that has:

- A production stage with rollback.
- A group of parallel tasks, each task with its own rollback.

The task named **UPD Deploy US** has the rollback pipeline **RB_Deploy_US**. If **UPD Deploy US** fails, the rollback follows the flow defined in the **RB_Deploy_US** pipeline.



If **UPD Deploy US** fails, the **RB_Deploy_US** pipeline runs after **UPD Deploy UK** and **UPD Deploy AU** have also completed or failed. Rollback does not occur immediately after **UPD Deploy US** fails. And because the production stage also has rollback, after the **RB_Deploy_US** pipeline runs, the stage rollback pipeline runs.

Connecting vRealize Automation Code Stream to endpoints

5

vRealize Automation Code Stream integrates with development tools through plug-ins. Supported plug-ins include Jenkins, Bamboo, Artifactory, vRealize Operations, Pivotal Cloud Foundry, Bugzilla, Team Foundation Server, Git, and more!

You can also develop your own plug-ins to integrate vRealize Automation Code Stream with other development applications.

To integrate vRealize Automation Code Stream with JIRA, an external plug-in is not needed, because the JIRA ticket creation capability is built into vRealize Automation Code Stream as a notification type. To create JIRA tickets on pipeline status, you must add a JIRA endpoint.

This chapter includes the following topics:

What are Endpoints in vRealize Automation Code Stream

An endpoint is an instance of a DevOps application that connects to vRealize Automation Code Stream to provide data for your pipelines to run, such as a data source, repository, or notification system.

Your role in vRealize Automation Code Stream determines how you use endpoints.

- Administrators and developers can create, update, delete, and view endpoints.
- Administrators can mark an endpoint as restricted, and run pipelines that use restricted endpoints.
- Users who have the viewer role can see endpoints, but cannot create, update, or delete them.

To connect vRealize Automation Code Stream to an endpoint, you add a task in your pipeline and configure it so that it communicates with the endpoint. To verify that vRealize Automation Code Stream can connect to the endpoint, you click **Validate**. Then, when you run the pipeline, your pipeline task connects to the endpoint to run the task.

Table 5-1. Endpoints that vRealize Automation Code Stream supports

Endpoint	What it provides	Versions supported
Bamboo	Creates build plans.	6.9.*
Docker	Native builds can use Docker hosts for deployment.	
Docker Registry	Registers container images so that a Docker build host can pull images.	2.7.1
Gerrit	Connects to a Gerrit server for reviews and trigger	2.14.*
Git	Triggers pipelines when developers update code and check it in to the repository.	Git Hub Enterprise 2.1.8 Git Lab Enterprise 11.9.12-ee
Jenkins	Builds code artifacts.	1.6.* and 2.*
Jira	Creates a Jira ticket when a pipeline task fails.	8.3.*
Kubernetes	Automates the steps that deploy, scale, and manage containerized applications.	1.9.*
Powershell	Create tasks that run Powershell scripts on Windows or Linux machines.	4 and 5
SSH	Create tasks that run SSH scripts on Windows or Linux machines.	7.0
TFS, Team Foundation Server	Manages source code, automated builds, testing, and related activities.	2015 and 2017
vRealize Orchestrator	Arranges and automates the workflows in your build process.	7.* and 8.*

Example YAML code for a GitHub endpoint

This example YAML code defines a GitHub endpoint that you can refer to in a Git task.

```
---
name: github-k8s
tags: [
  ]
kind: ENDPOINT
properties:
  serverType: GitHub
  repoURL: https://github.com/autouser/testrepok8s
  branch: master
  userName: autouser
  password: encryptedpassword
  privateToken: ''
description: ''
type: scm:git
isLocked: false
---
```

How do I integrate vRealize Automation Code Stream with Jenkins

vRealize Automation Code Stream provides a Jenkins plug-in, which triggers Jenkins jobs that build and test your source code. The Jenkins plug-in runs test cases, and can use custom scripts.

To run a Jenkins job in your pipeline, you use a Jenkins server, and add the Jenkins endpoint in vRealize Automation Code Stream. Then, you create a pipeline and add a Jenkins task to it.

Prerequisites

- Set up a Jenkins server that runs version 1.561 or later.
- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.
- Verify that a job exists on the Jenkins server so that your pipeline task can run it.

Procedure

1 Add and validate a Jenkins endpoint.

   a Click **Endpoints > New Endpoint**.

   b Select a project, and for the endpoint type select **Jenkins**. Then, enter a name and description.

   c If this endpoint is a business-critical component in your infrastructure, enable **Mark as restricted**.

   d Enter the URL for the Jenkins server.

e Enter the user name and password to log in to the Jenkins server. Then, enter the remaining information.

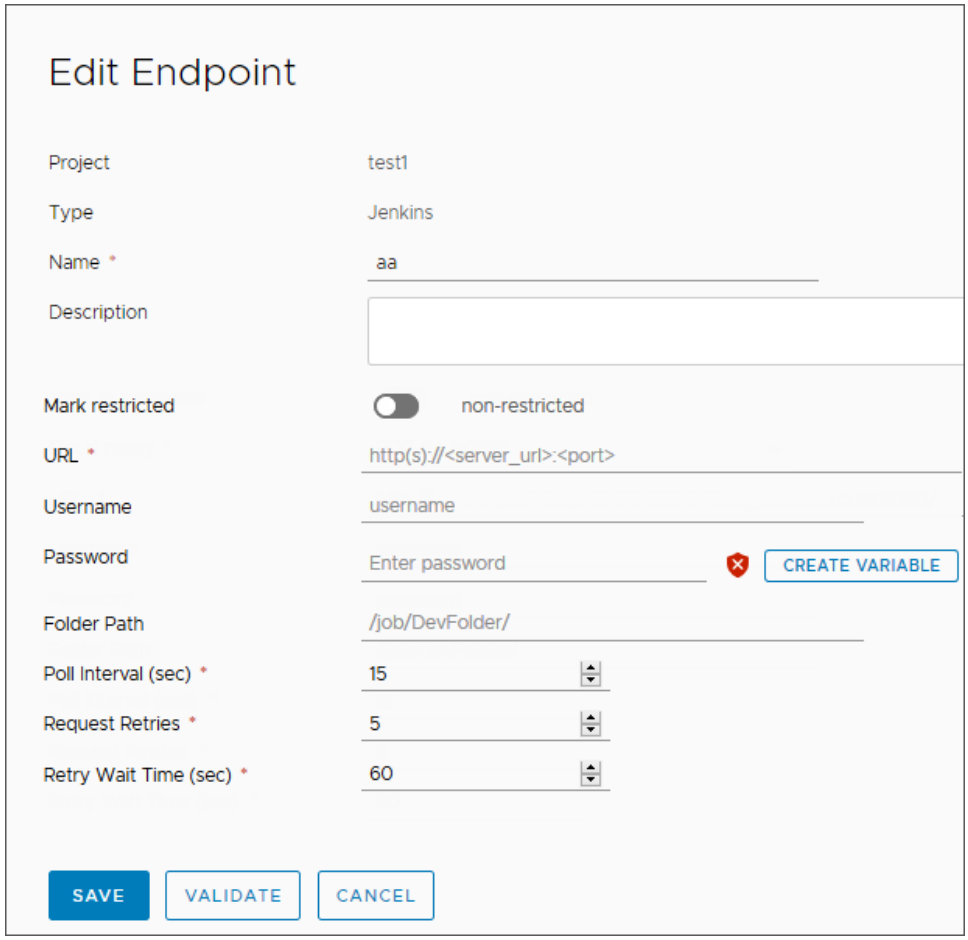
Table 5-2. Remaining information for the Jenkins endpoint

Endpoint entry	Description
Folder Path	Path for the folder that groups your jobs. Jenkins can run all jobs in the folder. You can create sub folders. For example: ■ `folder_1` can include `job_1` ■ `folder_1` can include `folder_2`, which can include `job_2` When you create an endpoint for `folder_1`, the folder path is `job/folder_1`, and the endpoint only lists `job_1`. To obtain the list of jobs in the child folder named `folder_2`, you must create another endpoint that uses the folder path as `/job/folder_1/job/folder_2/`.
URL	Host URL of the Jenkins server. Enter the URL in the form of `protocol://host:port`. For example: `http://192.10.121.13:8080`
Polling Interval	Interval duration for vRealize Automation Code Stream to poll the Jenkins server for updates.

Table 5-2. Remaining information for the Jenkins endpoint (continued)

Endpoint entry	Description
Request Retry Count	Number of times to retry the scheduled build request for the Jenkins server.
Retry Wait Time	Number of seconds to wait before retrying the build request for the Jenkins server.

f Click **Validate**, and verify that the endpoint connects to vRealize Automation Code Stream. If it does not connect, correct any errors, then click **Save**.



2 To build your code, create a pipeline, and add a task that uses your Jenkins endpoint.

a Click **Pipelines > New Pipeline > Blank Canvas**.

b Click the default stage.

c In the Task area, enter a name for the task.

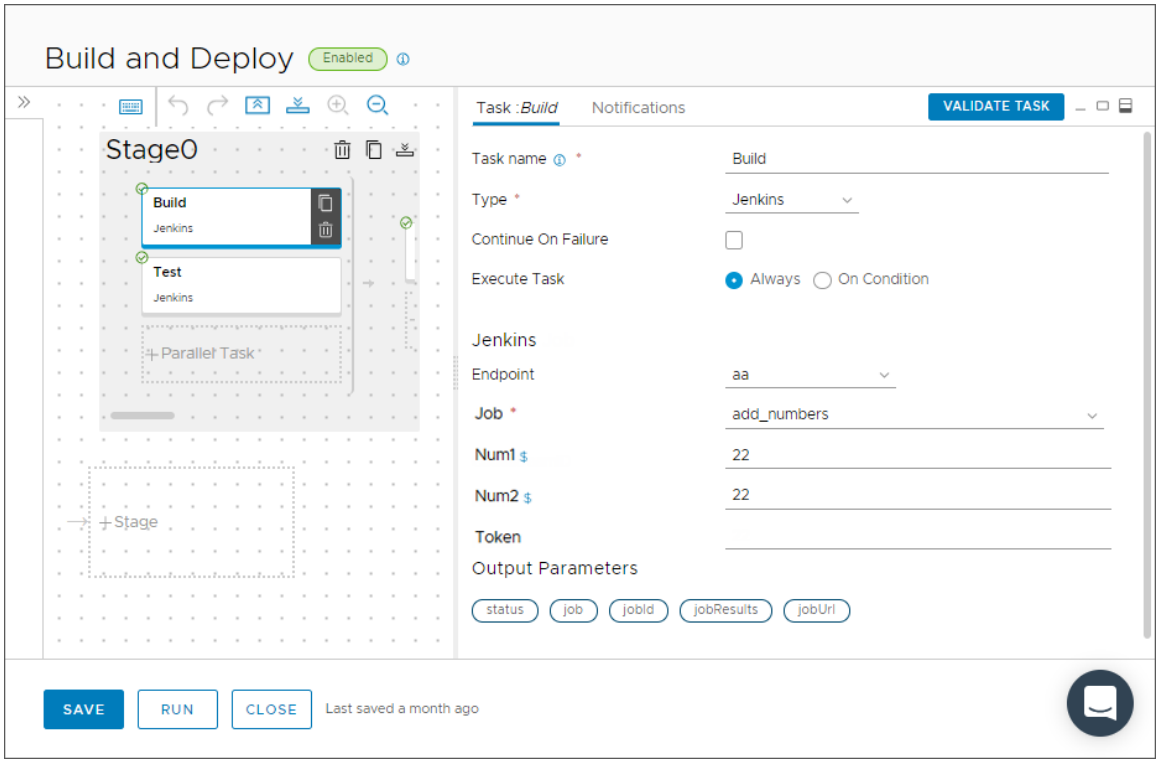
d Select the task type as **Jenkins**.

e Select the Jenkins endpoint that you created.

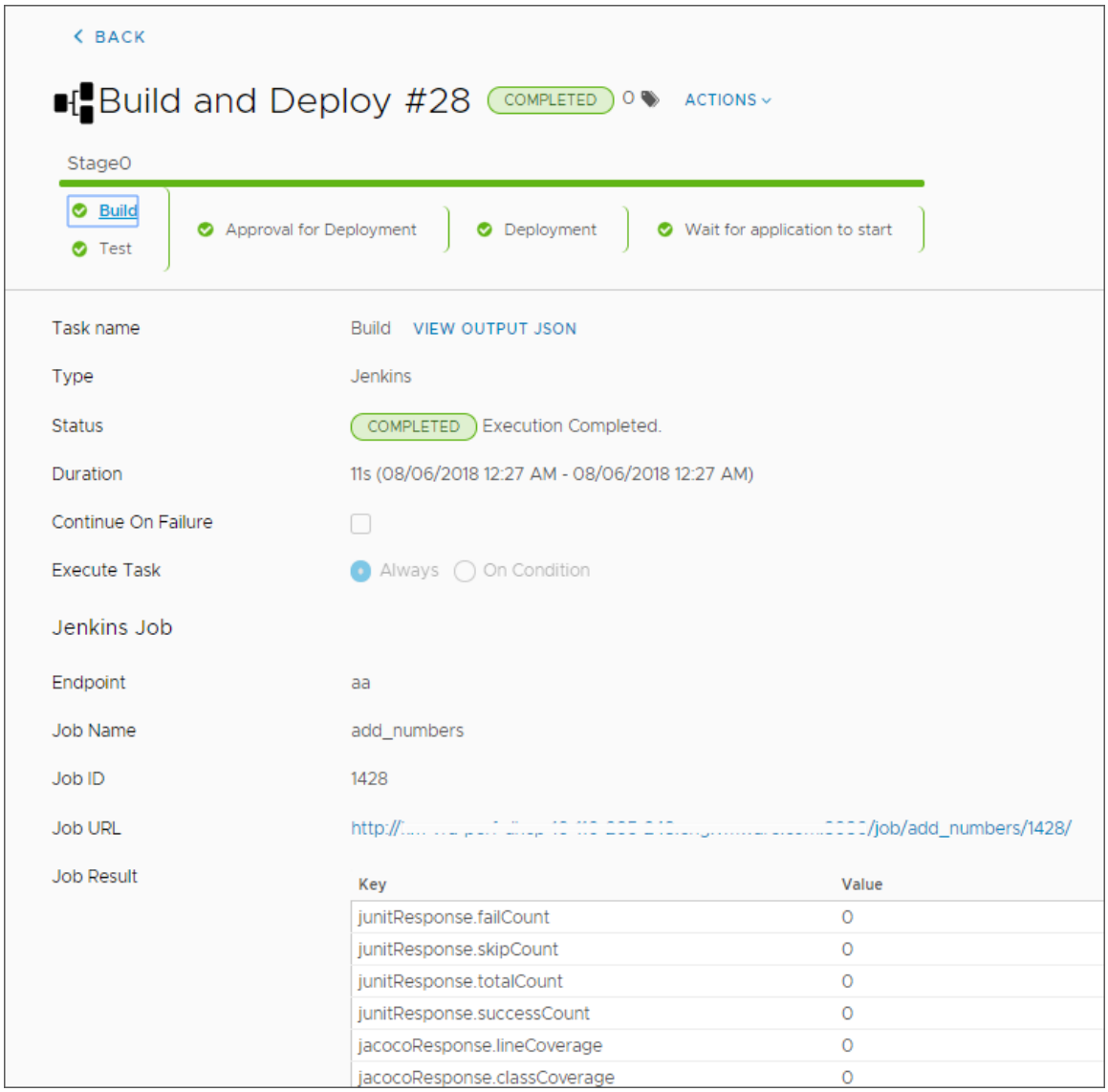
f From the drop-down menu, select a job from the Jenkins server that your pipeline will run.

g Enter the parameters for the job.

h Enter the authentication token for the Jenkins job.

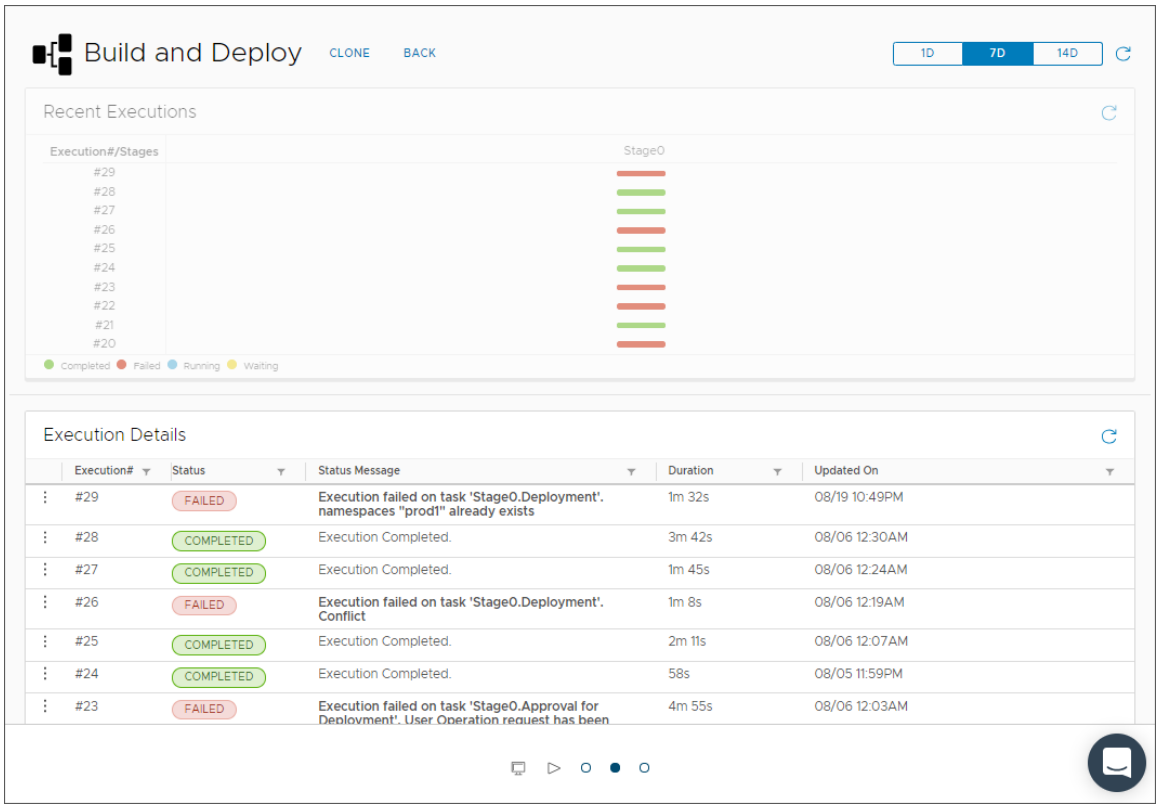


3 Enable and run your pipeline, and view the pipeline execution.



4 Look at the execution details and status on the pipeline dashboard.

You can identify any failures, and why it failed. You can also see trends about the pipeline execution durations, completions, and failures.



Results

Congratulations! You integrated vRealize Automation Code Stream with Jenkins by adding an endpoint, creating a pipeline, and configuring a Jenkins task that builds your code.

Example: Example YAML for a Jenkins build task

For the type of Jenkins build task used in this example, the YAML resembles the following code, with notifications turned on:

```
test:
  type: Jenkins
  endpoints:
    jenkinsServer: jenkins
  input:
    job: Add two numbers
    parameters:
      Num1: '23'
      Num2: '23'
```

What to do next

Review the other sections to learn more. See Chapter 5 Connecting vRealize Automation Code Stream to endpoints.

How do I integrate vRealize Automation Code Stream with Git

vRealize Automation Code Stream provides a way to trigger a pipeline if a code change occurs in your GitHub, GitLab, or Bitbucket repository. The Git trigger uses a Git endpoint on the branch of the repository that you want to monitor. vRealize Automation Code Stream connects to the Git endpoint through a webhook.

To define a Git endpoint in vRealize Automation Code Stream, you select a project and enter the branch of the Git repository where the endpoint is located. The project groups the pipeline with the endpoint and other related objects. When you choose the project in your webhook definition, you select the endpoint and pipeline to trigger.

Note If you define a webhook with your endpoint and you later edit the endpoint, you cannot change the endpoint details in the webhook. To change the endpoint details, you must delete and redefine the webhook with the endpoint. See How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.

Prerequisites

- Verify that you can access the GitHub, GitLab, or Bitbucket repository to which you plan to connect.
- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.

Procedure

1 Define a Git endpoint.
   a Click **Endpoints > New Endpoint**.
   b Select a project, and for the endpoint type select **Git**. Then, enter a name and description.
   c If this endpoint is a business-critical component in your infrastructure, enable **Mark as restricted**.
   d Select one of the supported Git server types.
   e Enter the URL for the repository with the API gateway for the server in the path. For example, enter **`https://api.gitlab.com/vmware-example/repo-example`**.

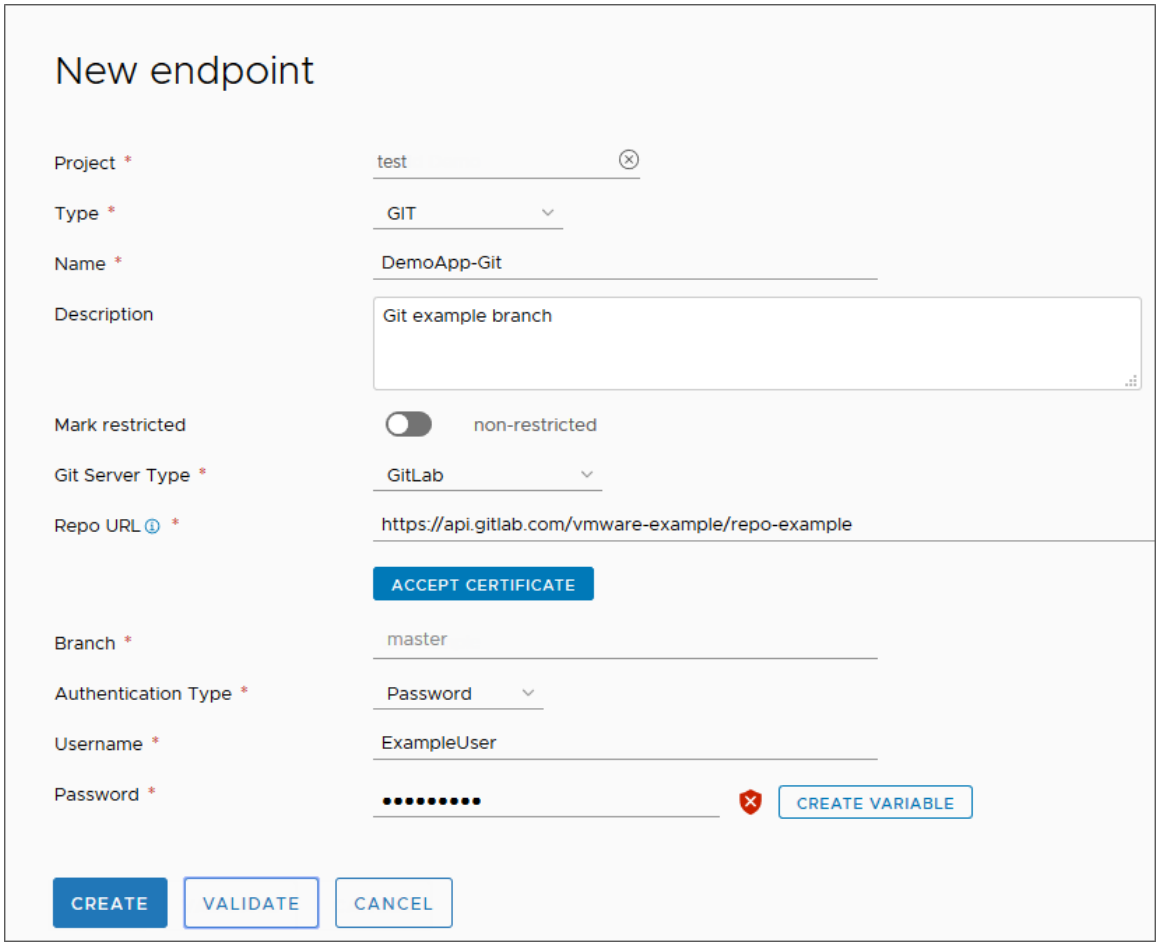
f Enter the branch in the repository where the endpoint is located.

g Select the Authentication type and enter the username for GitHub, GitLab, or BitBucket. Then enter the password, private token, or private key that goes with the username.

- Password. Your password provides completes access to the repository. You can also create a variable for the password.
- Private token. This token is Git-specific and provides access to a specific action. See https://docs.gitlab.com/ee/user/profile/personal_access_tokens.html. You can also create a variable for the private token.
- Private key. This SSH key is a private key that provides access to a specific repository. When a Git event occurs, vRealize Automation Code Stream uses this key to clone a repository. See https://help.github.com/articles/reviewing-your-ssh-keys/.

2 Click **Validate**, and verify that the endpoint connects to vRealize Automation Code Stream.

If it does not connect, correct any errors, then click **Create**.



What to do next

To learn more, review the other sections. See How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.

How do I integrate vRealize Automation Code Stream with Gerrit

vRealize Automation Code Stream provides a way to trigger a pipeline if a code review occurs in your Gerrit project. The Gerrit trigger definition includes the Gerrit project and the pipelines to run for different event types.

The Gerrit trigger uses a Gerrit listener on the Gerrit server that you want to monitor. To define a Gerrit endpoint in vRealize Automation Code Stream, you select a project and enter the URL for the Gerrit server. Then you specify the endpoint when you create a Gerrit listener on that server.

Prerequisites

- Verify that you can access the Gerrit server to which you plan to connect.
- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.

Procedure

1. Define a Gerrit endpoint.
   a. Click **Configure > Endpoints** and click **New Endpoint**.
   b. Select a project and for the endpoint type, select Gerrit. Then, enter a name and description.
   c. If this endpoint is a business-critical component in your infrastructure, enable **Mark as restricted**.
   d. Enter the URL for the Gerrit server.

      You can provide a port number with the URL or leave the value blank to use the default port.
   e. Enter a username and password for the Gerrit server.

      If you want the password to be encrypted, click **Create Variable** and select the type:

      - Secret. The password is resolved at the time of execution by a user with any role.
      - Restricted. The password is resolved at the time of execution by a user with the Admin role.

      For value, enter the password that you want to be secure, such as the password of a Jenkins server.

f For the private key, enter the SSH key used to access the Gerrit server securely.

This key is the RSA private key located in the .ssh directory.

g (Optional) If a passphrase is associated with the private key, enter the passphrase.

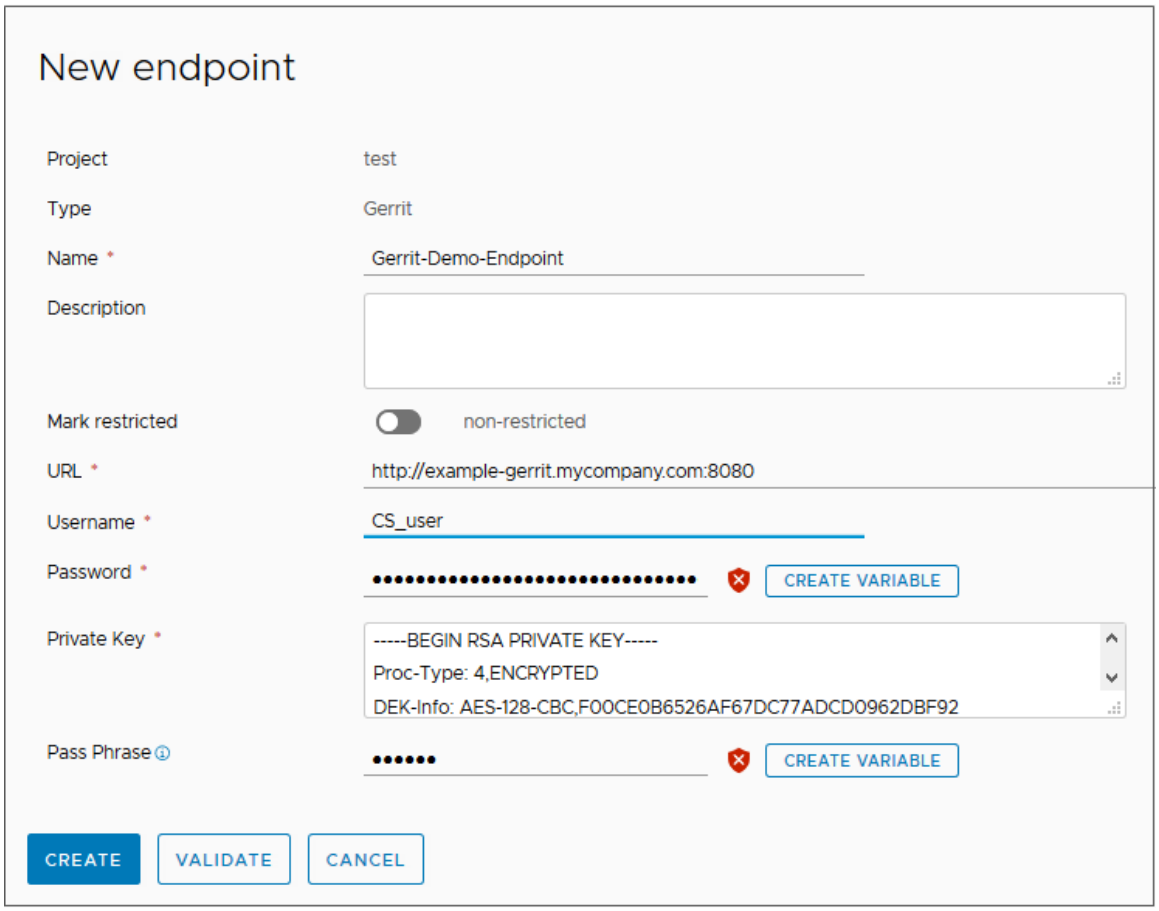
If you want the passphrase to be encrypted, click **Create Variable** and select the type:

- Secret. The passphrase is resolved at the time of execution by a user with any role.
- Restricted. The passphrase is resolved at the time of execution by a user with the Admin role.

For value, enter the passphrase that you want to be secure, such as the passphrase for an SSH server.

2 Click **Validate**, and verify that the Gerrit endpoint in vRealize Automation Code Stream connects to the Gerrit server.

If it does not connect, correct any errors, then attempt to validate it again.



3 Click **Create**.

What to do next

To learn more, review the other sections. See How do I use the Gerrit trigger in vRealize Automation Code Stream to run a pipeline.

How do I integrate vRealize Automation Code Stream with vRealize Orchestrator

VMware Code Stream can integrate with vRealize Orchestrator (vRO) to extend its capability by running vRO workflows. vRealize Orchestrator includes many predefined workflows that can integrate with third-party tools. These workflows help to automate and manage your DevOps processes, automate bulk operations, and more.

For example, you can use a workflow in a vRO task in your pipeline to enable a user, remove a user, move VMs, integrate with test frameworks to test your code as the pipeline runs, and much more. You can browse examples of code for vRealize Orchestrator workflows in code.vmware.com.

With a vRealize Orchestrator workflow, your pipeline can run an action as it builds, tests, and deploys your application. You can include predefined workflows in your pipeline, or you can create and use custom workflows. Each workflow includes inputs, tasks, and outputs.

To run a vRO workflow in your pipeline, the workflow must appear in the list of available workflows in the vRO task that you include in your pipeline.

Before the workflow can appear in the vRO task in your pipeline, an administrator must perform the following steps in vRealize Orchestrator:

1 Apply the CODESTREAM tag to the vRO workflow.

2 Mark the vRO workflow as global.

Prerequisites

- Verify that you can access an on-premises instance of vRealize Orchestrator as an administrator. For help, see your administrator and the vRealize Orchestrator documentation.
- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.
- In vRealize Automation Code Stream, create a pipeline and add a stage.

Procedure

1 Prepare a vRealize Orchestrator workflow for your pipeline to run.

   a In vRealize Orchestrator, find the workflow that you need, such as to enable a user.

   If you need a workflow that does not exist, you can create it.

   b Open the workflow that you intend to include in your vRealize Automation Code Stream pipeline.

c As an administrator, apply the tag named CODESTREAM to the workflow.

Then, when you add a vRO task in your vRealize Automation Code Stream pipeline, the workflow appears in the available workflow list.

d Mark the workflow as global.

2 In vRealize Automation Code Stream, create an endpoint for your vRealize Orchestrator instance.

a Click **Endpoints > New Endpoint**.

b Select a project.

c Enter a relevant name.

d Click **Accept Certificate**.

e Enter the user name and password for the vRealize Orchestrator server.

3 Prepare your pipeline to run the vRO task.

a Add a vRO task to your pipeline stage.

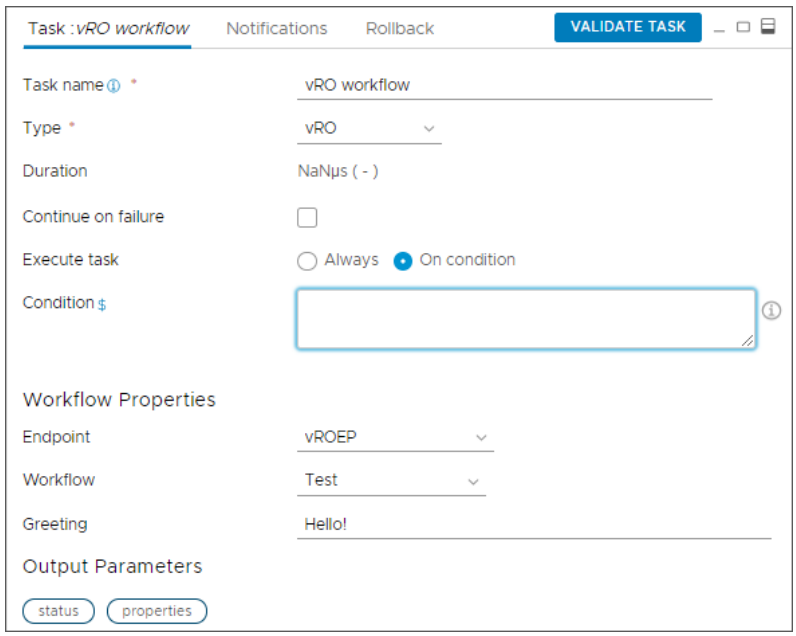
b Enter a relevant name.

c In the Workflow Properties area, select the vRealize Orchestrator endpoint.

d Select the workflow that you tagged as CODESTREAM in vRealize Orchestrator.

If you select a custom workflow that you created, you might need to enter the input parameter values.

e For **Execute task**, click **On condition**.



f Enter the conditions that apply when the pipeline runs.

When to run pipeline...	Select conditions...
On Condition	Runs the pipeline task only if the defined condition is evaluated as true. If the condition is false, the task is skipped. The `vRO` task allows you to include a boolean expression, which uses the following operands and operators. ■ Pipeline variables such as `${pipeline.variableName}`. Only use curly brackets when entering variables. ■ Task output variables such as `${Stage1.task1.machines[0].value.hostIp[0]}`. ■ Default pipeline binding variables such as `${releasePipelineName}`. ■ Case insensitive Boolean values such as, `true`, `false`, `'true'`, `'false'`. ■ Integer or decimal values without quotation marks. ■ String values used with single or double quotation marks such as `"test"`, `'test'`. ■ String and Numeric types of values such as `== Equals` and `!= Not Equals`. ■ Relational operators such as >, >=, <, and <=. ■ Boolean logic such as `&&` and `||`. ■ Arithmetic operators such as +, –, *, and /. ■ Nested expressions using round brackets. ■ Strings that include the literal value `ABCD` are evaluated as false, and the task is skipped. ■ Unary operators are not supported. An example condition might be `${Stage1.task1.output} == "Passed" || ${pipeline.variableName} == 39`
Always	If you select **Always**, the pipeline runs the task without conditions.

g Enter a message for the greeting.

h Click **Validate Task**, and correct any errors that occur.

4 Save, enable, and run your pipeline.

5 After the pipeline runs, examine the results.

a Click **Executions**.

b Click the pipeline.

c Click the task.

d Examine the results, input value, and properties.

You can identify the workflow execution ID, who responded to the task and when, and any comments they included.

Results

Congratulations! You tagged a vRealize Orchestrator workflow for use in vRealize Automation Code Stream, and added a `vRO` task in your vRealize Automation Code Stream pipeline so that it runs a workflow that automates an action in your DevOps environment.

Example: vRO task output format

The output format for a `vRO` task resembles this example.

```
[{
                "name": "result",
                "type": "STRING",
                "description": "Result of workflow run.",
                "value": ""
},
{
                "name": "message",
                "type": "STRING",
                "description": "Message",
                "value": ""
}]
```

What to do next

Continue to include `vRO` workflow tasks in your pipelines so that you can automate tasks in your development, test, and production environments.

Creating and using pipelines in vRealize Automation Code Stream

6

You can use vRealize Automation Code Stream to model your build, test, and deploy process. With vRealize Automation Code Stream, you set up the infrastructure that supports your release cycle and create pipelines that model your software release activities. vRealize Automation Code Stream delivers your software from development code, through testing, and deploys it to your production instances.

Each pipeline includes stages and tasks. Stages represent your development phases, and tasks perform the actions required to deliver your software application through the stages.

What are Pipelines in vRealize Automation Code Stream

A pipeline is a continuous integration and delivery model of your software release process. It releases your software from source code, through testing, to production. It includes a sequence of stages with tasks that represent the activities in your software release cycle. Your software application flows from one stage to the next through the pipeline.

You add endpoints so that the tasks in your pipeline can connect to data sources, repositories, or notification systems.

Creating Pipelines

You can create a pipeline by starting with a blank canvas, using a smart template, or by importing YAML code.

- Use the blank canvas. For an example, see Planning a CICD native build in vRealize Automation Code Stream before manually adding tasks.
- Use a smart template. For an example, see Chapter 4 Planning to natively build, integrate, and deliver your code in vRealize Automation Code Stream .
- Import YAML code. Click **Pipelines > Import**. In the **Import** dialog box, select the YAML file or enter the YAML code, and click **Import**.

When you use the blank canvas to create a pipeline, you add stages, tasks, and approvals. The pipeline automates the process to build, test, deploy, and release your application. The tasks in each stage run actions that build, test, and release your code through each stage.

Table 6-1. Example pipeline stages and uses

Example stage...	Examples of what you can do...
Development	In a development stage, you can provision a machine, retrieve an artifact, add a build task to create a Docker host to use for continuous integration of your code, and more. For example: ■ To plan and create a continuous integration (CI) build, which delivers your code by using the native build capability in vRealize Automation Code Stream, see Planning a CI native build in vRealize Automation Code Stream before using the smart template.
Test	In a test stage, you can add a Jenkins task to test your software application, and include post-processing test tools such as JUnit and JaCoCo, and more. For example: ■ Integrate vRealize Automation Code Stream with Jenkins, and run a Jenkins job in your pipeline, which builds and tests your source code. See How do I integrate vRealize Automation Code Stream with Jenkins. ■ Create custom scripts that extend the capability of vRealize Automation Code Stream to integrate with your own build, test, and deploy tools. See How do I integrate my own build, test, and deploy tools with vRealize Automation Code Stream. ■ Track trends on post-processing for a continuous integration (CI) pipeline. See How do I track key performance indicators for my pipeline in vRealize Automation Code Stream.
Production	In a production stage, you can integrate with blueprints in vRealize Automation Cloud Assembly to provision your infrastructure, deploy your software to a Kubernetes cluster, and more. For example: ■ To see example stages for development and production, which can deploy your software application in your own Blue-Green deployment model, see How do I deploy my application in vRealize Automation Code Stream to my Blue-Green deployment. ■ To integrate a blueprint into your pipeline, see How do I automate the release of an application that I deploy from a YAML blueprint in vRealize Automation Code Stream. You can also add a deployment task that runs a script to deploy the application. ■ To automate the deployment of your software applications to a Kubernetes cluster, How do I automate the release of an application in vRealize Automation Code Stream to a Kubernetes cluster. ■ To integrate code into your pipeline and deploy your build image, see How do I continuously integrate code from my GitHub or GitLab repository into my pipeline in vRealize Automation Code Stream.

You can export your pipeline as a YAML file. Click **Pipelines**, click a pipeline card, then click **Actions > Export**.

Approving pipelines

You can obtain an approval from another team member at specific points in your pipeline.

- To require approval on a pipeline by including a user operation task in a pipeline, see How do I run a pipeline in vRealize Automation Code Stream and see results. This task sends an email notification to the user who must review it. The reviewer must either approve or reject the approval before the pipeline can continue to run.

- In any stage of a pipeline, if a task or stage fails, you can have vRealize Automation Code Stream create a Jira ticket. See How do I create a Jira ticket in vRealize Automation Code Stream when a pipeline task fails.

Triggering pipelines

Pipelines can trigger when developers check in or review code, or when a build artifact is created or updated.

- To integrate vRealize Automation Code Stream with the Git lifecycle, and trigger a pipeline when developers update their code, use the Git trigger. See How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline.
- To integrate vRealize Automation Code Stream with the Gerrit code review lifecycle, and trigger a pipeline on code reviews, use the Gerrit trigger. See How do I use the Gerrit trigger in vRealize Automation Code Stream to run a pipeline.
- To trigger a pipeline when a Docker build artifact is created or updated, use the Docker trigger. See How do I use the Docker trigger in vRealize Automation Code Stream to run a continuous delivery pipeline.

For more information about the triggers that vRealize Automation Code Stream supports, see Chapter 7 Triggering pipelines in vRealize Automation Code Stream.

This chapter includes the following topics:

- How do I run a pipeline in vRealize Automation Code Stream and see results
- What task types are available in vRealize Automation Code Stream
- How do I continue or stop a pipeline in vRealize Automation Code Stream based on task output
- How do I send notifications about my pipeline in vRealize Automation Code Stream
- How do I create a Jira ticket in vRealize Automation Code Stream when a pipeline task fails
- How do I roll back my deployment in vRealize Automation Code Stream
- How do I use variable bindings in vRealize Automation Code Stream

How do I run a pipeline in vRealize Automation Code Stream and see results

You can run a pipeline from the pipeline card, in pipeline edit mode, and from the pipeline execution. You can also use the available triggers to have vRealize Automation Code Stream run a pipeline when certain events occur.

When all the stages and tasks in your pipeline are valid, the pipeline is ready to be run or triggered.

After you enable and run the pipeline from the pipeline card, or while you are in the pipeline, you can view the pipeline execution to confirm that the pipeline built, tested, and deployed your code.

You can also use the triggers to run a pipeline when specific events occur. For example:

- When developers update code, the Git trigger can run a pipeline.
- When developers review code, the Gerrit trigger can run a pipeline.
- When an artifact is created in a Docker registry, the Docker trigger can run a pipeline.
- After a Jenkins build finishes, you can have Jenkins run a pipeline by using the `curl` command.

For more information about using the triggers, see Chapter 7 Triggering pipelines in vRealize Automation Code Stream.

The following procedure shows you how to run a pipeline from the pipeline card.

Prerequisites

- Verify that one or more pipelines are created. See the examples in Chapter 3 Ways to use vRealize Automation Code Stream.

Procedure

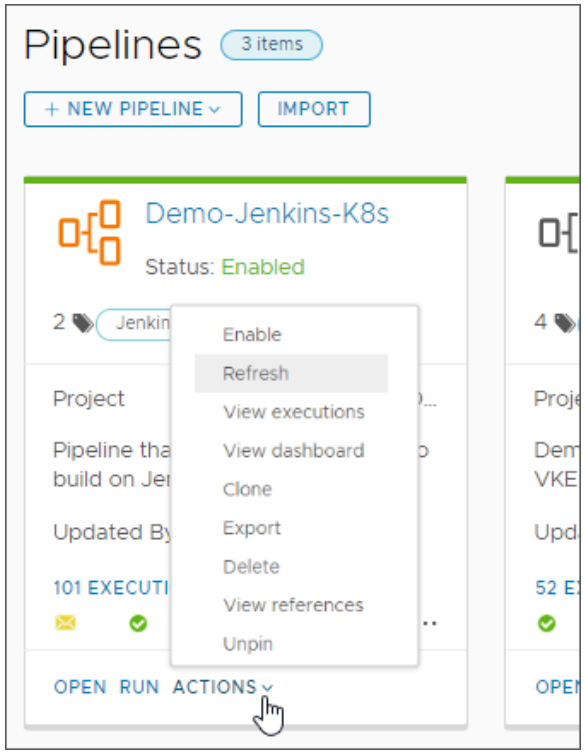
1 Enable and run your pipeline.

You must enable your pipeline before it can run. Otherwise, **Run** is deactivated.

a Click **Pipelines**.

b On your pipeline card, click **Actions > Enable**.

You can also enable your pipeline while you are in the pipeline. If your pipeline is already enabled, **Run** is active, and the **Actions** menu displays **Disable**.

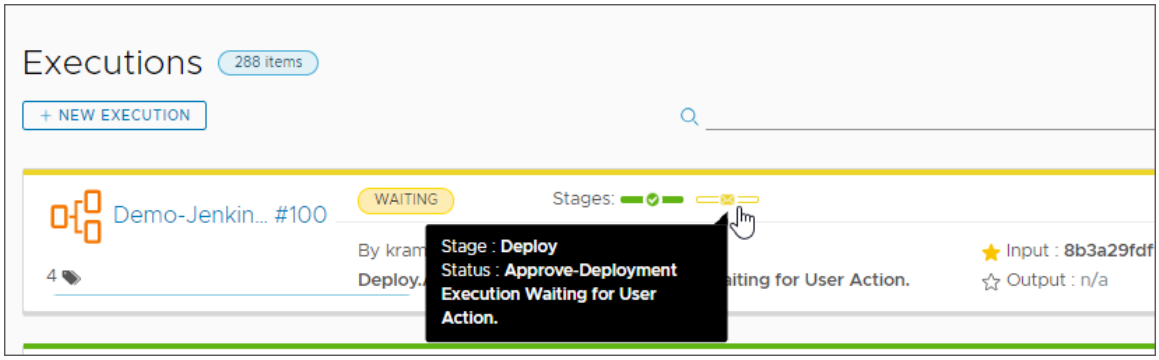


2 On the pipeline card, click **Run**.

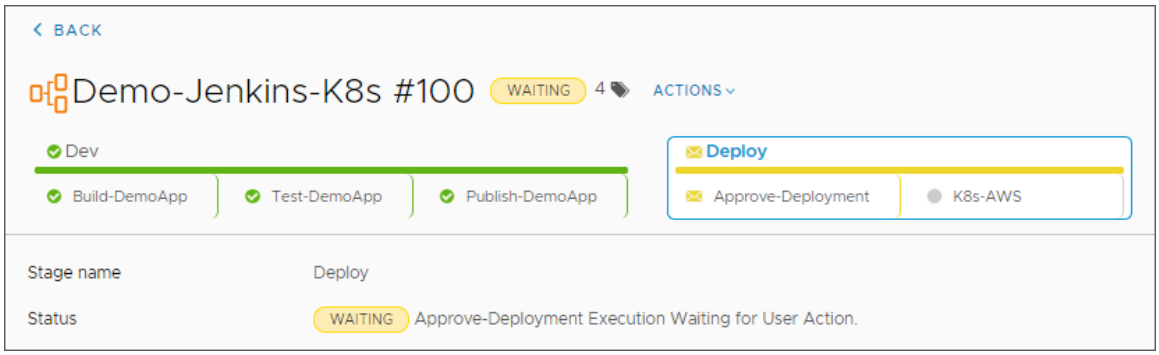
3 To view the pipeline as it runs, click **Executions**.

The pipeline runs each stage in sequence, and the pipeline execution displays a status icon for each stage. If the pipeline includes a user operation task, a user must approve the task for the pipeline to continue to run. When a user operation task is used, the pipeline stops running and waits for the required user to approve the task.

For example, you might use the user operation task to approve the deployment of code to a production environment.



4 To see the pipeline stage that is waiting for user approval, click the status icon for the stage.

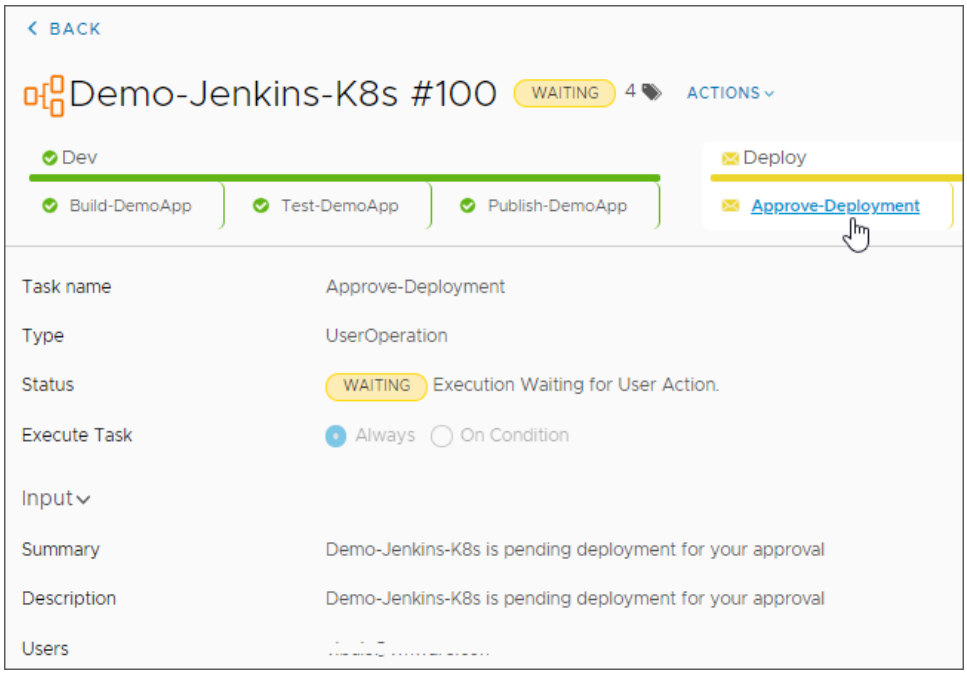


5 To see the details for the task, click the task.

After the required user approves the task, a user who has the appropriate role must resume the pipeline. For required roles, see How do I manage user access and approvals in vRealize Automation Code Stream.

If an execution fails, you must triage and fix the cause of the failure. Then, from the **Executions > Action** menu, run the execution again.

You can resume primary pipeline executions and nested executions.



6 From the pipeline execution, you can use the **Actions** menu to view the pipeline model, and make any changes.

7 To easily navigate between executions and see the details for a task, click **Executions**, and click a pipeline execution. Then, click the tab at the top of the execution, and select an execution.

Results

Congratulations! You ran a pipeline, examined the pipeline execution, and viewed a user operation task that required approval for the pipeline to continue to run. You also used the **Actions** menu in the pipeline execution to return to the pipeline model so that you can make any required changes.

What to do next

To learn more about using vRealize Automation Code Stream to automate your software release cycle, see Chapter 3 Ways to use vRealize Automation Code Stream.

What task types are available in vRealize Automation Code Stream

You can configure your pipeline to perform certain actions by adding specific task types to it. Each task type integrates with another application to enable your pipeline to accomplish what you design it to deliver.

Whether you need to pull artifacts from a repository for deployment, run a remote script, or require approval from a team member for your pipeline to run, vRealize Automation Code Stream has the task type for you!

Before you use the task type in your pipeline, verify that the corresponding endpoint is available.

Table 6-2. Obtain an approval or set a decision point

Task type...	What it does...	Examples and details...
User Operation	Enables a required approval that controls when a pipeline runs and must stop for an approval.	See How do I run a pipeline in vRealize Automation Code Stream and see results. and How do I manage user access and approvals in vRealize Automation Code Stream.
Condition	Adds a decision point, which determines whether the pipeline continues to run, or stops, based on condition expressions. When the condition is true, the pipeline runs successive tasks. When false, the pipeline stops.	See How do I continue or stop a pipeline in vRealize Automation Code Stream based on task output.

Table 6-3. Automate continuous integration and deployment

Task type...	What it does...	Examples and details...
Blueprint	Deploys an automation blueprint from GitHub and provisions an application, and automates the continuous integration and continuous delivery (CICD) of that blueprint for your deployment.	See How do I automate the release of an application that I deploy from a YAML blueprint in vRealize Automation Code Stream. When you select **Create** or **Update** in the blueprint task, then select **Blueprint** and **Version**, the blueprint parameters appear. You can add these elements, which accommodate variable bindings, to the input text areas in the blueprint task: ■ Integer ■ Enumeration string ■ Boolean ■ Array variable When you use variable binding in the input fields, be aware of these exceptions. For enumerations, you must select an enumeration value from a fixed set. For Boolean values, you must enter the value in the input text area. The blueprint parameter appears in the blueprint task when a blueprint in vRealize Automation Cloud Assembly includes input variables. For example, if a blueprint has an input type of `Integer`, you can enter the integer directly or as a variable by using variable binding.
CI	Enables continuous integration of your code into your pipeline by pulling a Docker build image from a registry endpoint, and deploying it to a Kubernetes cluster.	See Planning a CICD native build in vRealize Automation Code Stream before using the smart template.
Custom	Integrates vRealize Automation Code Stream with your own build, test, and deploy tools.	See How do I integrate my own build, test, and deploy tools with vRealize Automation Code Stream.
Kubernetes	Automate the deployment of your software applications to Kubernetes clusters on AWS.	See How do I automate the release of an application in vRealize Automation Code Stream to a Kubernetes cluster.
Pipeline	Nests a pipeline in a primary pipeline. When a pipeline is nested, it behaves as a task in the primary pipeline. On the Task tab of the primary pipeline, you can easily navigate to the nested pipeline by clicking the link to it. The nested pipeline opens in a new browser tab.	To find nested pipelines in **Executions**, enter **`nested`** in the search area.

Table 6-4. Integrate development, test, and deployment applications

Task type...	What it does...	Examples and details...
Artifactory	Interacts with jFrog Artifactory to integrate vRealize Automation Code Stream with various repositories, and search for artifacts in them, by using a search type that is specific to the repository and artifact.	Search for artifacts according to their package format, properties, archive, checksum value, and more. For example, use the `gavc` search type to search for the Maven artifacts.
Bamboo	Interacts with a Bamboo continuous integration (CI) server, which continuously builds, tests, and integrates software in preparation for deployment, and triggers code builds when developers commit changes. It exposes the artifact locations that the Bamboo build produces so that the task can output the parameters for other tasks to use for build and deployment.	Connect to a Bamboo server endpoint and start a Bamboo build plan from your pipeline.
Jenkins	Triggers Jenkins jobs that build and test your source code, runs test cases, and can use custom scripts.	See How do I integrate vRealize Automation Code Stream with Jenkins.
PCF	Interacts with Pivotal Cloud Foundry, and can run an action that deploys, scales, starts, stops, or deletes an application that developers created in Pivotal Cloud Foundry. The task can also bind and unbind services to the application.	Connect to a Pivotal Cloud Foundry endpoint, and enter properties for the Pivotal Cloud Foundry instance so that the task can deploy, scale, start, stop, and delete an application, and optionally bind services to it.
TFS	Allows you to connect your pipeline to Team Foundation Server to manage and invoke build projects, including configured jobs that build and test your code.	vRealize Automation Code Stream supports Team Foundation Server 2013 and 2015.
vRO	Extends the capability of vRealize Automation Code Stream by running predefined or custom workflows in vRealize Orchestrator.	See How do I integrate vRealize Automation Code Stream with vRealize Orchestrator.

Table 6-5. Integrate other applications through an API

Task type...	What it does...	Examples and details...
REST	Integrates vRealize Automation Code Stream with other applications that use a REST API so that you can continuously develop and deliver software applications that interact with each other.	See How do I use a REST API to integrate vRealize Automation Code Stream with other applications.
Poll	Invokes a REST API and polls it until the pipeline task meets the exit criteria and completes.	See How do I use a REST API to integrate vRealize Automation Code Stream with other applications.

Table 6-6. Run remote and user-defined scripts

Task type...	What it does...	Examples and details...
PowerShell	Allows the PowerShell script task type to run script commands on a remote host. For example, a script can automate test tasks, and run administrative types of commands. The script can be remote or user-defined. It can connect over HTTP or HTTPs, and can use TLS. The service named `winrm` must be configured on the Windows host, and `winrm` must be configured for `MaxShellsPerUser` and `MaxMemoryPerShellMB`.	When you configure `MaxShellsPerUser` and `MaxMemoryPerShellMB`: ■ The acceptable value for `MaxShellsPerUser` is `500` for 50 concurrent pipelines, with 5 PowerShell tasks for each pipeline. To set the value, run: `winrm set winrm/config/winrs '@{MaxShellsPerUser="500"}'` ■ The acceptable memory value for `MaxMemoryPerShellMB` is `2048`. To set the value, run: `winrm set winrm/config/winrs '@{MaxMemoryPerShellMB="2048"}'` The script writes the output to a response file that another pipeline can consume.
SSH	Allows the Bash shell script task type to run script commands on a remote host. For example, a script can automate test tasks, and run administrative types of commands. The script can be remote or user-defined. It can connect over HTTP or HTTPs, and requires a private key or password. The SSH service must be configured on the Linux host, and the SSHD configuration of `MaxSessions` must be set to `50`.	The script can be remote or user-defined. For example, a script might resemble: `message="Hello World" echo $message` The script writes the output to a response file that another pipeline can consume.

How do I continue or stop a pipeline in vRealize Automation Code Stream based on task output

You can have the output of a task in your pipeline determine whether the pipeline runs or stops based on a condition that you supply. To pass or fail the pipeline based on the task output, you use the Condition task type.

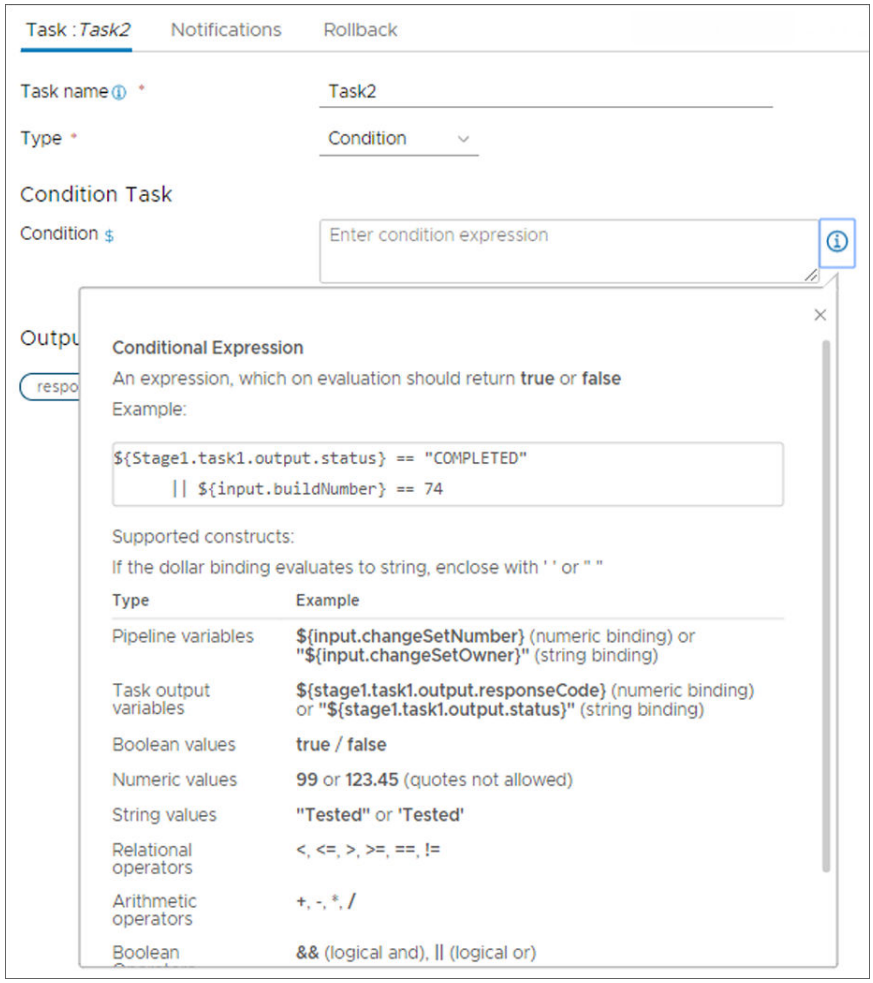
You use the **Condition** task type as a decision point in your pipeline. By using the Condition task with a condition expression that you provide, you can evaluate any properties in your pipeline, stages, and tasks.

The result of the Condition task determines whether the next task in the pipeline runs.

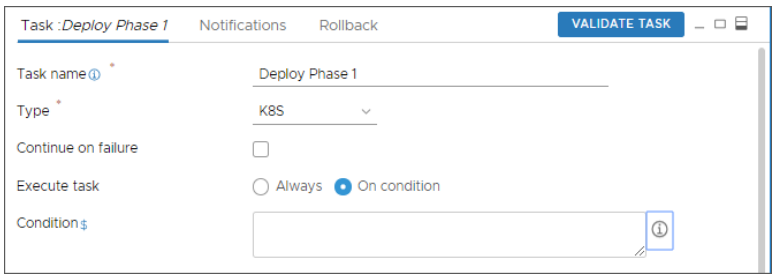
- A true condition allows the pipeline to continue to run.
- A false condition stops the pipeline.

For examples of how to use the output value of one task as the input to the next task by binding the tasks together with a Condition task, see How do I use variable bindings in vRealize Automation Code Stream.

Table 6-7. How the Condition task and its condition expression relate to the pipeline

Condition task type...	What it affects...	What it does...
Condition task	Pipeline	The **Condition** task type determines whether the pipeline runs or stops at that point, based on whether the task output is true or false.
Condition expression	Condition task output	When the pipeline runs, the condition expression that you include in the **Condition** task produces a true or false output status. For example, a condition expression might require the Condition task output status to be `Completed`, or to use a build number of `74`. The condition expression appears on the Task tab in the Condition task type. 

The **Condition** task type differs in function and behavior from the **On Condition** setting in other task types.



In other task types, the **On Condition** setting:

- Determines whether the current task runs, rather than successive tasks, based on the evaluation of its precondition expression of true or false. The condition expression for the On Condition setting produces a true or false output status for the current task when the pipeline runs.
- Appears on the Task tab with its own condition expression.

This example uses the Condition task.

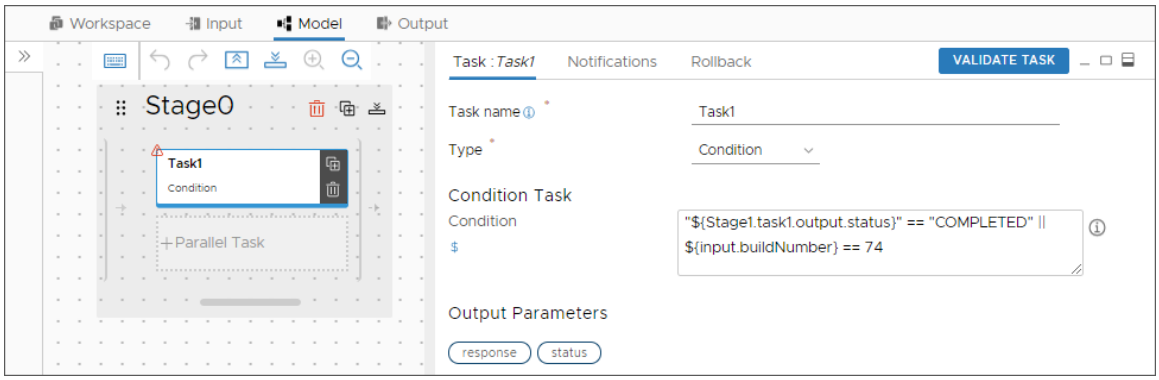
Prerequisites

- Verify that a pipeline exists, and includes stages and tasks.

Procedure

1. In your pipeline, determine the decision point where the Condition task must appear.
2. Add the Condition task before the task that depends on its pass or fail status.
3. Add a condition expression to the Condition task.

   For example: `"${Stage1.task1.output.status}" == "COMPLETED" || ${input.buildNumber} == 74`



4. Validate the task.
5. Save the pipeline, then enable and run it.

Results

Watch the pipeline executions and notice whether the pipeline continues to run, or stops at the Condition task.

What to do next

You can also use the Condition task type if you decide to roll back a pipeline deployment. For example, in a rollback pipeline, the Condition task helps vRealize Automation Code Stream mark a pipeline failure based on the condition expression, and can trigger a single rollback flow for various failure types.

To roll back a deployment, see How do I roll back my deployment in vRealize Automation Code Stream.

How do I send notifications about my pipeline in vRealize Automation Code Stream

Notifications are ways to communicate with your teams and let them know the status of your pipelines in vRealize Automation Code Stream.

You can configure vRealize Automation Code Stream to send notifications on the status of the entire pipeline, stage, or task:

- Email. Send an email when the pipeline completes, is waiting, or fails.
- Ticket. When the pipeline fails or completes, create a ticket and assign it to a team member.
- Webhook. Send a request to another application when the pipeline fails, completes, is waiting, or is canceled.

When the pipeline runs, vRealize Automation Code Stream sends the notifications based on the result of a pipeline stage or task, or on the entire pipeline status.

To obtain approval at a specific point in your pipeline, you can include a user operation task. This task sends an email notification to the person who must approve the task. You can create a JIRA ticket when a pipeline task fails. Or, you can notify a Slack channel about the status of a pipeline based on the pipeline event.

You can use variables in all types of notifications. For example, you can use **`${var}`** in the URL in a Webhook notification.

Prerequisites

- Verify that one or more pipelines are created. See the use cases in Chapter 3 Ways to use vRealize Automation Code Stream.
- To send email notifications, verify that you can access a working email server. For help, see your administrator.
- To create tickets, such as a JIRA ticket, verify that the endpoint exists. See What are Endpoints in vRealize Automation Code Stream .
- To send a notification based on an integration, you create a webhook notification. Then, you verify that the webhook is added and working. You can use notifications with applications such as Slack, GitHub, or GitLab.

Procedure

1 Open a pipeline.

2 To create a notification for the overall pipeline status, or the status of a stage or task:

To create a notification based on...	What you do...
Pipeline status	Click a blank area on the pipeline canvas.
Status of a stage	Click a blank area in a stage of the pipeline.
Status of a task	Click a task in a stage of the pipeline.

3 Click the **Notifications** tab.

4 Click **Add**, select the type of notification, and configure the notification details.

5 To create a Slack notification when a pipeline succeeds, create a webhook notification.

   a Select **Webhook**.

   b Enter the information to configure the Slack notification.

   c Click **Save.**

   d When the pipeline runs, the Slack channel receives the notification of the pipeline status. For example, users might see the following on the Slack channel:

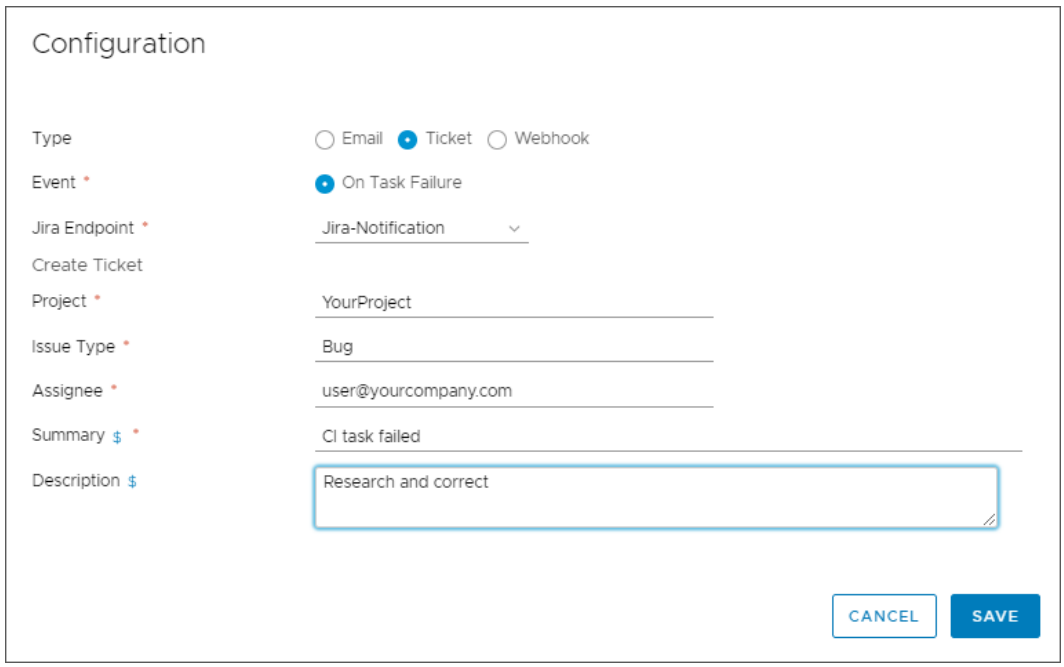
```
Codestream APP [12:01 AM]
Tested by User1 - Staging Pipeline 'User1-Pipeline', Pipeline ID
'e9b5884d809ce2755728177f70f8a' succeeded
```

6 To create a JIRA ticket, configure the ticket information.

a Select **Ticket**.

b Enter the information to configure the JIRA notification.

c Click **Save.**



Results

Congratulations! You learned that you can create various types of notifications in several areas of your pipeline in vRealize Automation Code Stream.

What to do next

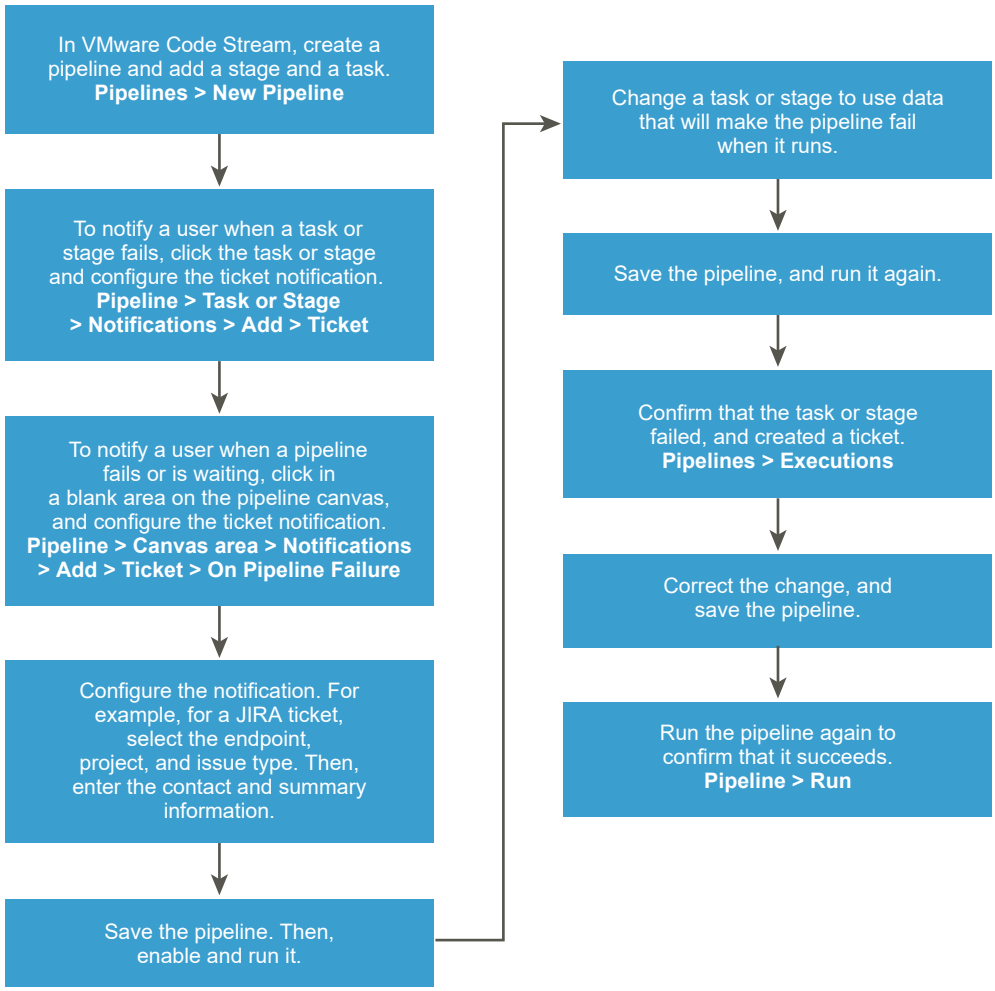
For a detailed example of how to create a notification, see How do I create a Jira ticket in vRealize Automation Code Stream when a pipeline task fails.

How do I create a Jira ticket in vRealize Automation Code Stream when a pipeline task fails

If a stage or task in your pipeline fails, you can have vRealize Automation Code Stream create a Jira ticket. You can assign the ticket to the person who needs to resolve the problem. You can also create a ticket when the pipeline is waiting, or when it succeeds.

You can add and configure notifications on a task, stage, or pipeline. vRealize Automation Code Stream creates the ticket based on the status of the task, stage, or pipeline where you add the notification. For example, if an endpoint is not available, you can have vRealize Automation Code Stream create a Jira ticket for the task that fails because it cannot connect to the endpoint.

You can also create notifications when your pipeline succeeds. For example, you let your QA team to know about pipeline success so that they can verify the build and run a different test pipeline. Or, you let your performance team know so that they can measure the performance of the pipeline and prepare for an update to staging or production.



This example creates a Jira ticket when a pipeline task fails.

Prerequisites

- Verify that you have a valid Jira account and can log in to your Jira instance.
- Verify that a Jira endpoint exists, and is working.

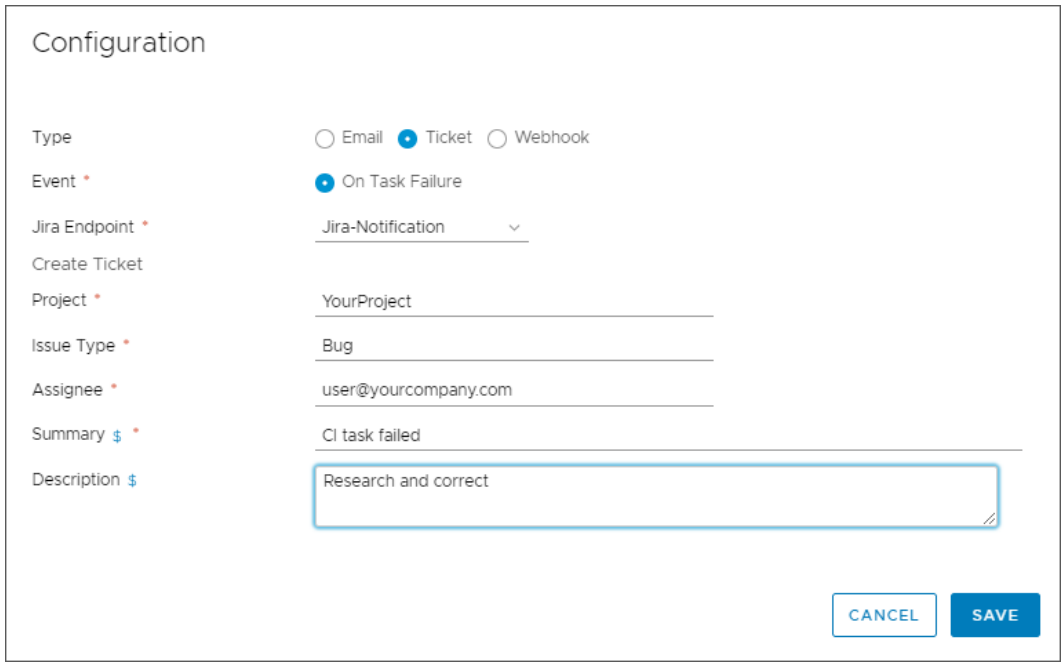
Procedure

1. In your pipeline, click a task.
2. In the task configuration pane, click **Notifications**.
3. Click **Add**, and configure the ticket information.
   a. Click **Ticket**.
   b. Select the Jira endpoint.

c Enter the Jira project and issue type.

d Enter the email address for the person who will receive the ticket.

e Enter a summary and description of the ticket, then click **Save**.



4 Save the pipeline, then enable and run it.

5 Test the ticket.

a Change the task information to include data that makes the task fail.

b Save the pipeline, and run it again.

c Click **Executions**, and verify that the pipeline failed.

d In the execution, verify that vRealize Automation Code Stream created the ticket and sent it.

e Change the task information back to correct it, then run the pipeline again and ensure that it succeeds.

Results

Congratulations! You had vRealize Automation Code Stream create a Jira ticket when the pipeline task failed, and assigned it to the person who needed to solve it.

What to do next

Continue to add notifications to alert your team about your pipelines.

How do I roll back my deployment in vRealize Automation Code Stream

You configure rollback as a pipeline with tasks that return your deployment to a previous stable state following a failure in a deployment pipeline. You attach the rollback pipeline to tasks or stages that you want to roll back in the event of a failure.

Depending upon your role, your reasons for rollback may vary.

- As a release engineer, I want vRealize Automation Code Stream to verify success during a release so that I can know whether to continue with the release or roll back. Possible failures include task failure, a rejection in UserOps, exceeding the metrics threshold.
- As an environment owner, I want to redeploy a previous release so that I can quickly get an environment back to a known-good state.
- As an environment owner, I want to support roll back of a Blue-Green deployment so that I can minimize downtime from failed releases.

When you use a smart template to create a CD pipeline with the rollback option clicked, rollback is automatically added to tasks in the pipeline. In this use case, you will use the smart template to define rollback for an application deployment to a Kubernetes cluster using the rolling upgrade deployment model. The smart template creates a deployment pipeline and one or more rollback pipelines.

- In the deployment pipeline, rollback is required if Update Deployment or Verify Deployment tasks fail.
- In the rollback pipeline, deployment is updated with an old image.

You can also manually create a rollback pipeline using a blank template. Before creating a rollback pipeline, you will want to plan your rollback flow. For more background information about rollback, see Planning for rollback in vRealize Automation Code Stream.

Prerequisites

- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.
- Set up the Kubernetes clusters where your pipeline will deploy your application. Set up one development cluster and one production cluster.
- Create the Kubernetes development and production endpoints that deploy your application image to the Kubernetes clusters.
- Verify that you have a Docker registry setup.
- Verify that you have a Kubernetes YAML file to apply to the deployment.
- Familiarize yourself with the CD smart template. See Planning a CD native build in vRealize Automation Code Stream before using the smart template.

Procedure

1 Click **Pipelines > New Pipeline > Smart Template > Continuous Delivery**.

2 Enter the information in the smart template.

a Select a project.

b Enter a pipeline name such as **`RollingUpgrade-Example`**.

c Select the environments for your application. To add rollback to your deployment, you must select **Prod**.

d Click **Select**, choose a Kubernetes YAML file, and click **Process**.

The smart template displays the available services and deployment environments.

e Select the service that the pipeline will use for the deployment.

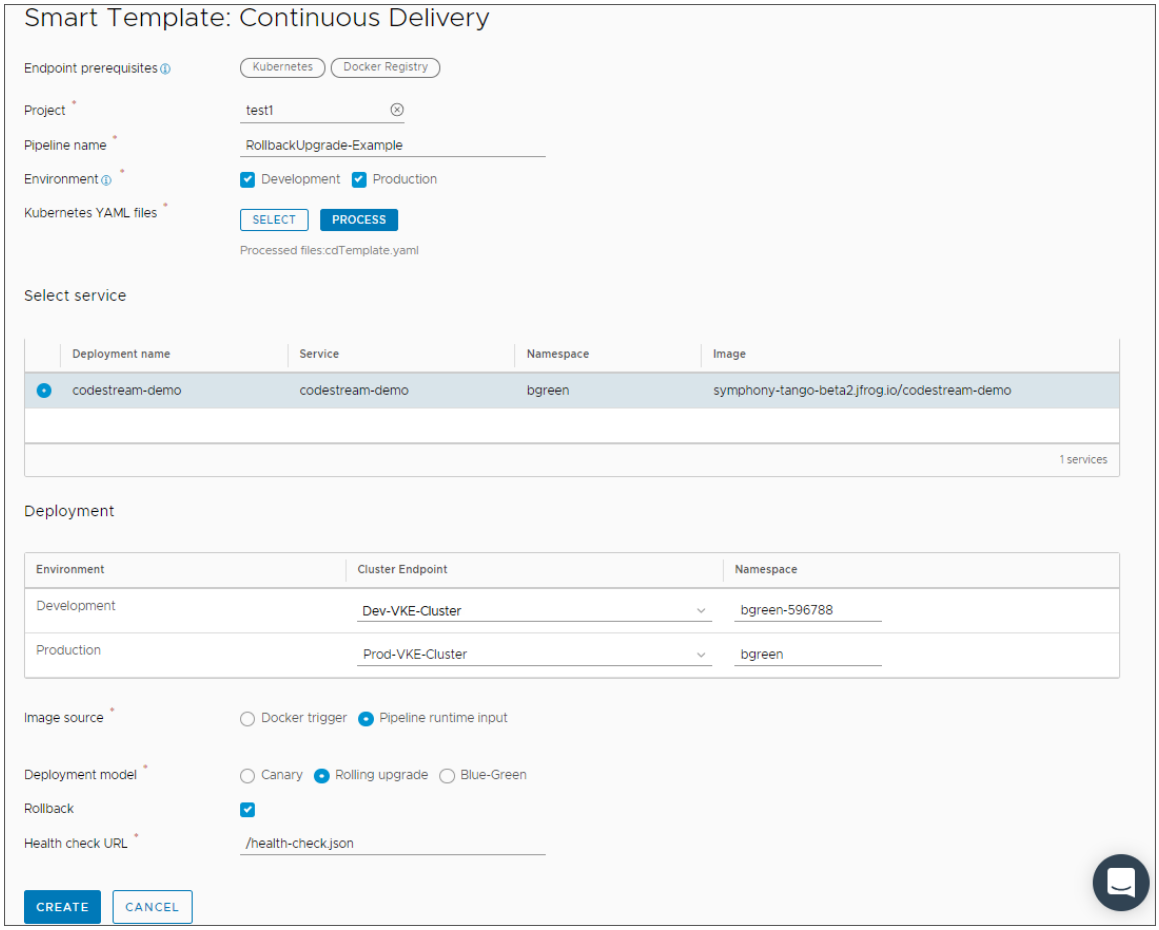
f Select the cluster endpoints for Dev and Prod environments.

g For the Image source, select **Pipeline runtime input**.

h For the Deployment model, select **Rolling Upgrade**.

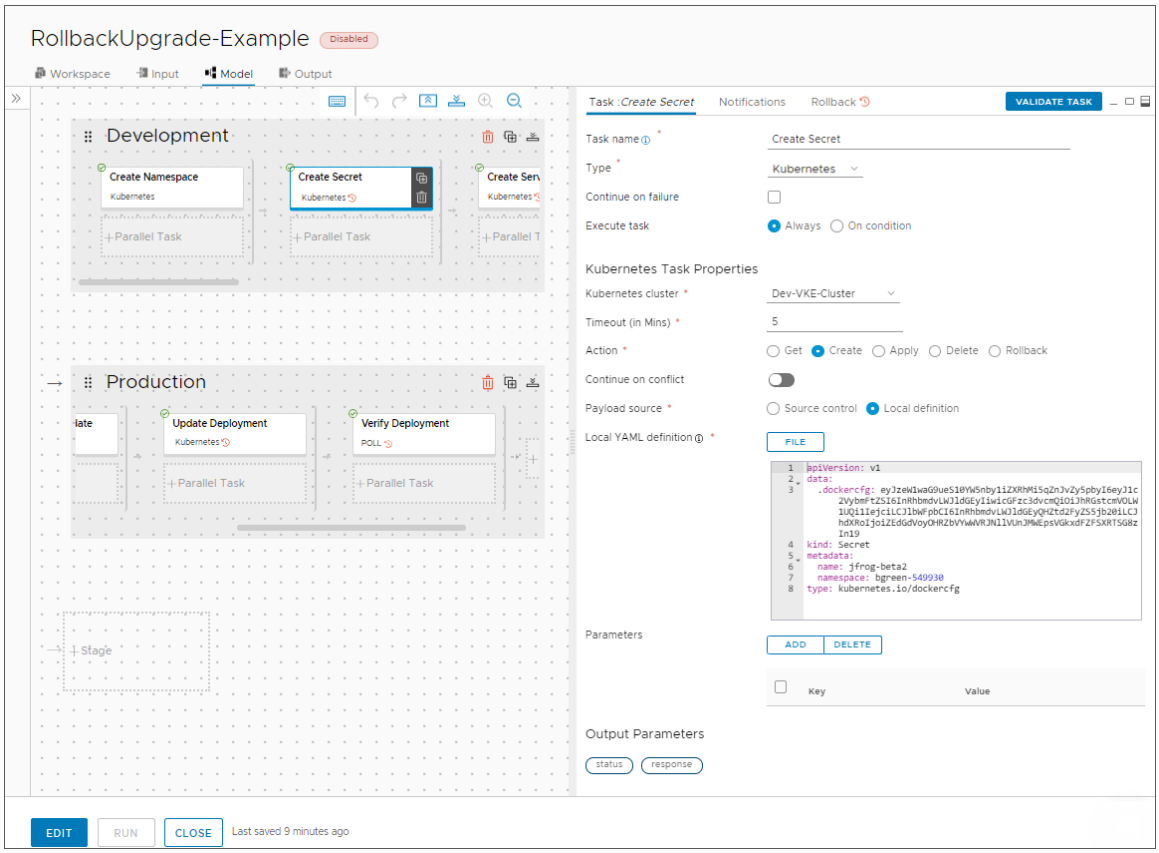
i Click **Rollback**.

j Provide the Health check URL.



3 To create the pipeline named RollbackUpgrade-Example, click **Create**.

The RollbackUpgrade-Example pipeline appears with the rollback icon on tasks in the Development and Production stages that can be rolled back.



4 Close the pipeline.

On the Pipelines page, you'll see the that pipeline you created and a new pipeline for each stage in your pipeline.

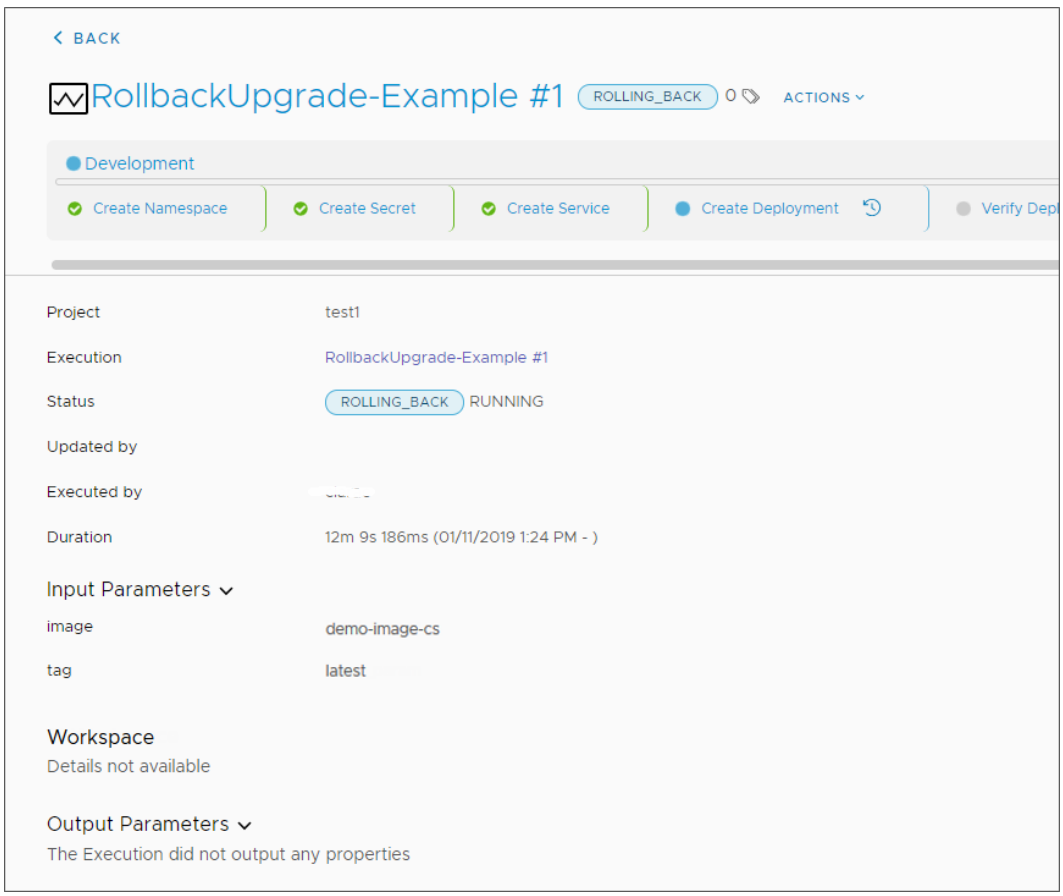
- RollingUpgrade-Example. vRealize Automation Code Stream deactivates the pipeline that you created by default, which ensures that you review it before you run it.
- RollingUpgrade-Example_Dev_Rollback. This rollback development pipeline is invoked on the failure of tasks in the development stage, such as Create service, Create secret, Create deployment, Verify deployment. The rollback development pipeline is enabled by default to ensure the rollback of development tasks.
- RollingUpgrade-Example_Prod_Rollback. This rollback production pipeline is invoked on the failure of tasks in the production stage, such as Deploy phase 1, Verify phase 1, Deploy Rollout phase, Finish Rollout phase, Verify rollout phase. The rollback production pipeline is enabled by default to ensure the rollback of production tasks.

5 Enable and run the pipeline you created.

When you start the run, you are prompted for input parameters. You provide the image and tag for the endpoint in the Docker repository that you are using.

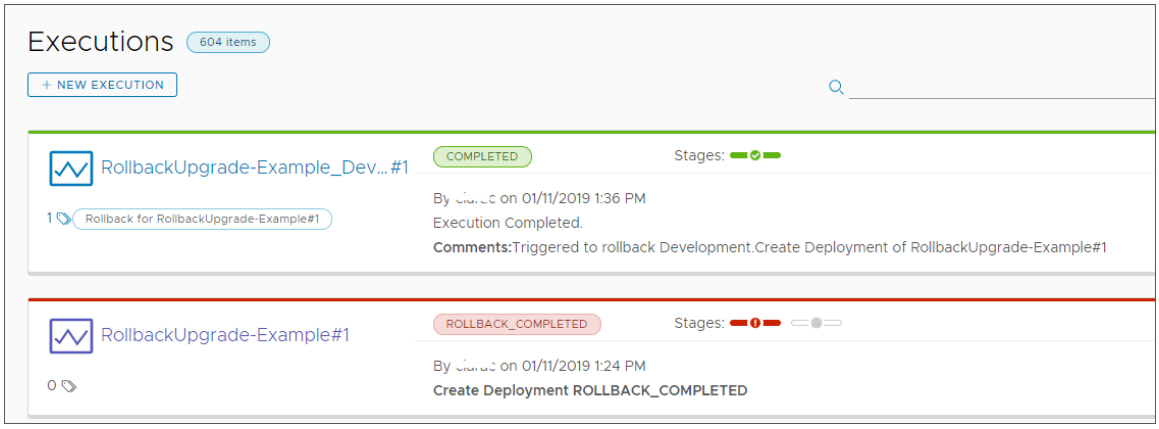
6 On the Executions page, select **Actions > View Execution** to watch the pipeline execution.

The pipeline starts **RUNNING** and moves through the Development stage tasks. If the pipeline fails to run a task during the Development stage, the pipeline named RollingUpgrade-Example_Dev_Rollback is triggered to roll back the deployment and the pipeline status changes to **ROLLING_BACK**.



After rollback, the Executions page lists two RollingUpgrade-Example pipeline executions.

- The pipeline you created that was rolled back shows **ROLLBACK_COMPLETED**.
- The rollback development pipeline that was triggered to perform the rollback shows **COMPLETED**.



Results

Congratulations! You successfully defined a pipeline with rollback and watched vRealize Automation Code Stream roll back the pipeline at the point of failure.

How do I use variable bindings in vRealize Automation Code Stream

You can bind tasks by using the dollar sign variable ($). You can use it to bind a REST task to a URL. Or, when a pipeline runs and a task generates an output value, you can use that value as the input to the next task.

Binding a URL to a REST task

You can add a URL binding variable to a REST task, so that when the REST task runs, a user must enter a URL. For example, to bind a REST task to a Git server URL:

1 In your pipeline, click the **Input** tab, and set **Auto inject parameters** to **Git**.

2 In a REST task, on the **Task** tab in the URL area, enter **$**, then select **input** and **GIT_SERVER_URL**.

3 To verify the integrity of the variable binding for the task, click **Validate Task**.

4 When the pipeline runs and reaches the REST task, a user must enter the URL to the Git server.

Binding two tasks

To bind two tasks together, you add a binding variable to the input configuration of the receiving task. Then, when the pipeline runs, a user replaces the binding variable with the required input. For an example of using the output of a task in your pipeline to determine whether the pipeline runs or stops based on a condition that uses variable binding, see How do I continue or stop a pipeline in vRealize Automation Code Stream based on task output.

Sample syntax for using variable bindings between tasks

Consider these sample syntax formats:

- Using a task output value for pipeline notifications and pipeline output properties: **`${<Stage Key>.<Task Key>.output.<Task output key>}`**
- Referring to the previous task output value as an input for the current task: **`${<Previous/Current Stage key>.<Previous task key not in current Task group>.output.<task output key>}`**

Examples of using variable bindings between tasks

Table 6-8. Using the output of a Jenkins build task as a conditional input to a Bash script configuration task

Task binding	Syntax
Output of Jenkins build task:	`${DEV.build-jenkins.status} == 'COMPLETED' && ${DEV.build-jenkins.status} != 'FAILED'`
Command line argument for script task:	`${DEV.configure-script.output.outputConfig[0].name}`

Table 6-9. After an Artifactory task fetches an artifact, having a Bash configuration script conditionally accept the artifact when you enter the URL

Task binding	Syntax
Condition on script task:	`${input.param1} != 'test'`
Command line argument on script task:	`${PROD.fetch-artifact.output.artifacts.Dummy-jar.downloadUrl}`

Table 6-10. Always having a Bash script configuration task use the output of a successful Jenkins build task

Task binding	Syntax
Input to Bash script configuration task:	`${DEV.configure-script.status} != 'FAILED' && ${UAT.build-jenkins.status} != 'SKIPPED'`

Table 6-11. Conditionally running a Bash script configuration task after a Jenkins task runs

Task binding	Syntax
Condition on script task:	`${DEV.configure-script.status} != 'FAILED'`
Script task command line argument:	`${DEV.configure-script.output.outputConfig}`

Triggering pipelines in vRealize Automation Code Stream 7

You can have vRealize Automation Code Stream trigger a pipeline when certain events occur.

For example, you can:

- Use the Docker trigger to run a pipeline when a new artifact is created or updated.
- Use the Git trigger to trigger a pipeline when developers update code.
- Use the Gerrit trigger to trigger a pipeline when developers review code.
- Use the `curl` command to have Jenkins trigger the pipeline after a build completes.

This chapter includes the following topics:

How do I use the Docker trigger in vRealize Automation Code Stream to run a continuous delivery pipeline

As a DevOps administrator or developer, you can use the Docker trigger in vRealize Automation Code Stream. The Docker trigger runs a standalone continuous delivery (CD) pipeline whenever a build artifact is created or updated. The Docker trigger runs your CD pipeline, which pushes the new or updated artifact as a container image to a Docker Hub repository. The CD pipeline can run as part of your automated builds.

For example, to continuously deploy your updated container image through your CD pipeline, use the Docker trigger. When your container image gets checked into the Docker registry, the webhook in Docker Hub notifies vRealize Automation Code Stream that the image changed. This notification triggers the CD pipeline to run with the updated container image, and upload the image to the Docker Hub repository.

To use the Docker trigger, you perform several steps in vRealize Automation Code Stream.

Table 7-1. How to use the Docker trigger

What you do...	More information about this action...
Create a Docker registry endpoint.	For vRealize Automation Code Stream to trigger your pipeline, you must have a Docker Registry endpoint. If the endpoint does not exist, you can select an option that creates it when you add the webhook for the Docker trigger. The Docker registry endpoint includes the URL to the Docker Hub repository.
Add input parameters to the pipeline that auto inject Docker parameters when the pipeline runs.	You can inject Docker parameters into the pipeline. Parameters can include the Docker event owner name, image, repository name, repository namespace, and tag. In your CD pipeline, you include input parameters that the Docker webhook passes to the pipeline before the pipeline triggers.
Create a Docker webhook.	When you create the Docker webhook in vRealize Automation Code Stream, it also creates a corresponding webhook in Docker Hub. The Docker webhook in vRealize Automation Code Stream connects to Docker Hub through the URL that you include in the webhook. The webhooks communicate with each other, and trigger the pipeline when an artifact is created or updated in Docker Hub. If you update or delete the Docker webhook in vRealize Automation Code Stream, the webhook in Docker Hub is also updated or deleted.
Add and configure a Kubernetes task in your pipeline.	When an artifact is created or updated in the Docker Hub repository, the pipeline triggers. Then, it deploys the artifact through the pipeline to the Docker host in your Kubernetes cluster.
Include a local YAML definition in the task.	The YAML definition that you apply to the deployment task includes the Docker container image and any secret keys that are required to pull the image from the repository for deployment.

When an artifact is created or updated in the Docker Hub repository, the webhook in Docker Hub notifies the webhook in vRealize Automation Code Stream, which triggers the pipeline. The following actions occur:

1 Docker Hub sends a POST request to the URL in the webhook.

2 vRealize Automation Code Stream runs the Docker trigger.

3 The Docker trigger starts your CD pipeline.

4 The CD pipeline pushes the artifact to the Docker Hub repository.

5 vRealize Automation Code Stream triggers its Docker webhook, which runs a CD pipeline that deploys the artifact to your Docker host.

In this example, you create a Docker endpoint and a Docker webhook in vRealize Automation Code Stream that deploys your application to your development Kubernetes cluster. The steps include the example code for the payload that Docker posts to the URL in the webhook, the API code that it uses, and the authentication code with the secure token.

Prerequisites

- Verify that a continuous delivery (CD) pipeline exists in your vRealize Automation Code Stream instance. Also verify that it includes one or more Kubernetes tasks that deploy your application. See Chapter 4 Planning to natively build, integrate, and deliver your code in vRealize Automation Code Stream .
- Verify that you can access an existing Kubernetes cluster where your CD pipeline can deploy your application for development.
- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.

Procedure

1 Create a Docker registry endpoint.

   a Click **Endpoints**.

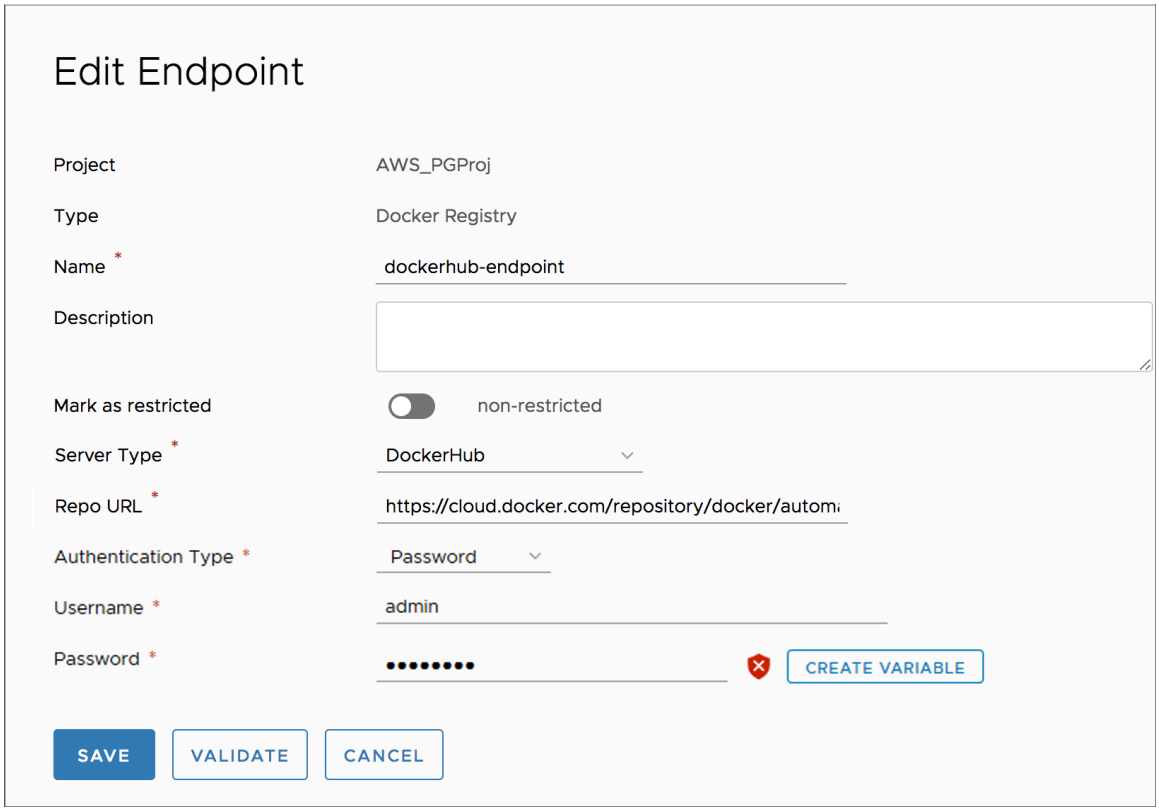
   b Click **New Endpoint**.

   c Enter a relevant name.

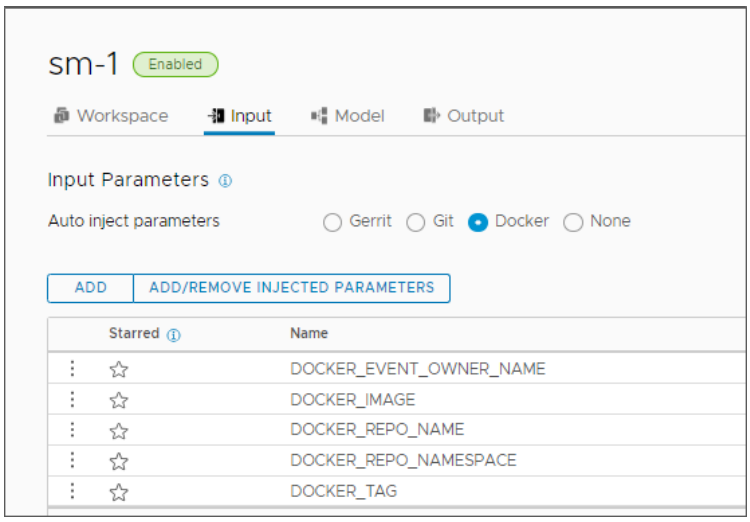
   d Select the server type as **Docker Hub**.

e Enter the URL to the Docker Hub repository.

f Enter the name and password that is used to access the repository.



2 In your CD pipeline, set the input properties to auto inject Docker parameters when the pipeline runs.



3 Create a Docker webhook.

a Click **Triggers > Docker**.

b Click **New Webhook for Docker**.

c Select a project.

d Enter a relevant name.

e Select your Docker registry endpoint.

If the endpoint does not yet exist, click **Create Endpoint** and create it.

f Select the pipeline with Docker injected parameters for the webhook to trigger. See Step 2.

If the pipeline was configured with custom added input parameters, the Input Parameters list displays parameters and values. You can enter values for input parameters that will be passed to the pipeline with the trigger event. Or you can leave the values blank, or use the default values if defined.

For more information about parameters on the input tab, see How you'll create the CICD pipeline and configure the workspace.

g Enter the API Token.

The API token authenticates you for external API connections with vRealize Automation Code Stream. To obtain the API token:

1 Click **Generate Token**.

2 Enter the email address associated with your user name and password and click **Generate**.

The token that you generate is valid for six months. It is also known as a refresh token.

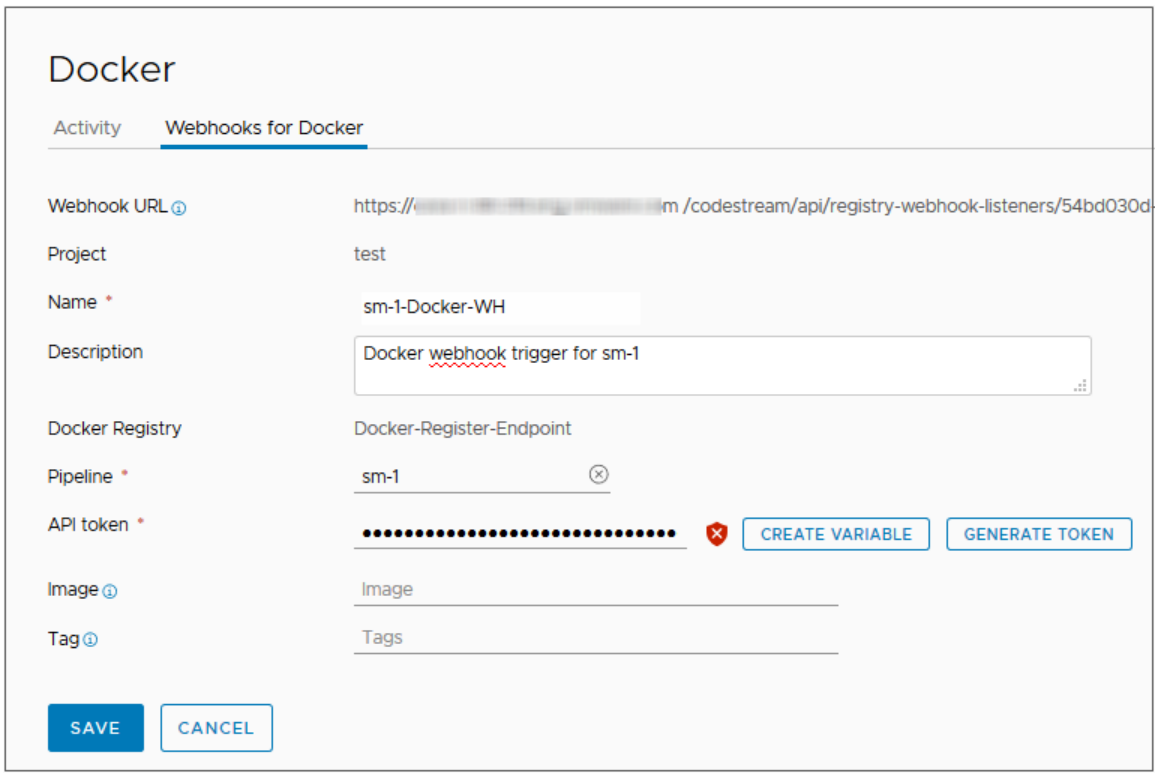
- To keep the token as a variable for future use, click **Create Variable**, enter a name for the variable and click **Save**.
- To keep the token as a text value for future use, click **Copy** and paste the token into a text file to save locally.

You can choose to both create a variable and store the token in a text file for future use.

3 Click **Close**.

h Enter the build image.

i Enter a tag.



j Click **Save**.

The webhook card appears with the Docker webhook enabled. If you want to make a dummy push to the Docker Hub repository without triggering the Docker webhook and running a pipeline, click **Disable**.

4 In your CD pipeline, configure your Kubernetes deployment task.

a In the Kubernetes task properties, select your development Kubernetes cluster.

b Select the **Create** action.

c Select the **Local Definition** for the payload source.

d Then select your local YAML file.

For example, Docker Hub might post this local YAML definition as the payload to the URL in the webhook:

```
{
"callback_url": "https://registry.hub.docker.com/u/svendowideit/testhook/hook/
2141b5bi5i5b02bec211i4eeih0242eg11000a/",
"push_data": {
"images": [
"27d47432a69bca5f2700e4dff7de0388ed65f9d3fb1ec645e2bc24c223dc1cc3",
"51a9c7c1f8bb2fa19bcd09789a34e63f35abb80044bc10196e304f6634cc582c",
"..."
],
"pushed_at": 1.417566161e+09,
"pusher": "trustedbuilder",
"tag": "latest"
},
"repository": {
"comment_count": 0,
"date_created": 1.417494799e+09,
"description": "",
"dockerfile": "#\n# BUILD\u0009\u0009docker build -t svendowideit/apt-
cacher .\n# RUN\u0009\u0009docker run -d -p 3142:3142 -name apt-cacher-
run apt-cacher\n#\n# and then you can run containers with:\n#
\u0009\u0009docker run -t -i -rm -e http_proxy http://192.168.1.2:3142/
debian bash\n#\nFROM\u0009\u0009ubuntu\n\n\nVOLUME\u0009\u0009[\/var/cache/apt-cacher-
ng\]\nRUN\u0009\u0009apt-get update ; apt-get install -yq apt-cacher-ng\n\nEXPOSE
\u0009\u00093142\nCMD\u0009\u0009chmod 777 /var/cache/apt-cacher-ng ; /etc/init.d/apt-
cacher-ng start ; tail -f /var/log/apt-cacher-ng/*\n",
"full_description": "Docker Hub based automated build from a GitHub repo",
"is_official": false,
"is_private": true,
"is_trusted": true,
"name": "testhook",
"namespace": "svendowideit",
"owner": "svendowideit",
"repo_name": "svendowideit/testhook",
"repo_url": "https://registry.hub.docker.com/u/svendowideit/testhook/",
"star_count": 0,
"status": "Active"
}
}
```

The API that creates the webhook in Docker Hub uses this form: `https://cloud.docker.com/v2/repositories/%3CUSERNAME%3E/%3CREPOSITORY%3E/webhook_pipeline/`

The JSON code body resembles:

```
{
"name": "demo_webhook",
```

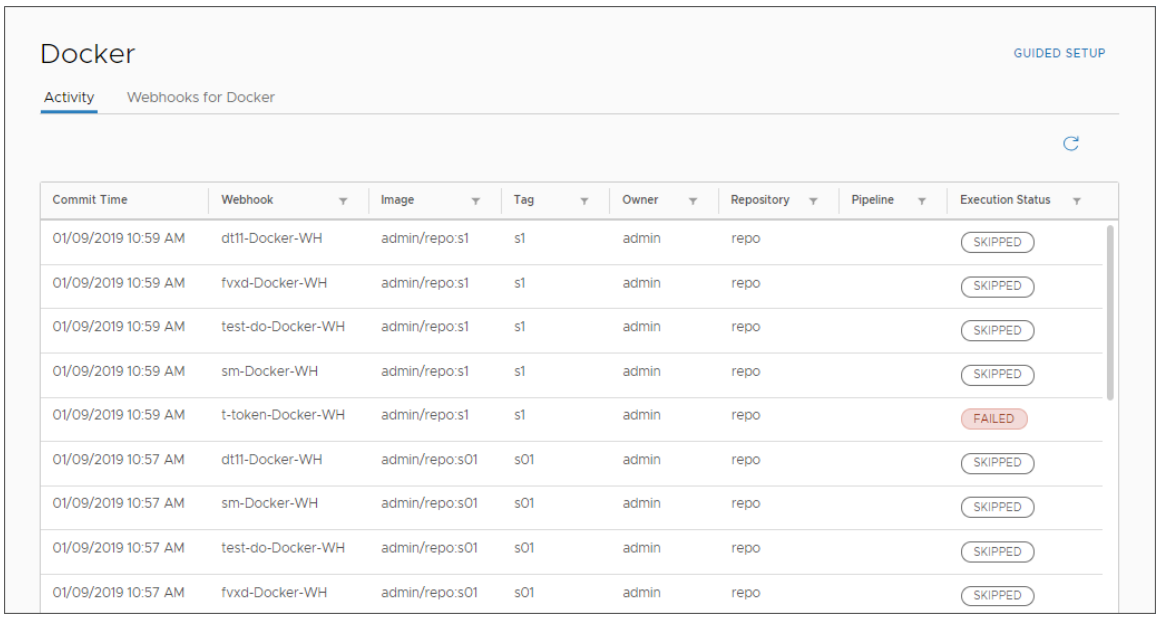
```
"webhooks": [
{
"name": "demo_webhook",
"hook_url": "http://www.google.com"
}
]
}
```

To receive events from the Docker Hub server, the authentication scheme for the Docker webhook that you create in vRealize Automation Code Stream uses an allowlist authentication mechanism with a random string token for the webhook. It filters events based on the secure token, which you can append to `hook_url`.

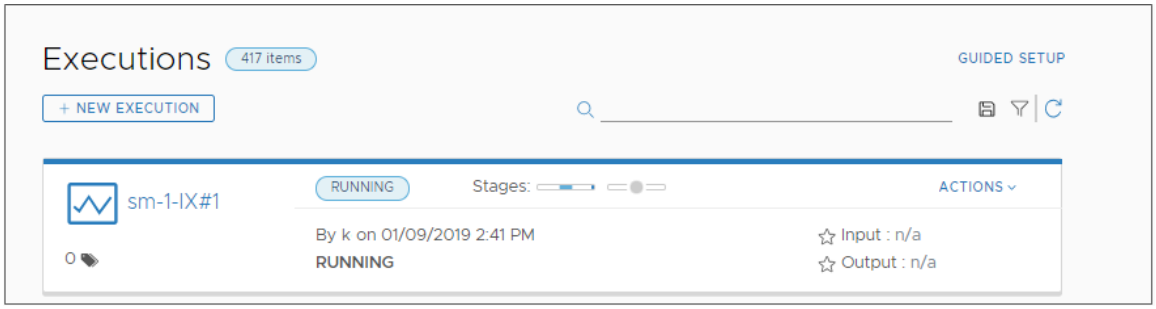
vRealize Automation Code Stream can verify any request from the Docker Hub server by using the configured secure token. For example: `hook_url = IP:Port/pipelines/api/docker-hub-webhooks?secureToken = ""`

5 Create a Docker artifact in your Docker Hub repository. Or, update an existing artifact.

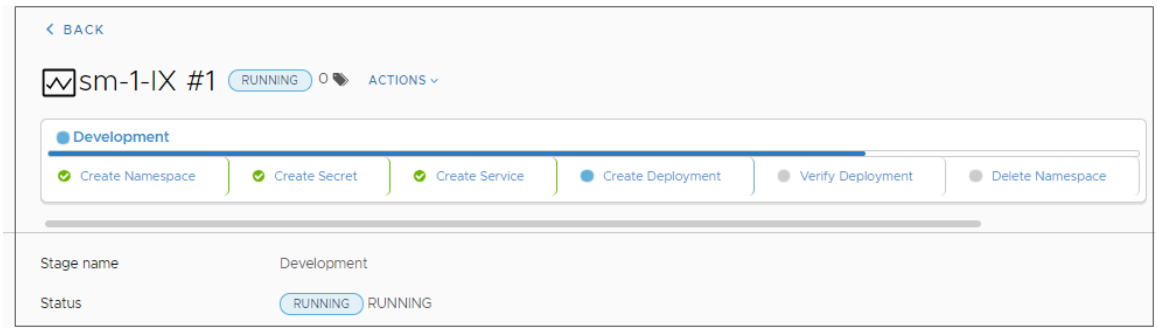
6 To confirm that the trigger occurred, and see the activity on the Docker webhook, click **Triggers > Docker > Activity**.



7 Click **Executions**, and track your pipeline as it runs.



8 Click the running stage and view the tasks as the pipeline runs.



Results

Congratulations! You set up the Docker trigger to run your CD pipeline continuously. Your pipeline can now upload new and updated Docker artifacts to the Docker Hub repository.

What to do next

Verify that your new or updated artifact is deployed to the Docker host in your development Kubernetes cluster.

How do I use the Git trigger in vRealize Automation Code Stream to run a pipeline

As a DevOps administrator or developer, you can use the Git trigger to integrate vRealize Automation Code Stream with the Git lifecycle. When you make a code change in GitHub, GitLab, or Bitbucket Enterprise, the event communicates with vRealize Automation Code Stream through a webhook and triggers a pipeline to run.

When you add the webhook for Git in vRealize Automation Code Stream, it also creates a webhook in the GitHub, GitLab, or the Bitbucket repository. If you update or delete the webhook later, the webhook in GitHub, GitLab, or Bitbucket is also updated or deleted.

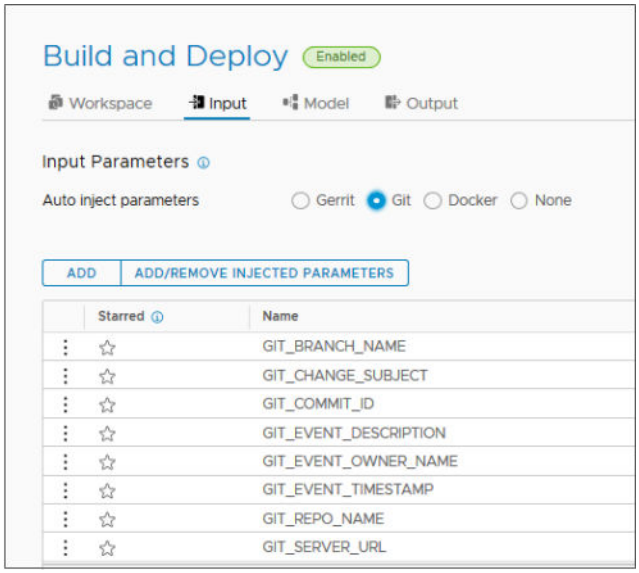
Your webhook definition must include a Git endpoint on the branch of the repository that you want to monitor. vRealize Automation Code Stream uses the Git endpoint to create the webhook. If the endpoint does not exist, you can create it when you add the webhook. This example assumes that you have a predefined Git endpoint in GitHub.

This example shows you how to use the Git trigger with a GitHub repository.

Prerequisites

- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.
- Verify that you have a Git endpoint on the GitHub branch you want to monitor. See How do I integrate vRealize Automation Code Stream with Git.
- Verify that you have rights to create a webhook in the Git repository.

- For the pipelines you want to trigger, verify that you have set the input properties to inject Git parameters when the pipeline runs.



  For information about input parameters, see How you'll create the CICD pipeline and configure the workspace.

Procedure

1 In vRealize Automation Code Stream, click **Triggers > Git**.

2 Click the **Webhooks for Git** tab, then click **New Webhook for Git**.

  a Select a project.

  b Enter a meaningful name and description for the webhook.

  c Select a Git endpoint configured for the branch you want to monitor.

    When you create your webhook, the webhook definition includes the current endpoint details.

    - If you later change the Git type, Git server type, or Git repository URL in the endpoint, the webhook will no longer be able to trigger a pipeline because it will try to access the Git repository using the original endpoint details. You must delete the webhook and create it again with the endpoint.
    - If you later change the authentication type, username, or password in the endpoint, the webhook will continue to work.

    See How do I integrate vRealize Automation Code Stream with Git.

  d (Optional) Enter the branch that you want the webhook to monitor.

    If left unspecified, the webhook monitors the branch configured for the Git endpoint.

e (Optional) Generate a secret token for the webhook.

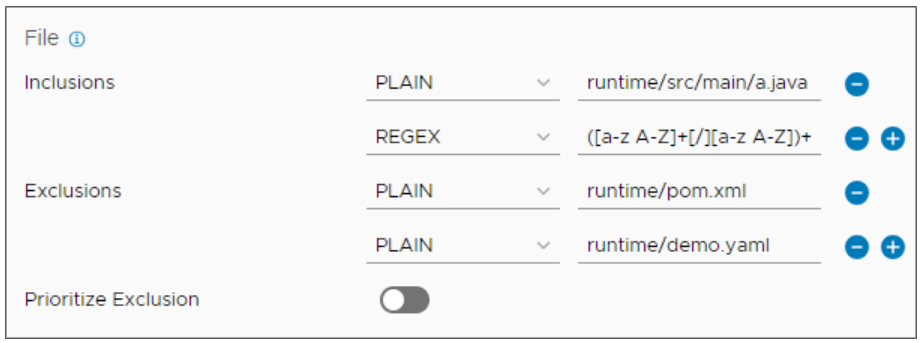
If used, vRealize Automation Code Stream generates a random string token for the webhook. Then, when the webhook receives Git event data, it sends the data with the secret token. vRealize Automation Code Stream uses the information to determine if the calls are coming from the expected source such as the configured GitHub instance, repository, and branch. The secret token provides an extra layer of security that is used to verify that the Git event data is coming from the correct source.

f (Optional) Provide file inclusions or exclusions as conditions for the trigger.

- You provide file inclusions so that when any of the files in a commit match the files specified in the inclusion paths or regex, pipelines are triggered. With a regex specified, vRealize Automation Code Stream only triggers the pipelines with filenames in the changeset that match the expression provided. The regex filter is useful when configuring a trigger for multiple pipelines on a single repository.
- You provide file exclusions so that when all the files in a commit match the specified files in the exclusion paths or regex, pipelines are not triggered.
- When toggled on, Prioritize Exclusion ensures that pipelines are not triggered even if any of the files in a commit match the specified files in the exclusion paths or regex. The default setting is off.

If conditions for both inclusion and exclusion are met, pipelines are not triggered.

In the following example, both file inclusions and file exclusions are conditions for the trigger.



- For file inclusions, a commit with any change to `runtime/src/main/a.java` or any Java file will trigger pipelines configured in the event configuration.
- For file exclusions, a commit with changes only in both files will not trigger the pipelines configured in the event configurations.

g For the Git event, select a **Push** or **Pull** request.

h Enter the API Token.

The API token authenticates you for external API connections with vRealize Automation Code Stream. To obtain the API token:

1 Click **Generate Token**.

2 Enter the email address associated with your user name and password and click **Generate**.

The token that you generate is valid for six months. It is also known as a refresh token.

- To keep the token as a variable for future use, click **Create Variable**, enter a name for the variable and click **Save**.
- To keep the token as a text value for future use, click **Copy** and paste the token into a text file to save locally.

You can choose to both create a variable and store the token in a text file for future use.

3 Click **Close**.

i Select the pipeline for the webhook to trigger.

If the pipeline was configured with custom added input parameters, the Input Parameters list displays parameters and values. You can enter values for input parameters that will be passed to the pipeline with the trigger event. Or you can leave the values blank, or use the default values if defined.

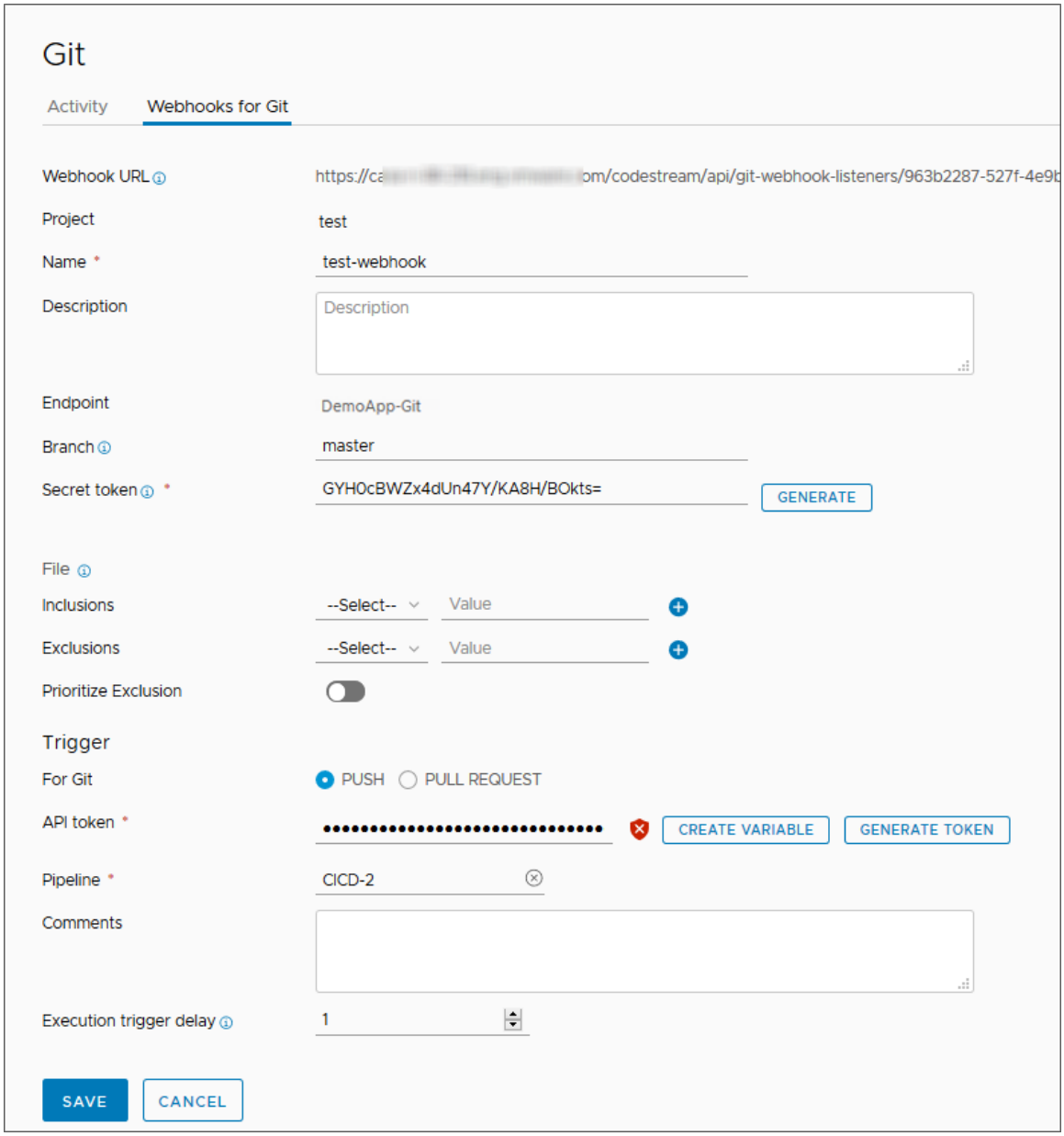
For information about Auto inject input parameters for Git triggers, see the Prerequisites.

j Click **Create**.

The webhook appears as a new card.

3 Click the webhook card.

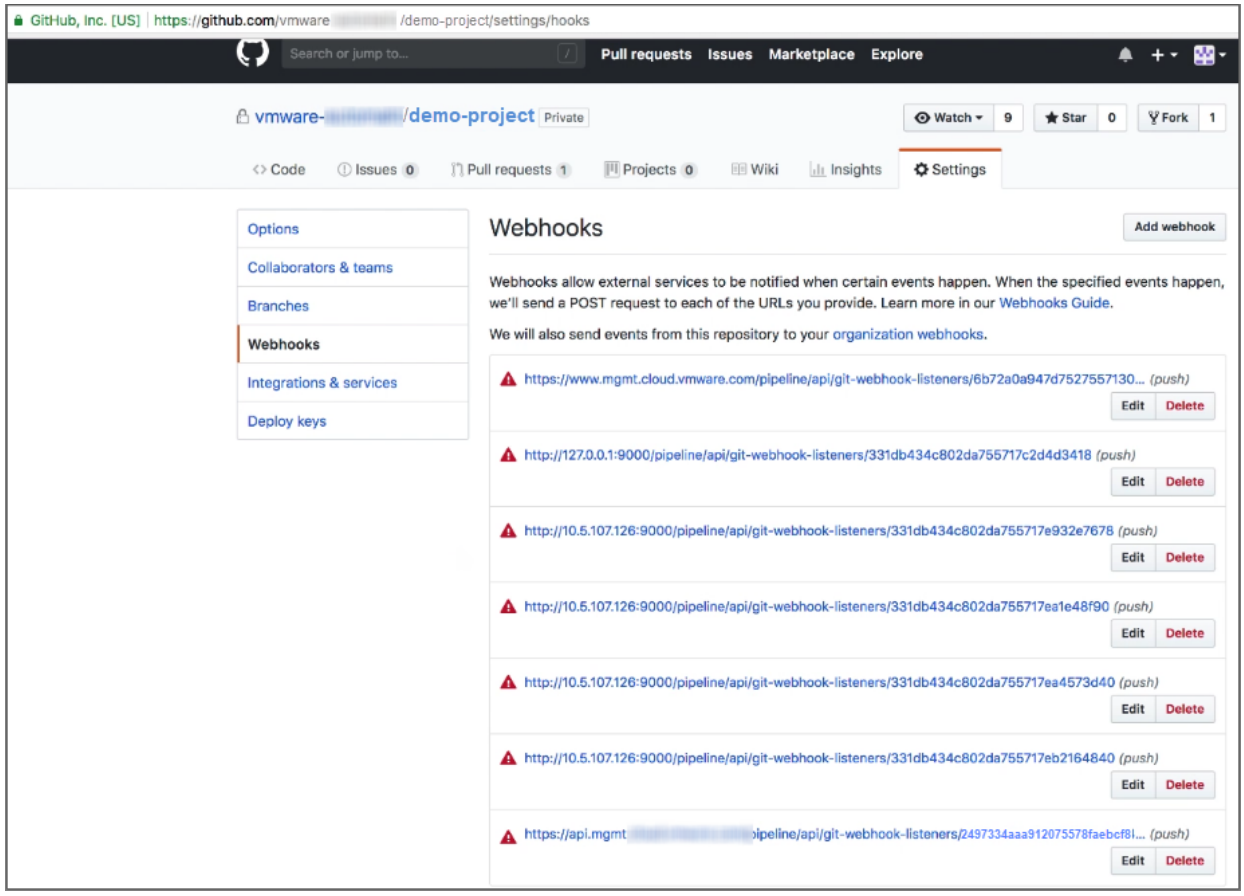
When the webhook data form reappears, you see a webhook URL added to the top of the form. The Git webhook connects to the GitHub repository through the webhook URL.


Git
Activity
Webhooks for Git
Webhook URL
https://ca om/codestream/api/git-webhook-listeners/963b2287-527f-4e9b
Project
test
Name *
test-webhook
Description
Description
Endpoint
DemoApp-Git
Branch
master
Secret token *
GYH0cBWZx4dUn47Y/KA8H/BOkts=
GENERATE
File
Inclusions
--Select--
Value
Exclusions
--Select--
Value
Prioritize Exclusion
Trigger
For Git
PUSH
PULL REQUEST
API token *
CREATE VARIABLE
GENERATE TOKEN
Pipeline *
CICD-2
Comments
Execution trigger delay
1
SAVE
CANCEL

4 In a new browser window, open the GitHub repository that is connected through the webhook.

a To see the webhook that you added in vRealize Automation Code Stream, click the **Settings** tab and select **Webhooks**.

At the bottom of the webhooks list, you see the same webhook URL.



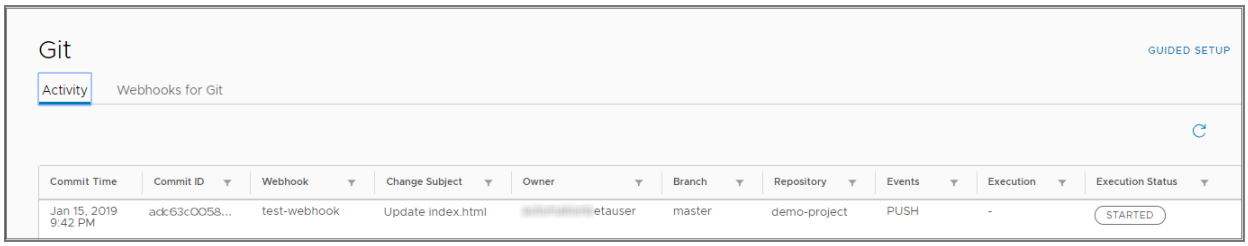
b To make a code change, click the **Code** tab and select a file to edit on the branch to edit. Commit the change.

c To verify that the webhook URL is working, click the **Settings** tab and select **Webhooks** again.

At the bottom of the webhooks list, a green checkmark appears next to the webhook URL.

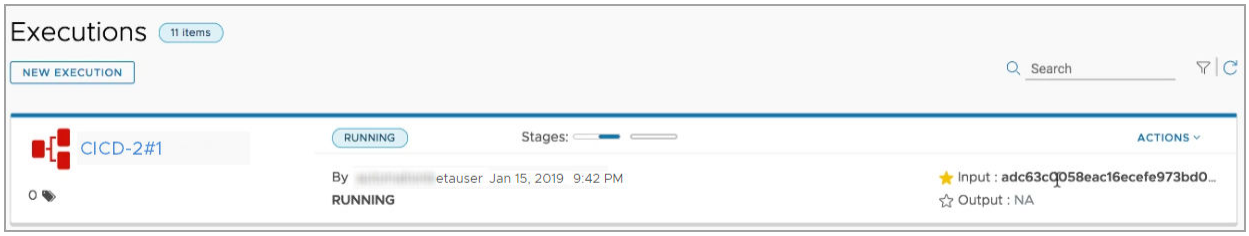
5 Return to vRealize Automation Code Stream to view the activity on the Git webhook. Click **Triggers > Git > Activity**.

Under Execution Status, verify that the pipeline run has started.



6 Click **Executions** to track your pipeline as it runs.

You can press the refresh button to watch the pipeline execution.



Results

Congratulations! You have successfully used a Git trigger to run a pipeline.

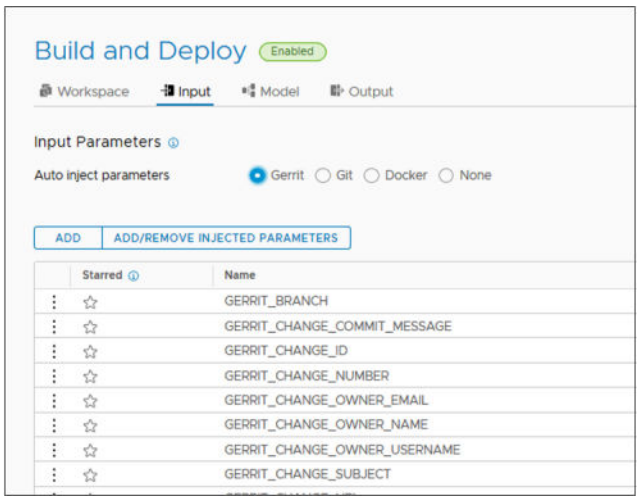
How do I use the Gerrit trigger in vRealize Automation Code Stream to run a pipeline

As a DevOps administrator or developer, you can use the Gerrit trigger to integrate vRealize Automation Code Stream with the Gerrit code review lifecycle. The event triggers a pipeline to run when you create a patch set, publish drafts, merge code changes on the Gerrit project, or directly push changes on the Git branch.

When you add the trigger for Gerrit, you select a Gerrit listener, a Gerrit project on the server, and configure Gerrit events. In this example your first configure a Gerrit listener, then you use that listener in a Gerrit trigger with two events on three different pipelines.

Prerequisites

- Verify that you are a member of a project in vRealize Automation Code Stream. If you are not, ask a vRealize Automation Code Stream administrator to add you as a member of a project. See How do I add a project in vRealize Automation Code Stream.
- Verify that you have a Gerrit endpoint configured in vRealize Automation Code Stream. See How do I integrate vRealize Automation Code Stream with Gerrit.
- For pipelines to trigger, verify that you set the input properties to inject Gerrit parameters when the pipeline runs.



For information about input parameters, see How you'll create the CICD pipeline and configure the workspace.

Procedure

1 In vRealize Automation Code Stream, click **Triggers > Gerrit**.

2 (Optional) Click the **Listeners** tab, then click **New Listener**.

Note Skip this step if the Gerrit listener that you plan to use for the Gerrit trigger is already defined.

a Select a project.

b Enter a name for the Gerrit listener.

c Select a Gerrit endpoint.

d Enter the API Token.

The API token authenticates you for external API connections with vRealize Automation Code Stream. To obtain the API token:

1 Click **Generate Token**.

2 Enter the email address associated with your user name and password and click **Generate**.

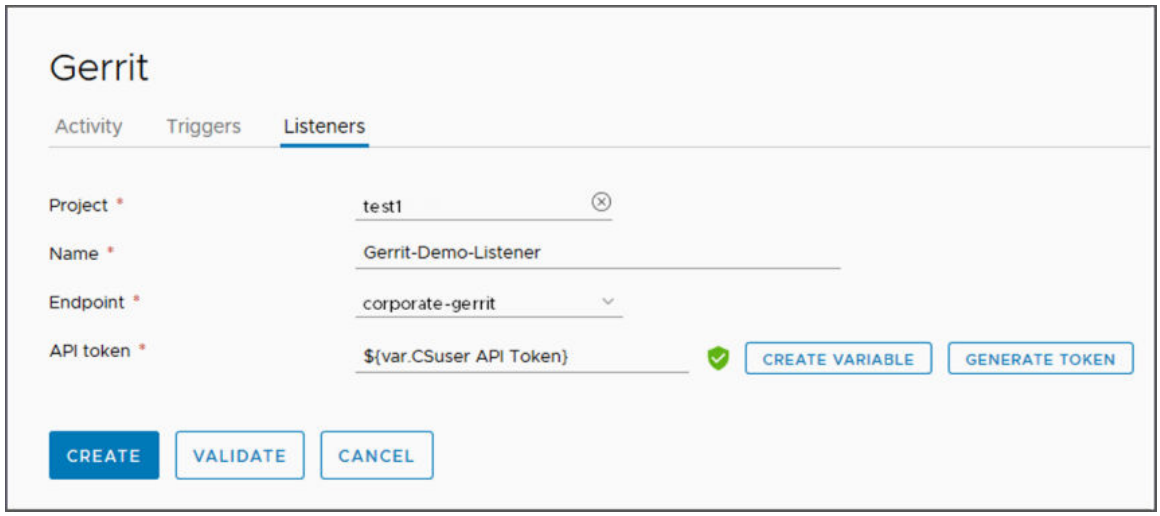
The token that you generate is valid for six months. It is also known as a refresh token.

- To keep the token as a variable for future use, click **Create Variable**, enter a name for the variable and click **Save**.
- To keep the token as a text value for future use, click **Copy** and paste the token into a text file to save locally.

You can choose to both create a variable and store the token in a text file for future use.

3 Click **Close**.

If you created a variable, the API token displays the variable name that you entered. If you copied the token, the API token displays the masked token.



e To validate the token and endpoint details, click **Validate**.

Your token expires after 90 days.

f Click **Create**.

g On the listener card, click **Connect**.

The listener starts monitoring all activity on the Gerrit server and listens for any enabled triggers on that server. To stop listening for a trigger on that server, you deactivate the trigger.

Note To update a Gerrit endpoint that is connected to a listener, you must disconnect the listener before updating the endpoint.

- Click **Configure > Triggers > Gerrit** .
- Click the **Listeners** tab.
- Click **Disconnect** on the listener that is connected to the endpoint that you want to update.

3 Click the **Triggers** tab, then click **New Gerrit Trigger**.

4 Select a project on the Gerrit server.

5 Enter a name.

The Gerrit trigger name must be unique.

6 Select a configured Gerrit listener.

vRealize Automation Code Stream uses the Gerrit listener selection to provide a list of Gerrit projects that are available on the server.

7 Select a project on the Gerrit server.

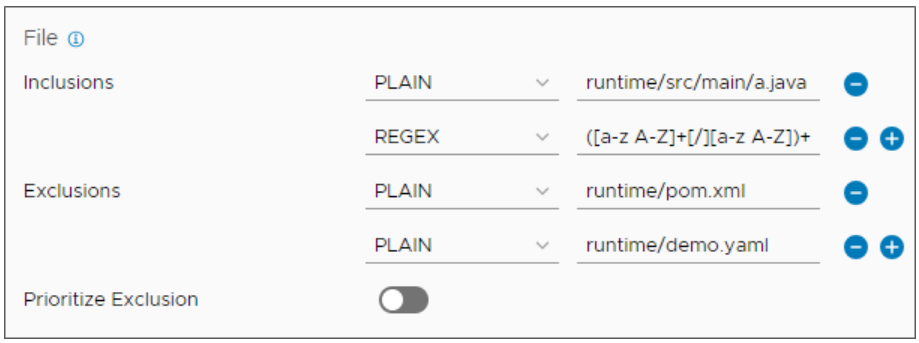
8 Enter the branch in the repository that is to be monitored.

9 (Optional) Provide file inclusions or exclusions as conditions for the trigger.

- You provide file inclusions to have trigger pipelines. When any of the files in a commit match the files specified in the inclusion paths or regex, pipelines are triggered. With a regex specified, vRealize Automation Code Stream only triggers pipelines with filenames in the changeset that match the expression provided. The regex filter is useful when configuring a trigger for multiple pipelines on a single repository.
- You provide file exclusions to keep pipelines from triggering. When all the files in a commit match the files specified in the exclusion paths or regex, the pipelines are not triggered.
- When toggled on, Prioritize Exclusion ensures that pipelines are not triggered. The pipelines will not trigger even if any of the files in a commit match the files specified in the exclusion paths or regex. The default setting is off.

If conditions for both inclusion and exclusion are met, pipelines are not triggered.

In the following example, both file inclusions and file exclusions are conditions for the trigger.



- For file inclusions, a commit with any change to `runtime/src/main/a.java` or any java file will trigger pipelines configured in the event configuration.
- For file exclusions, a commit with changes only in both files will not trigger the pipelines configured in the event configurations.

10 Click **New Configuration**.

a For a Gerrit event, select **Patchset Created**, **Draft Published**, or **Change Merged**. Or for a direct push to Git that bypasses Gerrit, select **Direct Git push**.

b Select the pipeline to trigger.

If the pipeline was configured with custom added input parameters, the Input Parameters list displays parameters and values. You can enter values for input parameters to be passed to the pipeline with the trigger event. Or you can leave the values blank, or use the default values.

Note If default values are defined:

- Any values you enter for the input parameters will override the default values defined in the pipeline model.
- Default values used to configure the trigger will not be updated if the parameter values in the pipeline model are changed.

For information about Auto inject input parameters for Gerrit triggers, see the Prerequisites.

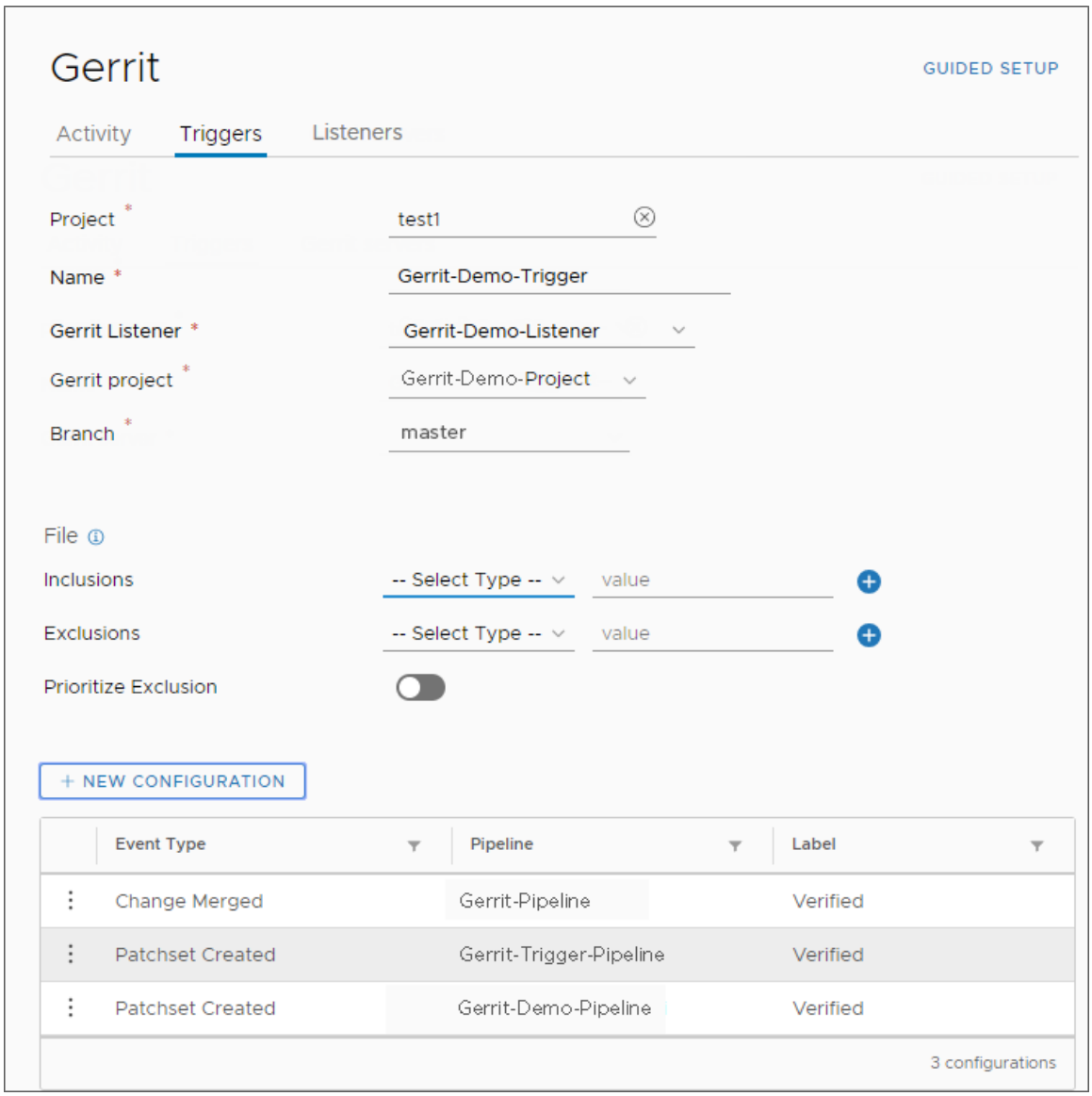
c For **Patchset Created**, **Draft Published**, and **Change Merged**, some actions appear with labels by default. You can change the label or add comments. Then, when the pipeline runs, the label or comment appears on the Activity tab as the **Action taken** for the pipeline.

d Click **Save**.

To add multiple trigger events on multiple pipelines, click **New Configuration** again.

In the following example, you can see events for three pipelines:

- If a **Change merged** event occurs in the Gerrit project, then **Gerrit-Pipeline** is triggered.
- If a **Patchset Created** event occurs in the Gerrit project, then **Gerrit-Trigger-Pipeline** and **Gerrit-Demo-Pipeline** are triggered.



11 Click **Create**.

The Gerrit trigger appears as a new card on the **Triggers** tab, and is set as **Disabled** by default.

12 On the trigger card, click **Enable**.

When the trigger is enabled, it uses the Gerrit listener to start monitoring events that occur on the branch of the Gerrit project.

When you create the trigger, you include the repository where the code commit occurs. If you want to create a trigger with the same file inclusion or exclusion conditions but with a different repository, for example, you can click **Clone** on the trigger card. Then click **Open** on the new trigger and change parameters.

Results

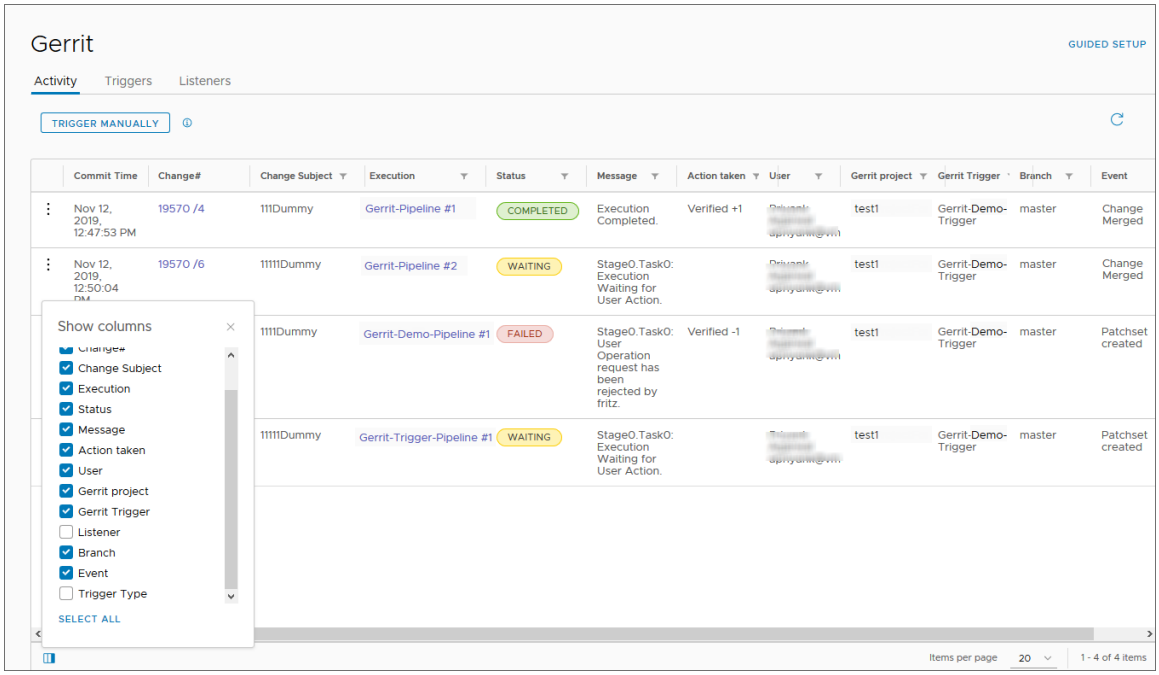
Congratulations! You have successfully configured a Gerrit trigger with two events on three different pipelines.

What to do next

After you commit a code change in the Gerrit project, check the Activity tab for the Gerrit event in vRealize Automation Code Stream. Verify that the list of activities includes entries corresponding to every pipeline execution configured in the trigger. When an event occurs, only pipelines in the Gerrit trigger that are related to the particular event type will run. In this example, if a patch set is created, only the **Gerrit-Trigger-Pipeline** and the **Gerrit-Demo-Pipeline** will run.

Information in the columns on the Activity tab describe each Gerrit trigger event. You can choose the columns to display.

- The Change Subject and Execution columns are empty if the trigger was a direct git push.
- The Gerrit Trigger column shows the trigger that created the event.
- The Listener is off by default. When selected, it shows the Gerrit listener that received the event. One listener can be associated with multiple triggers.
- The Trigger Type is off by default. When selected, it shows if the trigger was triggered manually or automatically.



To control the activity for a completed or failed execution, click the three dots at the left of any entry on the Activity screen.

- If the pipeline fails to run because of a mistake in the pipeline model or other problem, correct the mistake and select **Re-run** to run it again.
- If the pipeline fails to run because of a network connectivity issue or other problem, select **Resume** to restart the same pipeline execution. Doing so saves run time.
- Use **View Execution** to transfer to the Execution screen. See How do I run a pipeline in vRealize Automation Code Stream and see results.

- Use **Delete** to delete the entry from the Activity screen.

If a Gerrit event fails to trigger a pipeline, you can click the Trigger Manually button and enter the name of the Gerrit trigger and Change-Id.

Monitoring pipelines in vRealize Automation Code Stream

8

As a DevOps Administrator or developer, you use vRealize Automation Code Stream dashboards to monitor the trends and results of a pipeline execution. You can use the default pipeline dashboards to monitor a single pipeline, or create custom dashboards to monitor multiple pipelines.

What are pipeline dashboards

A pipeline dashboard is a view of the results for a specific pipeline that ran, such as trends, top failures, and successful changes. vRealize Automation Code Stream creates the pipeline dashboard when you create a pipeline.

What are custom dashboards

A custom dashboard is a view of the results for one or more pipelines that ran. You create the custom dashboard and add widgets to display the results you want to see. For example, you can create a project-wide dashboard with KPIs and metrics gathered from multiple pipelines. If an execution warning or failure is reported, you can use the dashboard to troubleshoot the failure.

This chapter includes the following topics:

How do I track key performance indicators for my pipeline in vRealize Automation Code Stream

As a DevOps administrator or developer, you need insight about the performance of your pipelines in vRealize Automation Code Stream. You need to know how effectively your pipelines release code from development, through testing, and to production.

To gain insight, you can use the default dashboard for your pipeline, or use a custom dashboard.

- Pipeline metrics include statistics such as mean times, which are available on the pipeline dashboard.
- To see metrics across multiple pipelines, use the custom dashboards.

You can have vRealize Automation Code Stream measure the mean times to recover, deliver, or fail a pipeline over time, and display the trends for those mean times.

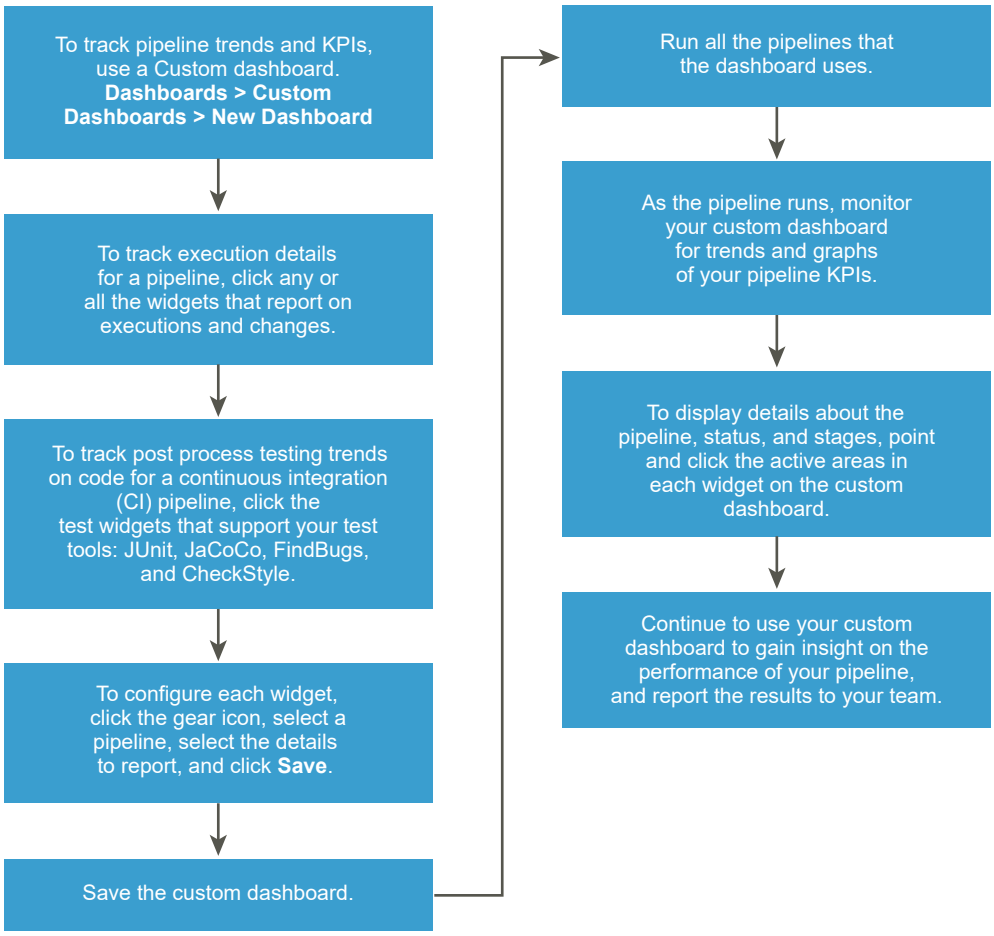
Table 8-1. Measuring mean times

What gets measured...	What it means...
Average CI	Average time spent in the continuous integration phase, measured by time in the CI task type.
Mean time to deliver a pipeline	Average time required by the pipeline to deliver an update after it triggers.
Mean time between successful deployments	Time between successful deployments, which indicates how often a production environment updates.
Mean time to fail a pipeline	Time it takes for a pipeline to fail after it triggers.
Mean time to recover from a pipeline failure	Average time to deliver a successful pipeline after the pipeline fails. Measures time between the failure of a build or test criteria and the next build that produces a successful pipeline run, averaged over a week or month.

You can also have vRealize Automation Code Stream display the top failed tasks and stages in a pipeline. This measurement reports the number and percentage of failures for development and post-development environments for each pipeline and project, averaged over a week or month. You view the top failures to troubleshoot problems in the release automation process.

For example, you can configure the display for a particular duration such as the last seven days and note the top failed tasks during that period of time. If you make a change in your environment or pipeline and run the pipeline again, then check the top failed tasks over a longer duration such as the last 14 days, the top failed tasks may have changed. With that result, you will know that the change in your release automation process improved the success rate of your pipeline execution.

To track trends and key performance indicators for your pipelines by using a custom dashboard, you add widgets to the dashboard, and configure them to report on your pipelines.



Prerequisites

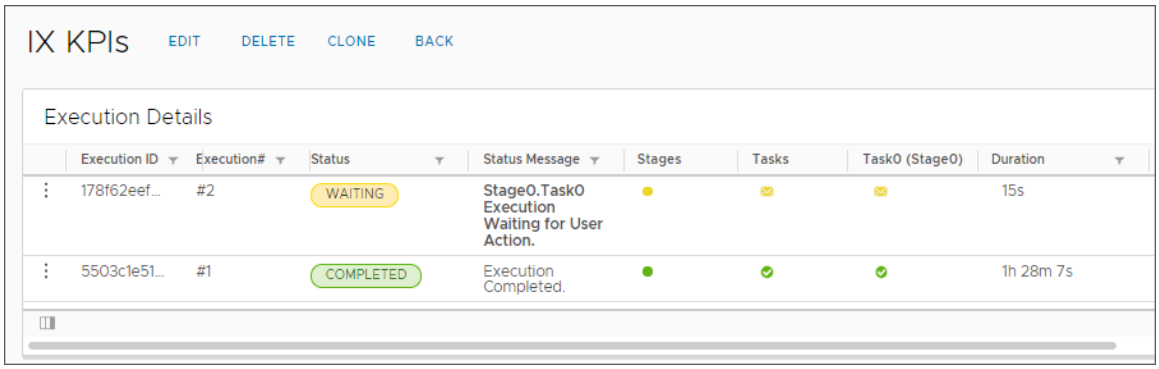
- Verify that one or more pipelines exist. In the user interface, click **Pipelines**.
- For the pipelines that you intend to monitor, verify that they ran successfully. Click **Executions**.

Procedure

1 To create a custom dashboard, click **Dashboards > Custom Dashboards > New Dashboard**.

2 To customize the dashboard so that it reports on specific trends and key performance indicators for your pipeline, click a widget.

For example, to display details about the pipeline status, stages, tasks, how long it ran, and who ran it, click the **Execution Details** widget. Or, for a continuous integration (CI) pipeline, you can track the trends on post-processing by using the widgets for JUnit, JaCoCo, FindBugs, and CheckStyle.



3 Configure each widget that you add.

a On the widget, click the gear icon.

b Select a pipeline, set the available options, and select the columns to display.

c To save the widget configuration, click **Save**.

d To save the custom dashboard, click **Save**, and click **Close**.

4 To display more information about the pipeline, click the active areas on the widgets.

For example, in the **Execution Details** widget, click an entry in the Status column to display more information about the pipeline execution. Or, on the **Latest Successful Change** widget, to display a summary of the pipeline stage and task, click the active link.

Results

Congratulations! You created a custom dashboard that monitors trends and KPIs for your pipelines.

What to do next

Continue to monitor the performance of your pipelines in vRealize Automation Code Stream, and share the results with your manager and teams to continue to improve the process to release your applications.

Learn more about VMware Code Stream

9

There are many ways for DevOps administrators and developers to learn more about vRealize Automation Code Stream and what it can do for you.

You can use this documentation to learn more about pipelines and their executions, and how to add endpoints.

Understand the permissions that roles provide. Learn how to use restricted resources, and require approvals on pipelines.

See the value of search in finding where specific jobs or components are located in your pipelines, executions, or endpoints.

This chapter includes the following topics:

What is Search in vRealize Automation Code Stream

You use search to find where specific items or other components are located. For example, you might want to search for activated or deactivated pipelines. Because if a pipeline is deactivated, it cannot run.

What can I search

You can search in:

- Endpoints
- Pipelines
- Executions
- Pipeline Dashboards, Custom Dashboards
- Gerrit Triggers and Servers
- Git Webhooks
- Docker Webhooks

You can perform column-based filter search in:

- User Operations
- Variables
- Triggers for Gerrit, Git, and Docker

You can perform grid-based filter search on the activity page for any trigger.

How does search work

The criteria for search varies depending on the page you are on. Each page has different search criteria.

Where you search	Criteria to use for search
Pipeline Dashboards	Project, Name, Description, Tags, Link
Custom Dashboards	Project, Name, Description, Link (UUID of an item on the dashboard)
Executions	Name, Comments, Reason, Tags, Index, Status, Project, Show, Executed by, Executed by me, Link (UUID of the execution), and Input parameters, Output parameters, or Status message by using this format: `<key>:<value>`
Pipelines	Name, Description, Status, Tags, Created by, Created by me, Updated by, Updated by me, Project
Endpoints	Name, Description, Type, Updated by, Project
Gerrit triggers	Name, Status, Project
Gerrit servers	Name, Server URL, Project
Git Webhooks	Name, Server Type, Repo, Branch, Project

Where:

- Link is the UUID of a pipeline, execution, or widget on a dashboard.
- Input parameter, Output parameter, and Status message notation and examples include:
  - Notation: `input.<inputKey>:<inputValue>`

    Example: **`input.GERRIT_CHANGE_OWNER_EMAIL:joe_user`**
  - Notation: `output.<outputKey>:<outputValue>`

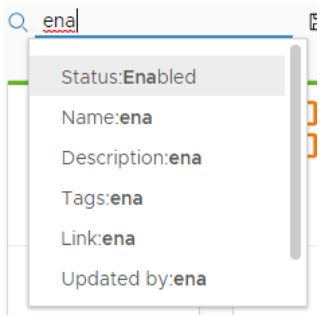
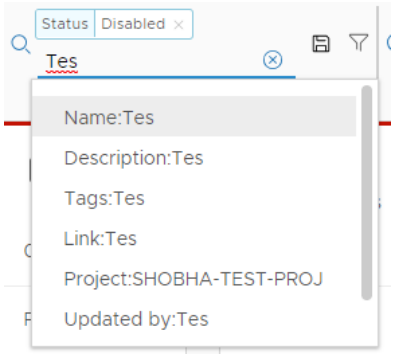
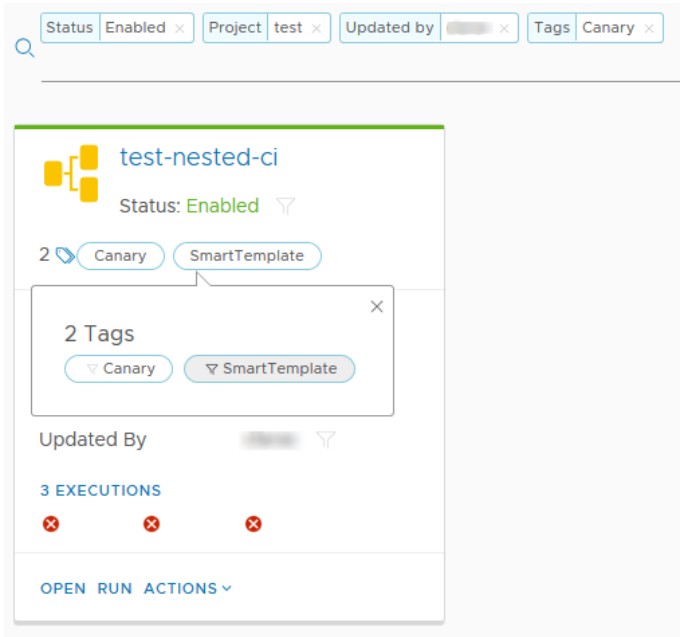
    Example: **`output.BuildNo:29`**
  - Notation: `statusMessage:<value>`

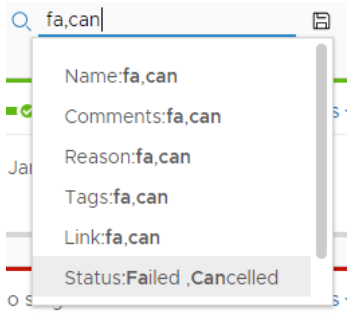
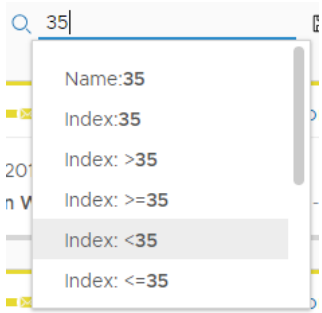
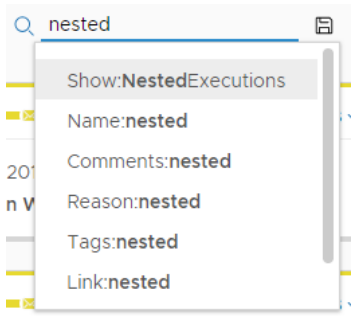
    Example: **`statusMessage:Execution failed`**
- Status depends on the search page.
  - For executions, possible values include: completed, failed, rollback_failed, or canceled.

- For pipelines or triggers, possible values include: enabled or disabled.

- Executed, Created, or Updated by me refers to me, the logged in user.

Search appears at the upper right of every valid page. When you start typing into the search blank, vRealize Automation Code Stream knows the context of the page and suggests options for the search.

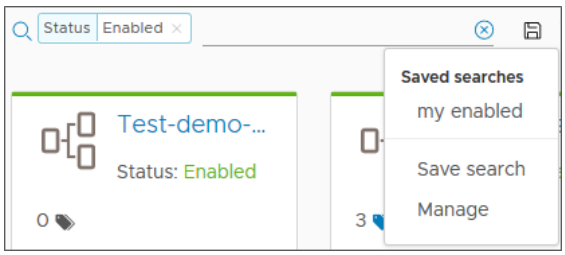
Methods you can use to search	How to enter it
Type a portion of the search parameter. For example, type **ena** to add a status filter that lists all the enabled pipelines.	
Add a filter to reduce the number of items found. For example, type **Tes** to add a name filter. The filter works as an AND with the existing **Status:disabled** filter to show only the deactivated pipelines with **Tes** in the name.	
Click the filter icon on properties of a pipeline or execution to reduce the number of items displayed. - For pipelines, **Status**, **Tags**, **Project**, and **Updated by** each have a filter icon. - For executions, **Tags**, **Executed by**, and **Status Message** each have a filter icon. For example on the pipeline card, click the icon to add the filter for the **SmartTemplate** tag to the existing filters for: **Status:Enabled**, **Project:test**, **Updated by:user** and **Tags:Canary**.	

Methods you can use to search	How to enter it
Use a comma separator to include all items in two execution states. For example, type **`fa,can`** to create a status filter that works as an `OR` to list all failed or canceled executions.	
Type a number to include all items within an index range. For example, type **35** and select **<** to list all executions with an index number less than 35.	
Pipelines that are modeled as tasks become nested executions and are not listed with all executions by default. To show nested executions, type **`nested`** and select the **Show** filter.	

How do I save a favorite search

You can save favorite searches to use on each page by clicking the disk icon next to the search area.

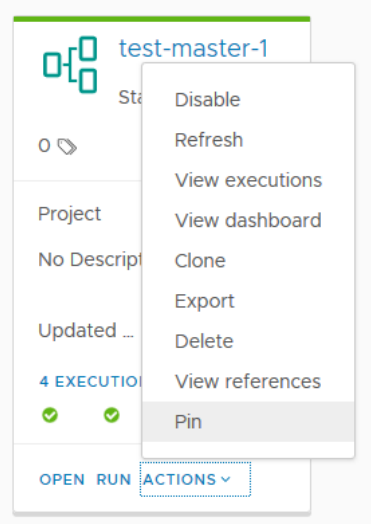
- You save a search by typing the parameters for search and clicking the icon to give the search a name such as **`my enabled`**.
- After saving a search, you click the icon to access the search. You can also select **Manage** to rename, delete, or move the search in the list of saved searches.



Searches are tied to your user name and only appear on the pages for which the search applies. For example, if you saved a search named **`my enabled`** for **Status:enabled** on the pipelines page, the **`my enabled`** search is not available on the Gerrit triggers page, even though **Status:enabled** is a valid search for a trigger.

Can I save a favorite pipeline

If you have a favorite pipeline or dashboard, you can pin it so that it always appears at the top of your pipelines or dashboards page. On the pipeline card, click **Actions > Pin**.



More resources for vRealize Automation Code Stream Administrators and Developers

As a DevOps administrator, or a developer, you can learn more about vRealize Automation Code Stream.

Table 9-1. More resources for DevOps administrators

To learn about...	See these resources...
Other ways DevOps administrators can use vRealize Automation Code Stream: ■ Configure pipelines to automate the testing and release of cloud native applications. ■ Automate and test developer source code, through testing, to production. ■ Configure pipelines for developers to test changes before they commit them to the primary branch. ■ Track key pipeline metrics.	vRealize Automation Code Stream ■ vRealize Automation Documentation ■ vRealize Automation product website VMware Hands On ■ Use the vRealize Automation Community. ■ Use the VMware Learning Zone. ■ Search the VMware Blogs. ■ Try the VMware Hands On Labs.

Table 9-2. More resources for developers

To learn about...	See these resources...
Other ways developers can use vRealize Automation Code Stream: ■ Use public and private registry images to build environments for new applications or services. ■ Set up development environments so that you can create branches from the latest stable build. ■ Update development environments with the latest code changes and artifacts. ■ Test uncommitted code changes against the latest stable builds of other dependent services. ■ Receive a notification when a change committed to a primary CICD pipeline breaks other services.	vRealize Automation Code Stream ■ vRealize Automation Documentation ■ vRealize Automation product website VMware Hands On ■ Use the vRealize Automation Community. ■ Use the VMware Learning Zone. ■ Search the VMware Blogs. ■ Try the VMware Hands On Labs.